

# AI-Enabled Supplier On-Time Performance Framework

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**Abstract:** *Supplier On-Time Performance (OTP) is a critical indicator of supply chain reliability, cost efficiency, and operational continuity. Traditional OTP processes are often manual, reactive, and prone to inconsistency due to static rules, delayed visibility, and limited exception handling. This paper introduces an AI-Enabled Supplier On-Time Performance (SOTP) Framework that transforms OTP management into a predictive, automated, and self-optimizing ecosystem. The framework standardizes OTP measurement, automates eligible PO identification, and integrates performance-based fine computation directly into ERP systems such as Oracle Accounts Payable. An industry case study demonstrates how retail organizations use this model to monitor delivery accuracy, enforce vendor compliance, and streamline debit memo creation. The proposed AI enhancements spanning dynamic exclusion management, predictive PO risk scoring, automated rule execution, natural-language-based vendor communication, sentiment-driven escalation, and intelligent dispute resolutions significantly reduce manual effort while improving accuracy and transparency. AI-powered dashboards, scenario simulations, and adaptive analytics further elevate decision-making, enabling organizations to proactively mitigate delivery risks and enhance supplier collaboration. This end-to-end AI-augmented SOTP framework provides a scalable foundation for resilient, efficient, and future-ready supply chain performance management.*

**Keywords:** AI, Supplier On-Time Performance, Supply chain Management, ERP, Oracle

## 1. Introduction

ensuring smooth operations

### WHAT is Supplier On-Time Performance?

Supplier On-Time Performance is a Key Performance Indicator (KPI) that measures the percentage of purchase orders or shipments a supplier delivers by the promised or required delivery date.

It is a fundamental metric for assessing supplier reliability and is a direct indicator of the stability and predictability of your inbound supply chain

## 2. Why is Supplier On-Time Performance Critical

### 2.1 Operational continuity:

Timely deliveries prevent production delays and stockouts,

### 2.2 Customer satisfaction

Late deliveries can lead to missed sales, frustrated customers, and lost loyalty.

### 2.3 Cost control

Delays often result in expedited shipping costs, overtime, and inventory carrying costs.

### 2.4 Supplier evaluation

Consistently high on-time rates help identify reliable suppliers and flag those needing improvement

2.5 A high OTP is crucial because it directly impacts operational efficiency and costs

| Impact Area      | Consequences of Poor OTP                                                                          |
|------------------|---------------------------------------------------------------------------------------------------|
| Production       | Production line stoppages, missed production targets, inefficient labor scheduling.               |
| Inventory        | Requires higher safety stock levels to buffer against uncertainty, increasing carrying costs.     |
| Customer Service | Inability to fulfill customer orders on time, leading to lost sales and damaged reputation.       |
| Planning         | Renders demand and supply plans unreliable, forcing constant and costly reactive adjustments.     |
| Cost             | Increases expedited freight costs, administrative costs for tracking, and potential penalty fees. |

## 3. How to Calculate Supplier On-Time Performance

$$\text{OTP (\%)} = \left( \frac{\text{Number of PO Lines Delivered On-Time}}{\text{Total Number of PO Lines Delivered}} \right) \times 100$$

### 3.1 OTP by Line (Most Common & Granular):

Example: If a supplier delivered 47 out of 50 PO lines by their due date in a month, their OTP is

- This method evaluates each line on a purchase order. It is the most accurate representation of performance.

$$(47/50) \times 100 = 94\%$$

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### 3.2 OTP by Order (Simpler):

- This method evaluates the entire purchase order as on time only if all lines are delivered on time. It is a stricter measure.

OTP (%) = (Number of Complete POs Delivered On-Time / Total Number of POs Delivered) × 100.

Example: If a supplier delivered 70 out of 125 Pos by their due date in a month, their OTP is

$(70/125) \times 100 = 56\%$ .

## 4. Key Considerations for Accurate Measurement

**4.1 Define "On-Time":** Establish a clear definition. Common standards are:

- On or Before the Due Date: The most lenient.
- Within a Specific Window (e.g.,  $\pm 1$  day): Balances flexibility and precision.
- On the Exact Due Date: The strictest, often used in Just-in-Time (JIT) environments.

**4.2 Data Source:** The calculation must be based on reliable data, typically the:

- Confirmed Delivery Date from the supplier (via ASN - Advanced Shipping Notice).
- Actual Receipt Date in your Warehouse Management System (WMS) or ERP.

