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 STATEMENT

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.

RESEARCH DESCRIPTION

Blue company has a laser cell which has several different processes within the flow. Such as part cleaning, deburring, anodizing, lasering, and packaging. About two to three workers operate this continuous, one-piece flow line each shift. Three shifts are operated at varying production scales. It currently displays a great deal of scrap and mayor idle time. These problems result in lower output, higher production costs, and detrimental effects on the environment.

RESEARCH TIMELINE

The research for the DMAIC method in January and February 2024, a laser production line's 5S (Sort, Set in order, Shine, Standardize, Sustain) problems, scrap creation, and downtime incidents are addressed using a DMAIC technique. The project is started in January with the Define phase, which involves setting specific goals, putting together a committed project team, and describing the extent of improvement initiatives. Insights are gathered from key stakeholders, and baseline metrics are created for scrap rates, downtime length, and 5S compliance. As February approaches, the Measure phase entails putting procedures in place for gathering data and making extensive observations in order to verify and examine previous data. In parallel, the Analyze phase includes statistical analysis, root cause analysis workshops, and process mapping activities to go deeper into finding the reasons of problems. Potential solutions are generated in March and ranked according to their expected impact. Detailed action plans are then created and scheduled for implementation during the Improve phase. By April, improvement projects, such as process reform and training initiatives, are under way. Development is regularly tracked, and roadblocks are quickly resolved. Lastly, in May, the Control phase makes sure that the gains are maintained by putting control mechanisms in place, conducting frequent performance evaluations, and continuing corrective action. Documenting lessons learned helps the business develop a culture of knowledge sharing and ongoing improvement. Effective collaboration, communication, and feedback mechanisms are critical to the success of the DMAIC project and to attaining measurable improvements in the quality standards and efficiency of the laser production line throughout the course of the timeline (Refer to Figure 1).

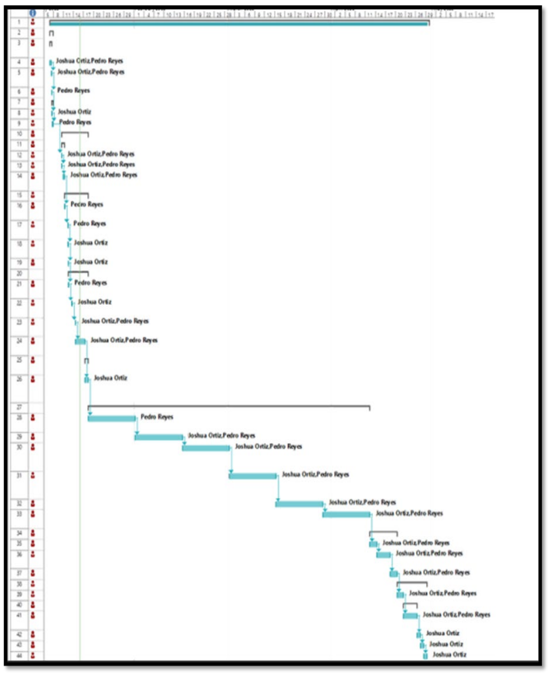


Figure 1
Project Timeline in January to May 2024

RESEARCH CONTRIBUTIONS

By addressing the root causes of wasted time and materials, research aiming at reducing idle time and scrap waste can help to improve product quality. By identifying idle time patterns and associating them with particular processes, this could be achieved. Through the entire production process, reducing idle time can save a significant amount of time. Enhancing the process flow can reduce the amount of scrap waste, which directly correlates to cost savings by lowering the consumption of resources and raw materials. Lean manufacturing concepts and waste reduction techniques can be integrated, according to research, to cut back on wasteful spending. A company's competitive advantage is increased, its market position is strengthened, and it becomes recognized as a pioneer in effective and ethical manufacturing methods as a result of all these efforts.

LITERATURE REVIEW

Manufacturing production cells serve as the backbone of industrial operations, translating raw materials into finished products. In the realm of manufacturing, efficient production processes are paramount to organizational success. Efficient operation is crucial for profitability and competitiveness. Two significant challenges faced by manufacturers are scrap (defective products) and idle time (unproductive periods). This literature review explores existing research on the causes, consequences, and strategies for mitigating scrap and idle time in manufacturing production laser cell.

