Kanban (Pull System) Development in the Cigarette Manufacturing Production Area

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ABSTRACT

This research elaborates the process of the overall analysis of Indonesia's leading tobacco company's operations in supplying DIM (Direct Input Materials) from Factory Logistics to the Manufacturing – production floor. The analysis begins with detailing the operations workflow, identifying root causes using the Ishikawa diagram, proposing solutions, and enhancing workflow. The research concludes with an improvement strategy of shifting the material movement process from a push to a pull system and changing the responsibilities of the personnel involved. This initiative has reduced the operational cost by $33,000/year and can be further implemented in a similar workflow to improve productivity and efficiency.

Keywords: productivity, pull system, operational cost reduction, Kanban.

1. INTRODUCTION

For more than a decade, Angara Tobacco has been one of the leading tobacco companies in Indonesia. The scope of activities of Angara Tobacco comprises, among others, manufacturing, trading, and distributing cigarettes. Angara Tobacco has several facilities to produce the cigarette, which are: Quality Assurance (QA), Primary Processing (PP), Secondary Processing (SP), and Factory Logistics (FL). QA department is responsible for ensuring that all manufactured product meets the company's quality standard and this department is equipped with the testing machine for both processes, PP and SP.

PP is the plant to blend tobacco leaves with other ingredients. After the tobacco is blended, the tobacco blend is finely cut before passing through a drying cylinder to reduce moisture. When the moisture is optimal, the blend (called cut filler) is ready for the following cigarette manufacturing process, SP. SP is the plant of cigarette manufacturing that has a fast-paced, highly automated process. Angara Tobacco's machines can produce up to 20,000 cigarettes per minute. Individual cigarettes are sorted into pack-sized groups and wrapped in foil. The finished pack is then wrapped with a protective film and are placed into a master case for shipment. The last facility is FL, which manages the tobacco, clove, cut filler, DIM (Direct Input Materials), printed packaging, ingredients, spare parts, and tax stamp.

This research covers the supply chain analysis of DIM from FL (DIM Warehouse) to Manufacturing – SP (production floor) and the initiatives to improve productivity and efficiency.

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2. BACKGROUND

Angara Tobacco's SP runs 24 hours a day, seven days a week, which then the workers are divided into four groups, working in shift with rotating working days. Currently, under Business Unit Manager, there are 36 employees, who are 4 Material Supervisors (1 person/group), 24 Forklift Drivers (6 persons/group), 4 Production Administrators (1 person/group), and 4 Supporting Administrators (1 person/group).

Out of 6 Forklift Drivers (FD), there is one computer-literate FD. The computer-literate FD is assigned to calculate DIM requirements for one shift ahead of the production. Then FL team prepares and sends the requested DIM to the production floor. All FDs then check the incoming DIM from the warehouse (quantity & quality). All FDs get around on the production floor to check any material shortage/required in the machine. If they find any supply shortage in a specific machine, the FDs will top up the material to the machine. This process is very manual and not efficient as the FDs have neither consumption records nor material replenishment calculator. By the end of production, FDs are responsible for checking the consumption of DIM used in every machine. Any discrepancy will be reported to the Material Supervisor to be reconciled (physical inventory should match the system). The unused materials will be returned to the DIM warehouse.

3. BUSINESS ISSUES

3.1 Material Shortage and Transportation Waste

Materials calculations are still based on the computer-literate FD's personal judgment. Different knowledge and experience levels within FDs might affect their decision. When the FD requests more than the volume target, the production floor area is fully occupied with a massive quantity of materials, leading to high returned materials volume to the warehouse. When the FD requests less than the volume target, additional urgent requests must be placed to the warehouse. Thus, the material movement sometimes delays and affects overall production time.

3.2 Low Machine Uptime

Another challenge is the low utilization of the machine when there is a brand change procedure. The factory uses the Just in Time (JIT) principle to move new materials to the machinery. Most of the time, FDs are overwhelmed when more than one brand change happens in one period of time, resulting in slow product changeover times, so the machine needs to wait for FDs to prepare the material.

