Analysis of Causes and Risk Mitigation for Delivery Delays Based on On-Time In-Full (OTIF) Data in Non-Cement Distribution Using RCA and FMEA Methods at PT XYZ

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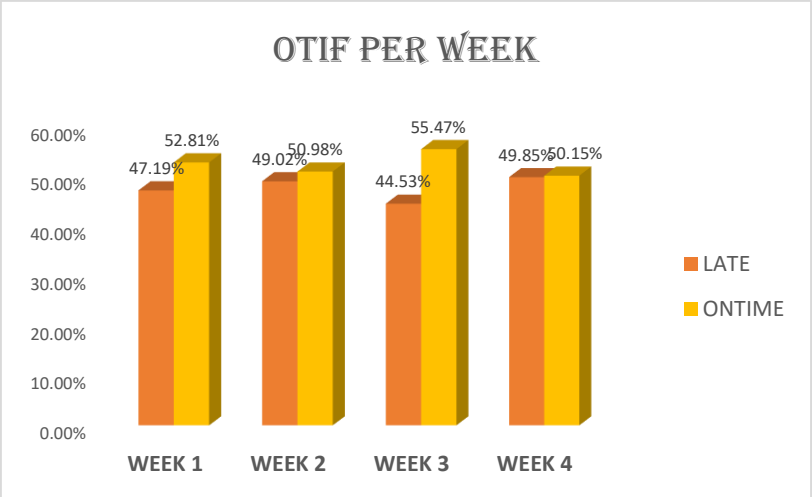
Abstract.
Delivery punctuality is an important indicator of logistics service performance, yet non-cement distribution at PT XYZ still experiences delays. On Time In Full (OTIF) data from May to July 2026 recorded that only 54.64% of 14,986 shipments were delivered on time. This study aims to determine the on-time delivery rate, identify the dominant causes and root causes of delay, and determine mitigation priorities. The methods used were Pareto diagram, Root Cause Analysis (RCA) with fishbone and 5 Why, and Failure Mode and Effect Analysis (FMEA), with Severity, Occurrence, and Detection rated by two respondents. The Pareto results show that long parking time (49.9%) and unloading schedule (41.1%) caused 91.0% of the delays. RCA identified the root causes as the absence of a standard maximum stopping time, a joint arrival scheduling mechanism with receivers, a procedure for communicating estimated arrival, and a cargo readiness confirmation procedure. Based on FMEA, the highest Risk Priority Number (RPN) belongs to the absence of a joint arrival scheduling mechanism with receivers (336), followed by the absence of an estimated arrival notification procedure (168) and a standard maximum stopping time (120). Joint arrival scheduling with receivers should be the priority for improvement.
Keywords: *On Time In Full, Root Cause Analysis, Failure Mode and Effect Analysis and Pareto.*

