STREAMLINING HDD PRODUCTION: INTEGRATION LINE DRIVES CAPACITY AND LEADTIME IMPROVEMENT

Ms. Desiree U. Icaro
Ms. Ferilyn Estrella
Ms. Marie Leizle Garcia

Process Engineering Department
Continuous Improvement Kaizen Team
FIRST SUMIDEN CIRCUITS, INC,
Ampere St. cor. Main Ave. Light Industry and Science Park 1, Bo. Diezmo, Cabuyao,Laguna
duicaro@fsci.sei.co.jp
fbestrella@fsci.sei.co.jp
megarcia@fsci.sei.co.jp

ABSTRACT

Low line capacity and long production lead time caused by batch production has been one of the major problem in HDD area. This study details how the integration of three processes ICT, Special Inspection (SI) and Final Visual Inspection (FVI) serves as a resolution in addressing the aforementioned problems using Plan-Do-Check-Act (PDCA) approach.

The project aimed to increase production capacity and lessen production lead time through implementation of integration line by introducing nylon blue inspection pallet, relay out of ICT, SI and FVI, process improvement and MUDA elimination.

Integration line and one piece flow process implementation significantly reduced lead times, improved quality, increased flexibility and lower inventory cost. Producing and moving one item at a time through series of processes can minimizes waste, optimizes space and enables quicker detection and correction of defects. This is expounded into a detailed explanation in the following section of this paper.

1.0 INTRODUCTION

During capacity analysis of product X, it was determined that ICT, SI and FVI are the bottleneck processes which only have 19K (gearing in SI process) maximum capacity per day. Upon investigation, the current processing of wip is through batch production which leads to long lead time, unbalanced manpower and slow production.

Process	Leadtime
ICT (secs)	7200
SI (secs)	10800
FVI (secs)	16380
Total leadtime (hrs)	9.55

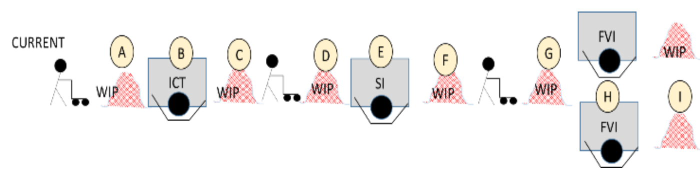

Fig 1. Current process flow of Product X

Based on Fig. 1, wip has been stocked in every process waiting for the batch to complete prior sending to next process. This results to lower production efficiency, higher inventory cost, potential for overproduction or under production, quality variability and increased risk of wastage.

To avoid the aforementioned risk due to batch production, one piece flow line must be implemented through integration of ICT, SI and FVI. In this way, we reduced manufacturing cycle time, improved quality and lead time and minimized waste.

2. 0 REVIEW OF RELATED WORK

NA

3.0 METHODOLOGY

The first step is to study the current condition of line through capacity analysis.

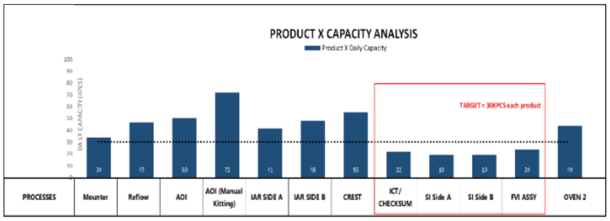

Fig 2. Capacity Analysis ICT to FVI of Product X

Based on data presented, Product X will have negative capacity on ICT, SI and FVI using the existing parameters. This can be solved by adding additional ICT jig, manpower and station but it will incurred production cost.

As the researcher need to identify, what is the optimized assembly line looked like by distributing tasks to minimize idle time and maximize efficiency, line balancing for the three processes was conducted.

Parameters	
Yield (%)	98%
Utilization (%)	85%
Working hrs	22
Working days	26
Batch QTY	3600

ITEM	ICT	SI	FVI
Cycle Time (sec/pc)	5.9	8.9	27.3
PPH	613	406	132
Capacity/hr (pcs)	511	338	110
Machine allocation	3	14	22
Leadtime (mins)	**117**	**38**	**74**
Capacity/day (kpcs)	33.7	104.2	53.2
Capacity/month (kpcs)	876.2	2708.3	1383.7

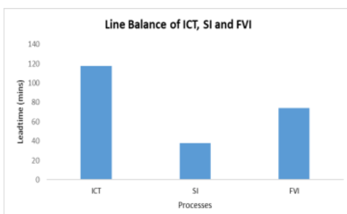

Fig 3. Line balancing of ICT, SI and FVI

Based on figure no. 3, line balance percentage of the three processes is at 65% which means that the production lines flexibility is not enough to absorb external and internal irregularities.