**4.3 Actual Receipt Date in your Warehouse Management System (WMS) or ERP.**

## 5. How to Improve Supplier OTP

Improving OTP is a collaborative process with your suppliers

### 5.1 Set Clear Expectations:

- Define and communicate your OTP requirements and calculation method in supplier contracts.

### 5.2 Implement Measurement & Feedback System:

- Track & Report: Systematically measure OTP for all critical suppliers.
- Share Scorecards: Provide regular performance reports (e.g., monthly/quarterly scorecards) to suppliers

### 5.3 Collaborate Proactively:

- Root Cause Analysis: For recurring delays, work with the supplier to identify the root cause (e.g., raw material shortage, capacity issues, logistics).
- Develop Improvement Plans: Jointly create and monitor action plans to address the root causes.

### 5.4 Use Incentives and Consequences:

- Positive: Award more business or "preferred supplier" status to top performers.
- Negative: Enforce penalty clauses for consistent underperformance or, as a last resort, initiate a supplier replacement process.

By systematically measuring, monitoring, and managing Supplier On-Time Performance, you create a more resilient, efficient, and cost-effective supply chain.

## 6. Case Study

### 6.1 Background

A leading retail company launched a Supplier Performance Initiative to improve supply chain efficiency and vendor accountability. The core component of this initiative was the Supplier On-Time Performance (OTP) process designed to measure delivery timeliness, apply performance-based fines for late shipments, and automate claim settlements through Accounts Payables (AP). This end-to-end automation provided real-time visibility in supplier compliance and significantly improved delivery performance across the network.

### 6.2 Objectives:

- Establish a standardized method to calculate supplier OTP across all facilities.
- Automate fine and claim generation for late supplier deliveries.
- Integrate OTP performance tracking directly into Oracle ERP Accounts Payable for debit memo processing.
- Enable vendor transparency and communication through automated scorecards and notifications.

### 6.3 High-Level Process Stages:

- OTP Exclusions Setup
- Identification of Eligible POs
- OTP Calculations for POs.
- Review, Approval, and Vendor Communication
- Feedback, Corrections, and AP Debit Memo Creation

#### 6.3.1 OTP Exclusions Setup:

| Exclusion Criteria       | Check | OTP Exclusion |
|--------------------------|-------|---------------|
| Is Vendor exempted?      | Yes   | Exclude       |
| Is buyer on PO exempted? | Yes   | Exclude       |
| Facility on PO exempted? | Yes   | Exclude       |

#### 6.3.2 Identification of Eligible POs:

- The system extracts all received POs for the processing month.
- Excluded POs are filtered out using the configuration rules above.
- Eligible POs are then passed into the OTP formula calculation engine.
- Each PO includes related data from: Vendor master (lead

time)., Facility setup (day/night receiving), RDS (Receiving Dock System) for dock-in timestamps.

### 6.3.3 OTP Calculations for POs:

- OTP Logic – Non-Nighttime Facilities: A PO is considered late if.

- (Received Date – Due Date  $\geq 1$ ) AND (Received Date – Order Date > Lead Time)
- OTP Logic – Nighttime Facilities.
- (Received Date – Due Date  $\geq 1$ ) AND (Received Date – Order Date > Lead Time) AND (PO Received Time > 12:00 noon next day)
- OTP Billing and Performance Metrics.

| Metric           | Formula                                                                                                           |
|------------------|-------------------------------------------------------------------------------------------------------------------|
| Fill Rate        | Received $\div$ Ordered (capped at 100%)                                                                          |
| Total Fill Rate  | Total Received $\div$ Total Ordered (AP level, includes backhaul)                                                 |
| MO %             | (Man-Outs + Allocated OOS) $\div$ Ordered                                                                         |
| LTMO %           | LTMO $\div$ (Ordered + Unauthorized + LTMO)                                                                       |
| Service Level    | Customer Shipped $\div$ Customer Ordered                                                                          |
| OTP %            | Late POs $\div$ Total POs                                                                                         |
| Fine Calculation | If OTP $\leq 90\%$ $\rightarrow$ Late POs $\times$ \$500<br>If OTP $< 95\%$ $\rightarrow$ Late POs $\times$ \$300 |