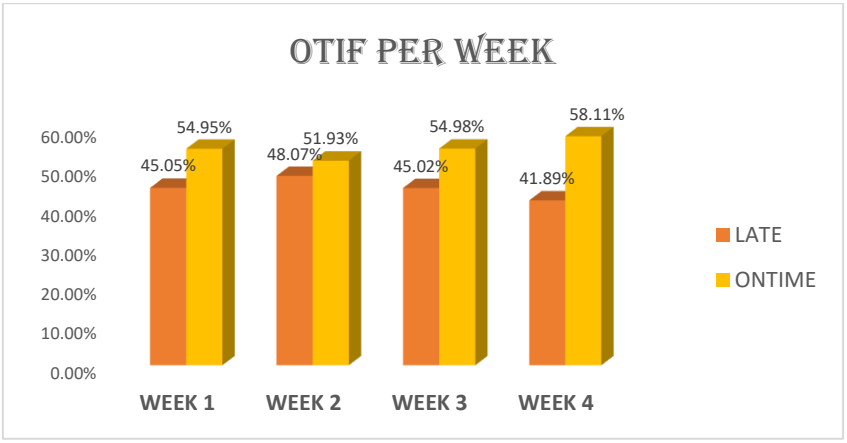
I. INTRODUCTION

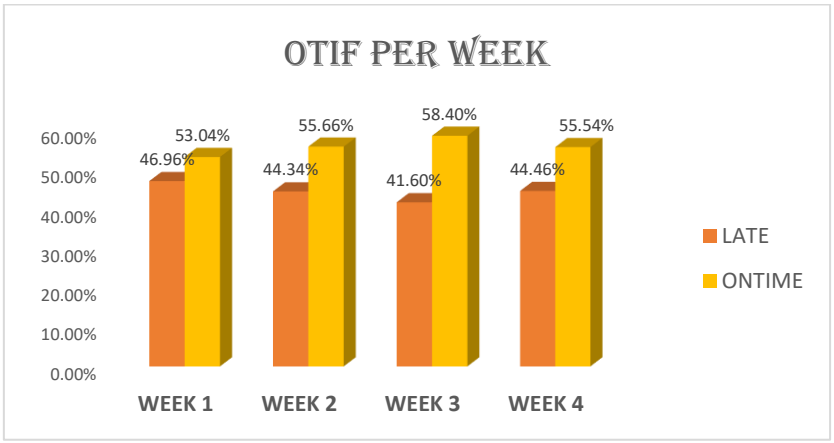
Timeliness of delivery determines the quality of a logistics company's services and reflects the effectiveness of its operational processes.(Adianto & Herawati, 2024); (Nelfiyanti, 2024) . The higher the timeliness, the greater the company's chances of meeting customer needs and maintaining their trust. Conversely, late delivery can lead to customer dissatisfaction and reduce service performance (Dinda Nurhalizah Mawardy & Kirono, 2026) ;(Kumala Dewi et al., 2026)).

PT XYZ handles not only cement distribution, but also non-cement distribution such as building materials and other goods according to customer needs. The types of goods, delivery destinations, and customer needs in non-cement distribution are more diverse, so the operational conditions of each delivery are different and maintaining timeliness is a challenge in itself. Delivery performance is monitored by the On Time In Full (OTIF) indicator, which is a measure of whether the delivery arrives on time and in the correct quantity (Pradipa, 2025)This study uses OTIF data only for the on-time aspect.

OTIF data from the PT XYZ Control Tower Department's monitoring system from May to July 2026 shows that of 14,986 non-cement shipments, only 54.64% were on time, while 45.36% were late. The on-time percentage per week also fluctuated between 50.15% and 58.40%, resulting in inconsistent performance, as shown in Figure 1.







Source: PT XYZ Internal Data, processed, 2026

Fig. 1. Percentage of Non-Cement OTIF Shipments per Week May–July 2026

Delivery delays have been analyzed using several methods. Fishbone diagrams and the 5 Whys model were used to trace the causes of delivery delays at distributors in Gresik.(Nur Cahyani & Hanif Dzulquarnain, 2025); and on the causes of label stock mismatch in the food and beverage industry(Zuhrotul Baida & Herwanto, 2025);(Firdausy & Koes Ardhiyanto, 2025) , while DMAIC is used for delivery delays at cargo agents(Luthfi Firdaus et al., 2026) and on OTIF performance(Pradipa, 2025).

Failure Mode and Effect Analysis(FMEA) is used to rank the causes of delays in delivery of cardboard sheet products.(Fatah et al., 2025) and package delivery failures, with delays being the highest risk. A combination of RCA and FMEA has been used in healthcare with fishbone first and FMEA to determine improvement priorities.(Anggraeni & Fety Nurlia Muzayanah, 2025)as well as on supply chain risk analysis in Pertamina's environment(Rizki & Saputra, 2022);(Firdausy & Koes Ardhiyanto, 2025). RCA finds the root cause of a problem, not just the symptoms.(Sholikhah et al., 2026), but it doesn't indicate which root causes are the riskiest and should be addressed first. FMEA complements this by identifying failure modes, their impacts, and causes, then ranking the risks using a Risk Priority Number (RPN).(Fatah et al., 2025) .

Based on the description, the formulation of the research problem is how is the level of on-time delivery of non-cement distribution at PT XYZ based on OTIF data for the period May to July 2026, what are the dominant causes of delays and their root causes, and which failure modes have the highest RPN and what improvement suggestions can be given. This study aims to determine the level of on-time delivery of non-cement distribution at PT XYZ, determine the dominant causes and root causes of delays using Pareto and RCA, and determine mitigation priorities based on RPN from FMEA.(Soleman et al., 2026).

II. RESEARCH METHODS

1. Research Approach

This study uses a quantitative descriptive approach, with qualitative analysis to trace the root causes of delays.(Zuhrotul Baida & Herwanto, 2025)A quantitative approach was used to summarize On Time In

Full (OTIF) data, construct Pareto diagrams, and calculate the Risk Priority Number (RPN). A qualitative approach was used in fishbone diagrams and the 5 Whys method.