Organizations seeking to decrease waste and downtime in their production processes can use the DMAIC technique from Six Sigma in combination with Lean concepts to create a strong foundation. DMAIC, with its organized approach of Define, Measure, Analyze, Improve, and Control, aids in pinpointing the causes of instances of idle time as well as the core causes of flaws that result in scrap. Organizations acquire important insights into the issues by setting clear objectives and gathering accurate data. On the other hand, lean concepts provide useful instruments for waste reduction, process optimization, and ongoing improvement [1].

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 [1].

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 [2].

The stages followed during this project were the following: (Refer to Table 1).

Table 1
Tools Used in Each Phase

Define	Critical to Quality (CTQ) Flowchart SIPOC Diagram
Measure	Scrap Waste Data Downtime Data Production Data
Analyze	Pie Chart Bar Chart
Improve	5S Visual Management Lean
Control	Control Plan

Following the DMAIC technique enables firms to carefully pinpoint the underlying reasons for idle time and scrap, put in place workable remedies, and set up checks to maintain the improvements, which results in more effective and economical production processes.

RESULTS AND DISCUSSION

The results analysis and discussion of the topic stated in Problem Statement & Results & Discussion. The results of the investigation or study are methodically reviewed, offering clarifications on the main points mentioned in the first chapter. This part attempts to clarify the nuances of the identified problem by carefully examining the collected data or experimental results.

Define

In this section we will define the goal of reducing Idle Time & Scrap using the DMAIC methodology. As discussed in Chapter 1, the purpose of reducing these two factors is to improve manufacturing process productivity and efficiency. Also, specify the project's parameters and extent. Name the processes in the laser cell that are being evaluated and decide which particular aspects of idle time and scrap will be dealt with.

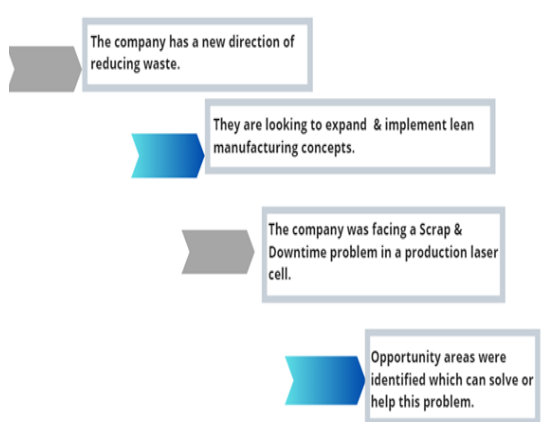


Figure 2
Project Motivation

The initiative's motivating aspects are visually represented in the project motivation diagram (Figure 2), which aims to decrease scrap and downtime on a laser manufacturing cell. Fundamentally, the graphic shows how the various components work together to drive the demand for manufacturing process improvement. Focusing on resource optimization, cost reduction, improved operational efficiency, and lean manufacturing concepts. The diagram illustrates how reducing scrap generation supports more ecologically friendly manufacturing practices and is consistent with sustainability objectives.

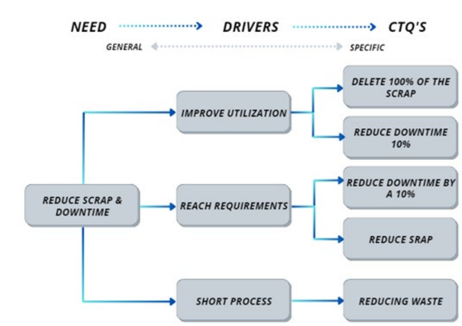


Figure 3

CTQ

The critical parameters that directly affect the overall quality and efficiency of the manufacturing process are systematically represented in the Critical to Quality (CTQ) diagram (refer to Figure 3), which is used to reduce scrap and downtime on a laser production cell. In order to satisfy operational objectives and customer expectations, this graphic identifies and ranks crucial factors. For example, cut 10% off of downtime and waste like scrap. To ensure that improvement initiatives are in line with the most important factors that contribute to quality and productivity, the CTQ diagram is an invaluable tool for the project team.