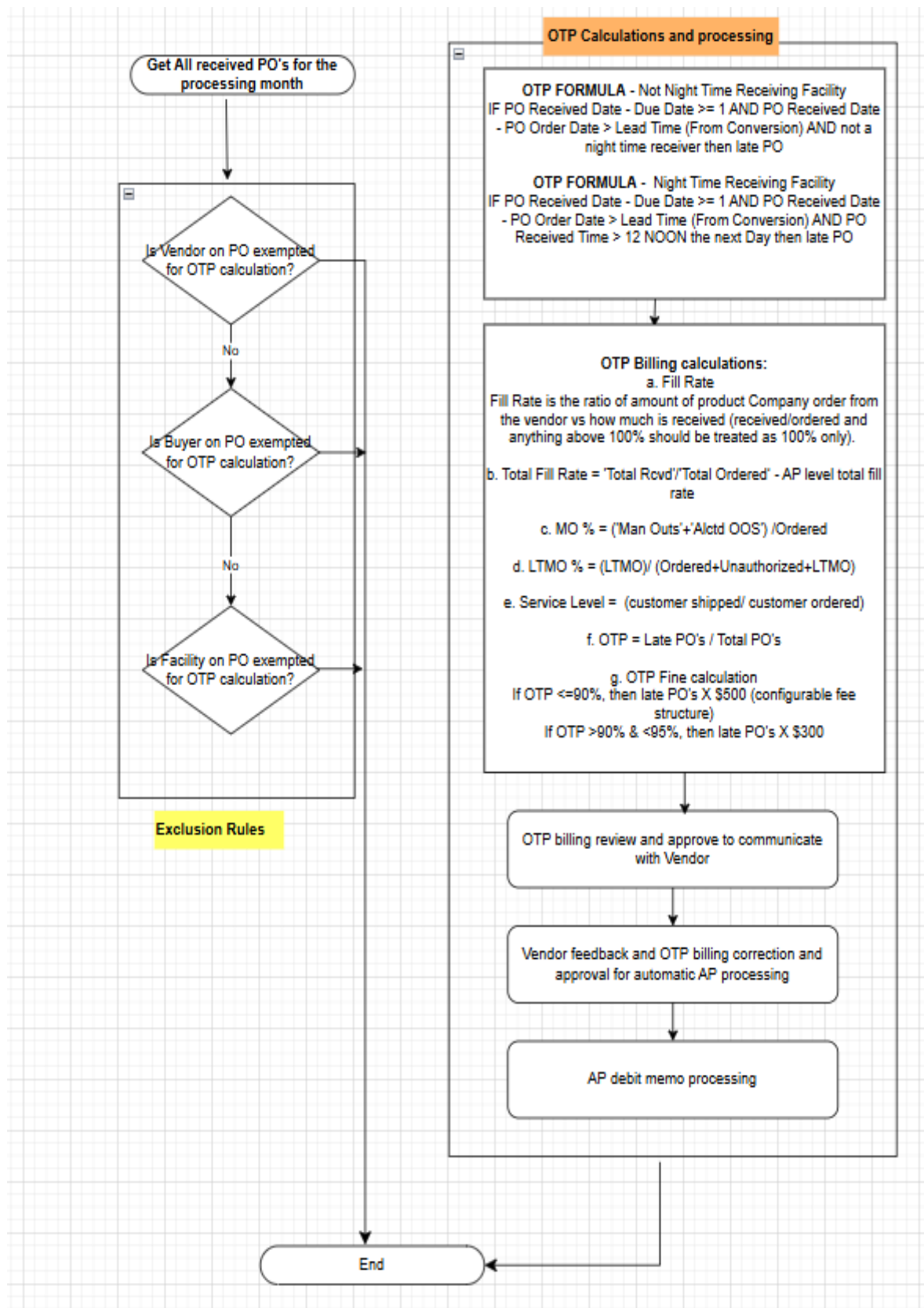
### 6.3.4 Review, Approval, and Vendor Communication:

- Automatic OTP Billing Computation: The system generates fine data and scorecards automatically after monthly processing.
- Review & Approval: Buyer or merchandising teams review OTP claims, validate exceptions, and approve vendor notification.
- Vendor Communication: Approved OTP scorecards are

automatically emailed to vendor contacts maintained in the Vendor Master.

