

Abstract— The manual Kanban system at PT XYZ, a subsidiary of the Yazaki Corporation, has encountered ongoing difficulties, such as production delays, workload disparities, and the improper handling of kanban cards. This research tackles these inefficiencies by employing a digital Kanban system in conjunction with the Elastic Load Balancing (ELB) algorithm. ELB dynamically distributes workloads among machines, days, and shifts to enhance resource usage and promote equity. A theoretical analysis of the algorithm demonstrates a time complexity of $O(J + M \cdot D \cdot S)$, ensuring scalability for large datasets. Empirical testing with actual production data yielded a 42.35% decrease in production time and a fairness index approaching 0.999, validating the equitable distribution of workloads. The results underscore the ELB algorithm's capacity to improve production efficiency and function as a scalable solution for extensive manufacturing settings.

Keywords— *Elastic Load Balancing, Digital Kanban System, Temporal Efficiency, Fairness Index, Algorithm Complexity*