Design and Implementation of Digital Kanban System Architecture for Automobile Electrical Assembly Based on User Centered Design at PT XYZ

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Abstrak

Sistem Kanban adalah metodologi yang digunakan untuk mengelola dan melacak alur kerja guna mengoptimalkan efisiensi produksi. Studi ini menyelidiki permasalahan yang diidentifikasi melalui analisis observasi dan tinjauan retrospektif, yang mengungkap berbagai abnormalitas data seperti redundansi dan hilangnya kartu Kanban. Permasalahan ini berasal dari konsumsi data yang tidak real-time serta proses Stock Transfer Order (STO) yang berkepanjangan, sehingga menghambat pencapaian target produksi. Penelitian ini bertujuan untuk mengembangkan solusi antarmuka perangkat lunak dengan pendekatan User-Centered Design (UCD), yang dievaluasi melalui Usability Testing (UT) dan System Usability Scale (SUS). Evaluasi kegunaan mencakup aspek Efektivitas, Efisiensi, Daya Ingat (Memorability), Kesalahan (Error), dan Kepuasan (Satisfaction). Hasil penelitian menunjukkan Efektivitas sebesar 93,3% dengan peningkatan 3,03% pada pengujian kedua, sedangkan Efisiensi tercatat pada 151,83 detik untuk menyelesaikan semua tugas dan 70,23 detik pada pengujian kedua, menunjukkan penurunan waktu di seluruh tugas yang menghasilkan daya ingat yang baik. Tingkat kesalahan juga rendah, yaitu 17,8% dan turun menjadi 3,9% pada pengujian kedua. Oleh karena itu, skor SUS yang diperoleh adalah 8,41 dengan nilai A, yang menunjukkan bahwa solusi ini dapat diterima dan dikategorikan sebagai sangat baik.

Kata Kunci: Sistem Kanban, *User Centered Design, Usability Testing, System Usability Scale*

Abstract

The Kanban system is a methodology used to manage and track workflows to optimize production efficiency. This study investigates issues identified through observational analysis and retrospective reviews only to reveals many data abnormalities such as redundancy and loss of Kanban cards. These issues stem from non-real-time data consumption and prolonged Stock Transfer Order (STO) processes, which impede the achievement of production targets. The research aims to develop a software interface solution utilizing a User-Centered Design (UCD) approach, assessed through Usability Testing (UT) and the System Usability Scale (SUS). Evaluating usability to encompasses the aspects of Effectiveness, Efficiency, Memorability, Error, and Satisfaction. The results showed an Effectiveness of 93.3% with an increase of 3.03% on the second test, while Efficiency was recorded at 151.83 seconds to complete all the task and 70.23 seconds on the second test, a decrease in time across all the task resulting in a great Memorability while having the Error rate low at 17.8% and 3.9% on the second test. Therefore, having the SUS to yield a score of 8.41, with a grade of A, indicating that it is acceptable and categorized as excellent.

Keywords: Kanban System, User Centered Design, Usability Testing, System Usability Scale

1. Introduction

Background

Kanban is a concept or methodology used to manage and track each job as it passes through a different process to optimize the production process. Kanban is commonly used in manufacturing plants by ensuring each phase is passed in sequence that must be fully completed before moving on to the next phase to ensure the quality of the final product [1].

This study focuses on solving the problems of the redundancy and loss of Kanban cards and accumulation in the store which caused a long process of Kanban Stock Transfer Order (STO) which affecting the total lead time of pre-assy to store final-assy (circuit) which was longer, thus hampering the actualization of production achievement targets [2]. This has been the main issue faced by one of the subsidiary of Yazaki Corporation which focuses on the field of automotive component manufacturing, electrical instrumentation of motor vehicles and producing wiring harness components, which is one of the components that is a wire/circuit/connector binding system that connects the electrical system in motor vehicles, such as the ignition system (CDI) and injection system [3]. The right choice of policy to deal with this problem is to fix the *kaizen* strategy which is a continuous improvement in the production process to yield a better outcome [4].

Table 1 Lead Time Report Pre Assy to Final Assy

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

Table 1 shows the indication which was triggered by the report of circuit transfer at that time required a total time of 9.28 hours from November 2022 to March 2023. It is worth to note at that time there has been 699 Kanban card was lost resulting in a poor lead time stagnation, considering that the reports can only be reviewed when there is an indication and cannot be mitigated in real-time.

To overcome the problems of several main factors of the problems mentioned above, it is necessary to design a Digital Kanban System that is used to control the rotation of Kanban in an integrated manner with Kanban cards that are recorded in real-time. By analyzing the issues of the production process, this study is expected to provide significant contributions in a more sophisticated and optimal improvement of the *kaizen* strategy. The results of this study are expected to improve the efficiency and performance of production process to minimize the difference in Kanban quantity between plan and actual loading and overcome the sedimentation and long Stock Transfer Order (STO) process.

This study discussed the use of UCD methods for making a digital Kanban system to draw conclusions from the problem and design a software interface solution which will be discussed in several important points, such as related studies in section 2, the system built in section 3, evaluation in section 4, and the conclusions in section 5.

Limitation of Study

This study was conducted based on the problem of the Yazaki Corporation subsidiary which rely on production data from November 2022 to March 2023, which will be compared with more recent production data from August 2023 to December 2023. Observations will involve stakeholders such as production staff, supervisors, and the Kanban master during this timeframe to validate data consistency. The UCD methodology will be applied specifically to the development of a web-based application. Third, the observation period for the user-centered design method will be limited to the first 6 months post-implementation, gathering feedback from users directly interacting with the system. Finally, the evaluation of the user-centered design method for the developed software system will utilize the Usability Test (UT), evaluating usability to encompasses the aspects of Effectiveness, Efficiency, Memorability, Error, and Satisfaction and System Usability Scale (SUS). However, production scale observation cannot be done simultaneously due to time constraints of the project agreement being implemented and the construction of

other architectures that support the improvement of the kaizen strategy which takes a long time to be able to do the same test. As a solution, the latest production data with this system will be compared with how long the circuit transfer process took in the previous production data to get a rough picture of the optimized time efficiency.