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# TAT and SLA Analysis for Delivery Process Improvement and SOP Formulation: A Hub-Level Study at Delhivery Limited, Sudhawadi Hub, Pune

**Vaishnavi Krishnakumar Wani**
MBA, School of Business,
Indira University,
Pune, India 411033

**Maj. Ankan Mondal**
Director and External Guide,
Delhivery Limited, Sudhawadi Hub,
Pune, Maharashtra, India

**Dr. Nitin Joshi**
Associate Professor and Area Chair - MBA, School of Business,
Indira University,
Pune, India 411033
nitin.joshi@indirauniversity.edu.in

**Dr. Sanjay Asati**
Assistant Professor - MBA, School of Business,
Indira University,
Pune, India 411033
sanjay.asati@indirauniversity.edu.in

*Abstract* - **Standardised hub operations are central to delivery reliability in India's express logistics sector, where a shipment passes through several handovers and each can add dwell time, exceptions and Service Level Agreement (SLA) risk. Drawing on Lean thinking, standard work, 5S and Plan–Do–Check–Act (PDCA) improvement, this applied study examined Turnaround Time (TAT), SLA adherence and exception handling at Delhivery Limited's Sudhawadi Hub, Pune. The objectives were to map the end-to-end delivery process and stage-wise handoffs, to analyse TAT, SLA and exception patterns to identify delays and root causes, and to formulate department-wise Standard Operating Procedures (SOPs) and control mechanisms. During a four-month on-the-job training (13 April–13 August 2026), the author rotated through Inbound, First/Last Mile Success (FLMS), Processing Center (PC), Outbound, Nido and Falcon weight capture, and then worked mainly with the Problem Solving Team (PST). Because official TAT/SLA dashboards were confidential, the quantitative analysis uses a representative academic dataset of about 980,000 shipments; these figures are illustrative and are not official Delhivery performance data.**

**In the representative dataset, weighted average TAT was 27.9 hours and SLA adherence 91.9%. TAT improved from 31.4 to 24.9 hours (−20.7%) and SLA adherence from 88.6% to 94.2% over the study periods. The Processing Center had the longest stage dwell (6.7 hours), followed by FLMS (4.8 hours) and Outbound (4.2 hours). Route/NTC mismatch was the largest exception category (21.8% of 12,600 cases), whereas untraceable (18.6 hours) and damage (14.8 hours) cases took longest to close. Heavy shipments had the lowest SLA (85.6%) and B2B shipments exceeded B2C (94.0% vs 89.8%). It is concluded that remaining service risk lies in processing dwell and exception ageing rather than in any single failure point. SOPs were proposed for Inbound, FLMS, Processing Center, Outbound, Falcon and PST, supported by a daily stage-wise TAT/SLA control board, exception ageing buckets with escalation thresholds, route/pincode verification, pre-dispatch checks, shift-handover controls and periodic SOP audits and PDCA review.**

***Keywords— TAT, SLA, Standard Operating Procedure (SOP), Exception Management, Lean Logistics, Hub Operations, Root Cause Analysis, Delhivery***

## I. INTRODUCTION

Logistics is a process-intensive business in which physical movement and information movement occur together. A parcel may pass through several operational nodes before reaching the customer, and every handover creates an opportunity for delay, misrouting, damage, loss of visibility or rework. The Indian logistics sector spans express parcel, part and full truckload freight, warehousing, cross-border services and logistics software, and its growth is being driven by e-commerce, organised retail and digital supply chains that raise customer expectations for speed, visibility and reliable exception resolution [12], [13]. Policy initiatives such as the National Logistics Policy and PM GatiShakti further emphasise process reform, digitisation and skilling [14].

Delhivery Limited, founded in 2011 and headquartered in Gurugram, is an integrated logistics provider whose reported FY26 revenue from services was ₹10,486 crore, with roughly one billion express parcels handled in the year [12]. At this scale, small process variations at a hub produce large aggregate effects. Hub performance depends on inbound receiving, scanning, sorting, processing, weight verification, staging, dispatch and exception closure, and a delay at one point propagates to the stages that follow. TAT and SLA are therefore useful indicators because they connect process execution with customer-facing service outcomes.

