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ANALYSIS OF RISK IMPACT ON TRANSPORTATION COSTS & EMPLOYEE PERFORMANCE

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Abstract

Companies everywhere will face problems. Some of these problems are caused by internal and external problems of the Company. These problems can result in small or large losses to the Company. The instrument of this research is quantitative research with data study analysis, namely observation and literature study. In this study, the Fault Tree Analyst approach will be used. The application of this method begins with defining the problem, describing the graphical model, finding the minimum cut set, conducting a qualitative analysis, and conducting quantitative analysis. This research is a research development of the Enterprise Risk Management method. In previous research, using ERM only focused on identifying and evaluating risks through a qualitative approach based on the perception and experience of internal stakeholders on potential operational disruptions. However, this study develops this method by integrating a quantitative and systematic Fault Tree Analysis (FTA) approach in mapping the root causes of delivery inaccuracy. If in the ERM approach the risk is identified in general based on the probability-impact matrix, then in the FTA approach, the risk is further traced to the level of components and basic events, so as to be able to provide a more detailed picture of the contribution of each causative factor. The problems faced in this company focus on risk control related to the transportation of product delivery in this company. To strengthen the results of this study, the author added recommendations for proposed improvements. The results of the study using Fault Tree show that the dominant risks in this company are extreme distribution delays, work accidents that occur during work, and damage to transport vehicles. The problems in this study focus on risk control related to product delivery transportation.

Keywords: Risk Management, Enterprise Risk Management, Fault Tree Analyst, Transportation, Distribution, Human Resources, Quantitative

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INTRODUCTION

The company currently operates both as a supplier and customer in Indonesia and globally. The company is currently facing a rapidly developing and increasingly complex supply chain. Risk management is part of the strategic plan for achieving the company's objectives. If risk control is not well organized, it can lead to weak risk management (Safitri and Rufaedah, 2020). Another important consideration for the company is understanding the factors influencing supply chain efficiency, obstacles, and risk management strategies to anticipate risks. Implementing risk management can have a positive impact on companies. Risk management is a series of organizational procedures for processing, monitoring, and preventing problems that occur within an organization (Pagestuti, 2019) in (Lubis and Imsar, 2022).

Risks that occur within a company pose unique challenges. These challenges require the company to be able to minimize existing risks. A company is considered healthy if it is able to manage risks, thereby minimizing or eliminating them (Mellisa, Andono, and 2013). The optimization of delivery in meeting inventory requirements must be designed with risk management in mind so that all conditions that arise can be minimized. Especially within a company, inventory is a vital aspect that must be coordinated to meet its needs at all times. According to (Ahmad, Tuli, and Mahmud, 2022), inventory consists of finished goods, raw

materials, and goods in process that are processed within the company for various purposes, such as production or sales transactions. Within the company's structure, inventory is the most frequently misused asset by company personnel.

Every company implements measures to minimize risks. In minimizing these risks, companies not only manage risks, but also conduct research within the company to find solutions using the FTA method. A Fault Tree is a research tool used to solve complex problems. One way to do this is by breaking down the problem into its largest and smallest components. Fault Trees are interconnected by analyzing cause-and-effect relationships, enabling companies to understand problems down to their most fundamental level.

Fault Tree Analyst (FTA) is a way of looking at something where adverse conditions associated with system failure are viewed in the context of how it works and its environment to understand the probability of the cause of the adverse event occurring. FTA analyzes from the largest to the smallest causes. The analysis begins with the initial event, and the specific causes can be analyzed in detail. A fault tree illustrates the state of system components (basic events) and the relationships between these components and the main event. Logic gates refer to diagram symbols that represent these relationships. The logical outcome of a fault is determined by the events included in the analysis. (Thomas Pyzdek, 2002:591 in Setyadi, 2020).