The research was conducted at the Control Tower Department of PT XYZ with the object of non-cement distribution shipments for the period May to July 2026. The data used consisted of secondary and primary data. Secondary data were in the form of OTIF recaps and RCA category records of causes of delays from the Control Tower monitoring system. The OTIF recaps contained the number of shipments, the number of on-time shipments, and the number of late shipments. Primary data were in the form of Severity (S), Occurrence (O), and Detection (D) assessments from the questionnaire.

2. Data collection

Secondary data was collected by exporting shipment data from the company's fleet monitoring system, supplemented by direct observations of the fleet monitoring process at the control tower. Fishbone diagrams and 5 Whys were constructed based on these observations.

Primary data was collected using the S, O, D assessment questionnaire. The questionnaire was compiled from the categories of causes of delay recorded in the RCA data of the monitoring system, which were treated as failure modes.(Fatah et al., 2025;(Nelfiyanti, 2024)Respondents were selected through purposive sampling, namely people who directly understand the delivery process and its control. There were two respondents. Both respondents were selected because they held the position of junior manager and monitoring officer who were directly involved in monitoring and controlling non-cement delivery in the Control Tower, thus understanding the process and operational constraints being assessed. The questionnaire was distributed and completed by both respondents simultaneously in one session, so the S, O, and D values were the result of a joint assessment. Both respondents rated each failure mode on a scale of 1 to 10 as shown in Table 1. A higher S value means a more severe impact, a higher O value means a more frequent occurrence, and a higher D value means the failure is more difficult to detect.

Table 1. Severity, Occurrence, and Detection Rating Scale

Mark	*Severity*(S): impact of delay	*Occurrence*(O): frequency of occurrence	*Detection*(D): detection capability
10	Very dangerous, very long delays and customer contracts are at risk	It almost always happens	Undetectable
9	Dangerous, very long delays and customers complaining	It happens very often	Almost undetectable
8	Very high, long delays and disrupting other delivery schedules	Often occur	Very difficult to detect
7	High, long delay and need special handling	It happens quite often	Hard to detect
6	Moderate, the delay is quite long and customers are disturbed	It happens sometimes	Low probability of detection
5	Quite influential, the delay is still within the tolerance limit	It's quite rare	The probability of detection is moderate
4	Low, short delays and almost no customer disruption	Rarely happening	The probability of being detected is quite high
3	Very low, very short delay	Very rare	High probability of detection
2	Almost no impact	Almost never happens	The probability of being detected is very high
1	No impact	Never happened	Definitely detected

3. Data processing

The research began with the identification of the problem of late delivery of non-cement distribution. The problem was further explored through literature and field studies, then formulated into problem formulation and research objectives. After that, three types of data were collected, namely OTIF data from May to July 2026, RCA categories of causes of delays, and S, O, D assessments. All three were processed into an OTIF recap, an RCA category recap, and the results of the S, O, D questionnaire. The OTIF recap calculates the percentage of on-time deliveries, which is the number of on-time deliveries divided by the total

deliveries, then multiplied by 100%. The RCA category recap calculates the number of cases of each cause category in late deliveries. The results of the S, O, D questionnaire were obtained from a joint assessment of both respondents for each failure mode. The processed results were analyzed using a Pareto diagram, RCA, and FMEA, then produced improvement proposals for the three highest RPNs as well as conclusions and suggestions.

4. Root Cause Analysis (RCA) Method

RCA analysis begins with a Pareto diagram, followed by root cause analysis. In the Pareto diagram, late deliveries are grouped according to RCA categories. The percentage of each category is calculated by dividing the total number of cases in that category by the total number of late deliveries, then cumulatively added to determine the dominant cause. These dominant causes are mapped using a fishbone diagram, which groups the causes into six factors: man, machine, method, material, measurement, and environment. Each dominant cause is then investigated using the 5 Whys method, which involves asking the question "why" repeatedly until an actionable root cause is found.