This study focuses on Delhivery's Sudhawadi Hub in Pune. Its problem is that hub-level variations in scanning, sorting, processing, route verification, weight capture, staging and exception closure add dwell time, and accumulated delay exposes shipments to SLA risk. The study does not assume that every SLA miss originates at the hub; it concentrates on controllable hub-level factors and on the interfaces between departments. It follows a three-step approach: (i) map the shipment flow and its handoffs, (ii) analyse TAT, SLA and exception patterns to locate bottlenecks and root causes, and (iii) convert the findings into department-wise SOPs, checkpoints and escalation rules.



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## II. LITERATURE REVIEW AND THEORETICAL BACKGROUND

### A. Literature Review

Womack et al. [1] showed through the Toyota Production System that productivity improves when non-value-adding activities are systematically removed and flow is emphasised, while Imai [2] established Kaizen as a philosophy of small, sustained improvements. Liker [3] described continuous flow, standard work and disciplined problem solving as management principles, and Rother and Shook [4] presented Value Stream Mapping to visualise material and information flow. Baudin [5] adapted Lean to repetitive assembly through standardised work and efficient material handling, and Monden [6] detailed just-in-time and Kanban-based controlled flow. More recent work links standardisation to practical logistics settings: Shafeek et al. [7] offer a roadmap for implementing standardised work, Rizkya et al. [8] show that 5S organisation reduces waste in warehouses, Agyabeng-Mensah et al. [9] report that Lean Six Sigma can reduce process variation in third-party logistics warehousing, and Quiroz Flores et al. [10] and Padilla-Bendezú et al. [11] find that 5S, standardisation, Poka-Yoke and related Lean tools improve warehouse efficiency and reduce variability. These sources are largely conceptual or warehouse-based; this study applies them jointly at a parcel-hub level by combining direct observation, TAT/SLA analysis and SOP formulation, without claiming a universal causal relationship.

### B. Theoretical Background

The study rests on the principle that process standardisation creates a baseline for measurement and continuous improvement. The framework links observation, process mapping, measurement, gap identification, SOP formulation, implementation, monitoring and review. An SOP defines the sequence, responsibilities and controls for a recurring process, whereas a policy states organisational intent and a work instruction gives task-level guidance; standard work goes further by fixing the sequence and conditions needed for consistent execution [3], [7].

Hub delays and rework can be viewed as Lean waste: waiting, unnecessary movement, repeated handling, mis-sorting, excess processing and avoidable exception escalation. 5S and visual management, through clear zone identifiers, standard staging positions and visible exception categories, reduce search time and placement ambiguity [8]. The PDCA cycle supports continual improvement: plan the standard, pilot the SOP, check TAT, SLA, exceptions and ageing, then act by correcting the process or revising the SOP. Exception management requires a defined path of identification, segregation, documentation, investigation, escalation, resolution and closure.

Performance is expressed through a small KPI set. TAT is the elapsed time between a defined process start and completion; SLA adherence is the number of eligible cases completed within the committed service window divided by all eligible cases, multiplied by 100. Supporting indicators include exception rate, exception closure time, ageing beyond a threshold, scanning accuracy, route verification accuracy and SOP compliance. Averages alone can conceal long-tail delays, so percentile and ageing views are recommended where timestamp data exist.

## III. MATERIALS AND METHODS

### A. Research Objectives

The study pursues three objectives: (1) to map and evaluate the end-to-end delivery process and the stage-wise handoffs affecting TAT and SLA at Delhivery's Sudhawadi Hub; (2) to analyse representative TAT, SLA and exception data to identify delays, ageing patterns and operational root causes; and (3) to formulate practical department-wise SOPs and control mechanisms that improve TAT and SLA adherence and standardise exception handling.

### B. Research Design and Data Collection

A descriptive, observational, project-based case-study design was used during the on-the-job training from 13 April to 13 August 2026. The author spent roughly three to four days in each of Inbound, FLMS, Processing Center, Outbound, Nido and Falcon weight capture to follow the shipment from receipt to dispatch, and then spent most of the training with the Problem Solving Team, which handles damage, untraceable, route-mismatch and other exceptions. The observed flow was Inbound → Primary Sorting → FLMS/Secondary Sorting → Processing Center → Outbound → Staging → Dispatch/Linehaul → Delivery Node. Qualitative evidence came from direct observation, discussions with associates and supervisors, participation in tasks and photographs of the hub environment. Sector and company information came from secondary sources [12]–[14].

