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Process Loss Reduction: Implementing Process Management System Through Digitization using a Web-Based Application

Mohammad Umar[1], Shashank Rohit[2]

[1]Mohammad Umar, Assistant Professor, National Institute of Fashion Technology, Department of Fashion Technology, Kangra, India,
[2]Shashank Rohit, National Institute of Fashion Technology, Department of Fashion Technology, Kangra, India

Abstract
This research identifies problem in Ethiopian denim trouser manufacturing unit between cut to ship, resulting in material loss. The area of study is chosen from the cutting to the packing of the unit. The study investigates the various process losses and their causes.
A web-based application that uses a QR code to track bundle movement is attached with bundles which will also generate production, Quality, Machine breakdown, recut, and WIP reports.
The design and system developed can track Real-time material movement throughout the process and generate real-time insightful and actionable data. Using real-time tracking, planning, and insightful data provides a vision for this project.
The significance of the research is immense as Reliance on the data is raised, planning becomes more manageable and effective, monitoring is improved, WIP is controlled, Gap Mitigation (Capacity to Performance) is streamlined and above all, "Transparency" of the floor becomes sharper.

Keywords: WIP, Shop-floor Control, Real-time data Collection, Kanban, Web application.

1. Introduction

Real-time bundle tracking enhances Shop floor control (SFC), where planning meets processes, and it lays the foundation of a production planning and control system. SFC has proximity to the actual manufacturing process and is also a natural vehicle for collecting Real-time data for use in the other planning and control modules and to empower the organization.

A well-designed SFC module controls the flow of material through the plant and makes the rest of the production planning system easier to design and manage. Despite its logical importance in a production planning hierarchy, SFC is frequently given little attention in practice. The system operates on the basis that it emphasizes shop-floor control and WIP tracking to create a production environment based on the theories of CONWIP and the Kanban System. The control point reduces the process and makes the production process more efficient. Data collection from the factory floor is often referred to using a variety of online and real-time terms, such as live-feed and continuous-feed.

For optimal production planning, it is necessary to obtain data from the Sewing floor with no lag time, which is not possible with conventional or manual methods. For almost a decade, people all around the world have had access to Real-Time Data Collection Systems. Still, real-time shop floor data collection in the PBU system has recently found acceptance among apparel manufacturers. The program's success has reached even smaller producers/exporters because of its advantages. WIP is the unfinished item in progress and is ready to feed up in production. Generally, it is measured in the number of garments. It is vital to keep the measure of the WIP regularly to maintain the proper flow and avoid material loss.

The study concludes by talking about the problems that arose, the things that were learnt, and the managerial repercussions that came from implementing the system.

2. Literature Review

(Lee, 2012) Resources management remarkably impacts production operations in terms of both productivity and efficiency. Faced with the competitive market's challenges, garment manufacturers always strive for shorter production cycles. Effective resource management is thus essential for the survival of garment manufacturers. Currently, there is a lack of standardized approaches for effective production resource management in the garment manufacturing industry. This may lead to inefficiency in production performance.

(Deep, 2017) Presently, there is a lack of a proper monitoring system to control production and analyze the daily reports, which is widely attributed to inadequate financial resources to acquire expensive Production Monitoring Systems. SMEs rely invariably on registers, challans, and manual data sheet-based monitoring, which are detrimental to the production process, including unscheduled production stoppages, as well as difficulty in ascertaining actuals with planned numbers. Track My Production (TMP) framework proposed for SMEs facilitates production monitoring and solves issues pertaining to production output addressing various impediments involved in the process. TMP app explains the method of monitoring real-time production and features analysis of resource availability in each department with the facility to monitor the status of sewing, cutting, and finishing at any time. The paper reveals the impact of TPM in apparel production planning through reports and their graphical analysis of the data collected to analyze the daily production based on various parameters involved in apparel production.

(Jain, 2019) A majority of small factories struggle to get timely production status. There is no transparency in sharing information. One can find a gap between actual production on the floor and production figures in status reports. The process can only improve with correct and timely data from a real-time system. Also, to add, Data recorders in a factory capture production data and make reports, which are then compiled. However, by the time the final compilation is made, many parameters change. Most of the time, management cannot take better action on time as people do not bother to analyze collected data to share with top management. So, a factory needs support from a sound floor control system and adequate data.

