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Analysis of Green Supply Chain Management Risk Mitigation in the Fiber Optic Service Provider Industry PT Era Bangun Telecomindo (PT EBTEL) East Java Regional

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Abstract. *PT. Era Bangun Telecomindo Regional East Java (PT EBTEL JATIM) is a company dedicated to providing fiber optic cable network services starting from the installation of new networks, network repairs and network rejuvenation in East Java which experiences problems in waste management and the emergence of high project fines due to lack of knowledge of risk identification, risk mitigation and green supply chain management. The purpose of the research is to find out the risk mitigation analysis that occurs in implementing Green Supply Chain Management (GSCM). This study uses a quantitative descriptive approach with the House Of Risk (HOR) method to analyze the risks within the company's Supply Chain Operation Reference (SCOR) framework. Data collection through the interview and questionnaire process, and data processing uses formula functions in Microsoft Excel. The results of the study found that there is risk identification, risk assessment, and risk mitigation from the company's Green Supply Chain Management framework, which can reduce the cost of fines incurred by the company.*

Keywords: *Fiber Optic, Green Supply Chain Management, House of Risk, Risks*

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INTRODUCTION

In the era of globalization and rapid industrial development, sustainability has become a major issue in various sectors, including the telecommunications industry (Santoso et al., 2022). Data from the Global e-Waste Monitor shows that electronic waste (e-waste) worldwide reaches 53.6 million tons per year, with Indonesia as one of the largest contributors in Southeast Asia. According to the projection, the increase in internet users will also be accompanied by an increase in electronic waste, the use of environmentally unfriendly raw materials, and the high cost of producing network infrastructure and telecommunications devices in the future in Indonesia (Mairizal et al., 2021).

The need for waste management, proper control of network infrastructure development costs and the responsibility of producing companies to manage the waste, one solution is to implement green supply chain management (Ali et al., 2020). The main principles of Green Supply Chain Management include Green Procurement, which ensures that raw materials come from environmentally friendly sources; Green Manufacturing, which emphasizes energy efficiency and waste reduction in the production process; Green Distribution, which prioritizes low-emission logistics methods; Reverse Logistics, which focuses on recycling and reprocessing used products; and Waste Management, which aims to reduce and manage waste more

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responsibly The main driving factors for the implementation of Green Supply Chain Management are strict regulations, consumer awareness, and pressure from stakeholders.

However, in Indonesia, many companies still face obstacles such as a lack of concrete regulatory support, high investment costs, and low understanding of the long-term benefits of implementing Green Supply Chain Management (Judijanto et al., 2024). One of the companies engaged in the telecommunications sector, specifically the fiber optic network service provider industry, is PT Era Bangun Telecomindo (PT EBTEL), a company dedicated to providing fiber optic cable network services that has collaborated with many leading service providers in the telecommunications sector in Indonesia. In carrying out its business activities, PT EBTEL, in this case PT EBTEL East Java Region, is not free from the risks inherent in its business activities, including the company's responsibility to ensure the sustainability of its business, social and environmental.

Table 1. Percentage of Network Waste in the Company's Operational Activity Process

Type of Work	Network Waste Percentage
New network installation	7%-12%
Fix network problems	2%-5%
Replace old network	90%-100%

Source: Company Processing Data – December 2024

The waste that appears in these operational activities is mostly just piled up waiting for someone to buy it without taking any other special actions. Therefore, the implementation of Green Supply Chain Management is a strategic step for PT EBTEL to improve operational efficiency while fulfilling environmental responsibilities. The implementation of an effective GSCM strategy also allows the company to comply with environmental regulations, improve brand reputation, and attract more customers who care about sustainability, which ultimately provides a competitive advantage (Utami & Buana, 2024).

In addition to the problem of leftover raw materials and waste that has not been utilized, the phenomenon of inefficiency collected from the interview process with field implementers/project managers shows that in 48 new installation projects and network replacements there was an average delay of 1.6 days and the percentage of fines was around 0.06% of the project contract value. Meanwhile, in network maintenance, there were more than 200 trouble tickets that were worked on with an average fine of 500 thousand / hour when it exceeded 6 hours of work from the issuance of the trouble ticket. The total fine recorded throughout 2024 was IDR 126,076,134.