3.3 High Labor Allocation

Seven direct employees support the material movement process only from FL (DIM Warehouse) to SP (production floor): five FDs, one computer-literate Forklift Driver, and 1 Supporting Administrators with six forklift units. High labor allocation is needed due to unstandardized material movement that requires constant monitoring and estimation of stock levels based on subjective judgement from the FDs.

This research objective is to examine the root cause of the inefficient material supply process and reduces the inefficiency in the material supply process.

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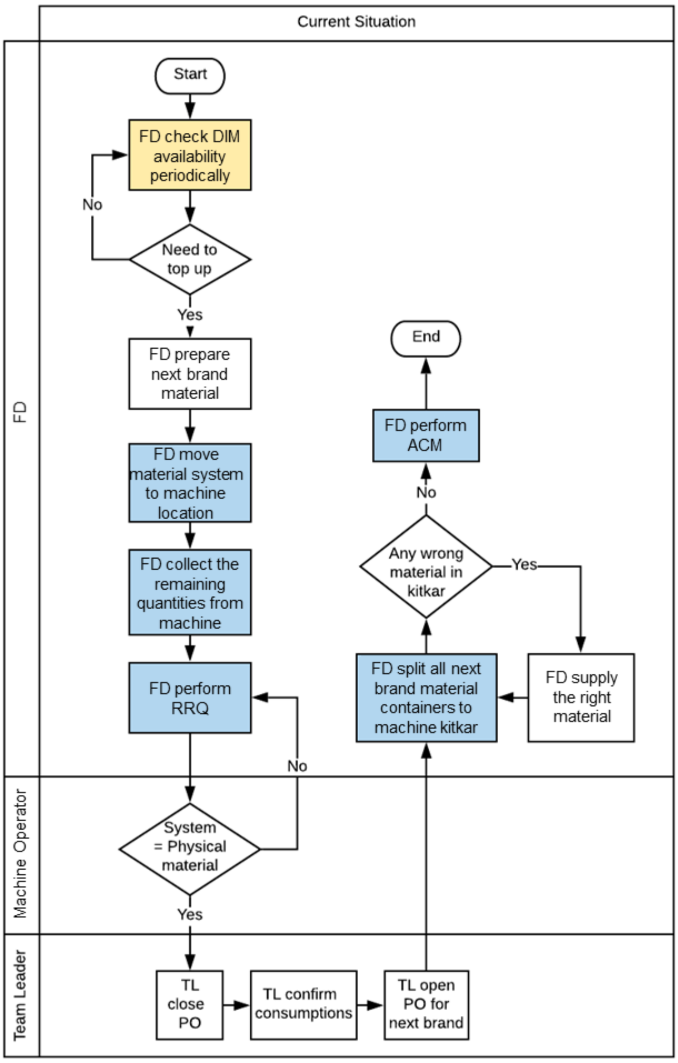

Figure 1. Production Flow Chart on Current Situation

Legend:

FD = Forklift Drivers
TL = Production Team Leader
RRQ = Reported Remaining Quantity
PO = Process Order
Kitkar = Virtual Container Location in the Manufacturing Execution System (MES)
ACM = Assign Container to Machine

4. ROOT CAUSE ANALYSIS

Ishikawa Diagram is a tool that helps to identify, sort, and display possible causes of a specific problem. It graphically illustrates the relationship between a given outcome and all the factors influencing the outcome (Aras and Özcan, 2016). The problems are divided into four different categories, as shown in the figures below.