(Maher Oner, 2017) Since radio frequency identification technology usage is rising, application in this area is rising day by day. The most striking result is that a radio frequency identification application could be implemented to support the tracking and tracing of work in progress in the denim production process. RFID technology could be able to be adopted practically and efficiently for real-time tracking of malfunctions and problems that occur in the production process.

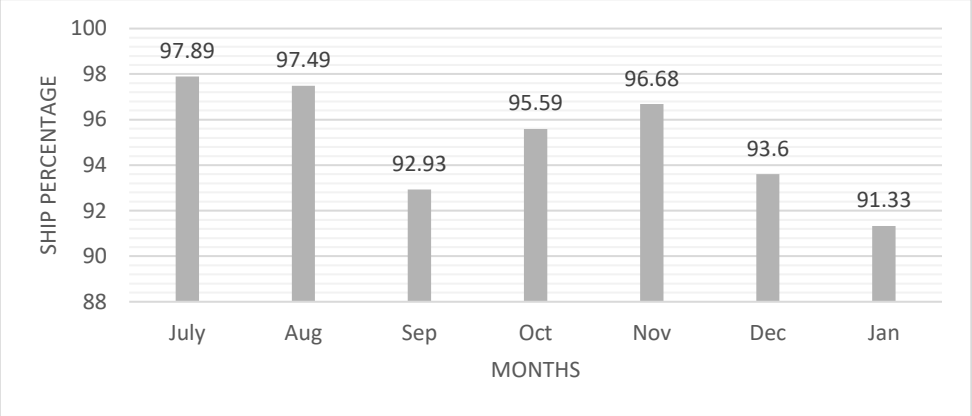
(Siva Kumar, 2007) The crucial sewing production data is the backbone for balancing the assembly line, but calculating data on the sewing floor is arduous. Traditional manual job tickets or recording systems cannot produce critical production-related data on time. Manual data collection is also laborious and error-prone. A Real-Time Production Control System is a mechanism for getting complete control of your apparel manufacturing unit. It operates on the basis of putting the emphasis on your information collection systems where it matters at the needlepoint. Using Real-Time means collecting and accessing labor cost and work-in-progress information at the time it is most relevant when it happens.

3. Methodology

3.1. Problem Identification and Analysis

Cut to Ship Ratio

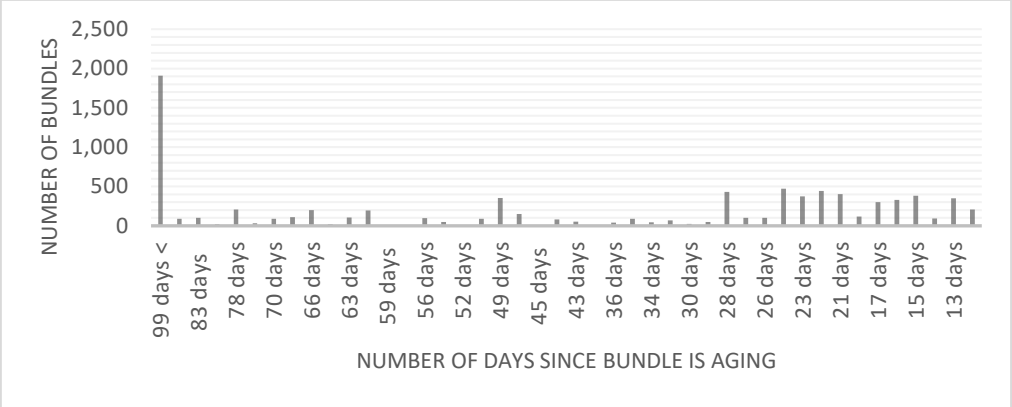
Figure 1: Cut to Ship % (July –Jan -2021)



The cut-to-ship loss was a major problem which is a minimum of 3% to a maximum of 9%; as we can see from the data for last month in Figure-1, this much loss is incurring a considerable profit margin for the organization. This cut-to-ship ratio is divided into three phases of process loss: Cutting to Sewing, sewing to finishing, and finishing to packing. The project is focused on encountering and solving problems from cutting to sewing. The back pocket Unit is the critical unit between cutting and sewing; most issues are central to this unit only. For further encounters of the major problems between cutting to sewing, studies have been conducted, and detailed problem analysis has been done to highlight the significant issues.