PT XYZ is a frozen food retail company that has been operating since 2015. The company produces nuggets and distributes them to large and small retail stores. The company has around five retail stores as customers, spread across both busy and remote areas. The delivery time for these nugget products is divided into several operational areas, including 5 retail stores with a delivery time of 1-2 hours. The high demand from customers has prompted the company to establish an efficient and timely delivery system to meet customer requests and ensure customer satisfaction. This system was developed to achieve the company's objectives.

The main activities at PT XYZ are experiencing operational risks. One of the risks focused on in this study is related to transportation, which includes delays, accidents, transportation costs, and vehicle quality, which are considered important factors affecting employee productivity and welfare. The problems faced by this company focus on controlling risks related to product delivery transportation. The dependent variable in this study is employee performance (productivity and job satisfaction). The independent variable is transportation delays in product delivery. The moderator variable is the company's policy regarding employee performance flexibility.

The problems that occur in the Company are part of an indication of poor internal control. Based on field observations, the Company has not been able to identify problems occurring in the internal and external environment of the company. Reflecting on the problems that occurred at PT XY, it is necessary to conduct a risk analysis that affects the Company so that the Company does not experience the impact of these risks related to transportation. Based on the identification and analysis of risks currently being studied, the company is focusing on the field of goods transportation. The identification and analysis of risks using the Fault Tree Analysis (FTA) approach aims to determine the factors causing the risks, identify the stages of failure, analyze the sources of risks, and investigate the occurrence of risks along with their efficiency.

In this study, the author previously analyzed using the ERM method to analyze various types of risks faced by the frozen food distribution company PT XYZ. The ERM approach in this study mapped the main risks through the stages of identification, assessment, and control of risks based on their probability and impact. The results showed that delivery delays and workplace accidents were the two dominant risks that directly affected operational efficiency and employee welfare. However, the ERM method used in the study had limitations in identifying the root causes of risks in depth, as it was more descriptive and qualitative in nature.

Given the limitations of previous research, the author developed the ERM method using the Fault Tree Analysis (FTA) approach, a quantitative method capable of tracing the cause structure of a failure event logically and systematically. Through the FTA method, this study not only identifies risks in general but also traces them back to the basic events that are the root causes. Thus, the analysis results can provide more in-depth input in developing targeted mitigation strategies. The integration of the FTA method as a development of ERM is done so that companies not only know which risks are dominant but also know how and why these risks occur in detail. Through the structure of the fault tree diagram, companies can evaluate the cause-and-effect relationships of various risk factors that influence delivery delays and transportation costs, which ultimately impact employee productivity and job satisfaction.

Although the ERM approach can provide a useful risk map for management, this method has limitations in terms of systematically and thoroughly exploring the root causes of risk. ERM does not specifically establish logical relationships between complex risk factors, nor can it quantitatively present the cause-and-effect pathways of a failure event. In other words, ERM is more strategic and descriptive in nature and is not yet sufficiently in-depth to explain how and why a risk can occur in a structured manner from the smallest components of the system.

Given these limitations, this study develops an ERM approach to the Fault Tree Analysis (FTA) method. FTA is a systematic, graph-based quantitative analysis method used to trace the root causes of a failure event (top event). Through a fault tree diagram, FTA identifies and organizes the logical relationships between various causes, from the most basic to the main event, using logic gates such as AND and OR. This approach allows researchers and practitioners to gain a deeper understanding of the structure of the problem and identify the critical points that require the most attention in mitigation efforts.

By integrating the FTA method as an extension of ERM, this study aims to bridge the gap between macro-level risk mapping (ERM) and micro-level, quantitative root cause analysis (FTA). FTA can assign probability weights to each basic event and generate a minimal cut set that more accurately indicates the combination of risk causes. Through this integration, companies not only identify which risks are dangerous but also understand their causal pathways and can design more precise, cost-effective, and data-driven mitigation strategies.