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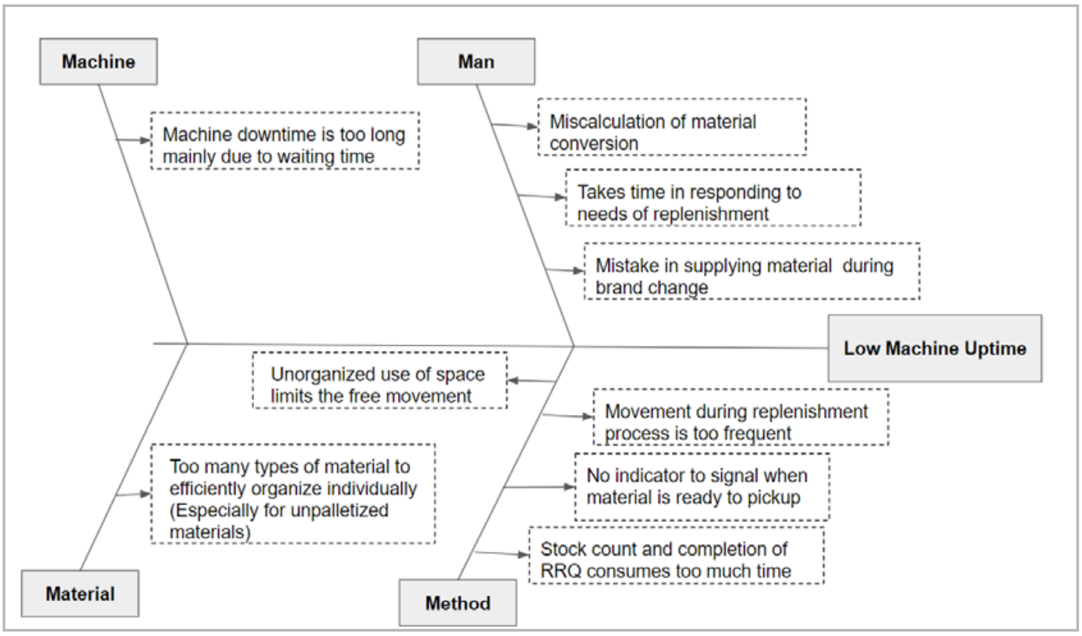

