Quality Improvement Analysis: Adhesive Failure in Part A and Part B Assembly Operations

Course Project Report

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Executive Summary

This report presents an affinity diagram analysis of adhesive bonding failures in the assembly of Part A and Part B. Customer returns have indicated that the adhesive is not holding the parts together as designed, necessitating a comprehensive root cause investigation. Through systematic categorization of ten identified potential causes into five predefined affinity themes (Machine, Personnel, Support, Vendor, and Design), this analysis reveals that machine-related issues and personnel factors each account for 30% of identified concerns, suggesting a multi-faceted problem requiring integrated solutions.

Problem Statement

Background

The organization has experienced customer returns of assembled products due to adhesive joint failures between Part A and Part B. This quality issue directly impacts customer satisfaction, warranty costs, and brand reputation. A brainstorming session generated ten potential root causes that require systematic organization and analysis.

Objective

The primary objective of this analysis is to organize the identified potential causes into predefined affinity categories to facilitate targeted investigation and corrective action planning.

Methodology

Affinity Diagram Approach

Affinity diagramming is a collaborative method used to organize large amounts of qualitative data into logical groupings based on natural relationships. This technique, also known as the KJ Method, enables teams to identify patterns and themes within complex problems.

Predefined Categories

For this exercise, five affinity themes were predetermined:

- **Machine**: Equipment, calibration, and automated process issues
- **Personnel**: Worker training, capability, and instruction-related factors
- **Support**: Documentation, specifications, and verification systems
- **Vendor**: Supplier quality and material sourcing concerns
- **Design**: Product design specifications and alternative solutions

Data Collection

Ten sticky note ideas were generated through brainstorming sessions with cross-functional team members including production, quality, engineering, and procurement personnel.

Affinity Diagram

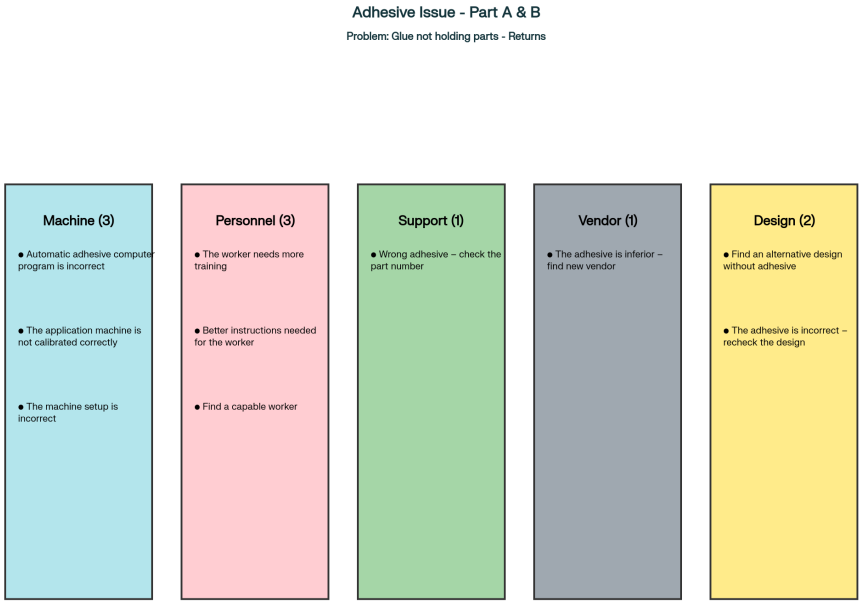

Figure 1: Affinity Diagram: Categorization of Adhesive Failure Root Causes

Findings and Analysis

Category Breakdown

The ten identified potential causes have been categorized as follows:

Affinity Category	Number of Items	Percentage
Machine	3	30%
Personnel	3	30%
Design	2	20%
Support	1	10%
Vendor	1	10%
Total	**10**	**100%**

Table 1: Distribution of Potential Causes Across Affinity Categories

Detailed Category Analysis

Machine Category (3 items - 30%)

- Automatic adhesive computer program is incorrect
- The application machine is not calibrated correctly
- The machine setup is incorrect

Analysis: The machine category represents the highest concentration of potential issues, suggesting significant concerns with equipment reliability and process control. These issues indicate potential systemic problems in the automated adhesive application process that could lead to inconsistent bond quality.

Implications: Machine-related failures typically result in batch-level defects rather than isolated incidents, which aligns with the pattern of customer returns. Immediate verification of machine calibration and program parameters is warranted.

Personnel Category (3 items - 30%)

- The worker needs more training
- Better instructions needed for the worker
- Find a capable worker

Analysis: Equal in frequency to machine issues, personnel factors represent a significant area of concern. The presence of three distinct personnel-related items suggests gaps in training programs, work instructions, and potentially operator selection criteria.

Implications: Human factors in manual adhesive application or machine operation may contribute to variability in bond quality. This category highlights the need for standardized training protocols and clearer standard operating procedures.

Design Category (2 items - 20%)

- Find an alternative design without adhesive
- The adhesive is incorrect – recheck the design

Analysis: Design-related concerns account for 20% of identified issues. These items suggest fundamental questions about whether the current adhesive bonding approach is optimal for the application, or if design specifications are appropriate for the chosen adhesive.