Previous research conducted by Metta Yolanda, Yurida Ekawati, and Sunday Noval (2023). The results of the identification showed that there were six types of errors in the manufacturing process. They are air bubbles, too thick or not thick enough, broken, double-folded edges that do not stick, streaked ink, and not fully printed. To analyze and reduce product defects, we used the Fault Tree Analysis (FTA) method. After creating a fault tree using the FTA method, the factors causing product defects could be identified, including human factors, the machines used, the equipment used, and the environment. A study conducted by Aryudi Susilo, R. Ismet Rohimat, and Hennie Husniah in 2019. One of the eleven main events causing chiller damage is as follows: bearing damage, clutch damage, relay contact damage, fuse damage, control device damage, oil shortage, shaft damage, pump damage, heater damage, and oil filter damage. Considering the failure effects, failure frequency, and failure control techniques, the RPN value is used to prioritize the repairs that must be carried out by technicians. We recommend performing preventive maintenance on the chiller, especially to detect leaks using a freon detection tool.

The author's research aims to identify the root causes of problems occurring in the operations of PT XYZ and to assess the risks involved. This risk analysis is based on the severity or impact of the risk (severity level) and the likelihood of the risk occurring (probability level). The identification of risk management measures evaluates the occurrence of risks and the efficiency of their management. Based on the background of the issues at hand, the author outlines the following problems: What risks might occur at PT XYZ? What is the

severity level and likelihood of occurrence of these risks? What is the likelihood of occurrence (occurrence rate)? Determining risk mitigation strategies; and, based on the results of the cutset data analysis, addressing the outcomes of the risks that occur.

METHOD

The objective of this study is PT. XYZ. Variables related to transportation risk are the subject of this study. This qualitative study determines the transportation risk factors that affect employee performance. The dependent variable of this study is employee performance, namely productivity and job satisfaction; the independent variables are transportation delays and transportation costs; and the moderator variable is company policy on work schedule flexibility. The research instrument used is a Fault Tree, which examines the effects occurring in this issue. The data collected through field observations includes the types and quantities of defects both before and after repairs. After identifying the types of defects that occur, the factors that may cause these defects will be analyzed.

Fault Tree is used to identify sources of defects in a product, including human, material, and other factors. The FTA method, also known as fault tree analysis diagram, uses a graphical model of various combinations to analyze problems and undesirable conditions in a system during a process. Environmental and operational conditions can be used to analyze these undesirable conditions (Vesely et al., 1981). Symbols are used in the FTA method (Tang, 2022). FTA has two basic types of notation: event gates and logic gates. After identifying the sources of defects, improvements will be provided to the organization. The purpose of these proposed improvements is to avoid failure, so that the number of defective products can be reduced in the future.

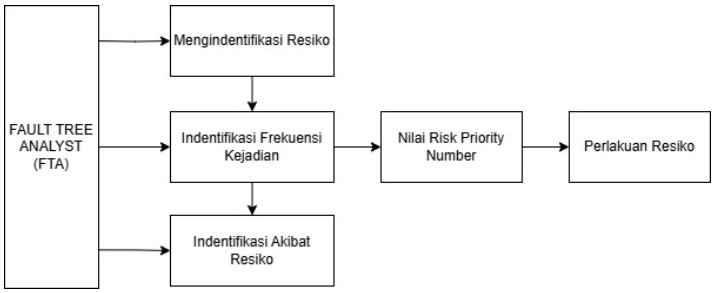

Figure 1 Stages of Problem Solving
Source: Author's analysis (2024)

This research applies the FTA method in analyzing the scope of the research problem. Identification of hazards and analysis of hazards that have occurred. In risk analysis, the risk priority value is calculated based on the fault tree that occurs. After identifying the source of the defect, improvements will be given to the organization. The purpose of these proposed improvements is to avoid failure, so that the number of defective products can be reduced in the future.

RESULTS AND DISCUSSION

The results of the risk analysis conducted at PT. XYZ as a result of business processes that did not run in accordance with the company's objectives. Operational risk is the focus of this study. Several problems arose as a result of the company's operations. These risks include human resource risk, productivity risk, and process risk.

