I. Introduction

A. Background

Kanban, a Japanese methodology, was developed in the 1950s as part of Toyota's Just-In-Time (JIT) production system. It focuses on producing only what is needed, when needed, and in the amount needed [12]. Kanban helps teams visualize workflow, limit work in progress, and manage workflow, improving efficiency and collaboration. Benefits include increased visibility of work, better communication, and effective task management [11].

The study focuses on solving the problem of the Yazaki Corporation subsidiary, which operates in the component manufacturing sector, with its main product wiring harness in optimizing production processes. Manual kanban systems are vulnerable to human error and loss of kanban cards, which can cause bottlenecks and delays in the production process. At a subsidiary of Yazaki Corporation, the manual kanban system encountered several issues, including circuit accumulation in the store that resulted in the stock activity process Old Kanban Transfer Order (STO), redundancy of kanban cards, and cutting processes without or missing kanban. This impacts the longer lead time between preassembly and the final circuit assembly for storage, impeding the accomplishment of production targets.

TABLE I. Lead Time Report from Pre-Assembly to Final Assembly

Lead Time Components	Processing Time (s)
Information Total	14400
Process Total	2885
Convey Total	928
Stagnation Total	15226

Table I presents data on circuit movement that underwent time inflation, resulting in delays from November 2022 to March 2023. The loss of 699 kanban at Yazaki Corporation's subsidiary substantially affected the stagnation in waiting times, creating urgent concerns about the management of the kanban system process.

A digital kanban system architecture is required to facilitate centralized management of kanban movement in order to tackle these problems. This system offers essential visibility and coordination in the production process, facilitating real-time monitoring of production status and is anticipated to diminish discrepancies between the initial plan and actual load, while also addressing issues related to stockpiling and delayed Stock Transfer Order (STO) kanban processes.

In the implementation of this digital kanban system, one of the approaches that can be taken is by using the elastic load balancing algorithm, where the use of this algorithm becomes crucial. Several relevant research references related to the elastic load balancing algorithm include Wandira & Hadiwandra, who discuss website design using elastic load balancing technology in VPC (Virtual Private Server). The use of elastic load balancing demonstrates a way to improve website performance and availability during traffic spikes [3]. Similarly, Zakutynskyi et al. explored dynamic loadbalancing techniques in distributed IoT systems, showcasing how adaptive algorithms can optimize computational resource use under fluctuating loads, which aligns with the scalable requirements of a production setting [19]. Furthermore, research by Mohit et al. discuss the development of an algorithm designed to dynamically allocate resources based on flexible time constraints, allowing the system to adjust to the workload it bears, thereby becoming more efficient [10].

Research has demonstrated that the implementation of digital applications enhances resource optimization and system control. For instance, the utilization of the UTAUT model to implement digital extension applications has resulted in enhanced user engagement and efficiency in resource management [16]. Furthermore, gaussian process regression methods have been implemented to optimize IoTbased systems by predicting temperature and humidity to improve resource allocation [17]. In the same vein, the potential of predictive algorithms to address operational inefficiencies in production systems has been demonstrated through the use of Regression Tree models [18]. Furthermore, the application of the Eliminate, Combine, Re-arrange, and Simplify (ECRS) concept has been instrumental in achieving balanced production lines by minimizing idle times and ensuring the seamless flow of resources. This approach, rooted in Just-in-Time (JIT) principles, enhances productivity and reduces waste, making it a valuable strategy for modern manufacturing processes [20].

This idea is usually used in cloud computing, but it can also be used in production to make sure that the data from the production plan is balanced on all of the machines that are used. Using the principle of elastic load balance algorithm, the kanban system can adapt to changes in the amount of production plan data. This makes sure that resources are used efficiently, and that the system can respond quickly to changes in demand. This not only speeds up the system but also lowers the chance of mistakes and slowdowns in the production process. This makes kanban management more accurate and real-time.

B. Limitation of Study

This study was conducted based on the problem of the Yazaki Corporation subsidiary. The new master data from August 2023 to December 2023 will be compared with the old master data from the Yazaki Corporation subsidiary, which uses production data from November 2022 to March 2023. The observation will involve the development and optimization of the back end of the digital Kanban system, specifically focusing on the implementation of elastic load balancing algorithms for mapping production plan data within the Kanban system at PT XYZ assembly plant. The development of this system will be limited to the use of the PHP framework, specifically Laravel, to build the back-end system and integrate the elastic load balancing algorithm. In addition, the implementation will be limited to the local network environment at PT XYZ. The performance standardization for this study will use Jain's Fairness Index as the chosen performance measurement method.