Optimizing Production Efficiency in the Fischertechnik 4.0 Learning Factory: A Simulation-Based Approached

1. Introduction

Maximizing profitability and operational efficiency is crucial for the success of manufacturing systems. This exam assignment focuses on the original purpose of optimizing the production rate within the Fischertechnik 4.0 Learning Factory, a simulated environment. The objective is to enhance productivity and efficiency through simulation-based optimization. A virtual replica of the factory has been developed using AnyLogic software [4], providing stakeholders with a comprehensive understanding of the system. The poster presents the methodology, simulation results, and a comparative analysis of the current system versus the optimized approach. By strategically improving production processes and resource allocation, the assignment aims to demonstrate the potential benefits of these enhancements in increasing profitability within the Fischertechnik 4.0 Learning Factory.

2. General Overview

The Fischertechnik 4.0 Learning Factory is an agent-based production system with a high-bay warehouse, conveyor belts, machining centers, a robot with grippers, and an optical quality control [1]. Operating from 8:00 am to 4:00 pm (8 hours), it aims to produce three differently colored products. Products are stored in the high-bay warehouse and transferred to various processing centers by a robot. Each color follows a specific order before transfer to quality control station as follows:

- Yellow: WS1 → WS2 → WS3 → WS4 → QS_Control
- Blue: WS4 → WS1 → QS_Control
- Red: WS3 → WS2 → QS_Control

The objective is to achieve equal quantities of yellow, red, and blue bricks within the 8-hour production window. And the focus is on optimizing the production process and profitability based on the joint KPI (Total Produced Product ÷ 8 hours) compared to the base simulation model of existing factory.

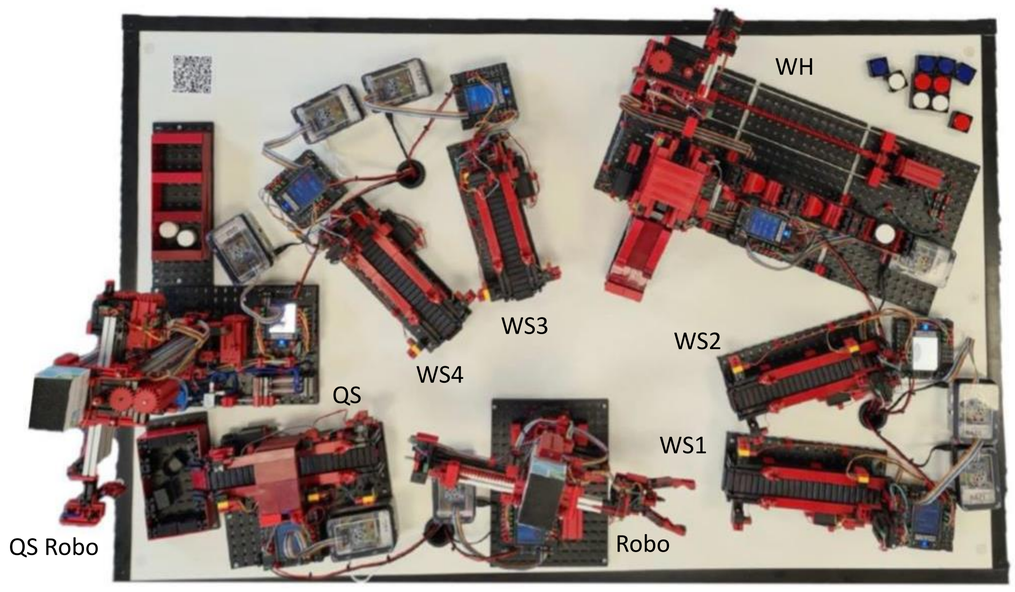

Figure 1: The Physical Fischertechnik 4.0 Learning Factory

3. Restrictions

In order to provide the 2D simulation model to reflect the physical behavior of the existing factory [3], there is still restriction impacting the model as follows:

- Consideration of pick-up time difference between the 2D model of the warehouse and the original high-bay warehouse.
- Due to AnyLogic block function limitations, average loading time of the crane robot is used instead of actual loading time at workstations.

4. Proposed improvement solution

Workstation rearrangement: By strategically rearranging the workstation positions, placing workstation one closest to the quality control station and workstation four furthest away reduces travel distance and improves efficiency. This assumed optimization aims to streamline the production process, resulting in improved overall performance within the factory.

Quality station rearrangement: Relocating the quality control station closer to the transport crane robot reduces the distance by half. This change is assumed to allow for faster unloading of workpieces, saving production time and increasing the production rate.

Reschedule production: By adjusting the production schedule, this assumed approach aims to ensure an equal quantity of output for each color (red, yellow, and blue) product, which is essential to the production´s requirements.