Initially, incidents were identified by analyzing literature from several journal references. The next step was to create indicators that showed the likelihood of risks occurring. Then,

indicators were selected by adding or removing several risk indicators that might occur in company management.

The author will present risk identification checksheet data based on defect frequency and impact classification:

Table 1. Risk Identification Checklist

Risk	Code	Defect	Check sheet	Frequency	Probability	Percentage
Risk of delivery delays,	P1	Driver indiscipline	IIII	4	0,04	4%
	P2	Vehicle damage	IIII	4	0,04	4%
	P3	Unstructured schedule	IIII	4	0,04	4%
	P4	Poorly organized goods	III	3	0,03	3%
	P5	Damaged roads	III	3	0,03	3%
	D1	Bad/extreme weather	III	3	0,03	3%
Risk of workplace accidents	P7	Fatigue due to long working hours or lack of rest.	III	3	0,03	3%
	P8	Poor health conditions, such as dizziness or vision problems.	III	3	0,03	3%
	P9	Lack of clear work safety procedures.	III	3	0,03	3%
	P10	Brake failure	IIII	4	0,04	4%
	F1	Damaged truck	IIII	4	0,04	4%
	D2	Unlit roads	IIII	4	0,04	4%
Risk of transportation costs,	F2	Lack of understanding of delivery routes	~~IIII~~ II	7	0,07	7%
	F3	Suboptimal delivery routes leading to increased fuel costs	~~IIII~~ II	7	0,07	7%
	P15	Damaged trucks	~~IIII~~ II	7	0,07	7%
	P16	Rare routine maintenance	~~IIII~~	5	0,05	5%
Risk of vehicle quality	P17	No vehicle technicians	~~IIII~~	5	0,05	5%
	P18	Damaged trucks	IIII	4	0,04	4%
	P19	Rare routine maintenance	~~IIII~~	5	0,05	5%
	F4	Extreme weather	III	3	0,03	3%

	P21	Damaged roads	III	3	0,03	3%
Risk of management & supply chain	P22	Incompetent PIC	IIII	4	0,04	4%
	P23	Poorly structured schedules	IIII	4	0,04	4%
	P24	Changes in operational policies	IIII	4	0,04	4%

Source: Author's processing (2024)

Fault Tree Analysis

The fundamental thing to do when performing a Fault Tree analysis is to identify potential sources of errors that develop in each subject to be investigated. This is done to find out the reasons for the defects, to create a Fault Tree. After analyzing and understanding the common causes of defects, each branch of the sequence that forms the fault tree is broken down thoroughly until the most basic event is found, also known as the basic event. Each step is carried out, detailing the sequence of causes and effects leading to the event described. Specific symbols are used to indicate the causes and effects of the event, as outlined in previous research. These symbols are used during the fault tree analysis. For each risk subject to be analyzed, the following fault tree is used.

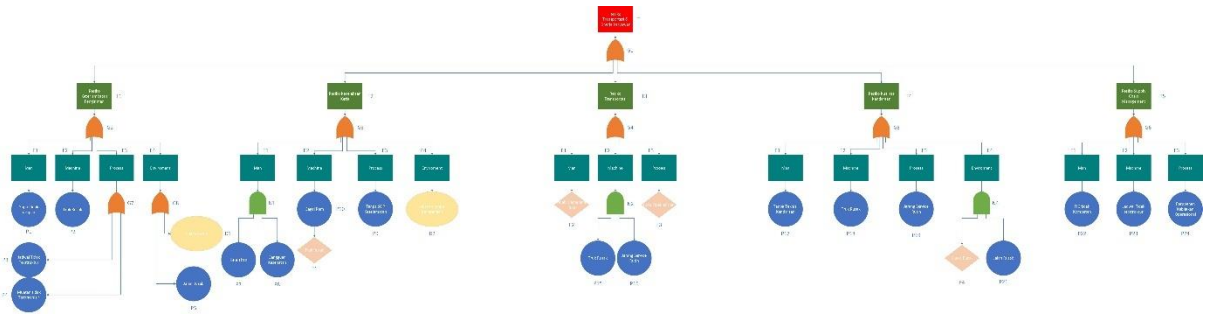

Figure 4 Fault Tree
Source: Author's work (2024)

