Six Sigma Green Belt Project

Reducing order packing errors in an E-commerce warehouse

What is Sigma Level?

- **Sigma Level** (or Z-score) is a statistical measure of process capability — how well a process performs compared to defect-free performance.
- It tells us how many standard deviations (σ) fit between the process mean and the nearest specification limit.
- In Six Sigma terms, **higher sigma = fewer defects.**

Defects vs Sigma Level (approximate values)

Sigma Level	Defects per Million Opportunities (DPMO)	Yield (Good Output)
1 σ	690,000	31%
2 σ	308,000	69%
3 σ	66,800	93.3%
4 σ	6,210	99.38%
5 σ	233	99.98%
6 σ	3.4	99.9997%

Problem Statement

An e-commerce warehouse has been facing frequent **order packing errors** (wrong items, damaged goods), which has led to a **30% increase in customer complaints over the past 2 months**. These errors negatively affect customer satisfaction and increase operational costs due to reverse logistics and re-packing.

To solve this issue, we applied the **DMAIC (Define, Measure, Analyze, Improve, Control)** methodology of Six Sigma.

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1. Define Phase

- **Project Goal:** Reduce packing errors to improve customer satisfaction and reduce operational costs.
- **CTQ (Critical to Quality):** Error-free order packing and accurate deliveries.
- **Business Impact:**
  - Complaints up by **30%**
  - Error rate = **4% (4 out of 100 orders)**
  - Additional cost from returns/replacements = ₹3,00,000 per month

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2. Measure Phase

- **Data Collected (Baseline):**
  - Total orders processed = **50,000 per month**
  - Orders with packing errors = **2,000 (4%)**
  - Cost per error = ₹150 (return shipping + re-packing)
  - Total monthly loss = **2,000 × 150 = ₹3,00,000**

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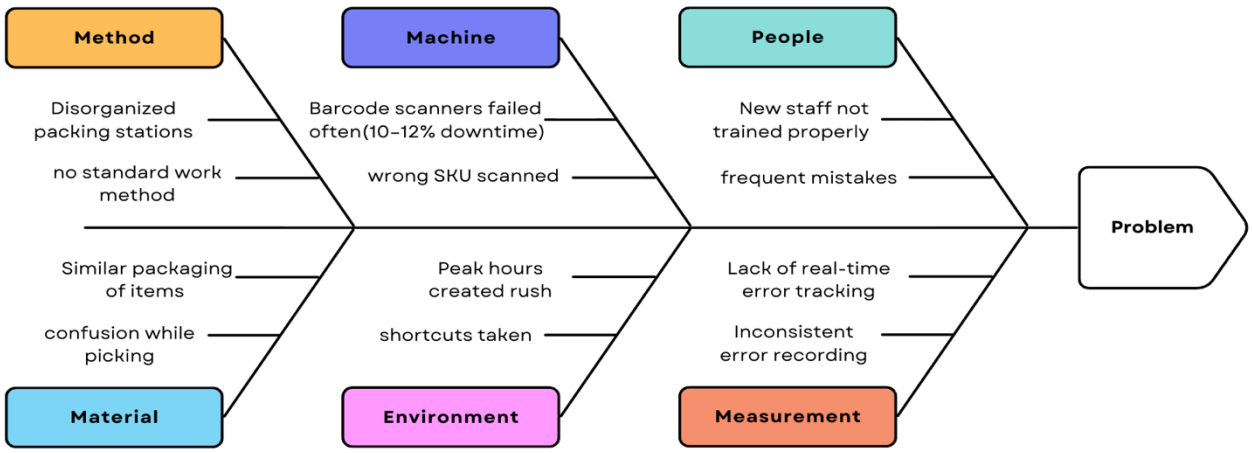
3. Analyze Phase

- **Root Cause Analysis using Fishbone diagram:**



Pareto Analysis of Error Sources:

- 50% due to untrained staff (1,000 errors)
- 30% due to scanner issues (600 errors)
- 20% due to packing station disorganization (400 errors)

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4. Improve Phase

Solutions Implemented:

1. **Training Program** → New staff received structured onboarding and hands-on packing training.
2. **New Barcode Scanners** → Replaced faulty scanners with reliable ones.
3. **5S System** at Packing Stations → Organized layout for efficiency (Sort, Set in order, Shine, Standardize, Sustain).

Projected Error Reduction:

- Staff training: Reduced 1,000 errors by 70% → **700 fewer errors**
- New scanners: Reduced 600 errors by 80% → **480 fewer errors**
- 5S system: Reduced 400 errors by 75% → **300 fewer errors**
- Total reduction = **1,480 errors/month**

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5. Control Phase

- Weekly audits of packing errors
- Dashboard with **real-time error % tracking**
- Ongoing **training refreshers** for staff
- Scanner maintenance schedule

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6. Result & Final Calculations

Sigma Level (Before):

→ Defects per Unit (DPU) = Defects / Units = 2,000 / 50,000 = **0.04**
→ Defects per Million Opportunities (DPMO) = (Defects ÷ (Units × Opportunities)) × 1,000,000
→ Opportunities per order = 1 (packing accuracy)
→ DPMO = (2,000 ÷ (50,000 × 1)) × 1,000,000 = **40,000 DPMO**
→ Converting DPMO to Sigma level using conversion table,
→ Approximate Sigma Level = **3.1 Sigma**

- **Before Improvement:**
  - Errors (E1) = **2,000/month (4%)**
  - Monthly loss = **₹3,00,000**
  - Sigma Level = **3.1**
- **After Improvement (6 weeks later):**
  - Errors (E2) = 2000 – 1480 = **520/month**
  - Monthly loss = 1480 x 150 = **₹78,000**
  - Sigma Level = **3.8**

Savings Achieved:

- Reduction in errors = ((E1-E2) ÷ E1) x 100 = **74%**
- Cost savings = ₹3,00,000 – ₹78,000 = **₹2,22,000/month**
- Annual savings = **₹26.6 lakh**
- Customer satisfaction improved significantly

Improvements:

→ Sigma level improved from **3.1 → 3.8**
→ Error rate reduced by **74%**
→ Customer satisfaction increased and annual cost savings achieved.