Through Gemba walk, the researcher found out that layout is one of the reasons of batch production in Product X line.

In farm type or functional layout, all machines and equipment are grouped by function rather than by the sequence of operations in a product assembly. The advantage of this layout is even one machine in a group breaks down, other machine in that group can still be used. On the other hand, this type of layout has its cons like inefficient material movement and long production lead time due to more time moving between functional areas that lead to increase of overall production time.

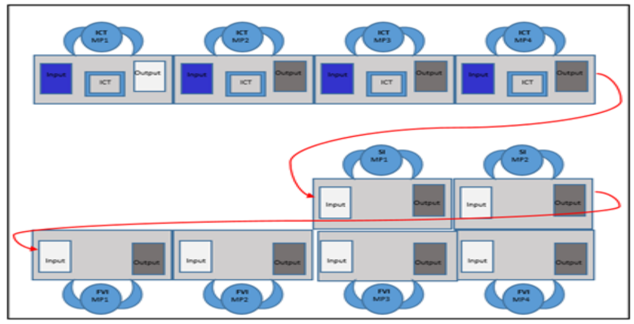

Fig 4. Existing farm type layout

As investigation leads that current layout is a constraint to implement one flow line between the aforementioned processes, re layout of Product X area was conducted.

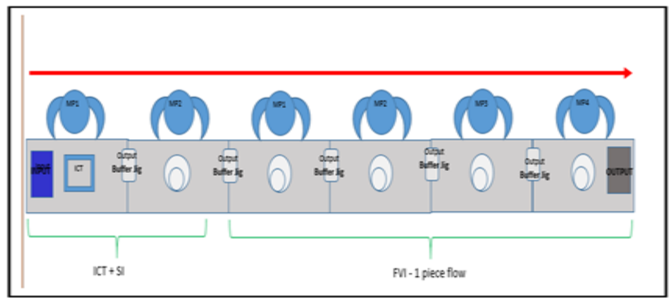

Fig 5. One piece flow layout

Stations are re arrange based from one piece flow or flow line process to eliminate wip stocking and improved lead time. Each station was arrange according to process flow and number of station based from the machine requirements used in improved line balancing. In this way, difficulty in transferring of unit from one station to another is being eliminated.

Aside from layout, how to integrate the three processes was the next step. The current flow of ICT, SI and FVI are designed to be per unit processing, therefore, transferring of unit from one process to another will be difficult.

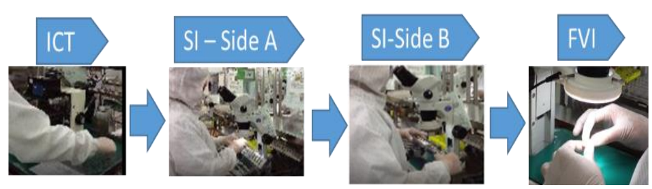

Fig 6. Process Flow of ICT, SI and FVI

ICT operators load unit to ICT machine then unload to processing tray. The process is continuous until one sublot was finished. From then, it will be transfer to wip rack for SI. From rack, SI operator will get the whole sublot for processing of Side A and Side B and transferred to processing tray. The processed units will be transferred again to wip rack for FVI process.

This frequent transferring and storing of units is a significant inefficiency in the production operation. It leads to increased cycle time and lead time, ultimately reducing overall production efficiency. Additionally, the repeated manual handling of units introduces a potential risk for quality issues if not properly controlled.

To address these issues, the researcher proposes the use of an inspection jig. This jig would allow multiple units to be transferred between stations without directly handling the individual units. By minimizing manual handling and streamlining the transfer process, this solution is expected to reduce cycle time and improve production output.

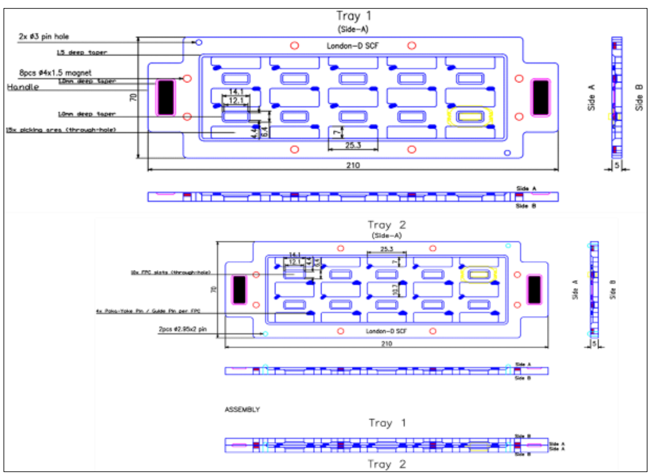

Fig 7. Inspection Jig Design

The proposed inspection jig design can hold 10 units at the same time. With 2 sides (Side A and B) for easily flipping of units during inspection. It also have 12 magnets on the sides to eliminate the risk of dislodging during transferring. Two

sides of inspection jig have holder to address operator's difficulty in handling while the inside design of jig has a finger slot for easily unloading of units at the end process.