The problem of delays in completing the work resulted in increased costs in completing the project due to late fines, increased labor costs, the impact of potential time losses to complete other projects and decreased turnover and company profits. According to Husin & Syahreza (2025), Delays in completing the work also resulted in decreased trust due to the inability to meet customer targets and expectations. Delays in completing the work also resulted in decreased trust due to the inability to meet customer targets and expectations. The incident allegedly occurred due to a lack of knowledge of risk identification in the implementation of the company's operational activities (Nasution, 2020).

Risk identification and risk mitigation are important in the company's operational activities starting from the plan, make-deliver, enable and return process in order to determine possible risk events, causes of risks, risk factors, risk impacts, risk severity and risk mitigation. One way to identify risks and mitigate risks is by using the House of Risk (HOR) method. HOR 1 is used to identify risk sources and measure the severity and probability of risk events. While HOR 2 is used to design mitigation strategies based on previously identified risk priorities.

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From the literature search process regarding risk mitigation analysis in the field of telecommunication activities providing fiber optic networks, researchers did not find any related articles, even though it is important to know the risk mitigation analysis in the field of fiber optic service provider activities. Therefore, there needs to be research on risk identification and suggestions for risk improvement in companies engaged in the field of telecommunication providing optical cable network services which are currently growing massively in Indonesia from micro business scale to mature and large companies (Lubis, 2023).

There are many studies on risk management but no knowledge was found regarding risk mitigation analysis in companies engaged in fiber optic network provision activities so that the growth of this business sector is accompanied by knowledge of risk management, how to mitigate the risk and make suggestions for improvements to the risks that occur especially the risk of company activities. Therefore, it is necessary to conduct a study on the Green Supply Chain Management Risk Mitigation Analysis in the Fiber Optic Service Provider Industry at PT Era Bangun Telecomindo (PT EBTEL) East Java Region, which is important to identify what risks may occur and find suggestions for improvement.

LITERATURE REVIEW

SCM is a strategic approach to managing the flow of goods, information, and finances from suppliers to end consumers, SCM aims to improve operational efficiency and optimize the use of resources in a production and distribution system (Oktalia et al., 202). While the concept of sustainable SCM is known as Green supply chain management (GSCM) as the integration of sustainability principles into the entire supply chain process, from planning, procurement of raw materials, production, to distribution and waste management (Asniwati et al., 2023). GSCM emphasizes that companies must ensure that all processes in their supply chain comply with standards set by the government and international regulatory bodies (Fazila et al., 2025).

The implementation of GSCM not only focuses on reducing environmental impacts, but also on increasing the company's efficiency and revenue (Wahyudi et al., 2025). By improving operational efficiency and reducing costs, companies can increase their profitability. At the same time, the increased reputation and customer satisfaction resulting from the implementation of GSCM opens up opportunities for sustainable revenue growth (Younis et al., 2016). The House of Risk (HOR) method is one of the risk analysis techniques widely used in supply chain management, including in the context of Green supply chain management (GSCM). This method functions to identify, evaluate, and mitigate risks that have the potential to hinder the implementation of sustainability strategies in a company's supply chain.

Align with research from Fauzan & Santoso (2024), With a systematic approach, the HOR method helps companies determine risk management priorities and develop effective mitigation strategies. Risk identification and mitigation are focused on the green supply chain operation reference (SCOR) framework which includes business process design, measurement, comparison, management practices and HR behavior in the company's supply chain flow. HOR was developed as part of proactive risk management in the supply chain, with two main stages, namely House of Risk 1 (HOR 1) and House of Risk 2 (HOR 2). HOR 1 is used to identify risk sources and measure the severity and probability of risk events. While HOR 2 is used to design mitigation strategies based on previously identified risk priorities.

