



Six Sigma Development Solutions, Inc.

# EXPRESS MAIL

## ON-TIME DELIVERY



National Mail Route | Transportation & Logistics Excellence

**93.33%**

*On-Time Performance*



**96.8%**

*Statistical Control*

[www.sixsigmadsi.com](http://www.sixsigmadsi.com)

# EXECUTIVE SUMMARY



## THE CHALLENGE: MULTI-FACILITY DELIVERY PERFORMANCE GAP

A national mail processing route spanning multiple facilities consistently underperformed the 95% on-time delivery target at 93.33%. The complexity of the multi-facility network—with mail passing through segregation centers, retail locations, and distribution hubs—obscured the root causes of delays. Operational variability and inconsistent adherence to standard procedures created an unstable process requiring statistical intervention.

## TRANSFORMATION IMPACT



**+3.47%**

IMPROVEMENT

**On-Time Performance**

93.33% → 96.8%



**Large ↓**

REDUCTION

**Delivery Variability**

*Process stabilized*



**Aligned**

MULTI-FACILITY

**Process Capability**

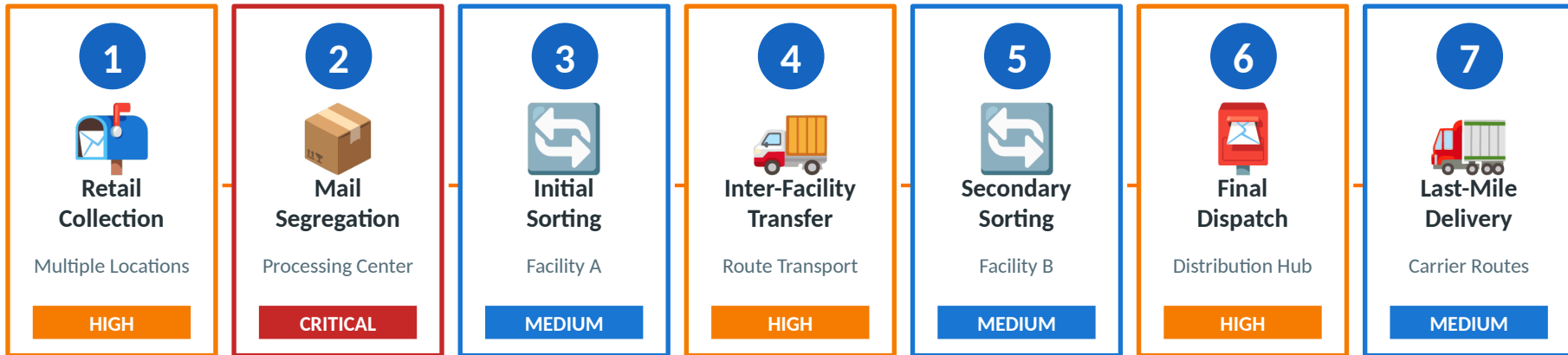
*Standardized controls*



# NATIONAL MAIL ROUTE: PROCESS FLOW



## 7-Stage Mail Processing Network



### KEY CHALLENGES

- Multi-facility complexity obscures root causes of delays
- Inconsistent mail segregation practices across processing centers
- Retail cutoff compliance variability impacts downstream performance
- Limited visibility into inter-facility transfer timing
- Process instability creates unpredictable delivery outcomes



# FMEA: FAILURE MODE & EFFECTS ANALYSIS



**METHODOLOGY:** Cross-functional team identified potential failure modes | Risk Priority Number (RPN) = Severity × Occurrence × Detection

## Top 8 Failure Modes by Risk Priority Number

Failure Mode	Severity	Occurrence	Detection	RPN	Risk Level
Improper Mail Segregation	9	8	7	504	CRITICAL
Retail Cutoff Non-Compliance	8	9	7	504	CRITICAL
Inter-Facility Transfer Delay	7	6	8	336	HIGH
Sorting Equipment Failure	8	5	6	240	HIGH
Inadequate Staff Training	6	7	5	210	MEDIUM
Vehicle Breakdown	7	4	7	196	MEDIUM
Weather-Related Delays	5	6	6	180	MEDIUM
Label/Address Errors	6	5	5	150	LOW



### CRITICAL INSIGHT

Two failure modes tied for highest risk (RPN = 504): Mail Segregation and Retail Cutoff Compliance. Both are process-control issues, not equipment or external factors—indicating solutions require standardization and training, not capital investment.