Since Product X is in cleanroom area and is required for non silicon material, it was also considered during the design phase of the inspection jig.

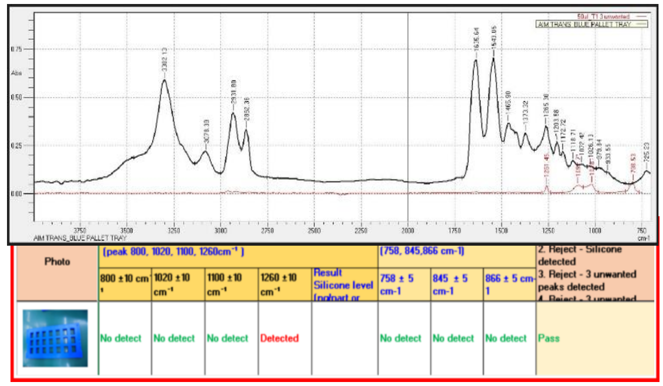

Fig 8. FTIR Result of Nylon Blue Material

Based on FTIR result of nylon blue material (proposed material to be used), it was passed in the silicon test.

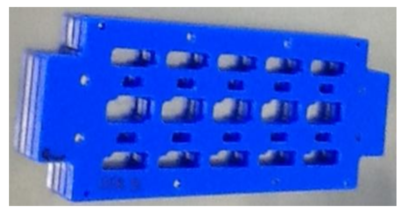

Fig 9. Actual inspection jig

This inspection jig will serve as the means of transferring of units from one station to another. In this way, flow line implementation will be feasible.

ICT will test the unit then transfer to inspection jig pallet until 10 units was finished. The inspection jig will be transferred to SI for inspection of Side A and Side B. After SI, the pallet will be transferred to FVI for final visual inspection. After FVI, it will be unload by the operator to oven tray for the next process.

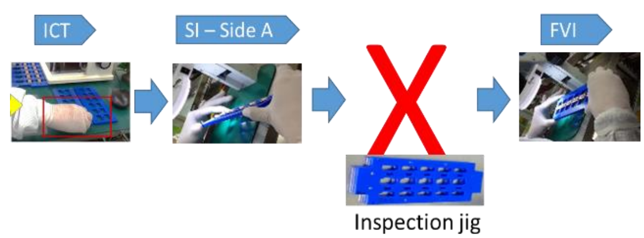

Fig 10. New process flow

Next difficulty in line was the transferring of inspection jig from SI going to different FVI stations. As stations design in one piece flow layout (See figure 5), the movement of

inspection jig to properly distribute it from FVI1 to FVI3 became a constraint.

Since the difficulty was determined, the proposal of having a gravity conveyor that will connect SI going to different stations of FVI was implemented.

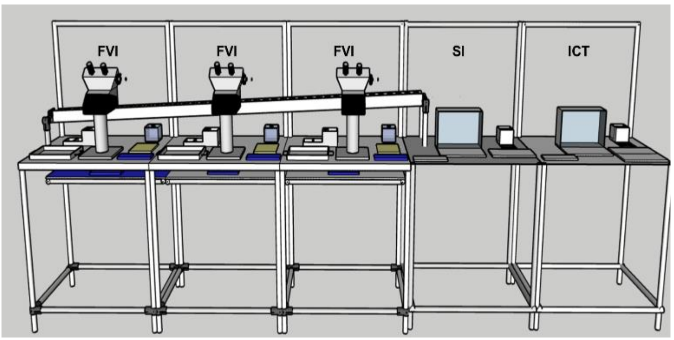

Fig 12. New set up including gravity conveyor

Gravity conveyor was installed from SI and ends at the last station of FVI. To ensure the stoppage of inspection jig in every station, stopper was included in conveyor design.