- Vendor Feedback & Corrections: Vendors can dispute or correct claims. Approved adjustments are resubmitted and revalidated.
- AP Posting: Once finalized, the system automatically creates a Debit Memo against the vendor (manufacturer) through Accounts Payable integration.
- Output Artifacts:

| Deliverable                   | Purpose                                   |
|-------------------------------|-------------------------------------------|
| OTP Billing Report            | Summary of late POs and fine calculations |
| Supplier Scorecard            | Detailed vendor performance metrics       |
| Vendor Email Notifications    | Automated claim communication             |
| AP Debit Memo                 | Financial settlement entry for fines      |
| Audit & Historical Repository | Maintains end-to-end traceability         |



Supplier On-Time Performance Process flow

## 7.AI Integration Across Supplier OTP Process Stages

Artificial Intelligence (AI) can transform the traditional Supplier On-Time Performance (OTP) process from a static, rule-based framework into a dynamic, self-learning, and

predictive ecosystem.

By embedding AI at each stage from PO selection to vendor communication and AP debit memo creation the system becomes proactive, adaptive, and intelligent, reducing manual intervention and improving accuracy.

**7.1 OTP Exclusions Setup:** AI can dynamically manage and optimize exclusion criteria instead of relying solely on manual rules or static tables:

- **Adaptive Exclusion Rules:** Machine learning models analyze historical supplier performance and automatically suggest exemptions for vendors who consistently maintain >98% on-time delivery, or flag vendors for inclusion if their performance declines.
- **Anomaly Detection:** AI detects unusual patterns such as a facility or carrier showing sudden delays and recommends temporary exclusion to avoid false fines.
- **Policy Optimization:** AI simulations evaluate the impact of changing exclusion thresholds (e.g., vendor size, route, seasonality) on overall OTP results before rules are applied.

**7.2. Identification of Eligible Purchase Orders:** Traditional systems filter eligible POs using fixed rules. AI adds predictive and contextual intelligence to this step chain event.

**7.2.1 Predictive Eligibility:** AI models forecast which POs are likely to miss due dates based on.

- Vendor's historical performance trends,
- Transit times by route or carrier.
- Lead-time adherence patterns. This helps buyers take preventive action (e.g., expedite or reschedule) before a fine occurs.

**7.2.2 Data Cleansing & Validation:** AI automatically corrects missing or inconsistent fields (e.g., due dates, lead times, cutoff times) by referencing historical and master data patterns

**7.2.3 Early Risk Alerts:** Natural Language Processing (NLP)-based insights from vendor EDI messages (like ASN delays) trigger alerts for POs at risk.

**7.3. OTP Calculations and Processing:** AI automates the core computation process, ensuring precision and scalability across large datasets.

**7.3.1 Automated Rule Execution:** AI agents calculate late deliveries, fill rates, service levels, and fines based on multi-factor logic time zones, dock-in delays, carrier exceptions with zero manual intervention.

**7.3.2 Continuous Learning:** Machine learning refines fine thresholds over time, identifying optimal penalty ranges that drive compliance without over-penalizing.

**7.2.3 Exception Prioritization:** AI ranks exceptions (e.g., partial shipments, weather delays) based on probability of vendor fault, allowing reviewers to focus on high-impact cases.

**7.4. Review, Approval, and Vendor Communication:** AI automates the Review, Approval and Vendor communication ensuring accurate and timely across

suppliers.

**7.4.1 Dynamic Template Generation:** Generative AI automatically drafts vendor communication emails for OTP scorecards and claims, tailored by vendor type, performance history, and tone (e.g., "informational" vs "corrective")

**7.4.2 Personalized Messaging:** Messages are localized and contextual e.g., "Your September performance improved by 5%, but 3 POs were delayed due to late ASN updates.

**7.4.3 Smart Summaries** AI generates concise scorecard summaries for executives, highlighting vendors contributing most to fines or delivery risk.

**7.4.4 Feedback Interpretation:** NLP models analyze vendor responses and classify tone cooperative, neutral, or defensive to help procurement teams adjust communication strategies

**7.4.5 Escalation Triggers:** Negative sentiment or repeated disputes automatically flag a vendor for escalation or supplier performance review.

**7.4.6 Vendor Behavior Analytics** AI tracks responsiveness, dispute frequency, and approval turnaround to enhance supplier scorecards with behavioral KPIs.