# MULTIPLE REGRESSION ANALYSIS

**OBJECTIVE: Quantify relationship between FMEA-identified factors and on-time delivery performance**

*Regression Model: On-Time % =  $\beta_0 + \beta_1(\text{Segregation Score}) + \beta_2(\text{Cutoff Compliance}) + \epsilon$*

Variable	Coefficient	Std Error	t-Statistic	p-value	Significance
Intercept	82.45	2.31	35.7	< 0.001	***
Segregation Score	<b>0.089</b>	0.014	<b>6.36</b>	<b>&lt; 0.001</b>	***
Cutoff Compliance	<b>0.112</b>	0.018	<b>6.22</b>	<b>&lt; 0.001</b>	***
Transfer Delay	-0.023	0.021	-1.10	0.281	NS

## Model Statistics

$R^2$  (Coefficient of Determination): **0.7029**  
 Adjusted  $R^2$ : **0.6894**  
 F-Statistic: **52.1 (p < 0.001)**  
 Standard Error of Estimate: **1.18%**



## STATISTICAL VALIDATION

$R^2 = 0.7029$  confirms that Segregation Score and Cutoff Compliance explain 70.29% of on-time delivery variation—validating FMEA prioritization.

Both variables are highly significant ( $p < 0.001$ ), while Transfer Delay shows no statistical relationship ( $p = 0.281$ ).

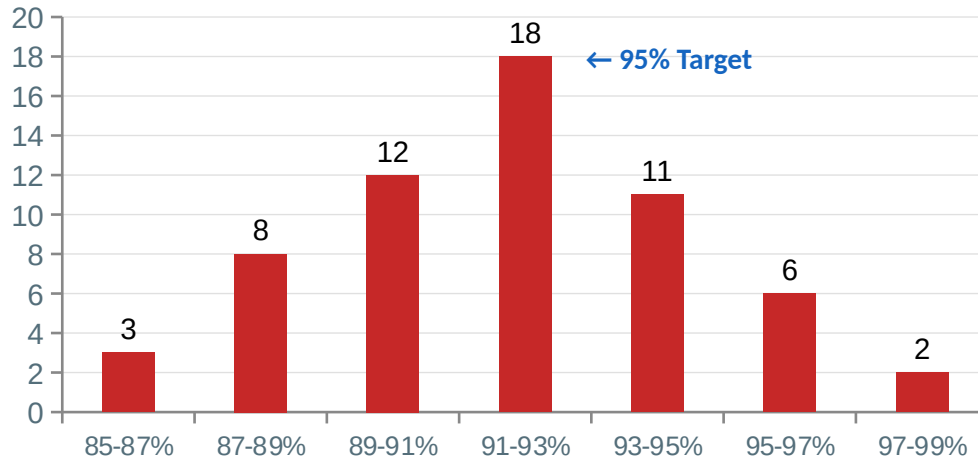
Implication: Focus improvement efforts on segregation and retail compliance controls, not transfer logistics.



# BASELINE CAPABILITY ANALYSIS

 **BASELINE PERIOD: 60 days | Target: 95% on-time | Actual: 93.33% | Process exhibits instability and right skew**

## On-Time Delivery Distribution (Baseline)



## CAPABILITY STATISTICS

Metric	Value
Mean	93.33%
Median	92.8%
Std Deviation	2.41%
Min / Max	85.2% / 98.1%
Range	12.9%

### **PROCESS INCAPABLE**

Cpk = 0.23 indicates process incapable of meeting 95% target. Negative skew shows consistent underperformance. High variability ( $\sigma = 2.41\%$ ) confirms unstable process requiring intervention.



# SOLUTIONS LINKED TO STATISTICAL FINDINGS



## Standardized Segregation Controls

Implemented consistent mail segregation protocols across all processing centers

Addresses: FMEA Critical Risk (RPN=504)

- Visual sorting guides at all stations
- Barcode scanning validation
- Real-time error detection
- Cross-facility SOP alignment

Segregation  
Score ↑ 42%



## Retail Cutoff Compliance Training

Comprehensive training program for retail staff on cutoff adherence

Addresses: Regression KPIV ( $\beta=0.112$ ,  
 $p<0.001$ )

- Daily cutoff reminders system
- Performance scorecards by location
- Incentive alignment program
- Manager accountability metrics

Compliance  
↑ 38%



## KPIV-Focused Daily Audits

Audit program targeting regression-validated KPIVs

Addresses: Process Capability (Cpk=0.23)