5. Failure Mode and Effect Analysis (FMEA) Method

FMEA is used to determine improvement priorities for the causes of delays analyzed using RCA. The analysis is conducted in three stages. The first stage identifies failure modes, impacts, and causes. The categories of delay causes in the RCA data are treated as failure modes, while the impacts and causes are taken from the results of the fishbone and 5 Whys. In the second stage, two respondents simultaneously assess the Severity (S), Occurrence (O), and Detection (D) for each failure mode using the scale in Table 1. The values of S, O, and D are determined based on the agreement of both respondents. The third stage calculates the Risk Priority Number (RPN) using the formula:

$$RPN = S \times O \times D$$

The failure modes are then ranked from highest to lowest RPN. The three failure modes with the highest RPN are prioritized for developing improvement proposals.

III. RESULTS AND DISCUSSION

1. OTIF data recap and categories of causes of delays

The processed data comes from the monitoring system of the PT XYZ Control Tower Department, namely 14,986 non-cement distribution shipments from May to July 2026. A summary of on-time and late shipments per month is shown in Table 2.

Table 2 Summary of On-Time and Late Deliveries per Month

Month	Total Shipping	*On Time*	*Late*	*On Time*(%)	*Late*(%)
May	4,552	2,390	2,162	52.50	47.50
June	5.110	2,827	2,283	55.32	44.68
July	5,324	2,972	2,352	55.82	44.18
Total	14,986	8,189	6,797	54.64	45.36

Source: PT XYZ Internal Data, processed, 2026

According to Table 2, the percentage of on-time deliveries increased from 52.50% in May to 55.32% in June and 55.82% in July. Despite the improvement, nearly half of the deliveries were still late. Overall, 8,189 deliveries (54.64%) were on time, and 6,797 deliveries (45.36%) were late.

All 6,797 late deliveries were recorded in the RCA category, so no data was discarded. Nine categories of causes were identified: long parking, unloading schedule, storage, driver permit, diesel barcode, system issues, accidents, driver resignations, and diversions. The three categories with the most cases are displayed separately, while the other six categories are combined into the "other" group due to their small contribution. The results are shown in Table 3.

Table 3 Summary of RCA Categories of Late Delivery

RCA Category	Number of Cases	Percentage (%)	Cumulative Percentage (%)
Long parking	3,390	49.9	49.9
Unloading schedule	2,793	41.1	91.0
Storing	365	5.4	96.3
Other	249	3.7	100.0

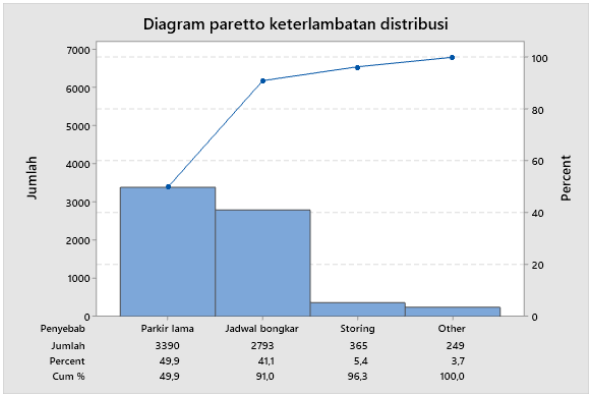
Total	6,797	100.0	

Source: PT XYZ Internal Data, processed, 2026

Based on Table 3, long parking times were the most common cause, with 3,390 cases (49.9%), followed by unloading schedules with 2,793 cases (41.1%). Together, the two contributed 6,183 of the 6,797 delays, or 91.0%.

2. Pareto diagram and determining dominant causes

The dominant causes were determined using a Pareto diagram from the RCA category summary results in Table 3. The data used were 6,797 late deliveries from May to July 2026. Categories were sorted from the highest to the lowest number of cases, and their cumulative percentages were plotted as a line. The results are shown in Figure 3.



Source: PT XYZ Internal Data, processed, 2026

Pig 3. Pareto Diagram of Causes of Delays in Non-Cement Distribution Delivery

Based on Figure 3, the causes of delays are concentrated in two categories. Prolonged parking was the largest cause, with 3,390 cases or 49.9% of all late deliveries, followed by late unloading schedules with 2,793 cases or 41.1%. These two categories cumulatively contributed 91.0% of the delays. Meanwhile, storage contributed only 365 cases (5.4%), and the other categories combined accounted for only 249 cases (3.7%). Looking at the total of 14,986 deliveries, prolonged parking caused 22.6% of late deliveries and late unloading schedules 18.6%.

Two of the nine RCA categories already explain more than 90% of the delays. Therefore, the root cause investigation in the next subsection focuses on long parking times and unloading schedules.