Implications: Design issues often require longer-term solutions but may provide more robust and permanent fixes. This category suggests the need for design review and validation testing.

Support Category (1 item - 10%)

- Wrong adhesive – check the part number

Analysis: A single item in the support category addresses the possibility of incorrect material specification or part number confusion in the procurement and inventory systems.

Implications: This represents a potential "quick win" opportunity. Part number verification can be conducted rapidly and corrective measures implemented immediately if discrepancies are found.

Vendor Category (1 item - 10%)

- The adhesive is inferior – find new vendor

Analysis: Vendor quality concerns represent 10% of identified issues, focusing on the possibility that the adhesive material itself does not meet required performance specifications.

Implications: This requires adhesive testing and comparison against specifications, potentially including evaluation of alternative suppliers. Material certification and quality documentation should be reviewed.

Root Cause Investigation Priority

Based on the affinity diagram analysis, the following investigation sequence is recommended:

Phase 1: Immediate Verification (1-3 days)

1. **Support**: Verify adhesive part numbers and specifications against design requirements
2. **Machine**: Check machine calibration records and perform calibration verification
3. **Machine**: Review automatic adhesive program parameters against specifications

Phase 2: Process Assessment (1-2 weeks)

1. **Machine**: Conduct machine setup audit and standardization
2. **Personnel**: Assess current training program effectiveness
3. **Personnel**: Review and update work instructions for clarity and completeness
4. **Vendor**: Perform adhesive material testing and review supplier quality records

Phase 3: Strategic Solutions (2-4 weeks)

1. **Personnel**: Implement enhanced training program and operator certification
2. **Design**: Conduct design review and evaluate alternative bonding methods
3. **Design**: Perform adhesive joint design validation testing

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Recommendations

Immediate Actions

- Establish a cross-functional task force including representatives from production, quality, engineering, and procurement
- Implement enhanced inspection protocols for adhesive joints until root cause is identified
- Quarantine suspect inventory and conduct 100% inspection of completed assemblies
- Document all customer return data to identify patterns (batch numbers, dates, operators, machines)

Short-Term Improvements

- Develop and implement machine calibration schedule with documented verification
- Create standardized work instructions with visual aids for adhesive application process
- Establish operator training and certification program with competency assessment
- Implement incoming adhesive material verification and testing protocols

Long-Term Strategic Initiatives

- Conduct Design Failure Mode and Effects Analysis (DFMEA) for the adhesive joint
- Evaluate alternative joining methods including mechanical fasteners, welding, or snap-fit designs
- Implement Statistical Process Control (SPC) for critical adhesive application parameters
- Establish supplier quality agreements with adhesive vendor including material specifications and testing requirements

Conclusion

The affinity diagram analysis has successfully organized ten potential root causes of adhesive failure into five logical categories, revealing that machine and personnel factors dominate the identified concerns at 30% each. This distribution suggests that the adhesive failure issue likely stems from a combination of equipment reliability problems and human factors rather than a single root cause.

The systematic categorization enables a structured investigation approach, beginning with rapid verification activities in the Support category, followed by comprehensive assessment of Machine and Personnel factors, and culminating in strategic evaluation of Design alternatives. This phased approach balances the need for immediate corrective action with longer-term sustainable solutions.

Success in resolving this quality issue will require integrated efforts across multiple departments, sustained management commitment, and systematic problem-solving using quality improvement tools. The affinity diagram serves as the foundation for this comprehensive quality improvement initiative, ensuring that all potential causes receive appropriate investigation and resolution.

Peer Review Grading Prompts

Content Completeness (40 points)

- Are all 10 sticky note ideas included and categorized?
- Are the five predefined categories (Machine, Personnel, Support, Vendor, Design) used correctly?
- Is each idea placed in the most appropriate category?
- Is the affinity diagram clearly presented and easy to understand?

Analysis Quality (30 points)

- Does the submission include analysis of the categorization results?
- Are the implications of each category discussed?
- Is there a logical investigation or action plan presented?
- Does the analysis demonstrate understanding of root cause investigation?

Presentation and Format (20 points)

- Is the document professionally formatted and organized?
- Are visual elements (diagram, tables) clear and properly labeled?
- Is the writing clear, concise, and free of errors?
- Does the document follow academic or professional report standards?

Critical Thinking (10 points)

- Does the submission show insight into the relationships between categories?
- Are priorities or recommendations logically justified?
- Does the analysis go beyond simple categorization to provide value-added insights?

References

[1] Mizuno, S. (1988). *Management for Quality Improvement: The 7 New QC Tools*. Productivity Press.

[2] Oakland, J. S. (2014). *Total Quality Management and Operational Excellence* (4th ed.). Routledge.

[3] Brassard, M., & Ritter, D. (2010). *The Memory Jogger 2: Tools for Continuous Improvement and Effective Planning* (2nd ed.). GOAL/QPC.

[4] American Society for Quality (ASQ). (2023). Quality Tools: Affinity Diagram. https://asq.org/quality-resources/affinity

[5] Imai, M. (2012). *Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy* (2nd ed.). McGraw-Hill Education.