METHODS

This research will be conducted with a quantitative descriptive approach. Data will be collected through interviews and questionnaires with management and staff related to the risks that occur. Descriptive analysis methods will be used to identify risks and compile GSCM risk mitigation based on sustainability indicators, such as efficiency of raw material use, waste management, and environmental impacts. Quantitative analysis techniques are used such as measuring the relationship between risk events and risk agents to obtain priority risk agents and

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measuring the relationship between risk agents and preventive measures to produce effective preventive measures in implementing GSCM risk mitigation to company operations. The object of research in this study is at PT Era Bangun Telecomindo (PT EBTEL) East Java Region. This study will analyze the risk mitigation of the implementation of GSCM principles and their impact on the sustainability of its business. The subjects of the study are individuals or groups who have direct involvement in the implementation of GSCM at PT Ebtel East Java Region. The subjects of the study include: Operational managers, and field implementers of PT Ebtel. This study uses a quantitative descriptive approach with primary data collection obtained directly from the first source. There are two main techniques used, namely interviews and questionnaires. Interviews are conducted through questions and answers between two or more parties to identify risk events and risk agents. Meanwhile, questionnaires are used to collect written data from respondents to assess the level of impact (severity) of risk events, the level of occurrence (occurrence) of risk causes, the level of difficulty in handling them, and the correlation between risk causes and handling.

Data Analysis

Waste Reduction

One of the main objectives of GSCM is to reduce waste at every stage of the supply chain. Measurement is done by comparing the amount of waste generated before and after the implementation of GSCM. The data will show the extent to which waste can be reduced through more efficient and environmentally friendly management. The calculation is Waste reduction = total input waste - waste utilized.

Potential Savings

Effectiveness measurement is done to assess how well GSCM contributes to improving company performance, especially in terms of operational efficiency and costs incurred. Data collected from various company departments will be analyzed to measure the results of GSCM implementation on cost reduction and process improvement so that the potential costs need to be calculated. Potential savings = Costs sacrificed - Costs gained.

RESULTS AND DICUSSION

Supply Chain Flow

The supply chain flow at PT EBTEL Regional East Java starts from the planning stage to the delivery of the final project results to customers. The following are the general stages of the supply chain flow in a fiber optic network construction project: A. The planning process identifies activities to prepare a network scheme, determine material requirements, and create a project implementation schedule based on client requests and survey results, B. The procurement process for the framework material, namely procuring fiber optic cables, ducts, pipes, joint boxes, ODPs, and other equipment through registered official suppliers. This procurement considers cost efficiency and quality of goods, as well as environmental feasibility (environmentally friendly), C. The construction and installation process identifies the framework The construction team carries out field work, including excavation, duct planting, cable pulling, splicing, and network testing. The results of the work must meet the established quality standards, D. The Return process is the stage of managing the return flow of materials, leftover goods, or damaged equipment from the project location to the warehouse or related vendors (Hakim, 2024). This process is important to ensure logistics efficiency, asset recovery, and environmental responsibility.

Risk Identification

This risk identification is a useful process to find out potential problems that can affect the smoothness of operational activities at PT EBTEL East Java region. Risk identification comes

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from the results of interviews and questionnaires that are adjusted between the research context and company activities, the results of which are in the following table.

Table 2. Risk Identification from Interview and Questionnaire Results

Code	Risk Description	Process	SCOR Category	Notes
P1	Project schedule delay	Plan	Reliability	Due to delays in material supply and FO route approval
P2	Installation time exceeds plan	Plan	Responsiveness	Construction process exceeds the scheduled time
P3	Actual cost exceeds budget	Plan	Cost	Unexpected expenses during project execution
M1	Rework due to technical errors	Make	Reliability	Rework caused by splicing errors or device configuration mistakes
M2	Damaged or non-compliant materials	Make	Reliability	Materials from suppliers do not meet technical specifications
M3	Project waste not properly managed	Make	Asset Management	Cable, pipe, and duct waste not handled according to environmental procedures
E1	Suboptimal daily supervision	Enable	Responsiveness	Lack of supervision causes work deviations
E2	Personnel not trained in environmental aspects	Enable	Asset Management	Lack of environmental impact training for field technicians

Impact and Likelihood Assessment

Each risk has a cause and a consequence to operational performance. To measure its priority level. Impact is how much loss or influence is caused and the risk probability is how often the risk occurs.