3. RCA analysis with fishbone and 5 Whys

AfterOnce the dominant cause is identified, the investigation continues to find the root cause. The investigation is carried out in two steps: a fishbone diagram to map the causal factors, and then the 5 Whys method to trace the problem to the root.

Fishbone Diagram

The causes of delays were grouped into six factors: man, machine, method, material, measurement, and environment, with the primary consequence being untimely fleet deliveries. The results are shown in Figure 4.

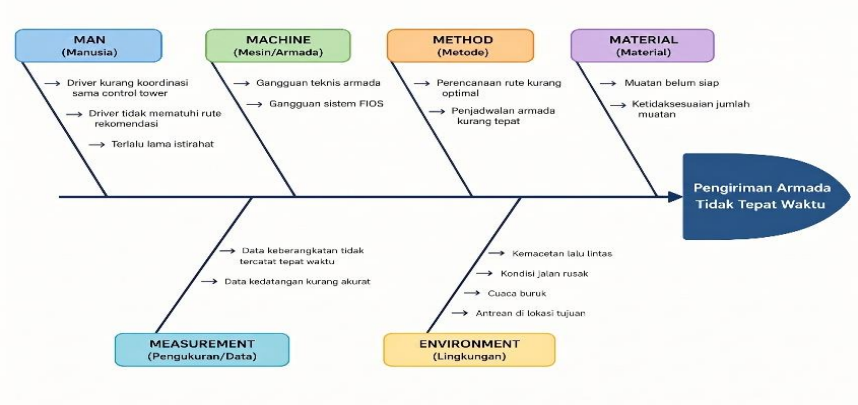


Fig. 4. Fishbone Diagram of Non-Cement Distribution Delivery Delays

Based on Figure 4, the human factor causes delays due to drivers not coordinating with the control tower, not following recommended routes, and taking too long breaks. This condition is directly related to the length of time the fleet is stopped in the parking area. The machine factor causes technical problems with the fleet and disruptions to the Fleet Integrated Operation System (FIOS). The method factor causes suboptimal route planning and inaccurate fleet scheduling. Inaccurate scheduling can cause the fleet to arrive when the unloading area is not ready, forcing the fleet to wait. This contributes to long parking and unloading schedules.

OnMaterial factors are caused by unprepared cargo and an inappropriate number of cargo, which can delay loading and unloading. Measurement factors include untimely recorded departure data and inaccurate arrival data, which can lead to inaccurate on-time status and monitoring. Environmental factors include traffic congestion, damaged roads, bad weather, and queues at destinations. Queues at destinations are most closely related to long parking times and unloading schedules.

The 5 Why Method

The factors in the fishbone were further explored using the 5 Whys method for the two dominant causes. The results for long parking times are shown in Table 4 and for unloading schedules in Table 5.

Table 4 Analysis of 5 Reasons Why Parking Takes a Long Time

***Why*to-**	**Line 1: Driver (man)**	**Line 2: Queue at the destination location (environment)**
Problem	Fleet stops too long in the parking area	Fleet stops too long in the parking area
1	*Driver*stop and rest for more than a reasonable time	The fleet must wait its turn at the destination location.
2	*Driver*lack of coordination with the control tower, so that the duration of the stop was not monitored	The unloading area is still being used by other fleets when the fleet arrives.
3	There is no obligation to report at any point during the trip.	Several fleets arrived at close times
4	There is no standard maximum stopping time limit.	The arrival of the fleet was not arranged with the recipient party.
5	Old monitoring stopped relying on officer observations, without standard and standard warnings.	There is no standard mechanism for preparing an arrival schedule with the recipient.
Root cause	There is no standard time limit for stopping and driver reporting obligations.	There is no mechanism for scheduling arrivals with recipients.

Table 5 Analysis of 5 Whys of Unloading Schedule

***Why*to-**	**Path 1: Scheduling (method)**	**Line 2: Load (material) readiness**
Problem	The unloading process is not according to schedule	The unloading process is not according to schedule
1	The fleet arrived when the area and recipient were not ready to unload.	The load is not ready or the quantity is incorrect
2	The fleet arrival schedule does not align with the recipient's schedule.	Readiness and quantity of cargo are not confirmed before the fleet departs.
3	Fleet scheduling does not take into account recipient readiness	Checking the load is not a condition of departure
4	Estimated arrival is not provided to the recipient before arrival.	There has been no confirmation of cargo readiness between the relevant parties.
5	There is no standard procedure for submitting estimated arrival times.	There is no standard procedure for confirming cargo readiness before departure.
Root cause	There is no standard procedure for scheduling and conveying estimated arrivals to recipients.	There is no procedure for confirming cargo readiness before departure.