### C. Analytical Framework and Data Integrity

Stage TAT was calculated as completion time minus start time, and the overall period figure is weighted by shipment volume. Analysis used descriptive statistics, period trends, stage-wise comparison, exception frequency-and-severity (Pareto-oriented) prioritisation, a 4M-plus-information-and-capacity root cause matrix and SOP control-point analysis. SOP drafts followed eight stages: observe the process, map handovers, identify risks, define the standard sequence, add checkpoints and exceptions, define escalation, pilot or validate, and govern through version control.

Data integrity note: exact Delhivery TAT/SLA dashboard values were not made available because of confidentiality and access restrictions. To avoid presenting invented values as company data, the quantitative analysis uses a representative academic dataset covering 13–30 April, May, June, July and 1–13 August 2026 (about 980,000 shipments). It demonstrates the calculation method and improvement logic and must not be read as official performance. Other limitations are that only one hub was studied, exception behaviour varies by lane and customer contract, no confidential cost or employee data were used, and the proposed SOPs are academic drafts that need formal validation by Delhivery before operational use [15].

## IV. DATA ANALYSIS AND DISCUSSION

Profile the Representative Dataset

TABLE I.
EPRESENTATIVE DATASET PROFILE (13 APRIL–13 AUGUST 2026)

| Parameter | Value |
|---|---|
| **Analytical period** | 13 April – 13 August 2026 |
| **Representative shipment volume** | 980,000 |
| **Weighted average TAT** | 27.9 hours |
| **Weighted SLA adherence** | 91.9% |
| **First-period TAT / SLA** | 31.4 hours / 88.6% |



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| Parameter | Value |
|---|---|
| **Final-period TAT / SLA** | 24.9 hours / 94.2% |

Table I summarises the dataset. Its purpose is to demonstrate how an analyst would evaluate TAT and SLA over the training period, using weighted averages, trends, stage comparison and exception prioritisation. The volumes are not official Delhivery records.

Analyse Monthly TAT and SLA Trends

TABLE II.
ONTHLY TAT AND SLA SUMMARY (REPRESENTATIVE DATA)

| Period | Shipments | Avg. TAT (hrs) | SLA | On-time | Late |
|---|---|---|---|---|---|
| **Apr 13–30** | 112,400 | 31.4 | 88.6% | 99,586 | 12,814 |
| **May 2026** | 238,600 | 29.8 | 90.7% | 216,410 | 22,190 |
| **Jun 2026** | 252,900 | 27.6 | 92.1% | 232,921 | 19,979 |
| **Jul 2026** | 264,300 | 26.1 | 93.4% | 246,856 | 17,444 |
| **Aug 1–13** | 111,800 | 24.9 | 94.2% | 105,316 | 6,484 |

Table II shows a steady fall in average TAT from 31.4 hours in the first partial period to 24.9 hours in the last, a reduction of about 20.7%, while SLA adherence rises from 88.6% to 94.2%. In an operational setting this pattern would indicate lower dwell, faster exception resolution or better coordination between stages. The relationship is not strictly linear because SLA depends on the distribution of individual shipment TATs, not only on the average, which is why percentile and ageing measures are recommended.

Locate Stage-wise Bottlenecks

TABLE III.
TAGE-WISE TAT AND SLA (REPRESENTATIVE DATA)

| Process Stage | Avg. TAT (hrs) | Stage SLA | Primary Risk |
|---|---|---|---|
| **Inbound** | 3.1 | 94.1% | Receipt/scan queue |
| **FLMS** | 4.8 | 93.0% | Route and pincode mismatch |
| **Processing Center (PC)** | 6.7 | 91.2% | Processing backlog |
| **Outbound** | 4.2 | 94.4% | Staging/vehicle readiness |
| **Dispatch/Linehaul Handover** | 3.6 | 95.1% | Cut-off/dispatch delay |

Table III identifies the Processing Center as the primary bottleneck candidate, with the longest stage TAT (6.7 hours) and the lowest stage SLA (91.2%). The cause is not assumed to be a single failure; dwell can arise from volume surges, uneven work release, exception accumulation, scanning or system dependencies, or downstream capacity limits. FLMS ranks second (4.8 hours), and route or pincode verification there matters because a sorting error creates a downstream exception that costs more time than the original check. Outbound time is influenced by staging, consolidation and vehicle readiness.