Figure 2. Ishikawa Diagram for Low Machine Uptime

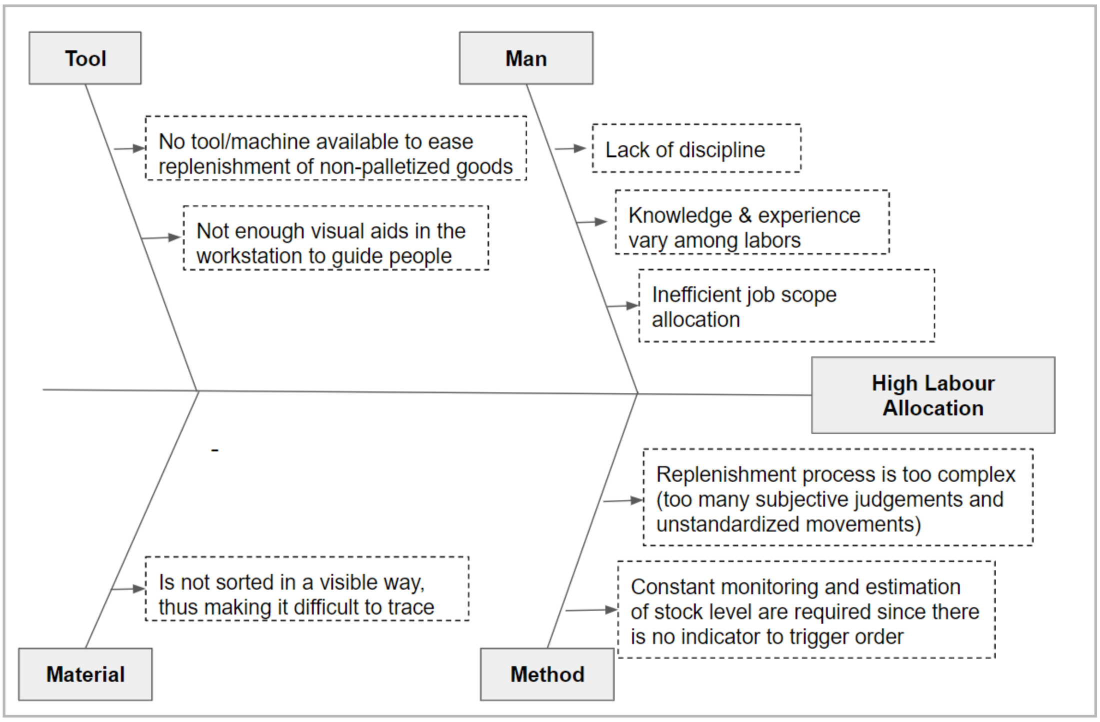

Figure 3. Ishikawa Diagram for High Labor Allocation

Based on the Ishikawa diagrams, it is concluded that the primary root cause is attributed to the changeover and replenishment process of the DIM during the operation. Thus, improvement in the replenishment and changeover process is required to achieve higher productivity.

5. LEAN IMPLEMENTATION

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Kanban is a human-based system in which people are active in continuous development, and the system's foundation is leadership and empowerment via education and training (Mouaky et al., 2019). The Kanban system will eliminate waste, reduce inventory, shorten lead times, and reduce capital losses (Ali et al., 2012). After examining the overall process condition, the researchers found some opportunities to reduce the cost of operation using Kanban pull system by focusing the improvement initiatives primarily on the two elements circled in Figure 4.

