Idle Time & Scrap Reduction on a laser production cell

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Abstract

This project focuses on the application of the Define-Measure-Analyze-Improve-Control (DMAIC) methodology to improve the efficiency of a laser production cell within a medical device company. The company currently faces challenges related to scrap generation and downtime in the manufacturing process, which can impact the quality and timely delivery of critical medical devices. By using DMAIC, a process flow improvement of up to 86% and a scrap reduction of 100% was achieved in this project.

Key Terms- *5S, DMAIC method, Downtime, Scrap.*

Problem

A worldwide corporation engaged in the creation, production, and sale of a broad range of medical products and treatments is known as Blue Company. Diabetes, Cardiac, Vascular, Neurological, and Spinal are just a few of the medical specialties that Blue Company produces goods and solutions for. This company has a substantial global footprint and has been instrumental in advancing medical technologies and enhancing patient outcomes. For modern industry to remain competitive and run sustainably, maximizing production efficiency, and reducing waste are essential. High demand production laser cells are used by Blue Company. Two severe issues are currently plaguing one of the production cells: idle time and scrap waste.

Methodology

Lean manufacturing concepts can help manufacturing processes operate more efficiently and more cheaply by drastically reducing waste and idle time. The focus of lean approaches is on waste reduction, streamlining processes, and ongoing improvement. Companies can reduce the amount of downtime brought on by inefficient operations by studying and improving each stage of the manufacturing process, locating, and removing bottlenecks, and standardizing procedures. Businesses that adopt lean principles can increase productivity, decrease downtime, and drastically reduce scrap, all of which contribute to more sustainable and profitable operations. DMAIC is a structured problem-solving approach that is employed in Six Sigma and other quality improvement initiatives. DMAIC provides a methodical approach to identify, assess, and improve the underlying causes when applied to decrease downtime and scrap in a production process.

The stages followed during this project were the following:

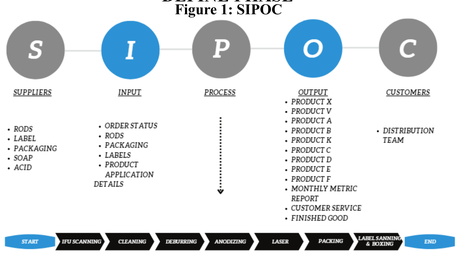
Stage	Purpose
Define	Define the process and establish goal
Measure	Measure to determine process needs
Analyze	Analyze the data to find the results
Improve	Implementing selected solutions to address root causes
Control	Monitoring performance metrics and ensuring sustained improvements

Table 1: DMAIC Methodology

Results and Discussion

DEFINE PHASE

Figure 1: SIPOC



MEASURE PHASE

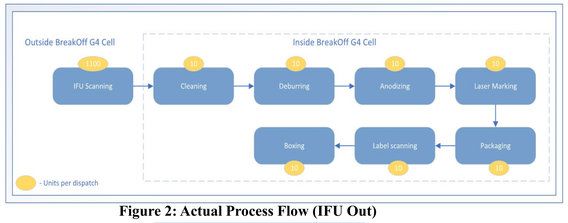


Figure 2: Actual Process Flow (IFU Out)

Month	Qty
Nov	358
Dec	204
Jan	296
Feb	127
Mar	317
Apr	313
May	685
Jun	736
Jul	325
Aug	293
Sep	370
Oct	196
Total of Scrap	4,220

Table 2: Scrap by Month of year 2023

Cost of Scrap
Cost of Scrap: $0.17
Total Scrap Units: 4,220
Total Cost of Scrap: $717.40

Table 3: Cost of Scrap

Downtimes (every 1,100 units)	IFU scanning Downtime (s)	Downtime per Shift (s)	Units lost to downtime (s)
2.6	3582	9389	1074.3

Table 4: IFU Downtime

Product	Target per week	Target per shift	Target per Day
Product X	18000	1200	3600
Product V	10500	700	2100
Product A	10000	1000	3000
Product B	25000	2000	6000
Product K	5000	500	1500
Product C	25000	1667	5001
Product D	8250	600	1800
Product E	2000	500	1500
Product F	103750	8167	24501