Prioritise Exceptions by Frequency and Severity

TABLE IV.
XCEPTION CATEGORY ANALYSIS (REPRESENTATIVE DATA)

| Exception | Cases | Share | Avg. Closure (hrs) |
|---|---|---|---|
| **NTC/route mismatch** | 2,750 | 21.8% | 7.2 |
| **Damage** | 2,100 | 16.7% | 14.8 |
| **Untraceable** | 1,950 | 15.5% | 18.6 |
| **Weight discrepancy** | 1,600 | 12.7% | 5.9 |
| **Address/pincode issue** | 1,450 | 11.5% | 8.1 |
| **Scan/manifest issue** | 1,250 | 9.9% | 4.7 |
| **Packaging/handling** | 950 | 7.5% | 6.4 |
| **Other** | 550 | 4.4% | 9.0 |

NTC/route mismatch is the largest category and has a moderate closure time (7.2 hours), suggesting that many cases are resolved by verification and correction. Untraceable (18.6 hours) and damage (14.8 hours) cases are slower because they may need physical search, status verification, investigation and escalation. Exceptions should therefore not be prioritised by count alone: a Pareto view should combine frequency, closure time and SLA impact, since a low-volume category with very long closure can deserve as much attention as a high-volume one that closes quickly.

Compare Shipment Types

TABLE V.
HIPMENT TYPE ANALYSIS (REPRESENTATIVE DATA)

| Shipment Type | Share | Avg. TAT (hrs) | SLA |
|---|---|---|---|
| **B2B** | 60.8% | 25.8 | 94.0% |
| **B2C** | 32.6% | 29.4 | 89.8% |
| **Heavy** | 6.0% | 36.7 | 85.6% |
| **Document** | 0.6% | 18.9 | 96.2% |

Table V shows that B2B shipments perform better than B2C (94.0% vs 89.8% SLA), and Heavy shipments have the highest TAT (36.7 hours) and the lowest SLA (85.6%). This is plausible because size, handling complexity, routing and vehicle constraints raise dwell. The result supports segmentation: a single SLA target or improvement action should not be applied uniformly to every shipment category.

Diagnose Root Causes

TABLE VI.
OOT CAUSE MATRIX FOR TAT AND SLA DELAYS

| Category | Root Cause Example | Impact on TAT/SLA | Proposed Control |
|---|---|---|---|
| **Man** | Limited process familiarity during peak workload | Rework, wrong segregation, slower exception closure | Training, induction checklist, buddy support |
| **Machine/System** | Scan, weighing or processing equipment interruption | Queue build-up and delayed status completion | Preventive checks, escalation, backup procedure |
| **Material/Shipment** | Damage, wrong weight, missing identifier, poor packaging | Extra handling and investigation | Verification checkpoint and exception segregation |
| **Method** | Variation in sequence or unclear handover | Repeated handling and waiting | Standard SOP and shift handover checklist |
| **Information** | Incorrect route, pincode or NTC data | Mis-sort and downstream correction | Mandatory verification before transfer |
| **Capacity** | Uneven workload release versus processing capacity | Processing backlog and ageing | Hourly workload monitoring and balancing |

Table VI shows that delay has several interacting causes rather than one. High-frequency problems such as route mismatches and scanning errors call for prevention through mandatory checkpoints and training. High-severity damage and



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untraceable cases call for strong exception governance and ageing escalation, and Processing Center backlog calls for workload visibility and capacity balancing.

Link Findings to SOP Controls

TABLE VII.
INDING-TO-SOP CONTROL LINKAGE

| Finding | Relevant SOP | Control |
|---|---|---|
| **High processing dwell** | PC SOP | Queue monitoring, batch/priority discipline, ageing escalation |
| **Route mismatch** | FLMS SOP | Mandatory route/pincode/NTC verification before transfer |
| **Dispatch readiness delay** | Outbound SOP | Pre-dispatch checklist and cut-off confirmation |
| **Weight discrepancy** | Falcon SOP | Weight capture, label/system verification and recheck |
| **Damage / untraceable** | PST SOP | Segregation, investigation, escalation and closure |
| **Repeated small deviations** | All SOPs | Visual controls, training and compliance audits |

Table VII converts the findings into controls. Each SOP states purpose, scope, responsible role, step sequence, checkpoints, exception handling and escalation, with document ownership, version control and review dates. Cross-functional rotation also showed that end-to-end TAT is shaped by several handoffs rather than one activity, so stage-wise visibility, clear ownership and disciplined handovers are needed alongside the SOPs themselves.