Table 3. Risk mapping Supply Chain Operations Reference

No.	Risk Code	Risk Description	Likelihood	Impact	Risk Score	Risk Level
1	P1	Project schedule delay	4	4	16	Very High
2	P2	Installation time exceeds plan	3	3	9	High
3	P3	Actual cost exceeds budget	3	4	12	High
4	M1	Rework due to technical errors	4	3	12	High
5	M2	Materials do not meet specifications	2	2	4	Low
6	M3	Project waste not properly managed	3	3	9	High
7	E1	Suboptimal daily supervision	3	2	6	Medium
8	E2	Personnel not trained in environmental aspects	4	3	12	High

House Of Risk Phase 1

House of Risk 1 (HOR 1) to evaluate and prioritize risk agents. HOR 1 is used to identify the most dominant risk agents based on their frequency and impact on risk. The results will later determine the ARV value to determine the size of the potential risk to the identified risks.

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Table 4. Identification and Prioritization of House of Risk Phase 1

Risk Event (Ei)	Risk Agent (Aj)	Correlation (Rij)	Severity (Si)	Occurrence (Oj)	ARP (Aggregate Risk Potential)
E1. Project schedule delay	A1. Delay in material procurement	9	4	4	144
	A2. Slow FO route approval	9	4	4	144
E2. Installation exceeds plan	A3. Difficult field conditions	3	3	3	27
E3. Project cost exceeds budget	A4. Changes in material prices	9	4	3	108
	A5. Overtime or additional work hours	3	4	3	36
E4. Rework due to technical errors	A6. Lack of technical training	9	3	4	108
E5. Materials do not meet specifications	A7. Supplier human error	9	2	2	36
E6. Project waste not properly managed	A8. Absence of a waste management system	9	3	3	81
E7. Suboptimal daily supervision	A9. Insufficient number of project supervisors	3	2	3	18
E8. Personnel unaware of environmental aspects	A10. Lack of environmental training	9	3	4	108

From the table, the risk agent with the highest ARV is "Lack of labor" (ARV = 68) which is related to many operational risks. Therefore, this risk agent will be a priority in designing mitigation strategies in HOR 2.

Risk Mitigation with House of Risk Phase 2

HOR 2 aims to select the most effective and efficient mitigation actions based on the effectiveness value and ease of implementation. The steps in HOR 2 include: Determining alternative mitigation actions for risk agents with the highest ARV, Giving a mitigation effectiveness score to each risk agent (scale 1-5), Giving a score of the level of implementation difficulty (scale 1-5; the smaller the easier), and calculating ETD (Effectiveness to Difficulty Ratio) with the formula: ETD = Effectiveness / Level of Difficulty.

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Table 5. Risk Mitigation Strategy House of Risk Phase 2

Mitigation Action (Ak)	Related Risk Agent (Aj)	Correlation (Ejk)	ARPj	Total Effectiveness (TEk)	Difficulty Level (Dk)	Effectiveness / Difficulty (ETDk)
Action 1: Develop an early material ordering schedule	A1: Delay in material procurement	9	144	1296	3	432
Action 2: Intensive coordination with route permit issuers	A2: Slow FO route approval	9	144	1296	4	324
Action 3: Regular evaluation of vendor pricing	A4: Fluctuation in material prices	9	108	972	3	324
Action 4: Routine technical training for technicians	A6: Lack of technical training	9	108	972	3	324
Action 5: Environmental training program for technicians	A10: Lack of environmental training	9	108	972	4	243
Action 6: Implement waste management SOP	A8: Absence of a waste management system	9	81	729	3	243

The mitigation strategy that is the main priority is to add daily personnel to dense projects (ETD = 2.5), because it is very effective and easy to implement. The implementation of this mitigation strategy is expected to reduce the risk of schedule deviations, rework, and improve supervision in the field. This also supports Green Supply Chain Management (GSCM) efforts through efficiency of time, energy, and reduction of work waste due to technical errors.