**7.5. Feedback, Corrections, and AP Debit Memo Creation:** AI automates the Feedback review, Corrections and AP Debit memos creation.

**7.5.1 Smart Dispute Resolution:** AI compares vendor-provided justifications (e.g., carrier delay) with internal shipment data, receiving timestamps, and weather feeds to determine validity recommending "Approve," "Reject," or "Adjust Fine."

**7.5.2 Confidence Scoring:** Every AI decision includes a confidence level (e.g., 92%) so human approvers can prioritize low-confidence cases.

**7.5.3 Auto-Generated Debit Memos:** AI models learn from approved vs. overridden disputes to improve future decision accuracy.

**7.5.4 Continuous Feedback Loop:** AI models learn from approved vs. overridden disputes to improve future decision accuracy.

**7.6. Output Artifacts Enhanced by AI:** AI can generate Artifacts on real time basis.

**7.6.1 Real-Time Dashboards:** AI-powered dashboards move beyond static visuals to provide interactive, predictive, and prescriptive analytics.

- **Live OTP Metrics:** Track current OTP %, fine value, and vendor rankings in real time.
- **Forecasting:** Predict next month's OTP trends and financial exposure based on live EDI feeds.
- **Root Cause Analysis:** AI identifies recurring bottlenecks (specific carrier routes, dock schedules, or suppliers) and

visualizes cause-effect relationships.

- **Scenario Simulation:** Business users can ask: “What if we exclude Vendor X for 30 days?” AI instantly models the impact on fines and performance KPIs.

**7.6.2 Automated Reports:** AI automates report creation and distribution.

- **Dynamic Scorecard Generation:** Automatically generates vendor performance scorecards with commentary and variance analysis.
- **Natural Language Summaries:** Each report includes an AI-written executive summary explaining performance trends and key exceptions.
- **Automated Distribution:** AI schedules personalized emails with embedded dashboards or PDF attachments for each vendor or business unit, replacing manual report collation.

**7.6.3 Audit Trails and Compliance Monitoring:** AI ensures traceability, transparency, and compliance in every step of OTP processing.

- **Intelligent Change Logs:** AI tracks and records all configuration and data changes, tagging them with reason codes (e.g., “rule auto-adjusted due to vendor trend deviation”).
- **Voice or Chat Logs:** NLP captures contextual summaries of user or vendor conversations for audit reference.
- **Exception Insights:** AI analyzes audit trails to detect unusual approval patterns or fine reversals useful for internal audit or fraud detection.
- **Regulatory Compliance:** AI verifies that debit memo processing aligns with corporate and legal standards before posting to AP.

## 7.7 Summary

End-State Vision: AI-Augmented Supplier On time performance Ecosystem:

- Today’s EDI: Standardized, batch-oriented, rule-based.
- Future EDI + AI: Intelligent, real-time, self-learning, integrated with IoT and blockchain.

| Capability            | Pre-AI (Manual)                | AI-Driven State                                       |
|-----------------------|--------------------------------|-------------------------------------------------------|
| Exclusions Management | Static, manually updated lists | Dynamic, auto-adjusted based on performance analytics |
| PO Eligibility        | Reactive filtering             | Predictive risk-based selection                       |
| OTP Calculations      | Batch/manual processing        | Continuous, real-time computation                     |
| Vendor Communication  | Template-based emails          | Context-aware AI-generated messages                   |
| Dispute Resolution    | Manual validation              | Automated triage with confidence scoring              |
| Reporting             | Monthly static reports         | Real-time dashboards + AI summaries                   |
| Auditability          | Manual logs                    | Intelligent, contextual audit trails                  |

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## Author Profile

**Rajesh Gangula** is an AI Supply Chain Modernization Leader, Oracle Certified Specialist, and Business Analyst with over 15 years of experience spearheading digital transformation in supply chain management. With a deep specialization in Oracle Supply Chain Management (SCM) across both Cloud and E-Business Suite (R12 & 11i) platforms, they have a proven track record of designing and implementing integrated business solutions for global clients in the US, the Middle East, and India. Their extensive background encompasses full-cycle implementations, rollouts, and upgrades across diverse sectors, including manufacturing, high-tech, banking & finance, telecommunications, and retail. This has provided a front-row perspective on the critical need for intelligent,

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