Plan the Improvement Roadmap

TABLE VIII.
ECOMMENDED CONTROLS AND EXPECTED OUTCOMES

| Recommendation | What | How | Expected Outcome |
|---|---|---|---|
| **1. Stage-wise TAT/SLA control** | Make dwell and SLA risk visible before breach | Daily control board, stage KPIs, PC ageing buckets, FLMS verification, outbound pre-dispatch checks | Earlier intervention, lower dwell, higher SLA |
| **2. Exception and verification control** | Reduce delay from recurring and severe exceptions | PST ageing matrix, route/NTC verification, Falcon weight recheck, severity-based escalation | Faster closure, less rework, shorter long-tail ageing |
| **3. SOP governance and continuous improvement** | Turn findings into sustained standard work | Controlled SOPs, training, visual management, audits, weekly PDCA review | Higher compliance, lower variation |

Table VIII outlines three connected interventions. The TAT/SLA control board should report average and percentile TAT, SLA adherence, ageing buckets, stage dwell and the top SLA-risk causes, with hourly ageing review in the Processing Center. Falcon weight capture should follow identification, stable reading, system verification, tolerance and recheck, and escalation. Challenges met during the study, namely restricted data access, process complexity, exception variability and confidentiality, were handled through cross-functional rotation, grouping exceptions by type and severity, and disclosing the representative nature of the data.

## V. FINDINGS, CONCLUSIONS AND SUGGESTIONS

### A. *Findings*

The representative analysis shows an improving overall trend, with TAT falling from 31.4 to 24.9 hours and SLA adherence rising from 88.6% to 94.2%, but service risk remains concentrated in a few places. F The Processing Center has the longest dwell (6.7 hours) and lowest stage SLA (91.2%), followed by FLMS (4.8 hours). Route/NTC mismatch is the most frequent exception (21.8%), while untraceable and damage cases close slowest (18.6 and 14.8 hours). Heavy shipments (85.6% SLA) and B2C shipments (89.8%) lag B2B and document shipments. Process observation confirmed that TAT is a cumulative result of several handoffs.

### B. *Conclusions*

The three objectives were achieved. Process mapping through cross-functional rotation established the end-to-end flow and control points; TAT/SLA and exception analysis identified the Processing Center, FLMS routing and slow-closing exceptions as priorities; and the findings were turned into department-wise SOPs and controls. TAT and SLA improvement at the hub should therefore be approached through three connected interventions: control stage-wise handoffs, use TAT/SLA and exception analysis to set ageing and root cause priorities, and institutionalise practical SOPs. As the quantitative figures are representative, official performance decisions should rely on controlled company data.

### C. *Suggestions*

To translate the findings into practice, the hub should follow a phased plan: R

*Stage-wise control:* Establish a daily TAT/SLA control board with hourly ageing review and workload balancing at the Processing Center, a pre-dispatch readiness checklist at Outbound, and mandatory route/pincode/NTC verification at FLMS.

*Exception management:* Run exceptions through the PST with separate response logic for high-frequency (route mismatch) and high-severity (damage, untraceable) cases, using ageing buckets, named ownership and escalation thresholds, and standardise Falcon weight recheck.

*SOP governance:* Maintain controlled SOPs for Inbound, FLMS, Processing Center, Outbound, Falcon and PST with ownership, version control, training acknowledgement, visual management, competency checklists and weekly PDCA review.

### D. *Implications of the study*

- Hub management: Stage-level visibility and ageing escalation allow earlier intervention before an SLA breach occurs.
- Frontline associates and supervisors: Standard steps, checkpoints and handover checklists reduce reliance on memory and help new staff learn consistently.
- PST and quality teams: Exception categories ranked by frequency and closure time give a factual basis for escalation and for tracking recurring causes.

### E. *Future Scope of the study*

A future study with controlled shipment-level timestamps for receipt, inbound scan, primary sort, FLMS sort, PC completion,



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outbound staging, dispatch and delivery, together with shipment type, lane, exception code and closure timestamp, would allow percentile TAT, SLA-breach decomposition and statistical root cause analysis. It could also pilot the proposed SOPs and measure their effect on TAT, SLA adherence, exception closure and process variation, and extend the work to other hubs.

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