Based on Table 4, long parking times are rooted in two factors. First, there is no standard stopping time limit and driver reporting requirement, so the length of time a fleet stops depends on the officer's observation. Second, there is no mechanism for scheduling arrivals with the recipient, so fleets arrive together and must wait their turn to unload. Based on Table 5, the unloading schedule is rooted in the lack of standard procedures for scheduling and communicating arrival estimates to recipients, as well as the lack of procedures for confirming load readiness before fleet departure. Co-scheduling arrivals with the recipient appears in both dominant causes, so this root cause requires the most attention.

The root causes in this study were compiled based on direct observations at the Control Tower and have not been verified through interviews with the recipients and drivers, so the results need to be seen as initial findings that can be strengthened in further research.

4. FMEA analysis: failure modes, S, O, D assessment, and RPN calculation

The failure mode was determined from the root cause of the long parking and unloading schedule resulting from the 5 Why analysis, namely four failure modes. Potential effects and current controls were identified for each mode, then two respondents simultaneously assessed Severity (S), Occurrence (O), and Detection (D). The values of S, O, and D were mutually agreed upon by both respondents, then the RPN was calculated using the formula RPN = S × O × D. The results are shown in Table 6.

Table 6 FMEA RPN Calculation

Code	Potential Impact	Current Control	S	O	D	RPN
M1	Fleets stop too long in the parking area, increasing delivery time and potentially disrupting the next delivery schedule.	Long-term monitoring has been stopped by control tower officers via FIOS, but there are no standard time limits or warnings.	6	5	4	120
M2	Fleets arrive together and have to wait for their turn to unload, increasing waiting times and disrupting the next distribution schedule.	Fleet monitoring by control tower officers, but there is no mechanism for scheduling arrivals with recipients.	8	6	7	336
M3	The fleet arrives when the recipient or unloading area is not ready so the unloading process is delayed and delivery time is increased.	Monitoring of fleet travel by control tower officers, but there is no standard procedure for conveying arrival estimates to recipients.	7	4	6	168
M4	The cargo is not ready or the quantity is not correct so that the departure is delayed or there is a delay during the unloading process.	There is no documented procedure for confirming cargo readiness before departure.	5	5	3	75

Berdasarkan Tabel 6, RPN tertinggi dimiliki M2, yaitu belum adanya mekanisme penjadwalan kedatangan bersama penerima, dengan nilai 336. Mode ini memiliki nilai Severity 8 karena armada yang tiba bersamaan harus menunggu giliran bongkar, sehingga waktu tunggu meningkat dan jadwal distribusi berikutnya terganggu. Nilai Detection 7 menunjukkan kegagalan ini sulit terdeteksi, karena kontrol yang ada hanya pemantauan armada oleh petugas control tower dan belum ada mekanisme penjadwalan kedatangan bersama penerima.

Peringkat kedua adalah M3, yaitu belum adanya prosedur baku penyampaian estimasi kedatangan kepada penerima, dengan RPN 168. Dampaknya cukup berat (S = 7) karena armada tiba saat penerima atau area bongkar belum siap, tetapi frekuensinya lebih rendah (O = 4) dibanding M2. Peringkat ketiga adalah M1, yaitu belum adanya standar batas waktu berhenti dan kewajiban lapor driver, dengan RPN 120. Nilai Detection M1 relatif rendah (D = 4) karena lama berhenti armada sudah dipantau petugas control tower melalui FIOS, meskipun belum ada batas waktu dan peringatan baku.

Adapun M4, yaitu belum adanya prosedur konfirmasi kesiapan muatan sebelum keberangkatan, memiliki RPN terendah yaitu 75, sehingga tidak termasuk tiga prioritas utama. Dengan demikian, tiga mode kegagalan dengan RPN tertinggi yang menjadi dasar usulan perbaikan adalah M2, M3, dan M1.

Penilaian S, O, dan D dilakukan bersama oleh dua responden dari internal perusahaan sehingga tidak mencerminkan penilaian independen, dan hasil RPN perlu diverifikasi dengan responden yang lebih banyak, termasuk pihak penerima.