5. Implemented simulation model

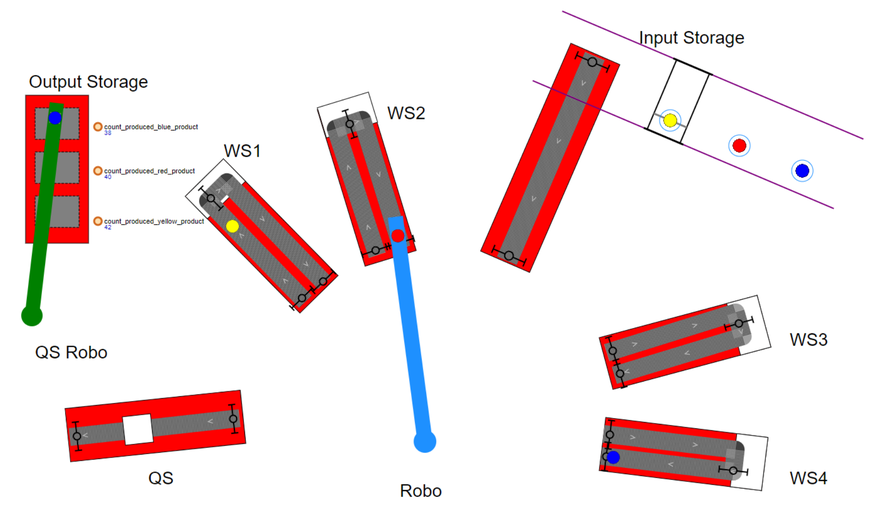

Figure 2: Proposed improvement 2D factory model

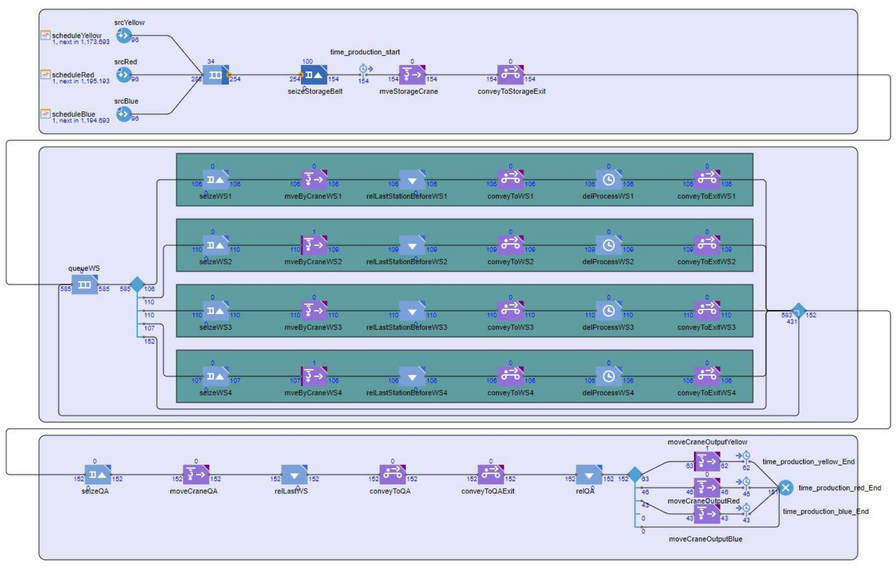

Figure 3: Logic

6. Result

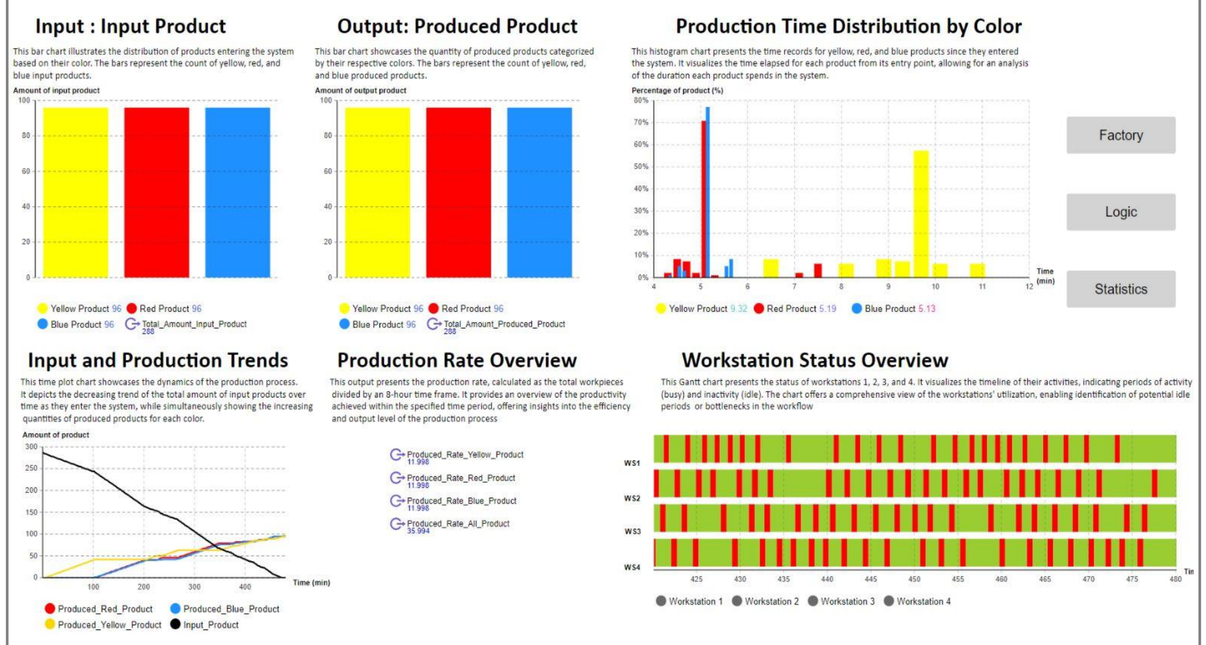

Figure 4: Statistics

7. Conclusion

- Strategic improvements in workstation arrangement, quality station relocation, and rescheduling have streamlined production processes, reduced travel distance, and enhanced flow, productivity, and profitability.
- Implementation of optimized layout and workflow improvements has led to a significant 12.5% increase in the production rate.
- Equal quantities of output for each color product have been achieved through rescheduling of the production process.

References

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[3] S. Kassen and H. Tammen, "Dimension of Fischertechnik - Model 4.0," Apr. 23, 2021. [Online]. Available: https://moodle.hs-emden-leer.de/moodle/pluginfile.php/399721/mod_resource/content/1/Dimension%20of%20Fischertechnik-Model%204.0.pdf. [Accessed: June 1, 2023].

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