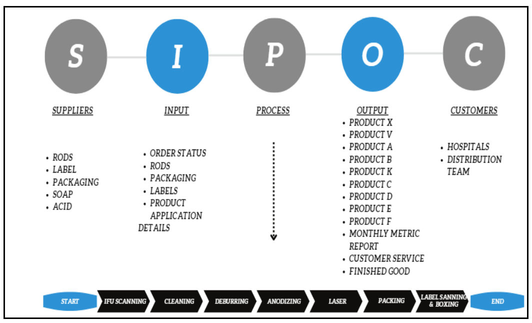


Figure 4

4 SIPOC

The purpose of creating a SIPOC (Figure 4) for this project addressing idle time and scrap in a laser cell is to provide a high-level overview and understanding of the key elements involved in the manufacturing process. Also, provide a structured and visual representation of the process, clarifying boundaries, identifying stakeholders, highlighting key steps, and supporting the overall improvement efforts throughout the DMAIC methodology.

Measure

In this phase key performance indicators (KPIs) for the laser cell's idle time and scrap are defined and identified. This could include parameters like total idle time, scrap rate, downtime causes, and specific scrap causes. Utilize a variety of sources, including production records, machine monitoring systems, and quality control reports, to gather pertinent data on idle time and scrap. Gather information over a range of time periods in order to identify trends and variances.

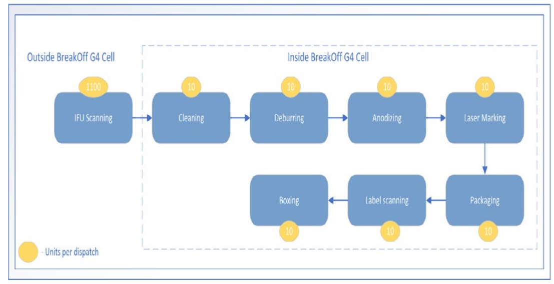


Figure 5

Current Process Flowchart

The process flow (refer to Figure 5) for Out-process Instructions for Use (IFU) with a substantial production volume of 1,100 units is designed to ensure precision and efficiency at each stage. Commencing with IFU scanning, the units undergo meticulous verification to guarantee accurate documentation and traceability throughout the entire process. Following this, the cleaning phase ensures the removal of any contaminants, setting the foundation for quality manufacturing. Subsequently, the deburring step addresses sharp edges and imperfections to enhance the overall safety and usability of the units. The anodizing process is then applied to provide a protective coating, contributing to corrosion resistance and increased durability.

Moving forward, laser marking is employed to engrave specific identification details or product information with precision. The units then progress to the packaging stage, where careful assembly and containment of the 1,100 units take place, ensuring their protection during transportation and storage. The label scanning step involves a thorough verification process to confirm the accuracy of labels and further ensures traceability. Finally, the boxing stage completes the process, with the units securely packaged and ready for distribution. This systematic and comprehensive process flow guarantees that the 1,100 units meet the highest standards of quality and compliance before reaching the end-users.

Table 2

Scrap by Month of Year 2023

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	**4220**

The dataset provides an overview of the variations in scrap production over the course of a year. (Refer to Table 2). The minimum amount of scrap, which was recorded at 127 units in February, points to a possible low point in production, while the maximum value of 736 units in June shows a significant increase, which may have been caused by certain factors like an increase in manufacturing or modifications to production procedures during that time.

By examining the data, one could investigate if any observable patterns or recurrent tendencies exist. As an example, May and June are notable for having comparatively greater scrap numbers, suggesting that there may be a spike in garbage output during these months. Determining the causes of these variations may provide light on the operational or environmental elements influencing scrap production.

Table 3
Cost of Scrap

COST of Scrap	$0.17
Total Scrap (Units)	4,220
Total Cost of Scrap	$717.40

The cost data related to the scrap amounts offers important financial context for understanding the total effects of trash production (refer to Table 3). The overall cost is determined by multiplying the unit cost by the total number of scrap units, using a $0.17 cost per unit of scrap. This yields a cumulative cost of $717.4. This monetary measure illustrates the cost incurred as a result of producing scrap and highlights the financial consequences of producing garbage throughout the designated time frame. The cost data is an essential tool for enterprises to assess the effectiveness of their manufacturing processes, as well as a way to quantify the financial burden associated with scrap. That's why the company is looking to the ability to reduce waste and optimize processes by enhanced and analyzing the relationship between scrap volumes and related expenses. This will ultimately lead to more cost-effective and efficient operations [3].