5. Usulan perbaikan untuk tiga RPN tertinggi

Usulan perbaikan disusun untuk tiga mode kegagalan dengan RPN tertinggi, yaitu M2, M3, dan M1, menggunakan metode 5W+1H. Usulan ini berupa konsep berdasarkan hasil analisis dan belum diimplementasikan. Hasilnya ditunjukkan pada Tabel 7.

Tabel 7 Usulan Perbaikan dengan Metode 5W+1H

Unsur	M2 (RPN 336)	M3 (RPN 168)	M1 (RPN 120)
What (apa yang diperbaiki)	Menyusun jadwal kedatangan armada bersama penerima	Menyusun prosedur baku penyampaian estimasi kedatangan kepada penerima	Menetapkan batas waktu maksimal berhenti dan kewajiban lapor driver
Why	Armada tiba bersamaan	Armada tiba saat penerima atau	Lama berhenti hanya

(mengapa)	dan menunggu giliran bongkar sehingga parkir lama	area bongkar belum siap sehingga bongkar tertunda	bergantung pada pengamatan petugas, tanpa batas waktu dan peringatan baku
Where (di mana)	Lokasi bongkar penerima, dikoordinasikan dari Departemen Control tower	Dari Control tower ke penerima di lokasi bongkar	Sepanjang perjalanan armada, dipantau melalui FIOS di Control tower
When (kapan)	Sebelum armada berangkat, pada setiap pengiriman	Sebelum armada tiba di lokasi tujuan, pada setiap pengiriman	Pada setiap perjalanan, sejak armada berangkat sampai tiba
Who (siapa)	Departemen Control tower bersama pihak penerima	Petugas control tower kepada penerima	Departemen Control tower dan driver
How (bagaimana)	Agree on arrival time slots with the recipient based on unloading capacity, then arrange the fleet to arrive according to the slot.	Prepare the format and procedure for notification of estimated arrival, then the officer sends it so that the recipient can prepare the area and unloading personnel.	Establish stop time limits in FIOS with warnings to officers, establish mandatory reporting points, and provide regular outreach regarding rest times and route compliance.

The proposals in Table 7 are sorted by RPN value. The first priority is scheduling arrivals with the recipient (M2), because it has the highest RPN and the root cause is found in long parking and unloading schedules. The second priority is communicating arrival estimates to recipients (M3), which completes the scheduling so that recipients are ready when the fleet arrives. The third priority is standard stop time limits and driver reporting requirements (M1), to reduce fleet idling time. Progress after the proposals are implemented can be monitored by comparing the percentage of on-time deliveries and the contribution of the RCA category with the initial conditions from May to July 2026, which were 54.64% on time and 45.36% late.

IV. CONCLUSION

Conclusion

Based on the analysis of PT XYZ's non-cement distribution OTIF data for the period May to July 2026, out of 14,986 shipments, 8,189 (54.64%) were on time and 6,797 (45.36%) were late. The on-time percentage increased from 52.50% in May to 55.32% in June and 55.82% in July, but almost half of the shipments were still late. Based on the Pareto diagram, the dominant causes of delays were long parking at 49.9% and unloading schedules at 41.1%, which cumulatively contributed 91.0%. The results of the RCA with fishbone and 5 Whys showed that the root causes were the lack of standard stopping time limits and driver reporting obligations, a mechanism for scheduling arrivals with recipients, standard procedures for conveying estimated arrivals to recipients, and procedures for confirming load readiness before departure. Based on the FMEA, the three failure modes with the highest RPNs were the absence of a mechanism for scheduling arrivals with the receiver (RPN 336), the absence of a standard procedure for conveying arrival estimates to the receiver (RPN 168), and the absence of standard stopping time limits and driver reporting obligations (RPN 120). Improvement proposals for all three were compiled using the 5W+1H method.

Suggestion

For companies, the best course of action is to start with the failure mode with the highest RPN, namely by developing a fleet arrival schedule with the recipient. Once the proposal is implemented, progress should be monitored by comparing the percentage of on-time deliveries and the contribution of the RCA category with the initial conditions from May to July 2026. Companies should also maintain the completeness and accuracy of OTIF and RCA category data recording, as all analysis relies on this data.

