Semester Project Proposal

Proposed to
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Optimization of PCB Manufacturing Processes Using Statistical Quality Control (SQC)

Introduction

In today's competitive manufacturing landscape, industries strive for enhanced efficiency, reduced costs, and superior product quality. The Printed Circuit Board (PCB) assembly process is particularly critical, as it serves as the backbone for various electronic devices. With the increasing complexity of electronic products, the need for robust manufacturing processes has never been more pressing. Statistical Quality Control (SQC) provides a systematic approach to monitor and improve these processes through statistical methods. SQC encompasses a variety of techniques that focus on measuring and analyzing production processes to identify areas for improvement. By utilizing control charts, process capability analysis, and other statistical tools, manufacturers can gain insights into their processes, leading to more informed decision-making [1].

This project aims to apply SQC methodologies to optimize a hypothetical PCB assembly line, targeting inefficiencies and defect rates that contribute to increased production costs and inconsistent product quality. Continuous monitoring of production metrics such as cycle times and defect rates allows manufacturers to detect variations in real-time and implement corrective actions before defects escalate [2]

The integration of SQC with lean manufacturing principles can amplify its effectiveness by streamlining processes and eliminating non-value-added activities [3]

Furthermore, quality control in PCB manufacturing is essential for ensuring that boards meet required standards and specifications, which directly impacts the reliability and functionality of electronic devices [4].

Effective quality control methods in PCB manufacturing include Automated Optical Inspection (AOI), X-Ray Inspection, and Electrical Testing. These methods help identify defects at various stages of production, ensuring that only high-quality boards proceed to assembly [5].

The implementation of artificial intelligence (AI) in quality control processes has also shown promise in enhancing defect detection rates, thereby improving overall operational efficiency [6].

By adopting advanced technologies for quality assurance, manufacturers can significantly reduce waste and enhance product quality [7].

Problem Statement

Frequent variations in cycle times and defects in manufacturing processes lead to increased production costs and inconsistent product quality. Traditional approaches often fall short due to their inability to provide real-time analysis necessary for addressing these inefficiencies. Therefore, there is an urgent need to implement a structured statistical approach that can effectively identify and mitigate these problems.

Required Skill Set

To successfully execute the project, the following skills and tools are essential:

- Proficiency in work and method study.
- Strong understanding of ergonomics and its impact on efficiency.
- Ability to develop process, material, and information flow charts/diagrams.
- Knowledge of lean methodologies such as six sigma, kaizen.

Relevant courses:

Statistical quality control, operations research, manufacturing processes, work study.

Methodology

1. **Process selection**
   Choose a manufacturing process for analysis, such as a PCB assembly line.
2. **Data collection**
   Collect cycle time, defect rate, and workstation-specific performance data.
3. **Analysis using SQC techniques**
   Develop control charts to monitor process stability.
4. **Propose solutions**
   Use findings to standardize cycle times, reduce variations, and minimize defects.
5. **Validation and assessment**
   Validate the proposed improvements by analysing the updated process metrics.

Expected Outcomes

1. **<u>PROCESS OPTIMIZATION:</u>** improved efficiency through reduced cycle time variations.

2. **<u>QUALITY ENHANCEMENT:</u>** lower defect rates and more consistent product quality.

3. **<u>ORGANIZATIONAL BENEFITS:</u>** reduced costs and increased productivity for manufacturing systems.

4. **<u>STUDENT LEARNING:</u>** practical application of statistical techniques to solve real-world industrial problem.

References

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