Cutset Risk Analysis

To determine the root cause of transportation risks and employee performance, a minimal cutset is created in detail in the fault tree for each defect. Boolean algebra can be used to simplify or refine complex algorithms into a series of easy-to-understand numerical algorithms. This is used in qualitative analysis known as minimal cut set (Widjanarka, 2006). The following fault tree analysis provides a minimal cut set.

Boolean equations

1. T= T1+T2+T3+T4+T5
T1=E1+E2+E3+E4
E1=P1
E2=P2
E3=P3+P4 (**OR** Gate)
E4=D1+P5
The equation from the substitution results is as follows:
T1= P1 + P2 + (P3 + P4) + (D1 + P5)

2. T2=E1+E2+E3+E4

E1=P7*P8 (**AND** gate)
E2=P10
E3=P9
E4=D2
The equation from the substitution results is as follows:
T2 = (P7 • P8) + P10 + P9 + D2
|symbol • state logic **AND**, whereas + state logic **OR**|

3. T3=E1+E2+E3
E1=F1
E2=P15*P16 (**AND** gate)
E3=F2
The equation from the substitution results is as follows:
T3 = F1 + (P15 • P16) + F2

4. T4=E1+E2+E3+e4
E1=P17
E2=P18
E3=P19
E4=F3*P21 (**AND** Gate)
The equation from the substitution results is as follows:
T4 = P17 + P18 + P19 + (F3 • P21)

5. T5=E1+E2+E3
E1=P22
E2=P23
E3=P24
The equation from the substitution results is as follows:
T5 = P22 + P23 + P24

The following is the equation from the substitution results T1 T2 T3 T4 T5

T = (P1 + P2 + P3 + P4 + D1 + P5) + ((P7 • P8) + P9 + P10 + D2) + (F1 + (P15 • P16) + F2) + (P17 + P18 + P19 + (F3 • P21)) + (P22 + P23 + P24)

Minimum Cut Set:

1. {P1}
2. {P2}
3. {P3}
4. {P4}
5. {D1}
6. {P5}
7. {P7, P8}
8. {P9}

9. {P10}
10. {D2}
11. {F1}
12. {P15, P16}
13. {F2}
14. {P17}
15. {P18}
16. {P19}
17. {F3, P21}
18. {P22}
19. {P23}
20. {P24}

The minimum cutset obtained from the processing results using the Boolean method based on the results of this study's analysis is 3, where three of them are AND gate combinations, namely:

- {P7, P8}
- {P15, P16}
- {F3, P21}

Boolean Algorithm
For each risk analyzed using Fault Tree Analyst, the author reinforces the results of this study by adding an analysis using the Boolean Algorithm. The analysis is presented below:

$$P(R) = 1 - \prod_i (1 - P(X_i))$$

Steps for calculating risk probability

1. Risk of Delivery Delays (R1)
P(R1)=1−(1−X(P1))×(1−X(P2))×(1−X(P3))×(1−X(P4))×(1−X(P5))×(1−X(D1))

=1-(1-0,03)*(1-0,05)*(1-0,04)*(1-0,02)*(1-0,02)*(1-0,02)

=0.141 = 14%

2. Work Accident Risk (R2)
P(R2)=1−[(1−X(P7))×(1−X(P8))×(1−X(P9))×(1−X(P10))×(1−X(F1))×(1−X(D2))

=1-(1-0,03)*(1-0,03)*(1-0,03)*(1-0,04)*(1-0,04)*(1-0,04)

= 0,1925 = (19%)

3. Transportation Cost Risk (R3)
P(R3)=1−(1−X(F2))×(1−X(F3))×(1−X(X15))×(1−X(X16))

=1-(1-0,07)*(1-0,07)*(1-0,07)*(1-0,05)