For further research, proposed improvements can be continued to the implementation stage, and the results measured by comparing conditions before and after the improvements. The S, O, D assessment can

also involve more respondents to strengthen the RPN results, and root causes can be verified through interviews or direct observation at loading and unloading locations. Furthermore, the research can take into account the length of delays and include all aspects of the process to assess OTIF's performance comprehensively.

REFERENCE

[1] Adianto, H., & Herawati, N. (2024). Analysis of Production Time Improvement to Achieve On-Time Results and Delivery to Customers. 2024.

[2] Anggraeni, A., & Fety Nurlia Muzayanah. (2025). Analysis of Total Quality Management with RCA and FMEA at XYZ Community Health Center, Indramayu. Mamen: ***Journal of Management***, 4(3), 328–342. https://Doi.Org/10.55123/Mamen.V4i3.5439

[3] Dinda Nurhalizah Mawardy, A., & Kirono, I. (2026). Process Evaluation of Package Delivery Delays at the Branch Office of PT Xyz Logistics & Services Company (Vol. 10). ***https://Jurnal.Ustjogja.Ac.Id/Index.Php/Manajemendewantara***

[4] Fatah, KMA, Lukman, I., Sidiq, A., & Wardhana, MW (2025). Analysis of the Causes of Delays in Delivery of Cardboard Sheet Products Using the FMEA Method and Recommended Solutions in the Cardboard Sheet Industry. ***Journal of Engineering, Technology, and Science,*** 9(2), 803–810. https://Doi.Org/10.33024/Jrets.V9i2.21518

[5] Firdausy, MF, & Koes Ardhiyanto, N. (2025). Risk Mitigation in the Biodiesel Supply Chain in Java Island Using Failure Mode and Effects Analysis (FMEA) and Root Cause Analysis (RCA) Methods. In Marsha Fazira Firdausy, Sntem (Vol. 5).

[6] Kumala Dewi, N., Ariffien, A., Gustamola, W., & Son Seran, D. (2026). Analysis of Factors of Delayed Delivery of Goods and Implications for Continuous Improvement. https://Doi.Org/10./Idealogist.

[7] Luthfi Firdaus, R., Hapsak Pradipto, G., & Teknik Industri, J. (2026). Analysis of the Causes of Delivery Delays at Indah Logistik Cargo (Ilc) Pilar Agents Using the DMAIC Method. ***Journal of Applied Industrial Technology and Management (Jtmit)***, 5(2), 1111–1121.

[8] Nelfiyanti. (2024). Analysis of Product Delivery Delay Factors to Consumers Using the FMEA Method at PT.Mrp.

[9] Nur Cahyani, A., & Hanif Dzulquarnain, A. (2025). Analysis of the Modern Retail Shipping Process at a Distributor Company in Gresik Using Root Cause Analysis. 6, 2027.

[10] Petty Wahyuningtyas, N., Eka Ratnawati, D., & Yudi Setiawan, N. (2023). Sentiment-Based Root Cause Analysis (RCA) Using the K-Nearest Neighbor (K-NN) Method (Case Study: Brawijaya Swimming Pool Visitors) (Vol. 7, Number 5). Http://J-Ptiik.Ub.Ac.Id

[11] Pradipa, R. (2025). Analysis and Identification of Factors Affecting On Time In Full (OTIF) Performance at PT X Using the Creative Dmaic Method, Jakarta 2025.

[12] Rizki, M., & Saputra, A. (2022). Supply Chain Management Risk Analysis Using Grey Failure Mode and Effect Analysis and Root Cause Analysis Methods at PT Pertamina Fuel Terminal Meulaboh. Serambi Engineering, Vii(1).

[13] Sholikhah, FA, Darmawan, H., Prastyo, Y., & Industri, JT (2026). Application of Root Cause Analysis (RCA) and Plan, Do, Check, Action (PDCA) Methods to Reduce Deadstock Value in Spare Part Warehouses. ***Journal of Applied Industrial Technology and Management (JTMIT),*** 5(3), 1221–1229.

[14] Soleman, Zaenal, & Vera. (2026). Analysis of Product Defect Causes Using the RCA and FMEA Methods to Reduce Defects in the Assembly Process. Journal of Engineering Management and Business Innovation, 4 (February), 67–74. https://doi.org/10.62375/jmrib.v4i2.828

[15] Zuhrotul Baida, A., & Herwanto, D. (2025). Analysis Of Factors Causing Non-Compatibility Of Label Stock Using The 5 Why And Fishbone Diagram Method In The Food And Beverage Industry.