Table 5: Production By Product

Checklist item	Criteria	Exist?	Rating	Comments
Sort - SEIRI				
Cabinets and shelves	No irrelevant reference materials, documents, drawings, etc.	Y	2	
Desks and tables	No irrelevant reference materials, documents, etc.	Y	2	
Drawers	No excess pieces of equipment, documents, etc.	Y	2	
Other storage area	Storage area is defined to store unneeded items and out-dated documents	Y	1	
Standards for disposal	Standards for eliminating unnecessary items exist and are being followed	Y	3	
Set in order - SEITON				
Tools and equipment	Locations of tools and equipment are clear and well organized	Y	3	
Materials and products	Locations of materials and products are clear and well organized	Y	2	
Labeling	Labels exist to indicate locations, containers, boxes, shelves & stored items	Y	3	
Inventory control	Evidence of inventory control exists (i.e. Kanban cards, FIFO, min & max)	Y	3	
Outlining / dividing lines	Dividing lines are clearly identified and clean as per standard	Y	1	
Safety	Safety equipment and supplies are clear and in good condition	Y	2	
Shine - SEISO				
Building structure	Floors, walls, ceilings & pipework are in good condition & free from dirt/dust	Y	4	
Racks and cabinets	Racks, cabinets and shelves are kept clean	Y	3	
Machines and tools	Machines, equipment and tools are kept clean	Y	4	
Stored items	Stored items, materials and products are kept clean	Y	3	
Lighting	Lighting is enough and all lighting is free from dust	Y	3	
Ventilation	Good movement of air exists through the room (limits the spread of viruses)	Y	4	
Pest control	Pest control exists and effective	Y	4	
Cleaning tools	Cleaning tools and materials are easily accessible	Y	3	
Cleaning responsibilities	Cleaning assignments are defined and are being followed	Y	2	
Standardize - SEIKETSU				
Visual controls	Information displays, signs, color coding & other markings are established	Y	2	
Procedures	Procedures for maintaining the first three S's are being displayed	Y	2	
5S documentation	5S checklists, schedules and routines are defined and being used	Y	2	
Responsibilities	Everyone knows his responsibilities, when and how	Y	2	
Regular Audits	Regular audits are carried out using checklists and measures	Y	1	
Sustain - SHITSUKE				
5S System	5S seems to be the way of life rather than just a routine	Y	2	
Success stories	Success stories are being displayed (i.e. before and after pictures)	Y	1	
Rewards and recognition	Rewards and recognition is part of the 5S system	Y	0	
Comments				
Make Monthly 5S Audits				
Remake Visual Controls				
Make a recognition Board				
Display de 5S Documentation				
		27	2.4	
		Score:	96.4%	94.9%

Table 6: Actual 5S

ANALYZE PHASE

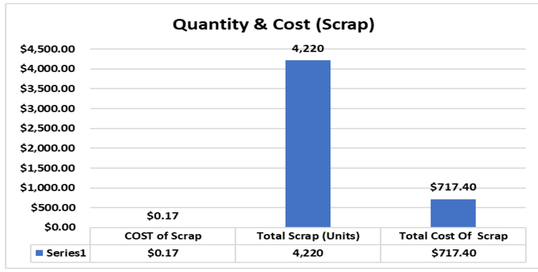


Figure 4: Cost of Scrap

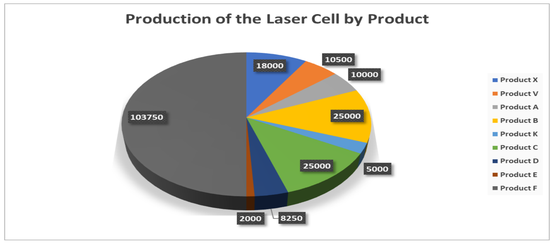


Figure 5: Production by Product

Scenario	Cycle time (s)	Shift (s)	Units per Shift	Downtimes (every 1,100 units)	IFU scanning Downtime (s)
IFU in	12	25200	2100	none	3582