Automatic Back Pocket Unit Bundle Aging

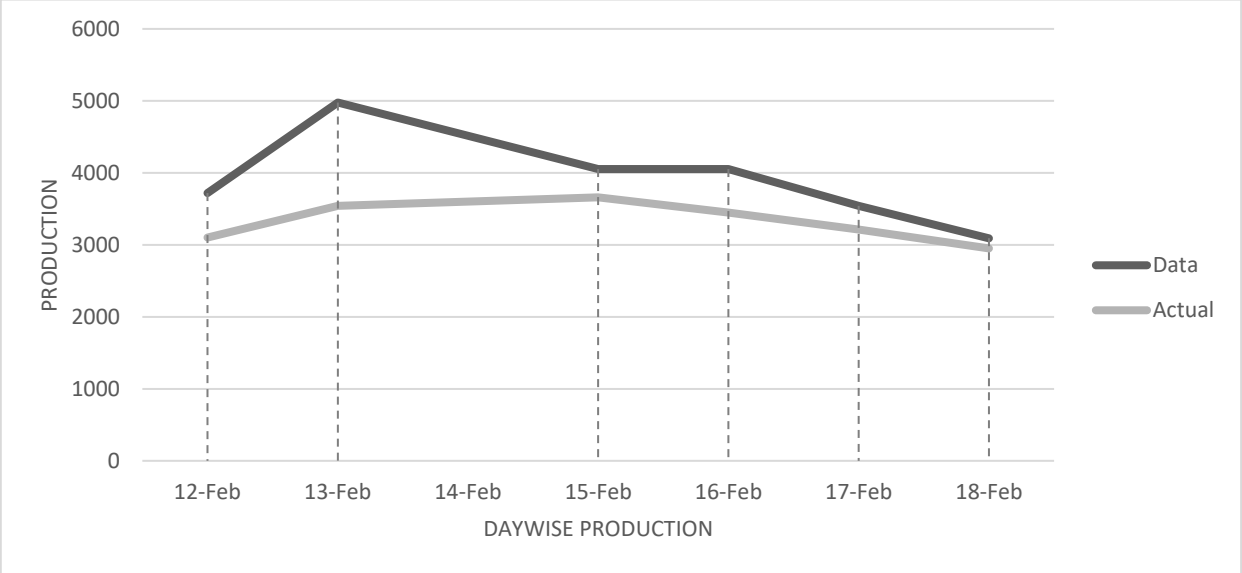
Figure 2: Bundle Aging In The Automatic Back Pocket Unit



The first problem is the bundle aging in the back-pocket section; Figure 2 shows the distribution of the pieces in day-wise aging in the back-pocket section. This data shows that more than 10,000 pieces are aged more than 13 days in the back-pocket section. It concludes with the significant material loss in the back-pocket section.