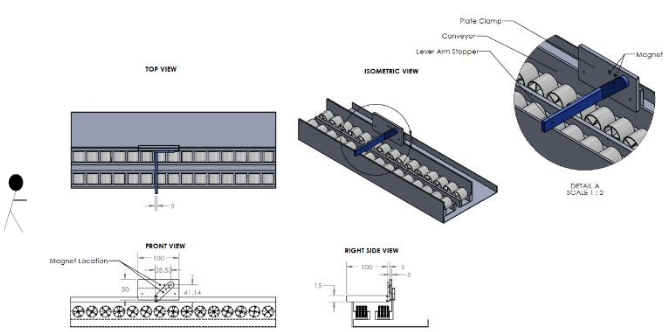

Fig 13. Gravity conveyor stopper design

The stopper was designed to make sure that the distribution of inspection jig with unit was properly distributed to FVI stations.

4.0 RESULTS AND DISCUSSION

The integration of ICT, SI, and FVI through the use of an inspection jig significantly enhanced the cycle time, line balance, and lead time for Product X. Additionally, we were able to optimize and reduce the existing manpower, leading to improved production efficiency.

Based on line balance result of product X it was improved

ITEM	ICT	SI	FVI
Cycle Time (sec/pc)	6.0	6.0	18.9
PPH	600	600	190
Capacity/hr (pcs)	500	500	158
Machine allocation	3	3	9
Leadtime (mins)	**120**	**120**	**126**
Capacity/day (kpcs)	33.0	33.0	31.3
Capacity/month (kpcs)	857.7	857.7	814.8
Line Balance Ratio	**97%**		

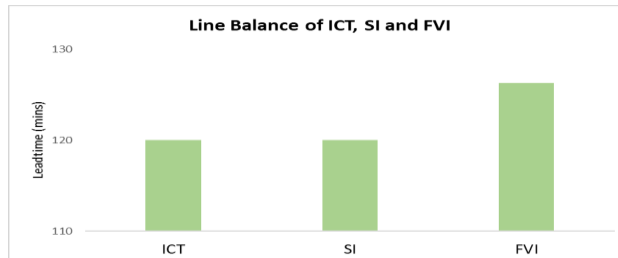

Fig 14: Improved line balance of Product X

from 65% to 97% due to manpower optimization and cycle time improvement.

Process	Leadtime
ICT (secs)	7200
SI (secs)	80
FVI (secs)	757.9
Total leadtime (hrs)	2.2

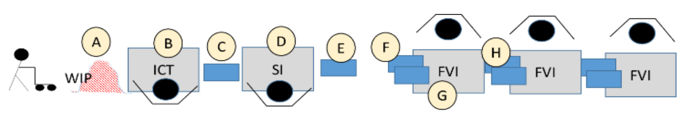

Fig 15: Improved lead time

Based on the new process flow, lead time drastically decreased from 9hrs to 2.2hrs.

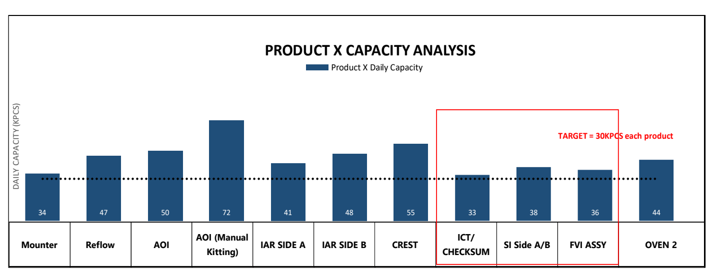

Fig 16: Improved capacity

The overall results show that the improvement increased the Product X capacity by 73%.

5.0 CONCLUSION

Capacity and lead time improvement is achieved by identifying and eliminating waste, streamlining workflows and optimizing each step of the process to make it more efficient and faster. Essentially, less time is spent in waiting or dealing with inefficiencies, leading to quicker delivery of products.
Integrating the three processes to lessen production lead time and improved capacity is successfully implemented. With a continuous flow, we streamlined processes and reduced bottlenecks leading to higher overall efficiency and throughput.

6.0 RECOMMENDATIONS

For future research, examining the current state through capacity analysis and line balancing can help identify the precise root cause and enable the implementation of effective countermeasures. Adopting strategies such as optimizing inventory management and improving production flow is essential to enhance production capacity and reduce lead time. This approach focuses on minimizing waste, increasing efficiency, and maintaining a seamless workflow throughout the production process.

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9.0 ABOUT THE AUTHORS

Desiree U. Icaro, BS Industrial Engineering graduate from University of Batangas. Currently works at First Sumiden Circuit Inc. as Kaizen Lead Engineer

Ferilyn B. Estrella, BS Industrial Engineering graduate from Pamantasan ng Cabuyao. Currently works at First Sumiden Circuit Inc. as Capacity Engineer

Marie Leizle Garcia, BS Industrial Engineering graduate from Polytechnic University of the Philippines. Currently works at First Sumiden Circuits Inc. as Continuous Improvement Head

10.0 APPENDIX

N/A