Table 7: IFU In Downtime

Total units per shift	$$$ per shift	$$lost per shift	Day $$	$$Yearly	Total units per shift
2100.0	11361	0	34083	$8,861,580.00	2100.0

Table 8: Units Lost IFU In

IMPROVE PHASE

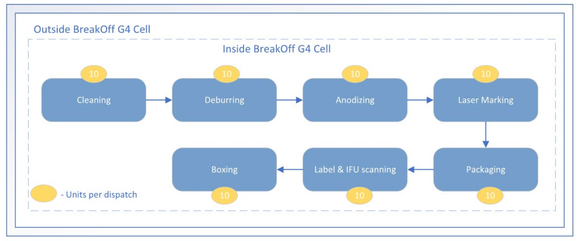


Figure 3: Process Flow (IFU In)

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Success stories	Success stories are being displayed (i.e. before and after pictures)	Y	3	
Rewards and recognition	Rewards and recognition is part of the 5S system	Y	4	
Comments				
Make Monthly 5S Audits				
Remake Visual Controls				
Make a recognition Board				
Display de 5S Documentation & Update Lines of the workstation				
		27	3.4	
		Score:	96.4%	83.9%

Table 10 : Future 5S

How much more?	$1,227,825.46
% of improvement	86%

Table 9: Improvement

CONTROL PHASE

Scrap	5S	Downtime
The organization will integrate scrap reduction strategies into the plan, addressing root causes through quality controls, training, and equipment maintenance, while establishing continuous monitoring and improvement mechanisms for sustained success.	The organization will implement a comprehensive 5S strategy to improve cleanliness, reduce scrap, and enhance organizational effectiveness, beginning with a thorough evaluation to identify areas for improvement. Also, create a simplified process flow for In-process Instructions for Use (IFU In), and apply efficient tactics for scrap reduction.	To achieve an 86% reduction in downtime, proactive maintenance schedules, predictive maintenance techniques, robust training programs, and real-time monitoring systems will be implemented. Continuous improvement initiatives, including downtime analysis and feedback mechanisms, will be utilized to optimize strategies and maintain operational efficiency.

Table 11: Control Phase

Conclusions

In conclusion, the remarkable reduction of scrap losses from 4,220 units incurring a cost of $717.40 to absolute elimination is a testament to the effectiveness of the implemented strategies. This achievement not only signifies substantial cost savings but also reflects a significant improvement in operational efficiency and waste reduction. The organization's commitment to identifying and addressing the root causes of scrap, along with the implementation of targeted corrective actions, has proven to be highly successful. This zero-scrap outcome not only translates to immediate financial benefits but also fosters a culture of continuous improvement and operational excellence. Moving forward, maintaining vigilance and adherence to these successful strategies will be key to ensuring sustained success in minimizing waste and optimizing production processes.

Achieving an impressive 86% improvement in downtime management, coupled with earnings of $1,227,825.46, marks a significant triumph in operational efficiency and financial performance. This remarkable outcome reflects a strategic and effective approach to addressing and mitigating downtime issues within the organization. The substantial reduction in idle time not only enhances overall productivity but also contributes directly to increased revenue generation. The successful implementation of targeted measures, such as proactive maintenance, streamlined processes, and efficient resource allocation, has evidently paid off.

Finally, the notable improvement in a 5S audit score from 58.9% to 83.9% reflects a significant advancement in organizational efficiency, cleanliness, and overall workplace organization. This transformative journey underscores the impact of continuous improvement and a steadfast commitment to 5S principles. The enhanced workplace not only fosters efficiency but also creates a safer and more conducive environment for productivity. While ongoing standardization initiatives have played a role in this progress, further refinement and documentation of protocols hold the potential to elevate uniformity, ensuring sustained excellence in operational practices.

Acknowledgements

I would want to thank Dr. Rafael Nieves, my processor and mentor, for his excellent advice and assistance in helping me finish my project and the courses. The completion of this project has been greatly aided by his constructive feedback.

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