= 0.2359 atau (24%)

4. Vehicle Quality Risk (R4)
P(R4)=1−(1−P(X17))×(1−P(X18))×(1−P(X19))×(1−P(F4))×(1−P(X21))

=1-(1-0,05)*(1-0,04)*(1-0,05)*(1-0,03)*(1-0,03)

= 0.1848 = (18%)

5. Risk Management & Supply Chain (R5)
P(R5)=1−(1−X(P22))×(1−X(P23))×(1−X(P24))
=1-(1-0,04)*(1-0,04)*(1-0,04)

= 0.1153 = (12%)

The Boolean analysis results show that each indicator has a risk of occurrence. The risk of delay has a percentage of occurrence:

Table 2. Risk Mapping Analysis

Risk Code	Risk Type	Cause (Indicator)	Frequency	Probability	Main Cause
R3	Transportation Costs (24%)	F2, F3, P15, P16	7, 7, 7, 5	7%, 7%, 7%, 5%	Inefficient routes, damaged trucks, infrequent servicing
R2	Workplace Accidents (19%)	P7, P8, P9, P10, F1, D2	3,4	3%, 4%	Brake failure, fatigue, no safety SOPs
R1	Delivery Delays (14%)	P1–P5, D1	3,4	2%, 5%	Driver indiscipline, irregular schedules, weather
R4	Vehicle Quality (18%)	P17–P19, F4, P21	3,5	3%,5%	Infrequent maintenance, extreme weather, unavailable technicians
R5	Supply Chain & Management (12%)	P22–P24	4	4%	Incompetent PIC, poor scheduling, changing policies

Source: Author's compilation (2024)

From this analysis, it was found that there are two risks that require special attention in order for the Company's operations to run smoothly. The risk that received risk mitigation was workplace accidents with an incidence rate of 19% caused by brake failure, fatigue, and the absence of safety SOPs. The highest risk with the highest failure rate is transportation costs, accounting for 24% of incidents, caused by inefficient routes, damaged trucks, and infrequent maintenance. From the minimum cutset analysis obtained, it was found that there are three critical AND GATE combinations:

- {P7, P8} → Fatigue and poor health cause accidents.
- {P15, P16} → Damaged trucks and infrequent servicing → high costs.
- {F3, P21} → poor routes and damaged roads → costs and delays.

Risk Mitigation

The author conducted an analysis and obtained results based on the categories of low risk, medium risk, and high risk. From the above categories, the author recommends several appropriate steps for handling these risks:

1. Transportation Risk (24%)

The following is an analysis related to risk mitigation that occurs in transportation indicators:

Table 3. Transportation Risk Mitigation

Risk Factors	Mitigation Strategies
Inefficient routes	Implementation of GIS and GPS-based route management systems
Damaged trucks	Regular service schedules, implementation of preventive maintenance
High fuel costs	Optimization of cargo loads and replacement of fleets with fuel-efficient vehicles
Logistics planning	Scheduling and consolidation of goods delivery systems for volume efficiency

Source: Author's compilation (2024)

2. Risk of workplace accidents (19%)

The following is an analysis related to risk mitigation that occurs in occupational accident indicators:

Table 4. Work Accident Mitigation

Risk Factors	Mitigation Strategy
Driver fatigue	Balanced work scheduling, adequate rest time
No safety SOPs	Development and dissemination of K3 SOPs, periodic training
Brake failure & vehicle damage	Regular brake system checks, vehicle safety audits
Dark roads	Coordination with local agencies for infrastructure improvements or alternative routes

Source: Author's compilation (2024)

CONCLUSION

From the results of research at PT. XYZ, several problems were identified through analysis using Fault Tree Analysis. The results of the analysis using the Boolean Algorithm showed that the highest risk was workplace accidents, with a percentage of 19%, caused by fatigue due to long working hours, unroadworthy vehicles (failed brakes, damaged trucks), lack of structured safety procedures, and poorly lit roads. The second highest risk is transportation costs, with a 24% risk percentage, due to suboptimal route management, infrequent vehicle maintenance and damage, and inadequate overall logistics planning. The risk mapping analysis using fault tree analysis identified a minimum cut set that explains the root causes of each risk. Three key factor combinations (AND Gate) indicate that certain risks will only occur if two or more factors occur simultaneously, such as fatigue + health issues, or vehicle damage + infrequent maintenance.