Table 4
IFU OUT Cycle Time

Scenario	Cycle time (s)	Shift (s)	Units per Shift
IFU out	8.74	25200	2883

The 8.74 second cycle time, which is comparatively short, indicates a quick production process that enables a high frequency of unit output. The production line can make 2,883 units during a shift that lasts 25,200 seconds. This suggests a strong capacity for production during the designated shift. (Refer to Table 4).

Table 5
IFU OUT Downtime

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

A frequency of 2.6 downtimes per 1,100 units may point to a maintenance issue or a poor-quality product failure. But it's crucial to assess these downtimes' need and effect on overall production efficiency with great care. The noteworthy length of the IFU scanning outage (3,582 seconds) indicates a large chunk of the overall outage. Investigating the causes of this particular outage can provide possibilities for process enhancements or optimizations. A significant amount of the entire shift period (25,200 seconds) is made up of the downtime every shift, which is 9,389 seconds. The estimated 1074.3 units lost as a result of downtime highlights the direct effect that planned disruptions have on the total yield of production. (Refer to Table 5) [4].

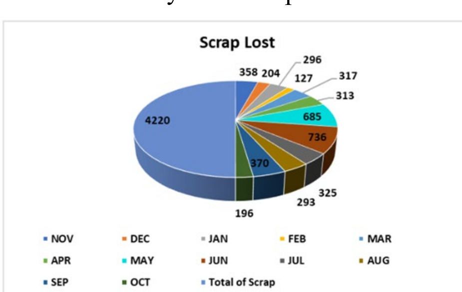
Table 6
Production by Product

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**

The given information traces week after week, per-shift, and day by day generation targets for a run of items, indicated by letters X, V, A, B, K, C, D, E, and Each product has distinct production, reflecting the varying demand and production capabilities (Refer to Table 6).

Analyze

Detailed analysis and interpretation of data are conducted during the analyze phase of a production or operational process in order to obtain a greater understanding of the effectiveness, performance, and possible areas for improvement. Examining the length and frequency of outages, such as the IFU scanning outage, can reveal information about the effect on overall production effectiveness. Finding relationships between production losses and downtime events enables focused enhancements to maintenance procedures, scheduling, or process redesign. Comprehending the correlation between cycle time and the quantity of units manufactured in a shift also aids in comprehending the velocity and efficacy of production. Decisions about process modifications or cycle time optimization to increase



throughput can be guided by this analysis.

Figure 6
Pie Chart: Scrap Loss

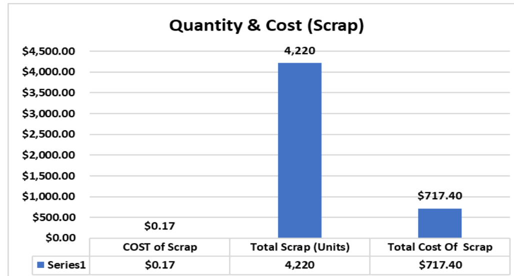
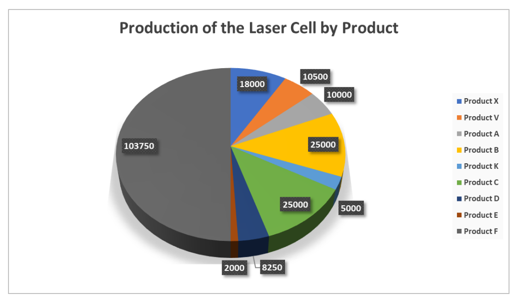


Figure 7
Quantity & Cost of Scrap 2023

The pie chart & Bar Chart (refer to Figures 6 & 7) was created to represent the monthly scrap quantities and as shown it exhibit variation throughout the year, ranging from a minimum of 127 units in February to a maximum of 736 units in



June. This indicates that different months have distinct levels of scrap generation. The months of June and May stand out with the highest scrap quantities (736 and 685 units, respectively), suggesting a potential peak in scrap generation during this period. Conversely, February has the lowest recorded scrap quantity at 127 units. The total scrap quantity for the entire period is 4,220 units. This cumulative figure represents the overall amount of scrap generated across all the months considered. Understanding the total scrap quantity is crucial for assessing the overall impact on production and potential financial implications.