The Discrepancy in Data Collection

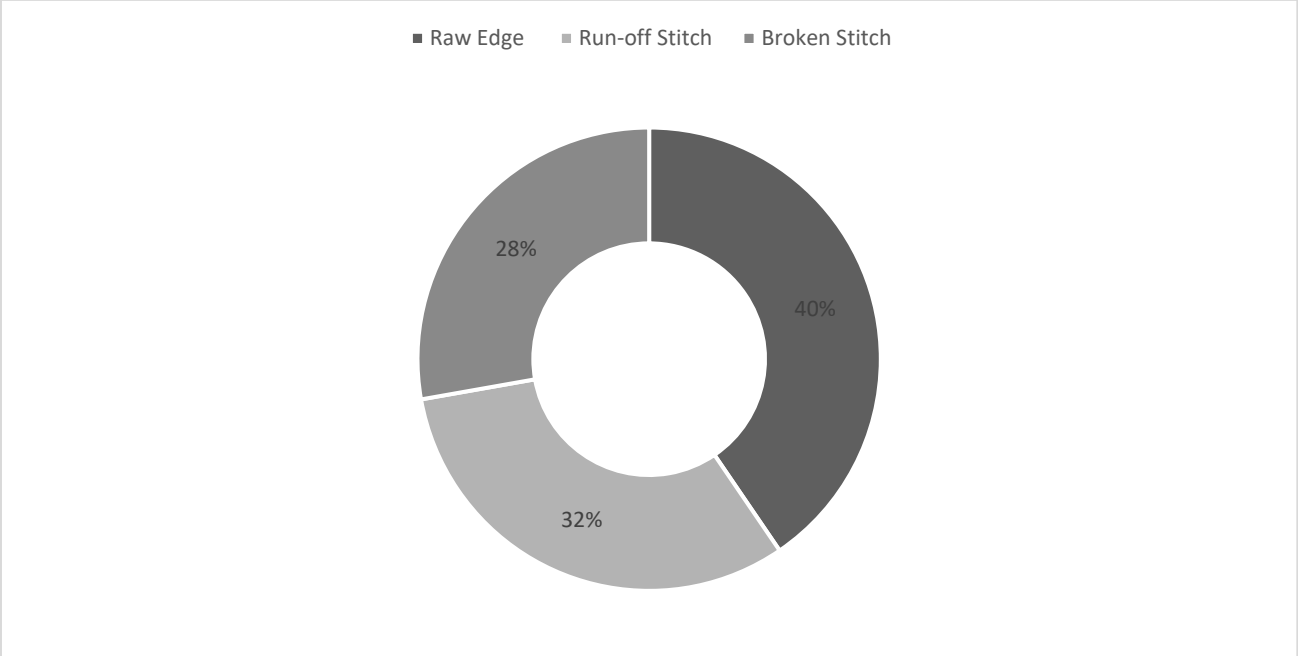
Figure 3: Production Data Collected vs. Actual



The data collected by operators are not accurate shown in figure 3, full of errors. The main reason behind this discrepancy is the target-based incentive and taking machine reading for production. Also, the data collected is not hourly. This discrepancy causes the top management to make a wrong projection of the unit's capacity. Also, the human element in data collection plays a significant part here.