This analysis is reinforced by the addition of risk mitigation. The purpose of adding this research instrument is expected to enable the author's article to provide input for the Company to address the problems occurring in the Company. The research proposal that the author concludes from this research is that occupational accident risks must be immediately addressed through safety training, vehicle maintenance, and driver time management. Additionally, for

transportation cost risks, the author recommends focusing on route optimization and vehicle maintenance. For delivery delay risks, the author suggests improvements through route management, better scheduling, and strict supervision.

REFERENCES

Ahmad, R.S., Tuli, H. and Mahmud, M. (2022) 'Penerapan Pengelolaan Persediaan Berdasarkan Sak Emkm Bagi Kelangsungan Usaha Mikro Di Kota Gorontalo', Jurnal Ilmiah Manajemen dan Bisnis, 5(1), pp. 217–229. Available at: https://ejurnal.ung.ac.id/index.php/JIMB/article/view/14732%0Ahttps://ejurnal.ung.ac.id/index.php/JIMB/article/viewFile/14732/4473.

Dwiasnati, S. and Hidayat, R.R. (2022) 'Penerapan Manajemen Risiko Menggunakan COSO: Enterprise Risk Management Framework Integrated Pada PT ALPHANET', Jurnal Tata Kelola dan Kerangka Kerja Teknologi Informasi, 8(2), pp. 66–72. Available at: https://doi.org/10.34010/jtk3ti.v8i2.7845.

Hasan, N.N., Rahmadini, F. and Dariyah, D. (2021) 'Application of Enterprise Risk Management to Banking Risk', MIZANIA: Jurnal Ekonomi Dan Akuntansi, 1(2), pp. 67–84. Available at: https://doi.org/10.47776/mizania.v1i2.245.

Lubis, M.D.S. and Imsar (2022) 'Analisis Manajemen Risiko Operasional Berdasarkan Pendekatan Enterprise Risk Management (Erm) Pada Ud. Anugrah Cabang Rantauprapat', JMBI UNSRAT (Jurnal Ilmiah Manajemen Bisnis dan Inovasi Universitas Sam Ratulangi)., 9(3), pp. 1492–1504. Available at: https://doi.org/10.35794/jmbi.v9i3.44457.

Mellisa, Andono and 2013 (2013) 'Penerapan Enterprise Risk Management Dalam Rangka Meningkatkan Efektifitas Kegiatan Operasional', Jurnal Ilmiah Mahasiswa Universitas Surabaya, 2(1), pp. 1–15.

Safitri, S.A. and Rufaedah, Y. (2020) 'Perancangan Enterprise Risk Management pada PerusahaanPeternakan (Studi Kasus pada PT Aretha Nusantara Farm)', Industrial Research Workshop and National Seminar, pp. 26–27.

Badan Pusat Statistik. (2021). Ekspor Maret 2021 Mencapai US$18,35 Miliar dan Impor Maret 2021 senilai US$16,79 Miliar.

Hanafi, M. M. (2016). Manajemen Risiko. Yogyakarta: UPP STIM YKPN.

Hartati, M., & Nurainun, T. (2018). Analisis Risiko Rantai Pasok Pabrik Kelapa Sawit dengan Menggunakan Metode SCOR. Seminar Nasional Teknologi Informasi, Komunikasi dan Industri (SNTKI-10), 588-598.

University of Iowa.2009. Chapter 12: Boolean Algebra And Combinatorial Circuits Discrete Mathematical Structures: Theory And Applications. http://www.cs.uiowa.edu/~icurto/discret-ppt/Chapter 12.ppt.