Potential Savings

Potential savings are calculated based on the costs that arise due to losses that occur due to unidentified risks, risk management, risk mitigation and the application of green supply chain principles minus the costs that occur after the risks are identified, risk management, risk mitigation and the application of green supply chain principles. The loss due to not implementing the research principle is IDR 126,076,134, the potential cost that occurs when implementing the principle in the research is rounding the average duration of delay multiplied by the number of projects multiplied by additional labor costs consisting of one technician (IDR 200,000/day) and three helpers (IDR 150,000/day)

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Potential savings = Costs sacrificed - Costs obtained

Potential savings

= 126,076,134 - (rounding delay × number of projects × labor costs)

= 126,076,134 - (2 days × 48 projects × 650,000)

= 126,076,134 - 62,000,000

= 63,676,134

The discussion in this study focuses on the interpretation of the results of the House of Risk (HOR) method stage 1 and stage 2 used to identify, evaluate, and develop mitigation strategies for risks in the operational project of fiber optic network development at PT Era Bangun Telecomindo (PT EBTEL) East Java Region. This process is important in supporting the implementation of sustainable Green Supply Chain Management (GSCM). The results of HOR 1 show that there are five risk agents (risk causes) that have the highest ARV (Aggregate Risk Potential Value) and are the dominant causes of the risks that have been identified. The five risk agents are related to major risks such as project schedule delays, rework due to technical errors, waste of project costs, and potential environmental pollution (Wang & Yuan, 2017).

This is a special concern in the context of the green supply chain (GSCM), because these factors contribute to the waste of energy, time, and resources (Kurniawan et al., 2023). The results of HOR 2 are the most appropriate and efficient mitigation actions for the risk agents prioritized in HOR 1. Where the mitigation results are, adding daily workers for dense projects to reduce excessive workloads and avoid deviations in work time, more intensive coordination of permits with related parties, using alternative suppliers, conducting environmental training, and more intensive communication between project functions (Daily & Huang, 2001). The main principle of GSCM is resource efficiency and reducing environmental impacts in all supply chain activities (Kurniawan et al., 2024).

According to Gustya et al. (2023), the implementation of this strategy is expected to significantly reduce risk while supporting the principles of green operation, such as energy efficiency, waste reduction, and improving quality and timeliness. Thus, HOR 2 not only helps companies reduce risk, but also as a managerial tool in designing a more responsive, sustainable, and environmentally oriented work system. In addition, regular training on environmental aspects for workers is also important in increasing awareness of project waste management and material reuse (Rusmini et al., 2024). Technical validation in the project planning stage is also a form of anticipation of the risk of rework that has the potential to cause waste of materials and energy.

Regular training on environmental aspects needs to be made a mandatory program, considering that one of the main causes of risk is the low awareness of the workforce towards environmental standards, project planning needs to be strengthened through a cross-divisional technical validation mechanism to avoid the risk of rework and delays if the incident does not occur the company is able to gain a potential profit of Rp 63,676,134 from risk management. This is also in line with the findings, supplier selection must consider distance, distribution efficiency, and compliance with environmental standards, in line with the concept of green procurement, integrating sustainability indicators into project KPIs, such as energy efficiency, waste management levels, and HR participation in environmental training.

CONCLUSION

Conclusion of green supply chain management risk analysis using supply chain operation reference approach as identified framework and risk mitigation with house of risk method found project schedule delay, cost over budget, rework due to technical error, to low environmental awareness of workforce. HOR 1 identified lack of workforce energy, slow path permit, material delay from supplier, no continuous environmental training, and weak validation of project

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planning as risk, HOR 2 compiled daily workforce addition, early coordination with related agencies, use of local suppliers, periodic environmental training, and technical validation of project as risk mitigation. These risk mitigation strategies help reduce resource waste, improve work efficiency, and strengthen awareness of the importance of waste and emission management in telecommunication infrastructure projects. All of these strategies have proven to be relevant and support GSCM principles.