Non-insightful, Non-actionable Quality Data

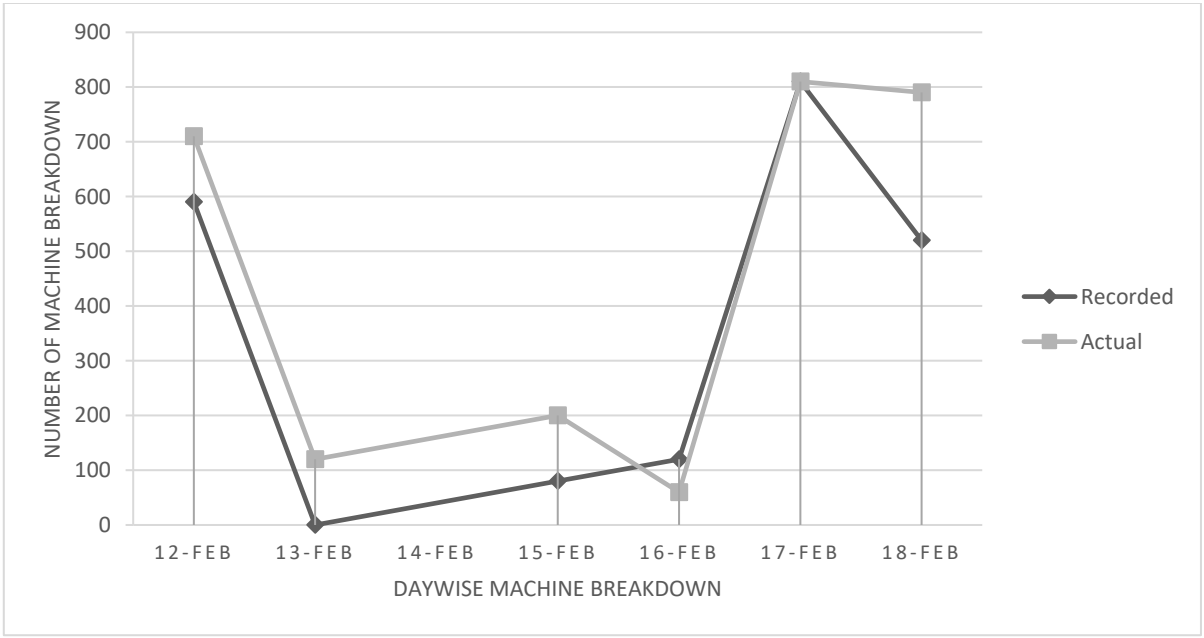
Figure 4: Top Three Defects



The data collected by the QC operator are only for the top 3 defects as per Figure 4, not for the complete; also, the data collected is full of errors. The data collected is not detailed, as the top management cannot do projects on defect minimization as the data will not be enough. Even the root cause analysis for the defects cannot be done based on this data.

Productivity Loss Due To Machine Downtime

Figure 5: Machine Breakdown Recorded vs. Actual



The productivity loss problem is unit, as the maintenance report process is entirely manual the mechanic takes much more time to start to repair the machine than required. As shown in Figure 5, there

was a considerable loss of machine time on 17 February due to a mechanic delay in repair. This is an example of an error due to the human element in manufacturing.

3.2. Objective Formulation

Primary Objective

• To reduce the process loss, improving the cut-to-ship ratio.

Sub-Objective

• To design a system to establish control on Shop-floor.
• To track the material movement and optimize the maintenance function.
• To Collect Insightful Real-time Data for Quality, Production, Recut, Maintenance, and WIP.

3.3. Feasibility Analysis

Technical Feasibility

The project needs scanning devices, a local LAN, and a computer system for its initial trial run. The company has all the required infrastructure and resources in the manufacturing unit to support the project and system development. The project is the need of the company to establish shop floor control to reduce material loss.

Economic Feasibility

The project will be very economical in terms of optimization and the solution it has for the shop floor. All manual data collection needs more human resources, and it is computed, and in the end, the data become very tedious to analyze and gather meaningful fact. Real-time monitoring, tracking, and planning will save time and manpower and establish control on the shop floor; the collected data will help identify critical problems, thus improving productivity and quality.

Operational Feasibility

The unit currently produces 12000-15000 denim per day, and the automatic back unit works in 2 shifts to level up the sewing floor production. The Current WIP of the automatic back unit is more than 65,000 pcs. This high volume of WIP is not easy to manage manually. Also, the data collection for the Production, Quality, and Machine Breakdown is recorded manually. The company needs to address this high volume of WIP inefficiently to create a discipline of first in-first out, production should be accurate, and machine breakdown should be reduced.

3.4. Conceptual Framework

Shop Floor Control

SFC is also a natural vehicle for collecting data for other planning and control modules. A well-designed SFC module both controls the flow of material through the plant and makes the rest of the production planning system easier to design and manage. If one narrowly interprets SFC as dispatching or flow control between machines, then studies like these tend to minimize its importance. However, suppose one takes the broader view that SFC controls flow and establishes links between other functions. In that case, the design of the SFC module serves to shape the entire production environment. For instance,

installing a Kanban system signals a commitment to small-lot manufacture and setup reduction. Moreover, a pull system automatically governs the release rate into the factory, thereby achieving the critical benefit.

Kanban System

The Kanban system is one of the tools under the lean manufacturing system that can achieve minimum inventory at any one time. The Kanban system provides many advantages in managing operations and business in the organization. Using the Kanban system is a strategic, operational decision to be used in the production lines. It helps to improve the company's productivity and, at the same time, minimize waste in production.

Data Visualization

Visualization is the use of computer-supported visual representation of data. Unlike static data visualization, interactive data visualization allows users to specify the format used in displaying data.

Digitization

Digitization is simply creating a computerized representation of a printed analog. There are many methods of digitizing and varied media to be digitized. However, the main focus rests primarily on texts and images, as these are the main objects in the digitization process; therefore, it refers to the conversion of materials that were created in another format. Technically, digitization involves converting an analog image into its corresponding numeric values.