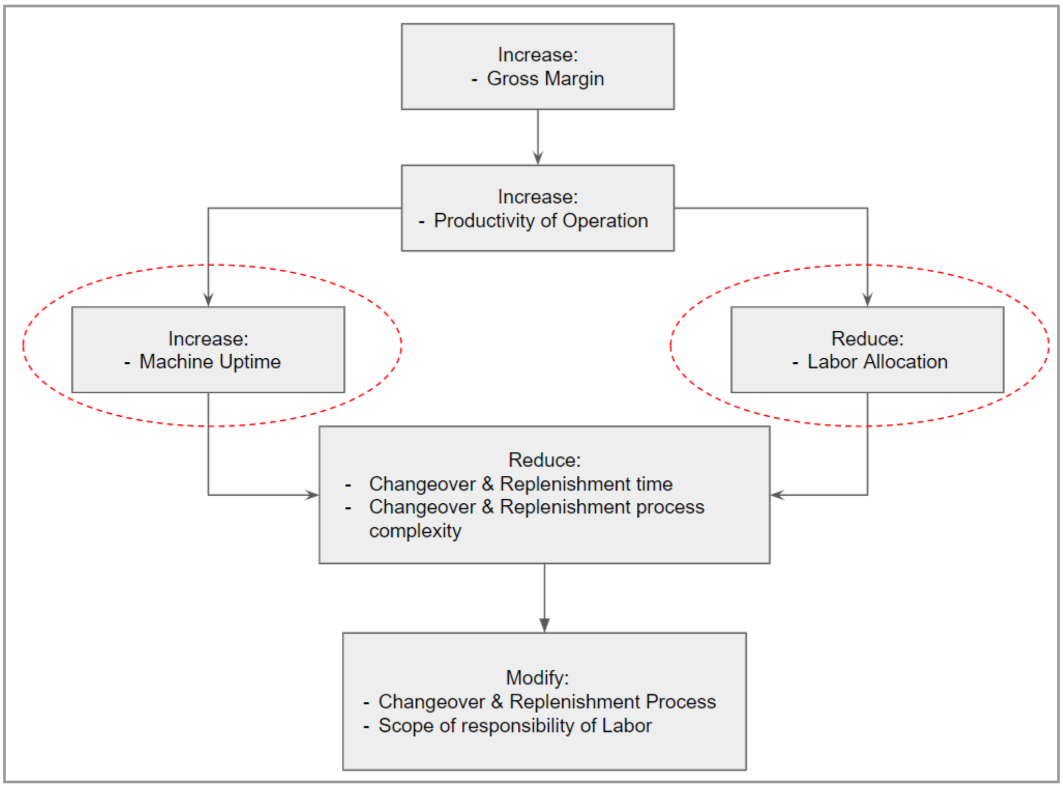

Figure 4. Operational Strategy Mapping

The analysis begins with reviewing the operational data that are linked to the productivity of the operations. Data shows that the current rate of SP machinery's uptime, in this case also known as Link-Up (one maker machine and one packer machine), is on average only around 48% of the total available capacity. Moreover, the whole operation is supported by six forklift headcounts and six forklift units dedicated exclusively to transport materials from the DIM warehouse to the Link-Ups.

Within the planning of the Kanban system, management should develop strategies to decrease loss in the production process for each department by appointing accountable individuals and stimulate enthusiasm in reducing loss (Yuphin et al., 2020). To increase productivity, businesses should also focus on production layout (Imaroh et al., 2018). To respond to these inefficiencies, two improvement initiatives were proposed:

1. Transform the replenishment and changeover process from push to pull system
2. Design a mean of transportation of materials which allows for the reduction of the use of forklift and delegate the job to the production operator

Below is the simplified version of how the improvement initiatives are illustrated.

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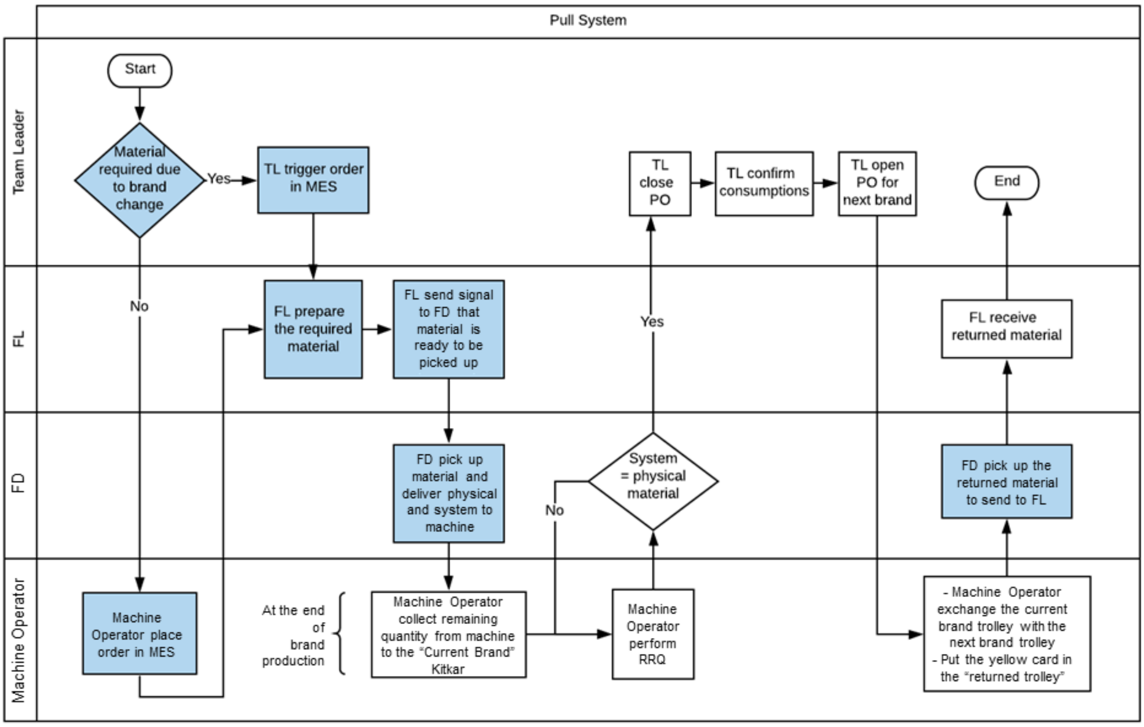