SUGGESTION

Project HR management suggestions need to be considered to strengthen both performance and capacity, validation in every project activity, developing project sustainability evaluation, alternative collaboration in selecting suppliers and the need for specific evaluation of risk identification, management and mitigation to always be relevant to dynamics in the field. In addition, there is a need for KPI assessment of supply chain performance, application of lean project principles and application of the HOR method in every company activity specifically.

REFERENCES

Ali, Y., Saad, T. B., Sabir, M., Muhammad, N., Salman, A., & Zeb, K. (2020). Integration of green supply chain management practices in construction supply chain of CPEC. *Management of Environmental Quality: An International Journal*, *31*(1), 185-200. https://doi.org/10.1108/MEQ-12-2018-0211

Asniwati, A., Nurhaeda, Z., Anita, A., & Bater, L. (2023). Peningkatan Kinerja Perusahaan Melalui Praktik Green Supply Chain Management. *Jurnal Manajemen STIE Muhammadiyah Palopo*, *9*(2), 242-258. http://dx.doi.org/10.35906/jurman.v9i2.1697

Daily, B. F., & Huang, S. C. (2001). Achieving sustainability through attention to human resource factors in environmental management. *International Journal of operations & production management*, *21*(12), 1539-1552. https://doi.org/10.1108/01443570110410892

Fauzan, M., & Santoso, B. J. (2024). Peran Manajemen Risiko dalam Meningkatkan Kinerja Mesin Filling Emulsion dengan Pendekatan House of Risk (HOR). *Benefit: Jurnal Manajemen dan Bisnis*, *9*(2). https://doi.org/10.23917/benefit.vi.6720

Fazila, E., Megantara, S., & Anastasya, G. (2025). Analisis Risiko Kualifikasi Pemasok dan Pendekatan Mitigasi Risikonya dalam Manajemen Rantai Pasok Industri Farmasi. *Jurnal Mahasiswa Ilmu Kesehatan*, *3*(2), 69-87. https://doi.org/10.59841/jumkes.v3i2.2536

Gustya, A. A., Fasa, M. I., & Suharto, S. (2023). Urgensi Penerapan Green Banking Sebagai Aspek Meningkatkan Kualitas Layanan Industri Perbankan Syariah. *Jaksya: Jurnal Akuntansi Syariah*, *1*(1), 55-61. https://doi.org/10.24952/jaksya.v1i1.7664

Hakim, A. N. (2024). *Analisis dan Usulan Perbaikan Kinerja Supply Chain Menggunakan Scor Digital Standard Pada Proses Procurement PT Kereta Api Indonesia (Persero) Upt Balai Yasa Yogyakarta* (Doctoral dissertation, Universitas Islam Indonesia).

Husin, C., & Syahreza, D. S. (2025). Pengaruh Self Efficacy dan Work Engagemen terhadap Kinerja Karyawan PT. Aroma Mega Sari Tanjung Morawa. *Innovative: Journal Of Social Science Research*, *5*(1), 1577-1593. https://doi.org/10.31004/innovative.v5i1.17863

Judijanto, L., Asniar, N., Kushariyadi, K., Utami, E. Y., & Telaumbanua, E. (2024). Application of integrated logistics networks in improving the efficiency of distribution and delivery of goods in Indonesia a literature review. *Sciences du Nord Economics and Business*, *1*(01), 01-10. https://doi.org/10.58812/sneb.v1i1.6

Kurniawan, D. R., Mahestri, N. A., & Maylawati, W. (2023, December). Dampak Managemen Hijau Rantai Pasok Terhadap Kinerja Keberlanjutan Ekonomi, Kinerja Kelestarian Lingkungan Dan Kinerja Keberlanjutan Sosial PT Krakatau Steel (Persero) TBK. In *Prosiding Business*