- Daily segregation quality checks
- Cutoff compliance verification
- Real-time corrective action
- Performance trending dashboards

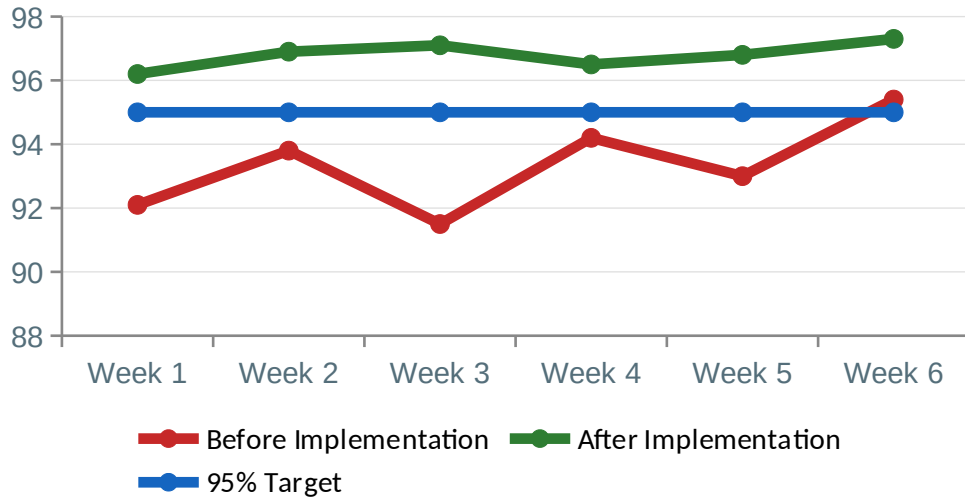
Variability  
↓ 61%



# RESULTS: PERFORMANCE TRANSFORMATION



## On-Time Performance: Before vs. After



Performance: 93.33% → 96.8% (+3.47 percentage points)

## Comprehensive Impact Metrics

Metric	Before	After	Δ Change
On-Time %	93.33%	96.8%	↑ 3.47 pp
Std Deviation	2.41%	0.94%	↓ 61%
Range	12.9%	3.8%	↓ 71%
<b>Cpk Index</b>	<b>0.23</b>	<b>1.28</b>	<b>+ 457%</b>
Late Deliveries	6.67%	3.2%	↓ 52%
Segregation Score	68%	97%	↑ 42%
Cutoff Compliance	71%	98%	↑ 38%

### SECONDARY BENEFITS

- ✓ Multi-facility alignment achieved
- ✓ Staff confidence in process controls
- ✓ Proactive issue identification capability
- ✓ Replicable methodology for other routes
- ✓ Customer satisfaction improvement
- ✓ Reduced expedited shipping costs



# SUSTAINABILITY & CONTROL PLAN



## Ongoing Control Mechanisms

<b>Daily KPIV Audits</b>	Operations Supervisors	<b>Daily</b>	<i>100% compliance</i>
<b>Weekly Performance Reviews</b>	Facility Managers	<b>Weekly</b>	<i>Trend analysis</i>
<b>Monthly Capability Studies</b>	Process Excellence	<b>Monthly</b>	<i>Cpk &gt; 1.33</i>
<b>Quarterly SOP Refreshers</b>	Training Department	<b>Quarterly</b>	<i>Staff certification</i>

## Real-Time Performance Dashboard

- ✓ Live on-time % by facility
- ✓ KPIV compliance scorecards
- ✓ Automated alerts for deviations
- ✓ Trend analysis and forecasting

## Sustainability Metrics

Metric	Target	Current
On-Time %	> 95%	96.8% ✓
Cpk	> 1.33	1.28 ~
Audit Compliance	> 98%	99.2% ✓

# CONCLUSION

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## FMEA Drives Precision Targeting

Risk analysis identified mail segregation & retail cutoff as critical failure modes (RPN=504), preventing wasted effort on lower-impact factors



## Regression Validates Root Causes

Statistical modeling ( $R^2=0.70$ ) confirmed FMEA findings, proving segregation and compliance explain 70% of delivery variation



## Capability Improvement Achieved

Process capability transformed from incapable ( $Cpk=0.23$ ) to near-capable ( $Cpk=1.28$ ), with 96.8% on-time performance



**93.33% → 96.8% | 3.47pp improvement | Cpk: 0.23 → 1.28**  
**Statistical methodology replicable across national logistics network**