3.5. Architectural Framework

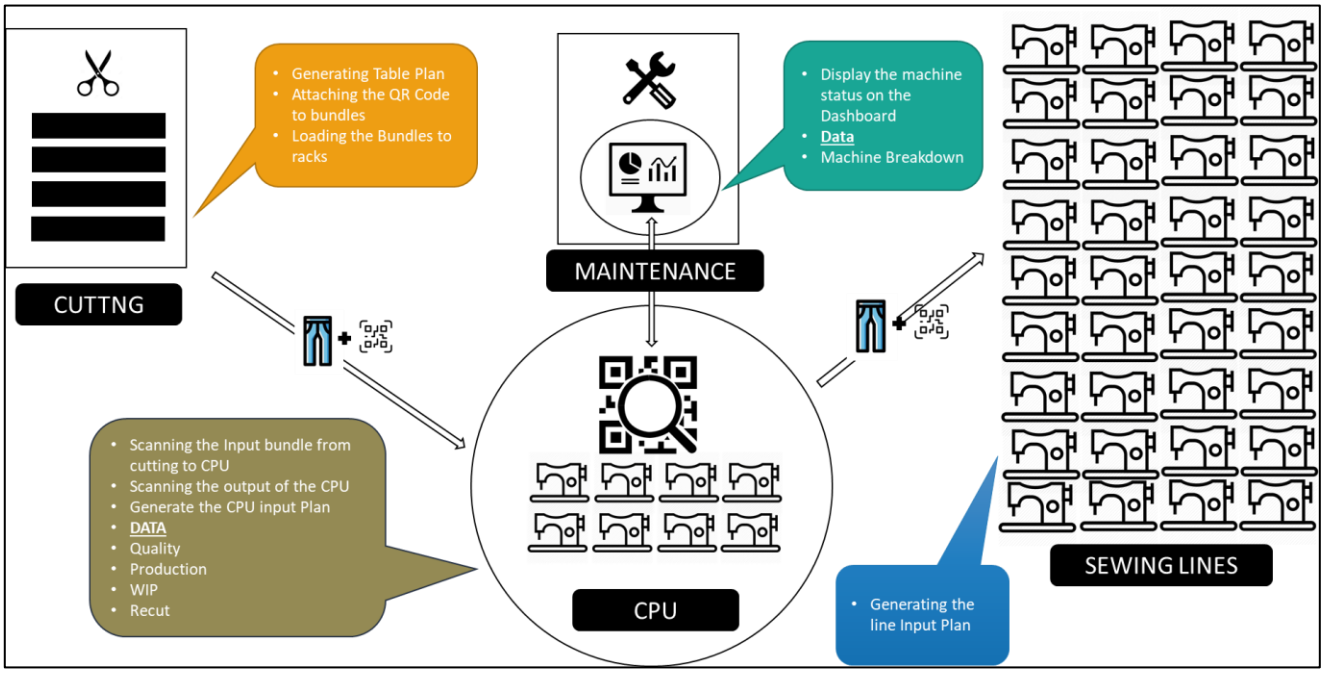
The project needs mobile devices to scan the QR Code on the local LAN. The data collected will be stored in the database in the form of tables on the local servers.

The dashboard will procure the data from local servers and show them in the form of visuals like graphs and pie charts. Current WIP, production, DHU, and other data can be seen on the display board. The project shall run with a mobile phone installed on all workstations of the automatic back pocket unit, data entry operator of the cutting section, and each quality checkpoint of the automatic back pocket unit. The data collected will be transported to the WAMP server through LAN. Utilization of the Assimilated data to generate a report and display the data on the dashboard is the project's outcome.

These are the architectural framework of the project:

- The marked racks
- The bundles tied with the QR code cards
- The Scanning devices on the required workstation
- The database: SQL
- The display panel in the Maintenance Room
- LAN
- Web-application