Adaptability, Change Management and Technopreneur Conferences (Vol. 1, No. 2, pp. 359-366). https://doi.org/10.46306/bacmatech.v1i2.30

Kurniawan, D. R., Mahestri, N. A., Maylawati, W., & Rustandi, T. (2024). Dampak Managemen pada Rantai Pasok Terhadap Kinerja Keberlanjutan Ekonomi, Kinerja Kelestarian Lingkungan dan Kinerja Keberlanjutan Sosial PT Krakatau Steel (Persero) Tbk. *Jurnal Sains dan Teknologi Maritim*, *25*(1), 127-140. https://doi.org/10.33556/jstm.v25i1.409

Lubis, A. N. A. (2023). *Analisis forecasting permintaan fiber optic cable 6t (studi kasus pada PT. Indonesia Comnets Plus SBU Regional Sumatera Bagian Selatan)* (Doctoral dissertation, UIN Syekh Ali Hasan Ahmad Addary Padangsidimpuan).

Mairizal, A. Q., Sembada, A. Y., Tse, K. M., & Rhamdhani, M. A. (2021). Electronic waste generation, economic values, distribution map, and possible recycling system in Indonesia. *Journal of Cleaner Production*, *293*, 126096. https://doi.org/10.1016/j.jclepro.2021.126096

Nasution, M. H. (2020). Telaah Kritis Berbagai Risiko SDM Dalam Mempertahankan Kelangsungan Perusahaan. *Jurnal BONANZA: Manajemen dan Bisnis*, *1*(1), 32-42. https://doi.org/10.47896/mb.v1i1.268

Oktalia, A., Agriffina, J., Ella, M., Cuandra, F., & Laulita, N. B. (2022). Analisis rantai pasok serta sistem ERP dalam kinerja operasional PT Nestle Indonesia. *Transekonomika: Akuntansi, Bisnis dan Keuangan*, *2*(3), 127-144. https://doi.org/10.55047/transekonomika.v2i3.134

Rusmini, R., Shalihah, I. A., Ainiyah, Q., & Muawanah, U. (2024). Pemberdayaan Limbah Kayu Plywood dalam Perekonomian Desa Dorogowok. *Pandalungan: Jurnal Pengabdian kepada Masyarakat*, *2*(2), 78-88. https://doi.org/10.62097/pandalungan.v2i2.1771

Santoso, R. E., Prawiyogi, A. G., Rahardja, U., Oganda, F. P., & Khofifah, N. (2022). Penggunaan dan manfaat big data dalam konten digital. *ADI Bisnis Digital Interdisiplin Jurnal*, *3*(2), 157-160. https://doi.org/10.34306/abdi.v3i2.836

Utami, A. P., & Buana, D. B. C. (2024). Analisis Halal Logistic dengan Pendekatan SWOT (Studi Kasus CV. X sebagai Penyedia Jasa di Cirebon). *YUME: Journal of Management*, *7*(2), 740-749. https://doi.org/10.37531/yum.v8i2.8324

Wahyudi, B., Danu, M., Mawasandi, F., Aziz, Z. N., & Rosyadi, M. F. G. (2025). Transformasi Manajemen Rantai Pasokan Berbasis Internet of Things (IoT): Tinjauan Literatur. *Jurnal Teknologi dan Manajemen Industri Terapan*, *4*(I), 32-44. https://doi.org/10.55826/jtmit.v4iI.535

Wang, J., & Yuan, H. (2017). System dynamics approach for investigating the risk effects on schedule delay in infrastructure projects. *Journal of Management in Engineering*, *33*(1), 04016029. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000472

Younis, H., Sundarakani, B., & Vel, P. (2016). The impact of implementing green supply chain management practices on corporate performance. *Competitiveness Review*, *26*(3), 216-245. https://doi.org/10.1108/CR-04-2015-0024

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