PROCESS MINING BASED NON-CONFORMANCE IDENTIFICATION, PROCESS ENHANCEMENT AND DEFECT DETECTION USING MACHINE VISION IN LARGE SCALE PCB ASSEMBLY

Jinal Prajapati, Industrial and Systems Engineering, MS candidate

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Zoom Link: https://binghamton.zoom.us/j/8748978656

Abstract: Optimizing Printed Circuit Board Assembly (PCBA) operations is key for maintaining operational performance and assuring high product quality in the competitive electronics manufacturing industry. As the complexity of PCBA operations enhances adoption of data driven techniques have become crucial for improving production. This thesis examines process optimization in the Surface Mount Technology and Plated Through Hole stages. It focuses on incorporating and analyzing the processes through process mining, deploying Key Performance Indicator tracking, parameter optimization, machine vision based defect detection and Work in Progress systems.

A key focus is the analysis of event logs extracted from Manufacturing Execution System through process mining. This method identifies operational nonconformity such as hidden deviations and bottlenecks from standard procedures. Real time KPI tracking improves visibility into critical production parameters by providing actionable insights. In addition, a Design of Experiments methodology was applied to optimize key variables in the SMT solder paste printing process that led to improve process capability. At the PTH stage, characterized by more manual procedures, raised additional challenges, notably in component positioning and flux cleaning. To address these, a machine vision system was developed and deployed that automates defect detection and improved inspection accuracy. Furthermore, a WIP management system was executed to prioritize tasks based on production flow by reducing delays and improving throughput. The thesis shows the importance of adopting data-driven and technology-based solutions in electronics manufacturing, aligning with Industry 4.0 principles for continuous improvement and competitiveness in a progressively automated industry.