Figure 5. Proposed Pull System

The proposed pull system is highlighted in blue color above and described in Table 1:

Push System	Proposed Pull System
Computer-literate FD requests materials to the DIM warehouse one shift prior to the machine running.	The responsibility is shifted to Machine Operator/Production Team Leader to request the materials needed to DIM Warehouse via MES 4 hours before usage.
FL prepared all the requested material in bulk as ordered by FDs; FDs are the ones who top up the materials to the machine.	FL prepared the requested material exactly as requested by each machine.
FL handovers the requested material at every end of shift to FDs in bulk, then move the materials into the production floor (production floor is crowded with the next shift materials).	FL sends signals to FDs that the requested material dedicated for each machine is ready. FDs pick up the material and send it directly to machine, less crowded production floor.
The handover of returned materials is performed at every end of the shift in bulk (human error may occur as the quantity is in bulk, and the system may not the same with physical returned materials).	FDs pick up and return material right after the material is returned from the machine. Directly return to FL for every returned material (more accurate and real-time inventory movement).

Table 1. Difference between Push and Proposed Pull System

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6. RESULTS AND ANALYSIS

Impacts of the improvement initiatives are detailed in the tables below:

Oase	Link Up	Uptime	
		Before	Expected
Oase-1	LU-21	72%	74%
	LU-22	72%	74%
	LU-23	70%	72%
	LU-11	72%	74%
	LU12	73%	74%

Oase	Link Up	Uptime	
		Before	Expected
Oase-2	LU-29	53%	55%
	LU-16	55%	57%
	LU-17	53%	55%

Oase	Link Up	Uptime	
		Before	Expected
Oase-3	LU-24	32%	35%
	LU-25	47%	49%
	LU-26	20%	22%
	LU-28	35%	37%
	LU-13	40%	42%
	LU-14	40%	42%
	LU-15	40%	42%

Table 2. Impact on Machine Uptime

Root cause no 1: low machine uptime is increased by 2.4%. The average of each machine working hours is 615 working hours per month (including 15 hours of waiting for brand changes. By implementing a pull system, waiting for brand changes is eliminated, reducing the machine working hours and increasing uptime by 2.4%.

Root cause no 2: high labor allocation is reduced to 5 per group because the responsibility to request materials is shifted from FDs to Production Operators and FL to perform the material preparation to reduce transportation and movement in FDs. The QA check of materials handover is performed by both parties (FDs and FL) on a real-time basis. Thus, the FDs headcount can be reduced and the cost-saving by Forklift Drivers reduction would be USD 20,000/year.

Forklift Headcounts (HC)	
Before	Expected
6 per group or 24 in total Cost = 24 HC x USD 5,000/year = USD 120,000/year	5 per group or 20 in total Cost = 20 HC x USD 5,000/year = USD 100,000/year Cost-saving = USD 20,000/year

Table 3. Expected Cost-Saving on Forklift Headcounts

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When FDs headcount is deducted, the forklift unit is deducted by one unit as well, and the cost-saving would be USD 13,000/year.

Forklift Rent Headcounts (HC)	
Before	Expected
6 units Cost = 6 units x USD 13,000/year = USD 78,000/year	5 units Cost = 5 units x USD 13,000/year = USD 65,000/year Cost-saving = USD 13,000/year

Table 4. Expected Cost-Saving on Forklift Rent

7. CONCLUSION

Many uncertainties may arise from employing a push system that lead to inefficiencies in operation, as shown in this case analysis. The initiative of implementing an improvement strategy of shifting the material movement process from a push to a pull system and changing the responsibilities of the personnel involved has reduced the operational cost by $33,000/year and can be further implemented in a similar workflow to reduce inefficiencies in the process and eliminate the non-value-added activities (e.g. waiting for materials).

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