R. R Moeler, "COSO Enterprise Risk Management Establishing Effective Governance, Risk, and Compliance Processes." Second Edition Willey Corporate F& A. John Wiley & Sons, Inc. New Jersey, 2019.

A. Tunggal, Widjaja, "Internal Audit, Enterprise Risk Management dan Corporate Governance," Jakarta: Harvarindo, 2020.

Mukhlisa*, S. a. (2018). Desain Sistem Manajemen Risiko pada Perguruan Tinggi Negeri Badan Hukum (PTN BH) Studi Kasus pada Universitas Gadjah Mada. Journal of Applied Accounting and Taxation Article History Vol. 3, No. 2, October 2018, 158-167 Received September, 2018 e-ISSN: 2548-9925 Accepted September, 2018 , 158-167.

Djuitaningsih, T. (n.d.). Efektivitas Enterprise Risk Management untuk Mencegah Terjadinya. p. 2. Retrieved September 25, 2021, from

http://repository.bakrie.ac.id/1251/1/005.%20artikel%20Tita%20Djuitaningsih%20untuk %20Perpustakaan%20UB.pdf

Neni Purwati*1, H. W. (2021). Transformasi Layanan Administrasi Akademik Perguruan Tinggi di Masa Pandemi COVID-19 . JURNAL TEKNIKA ISSN: 0854-3143 e-ISSN: 2622- 3481 Teknika Vol. 15, No. 01, Juni 2021, 23 – 31 .

Iqbal, D.N. (2022) Analisis Keselamatan Dan Kesehatan Kerja Menggunakan Metode Failure Mode And Effect Analysis (FMEA) dan Fault Tree Analysis (FTA) (Studi Kasus:PTPN V Sei Galuh). Universitas Islam Negeri Sultan Syarif Kasim Riau.

Fithri, P., Nofriyanti, Hasan, A., & Kurnia, I. (2020). Risk Analysis for Occupational Safety and Health in Manufacturing Company Using FMEA and FTA Methods: A Case Study. IOP Conference Series: Materials Science and Engineering, 1003(1). https://doi.org/10.1088/1757-899X/1003/1/012073

Kambey, S. K., Malingkas, G. Y., Lefrandt, L. I. R., Wilayah, B., & Sulawesi, S. (n.d.). ANALISIS RISIKO KECELAKAAN KERJA PADA PROYEK BENDUNGAN LOLAK KAB. BOLAANG MONGONDOW, SULAWESI UTARA MENGGUNAKAN METODE FMEA (FAILURE MODE AND EFFECT ANALYSIS) DAN METODE DOMINO. In Jurnal Ilmiah Media Engineering (Vol. 12, Issue 2).

A. R. Yosaka and M. Basuki, "Analisa Risiko Pembangunan Barge Mounted Power Plant (BMPP) 60 MW di PT. PAL Indonesia (Persero) Menggunakan Metode Failure Mode and Effect Analysis (FMEA) dan Matrik Risiko," J. Sumberd. Bumi Berkelanjutan, vol. 1, no. 1, pp. 476–492, 2022, doi: 10.31284/j.semitan.2022.3197.

F. I. Almaeda, "Penilaian Risiko Operasional Proses Pembangunan Kapal Wisata Trimaran Bottom Glass Menggunakan Metode Fault Tree Analysis dan Matrik Risiko Pada PT.ABC," J. Sumberd. Bumi Berkelanjutan, vol. 1, no. 1, pp. 127–135, 2022, doi: 10.31284/j.semitan.2022.3082.

J. P. S. Irawan, I. D. Mustaniroh, dan S. Asmaul, "Model Analisis dan Strategi Mitigasi Risiko Produksi Keripik Tempe, Jurnal Teknologi dan Manajemen," J. Teknol. Dan Manaj. Agroindustri, vol. 6, no. 2, hlm. 88–96, 2017.