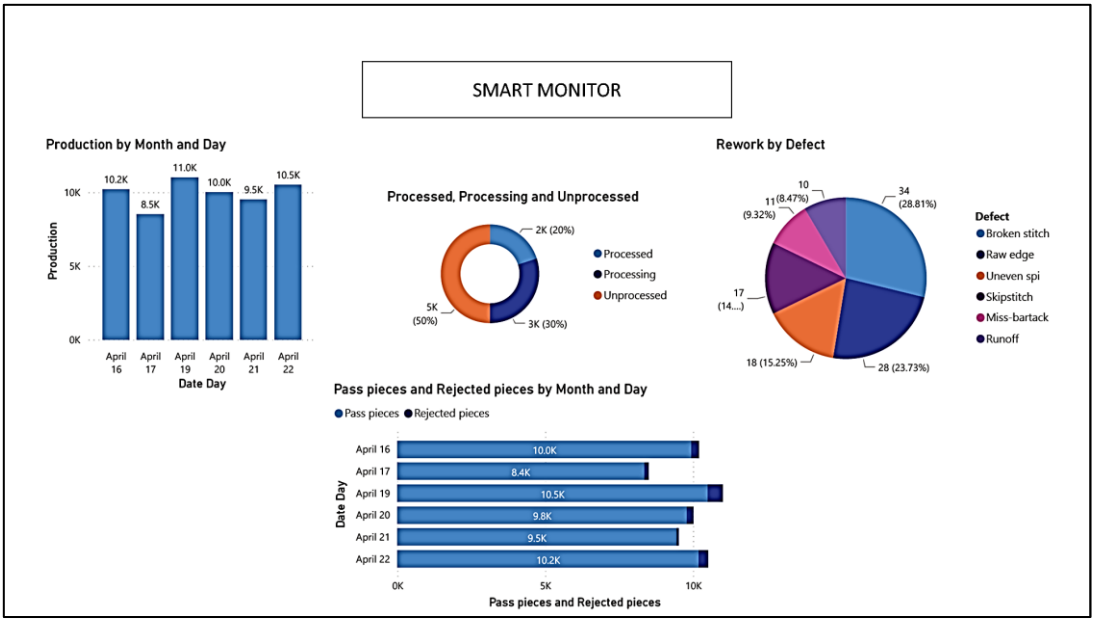
Figure 6: Mapping and Working of the Web-application



Roadmap for the Project

- **Phase 1**: Problem Identification and analysis – Project formulation – Project Approval – Module Selection and Front-end Logical Structuring
- **Phase 2**: Architectural framework building and Development of the Front End and Back end logical
- **Phase 3**: Pilot Run
- **Phase 4**: Sustain- Real-time data collection and Visualization
- **Phase 5**: Data generation and utilization – Deliverables- Expected Outcome

Figure 7: Smart Dashboard



4. Results And Discussion

Implementing the QR Code helps collect the required data for efficient working of the automatic back pocket unit and manage the operation. The Automatic Back Pocket Unit is now processed on the concept of first in – first out. Indeed, understanding the data and working with the new system was challenging, but it is a continuous development process.

The factory has become easy to manage as data collection becomes easy and KPIs are monitored in real-time. Analysis has been done for one week, and the data collected is promising.
The project has evolved the unit working from chaotic to easily manageable.

Different Data Sets being generated are as follows:

- Unfinished WIP
- Finished WIP
- Recut Report
- Quality Report
- Production Report
- Machine Breakdown Report

5. Conclusion

The discrepancy among the modules on the production floor and pre-existing lacunas such as data insufficiency, material loss due to huge uncontrolled WIP, Productivity Loss, and inaccuracy meant a need to bring the change. While the unit used initial methods to improve the shop floor, the effect reduced with time, and the factory struggled.

This Research project has a visionary impact and improvement plan. The goal is to overcome the above disparities and counter the existing issues. Conceptualization of Tools such as real-time production and performance monitoring through devices and QR codes on bundles to track the material movement was done. Human error in manufacturing concludes in considerable loss and problems sustained for a long time with a vague solution. This project delivers a unique solution to address every lacuna and fill every void while maintaining a structural and practical data collection that improves productivity. The data collected provides a solid base for analyzing various other problems and delivers an impactful solution.

A few concepts linked to the project described have been well initiated and are expected to throttle up soon. Real-time tracking of quality, rejection, and re-works shall help improve quality performance and wastage control for newer orders. The project is already a big success for the factory, as it has helped figure out the gap in performance and productivity, and Decision making has well improved. Improvement Drives for the desired outcome now have good real-time data backing.

Now, the unit is very effective in working with many WIP systems, streamlining the flow in a first-in-first-out manner. Real-time actionable data time shall be consolidated and utilized in every decision made by the factory management.

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