Figure 8
Daily Outputs of Product 2023

The provided data outlines weekly, per-shift, and daily production targets for a range of products, denoted by letters X, V, A, B, K, C, D, E, and F.

Each product has distinct production goals, reflecting the varying demand and production capabilities. Product F stands out with the highest weekly target of 103,750 units, equating to daily and per-shift targets of 24,501 and 8,167 units, respectively. This suggests that Product F is a high-volume production item, potentially a flagship or core product. Products B and C also have substantial weekly targets of 25,000 units each, distributed over shifts and days. In contrast, Products E and K have more modest targets, indicating a lower production volume requirement. (Refer to Figure 8).

Table 7
Units Lost IFU Out

Total units per shift	1809.0
$$$ per shift	9787
$$lost per shift	5811.762214
Day $$	29360.5944
%Day Lost	17435.2866
$$Lost Yearly	$7,633,754.54

The "IFU OUT" scenario refers to a production setting where the Instruction for Use (IFU) scanning process is conducted while the production line remains in operation. The "IFU OUT" scenario also outlines the production process (see Table 7) where IFU scanning and other downtimes are incorporated into the ongoing production line. Here's an explanation of the key aspects of this scenario:

- Cycle Time (s): The cycle time represents the time required to complete one full production cycle, and in this scenario, it is 8.74 seconds. This metric is critical for assessing the speed and efficiency of the production process.
- Shift (s): The total duration of the production shift is 25,200 seconds, indicating the operational time available for production within a standard working shift.
- Units per Shift: The production line generates 2,883 units during a single shift. This metric reflects the productivity of the production process within the specified time frame.
- Downtimes (every 1,100 units): Downtimes occur periodically, specifically every 1,100 units. In this scenario, there are 2.6 downtimes, suggesting that interruptions, maintenance, or other operational halts can occur during production.
- IFU Scanning Downtime (s): The IFU scanning downtime refers to the time during which the production line pauses for IFU scanning activities. In this case, the downtime associated with IFU scanning is 3,582 seconds.
- Downtime per Shift (s): The total downtime during a single shift is 9,389 seconds. This metric represents the cumulative time during which the production line is inactive due to various reasons, including IFU scanning and other scheduled downtimes.
- Units Lost to Downtime: Despite the production of 2,883 units, the downtime results in the loss of 1,074.363 units. These lost units contribute to a decrease in the overall output.
- Total Units per Shift: After accounting for downtime, the adjusted total units produced per shift are 1,809 units.
- $$$ per Shift: The total revenue generated per shift from the produced units is $9,787. This represents the income associated with the units that successfully pass through the production process.
- $$ Lost per Shift: The financial loss due to downtime is $5,811.762 per shift. This value accounts for the revenue that could have been generated if the production process had been uninterrupted.
- Day $$ (%day Lost): The total revenue loss for the day is $29,360.59, indicating the financial impact of downtime as a percentage of the total daily revenue. This percentage reflects the proportion of revenue lost due to the downtime events during the day.
- Yearly (Lost Yearly): On an annual basis, the revenue is $29,360.59 and the financial loss due to downtime over the year is $7,633,754.54. This underscores the substantial financial impact of downtime events on the overall yearly revenue.

Checklist item	Criteria	Exist? (Y / N)	Rating (0,1,2,3 or 4)	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 recognitition Board			
Display de 5S Documentation			
	27	2.4	
	Score: 96.4%	58.9%	

Figure 9
5S Actual

5S checklist was made (refer to Figure 9) and ended with a result of 58.9%. This denotes a modest degree of adherence to the assessed area's application of the principles of Sort, set in order, Shine, Standardize, and Sustain. Although there has been a noticeable area of improvement, more may be done to reach a better standard of organizational cleanliness and efficiency. Although standardization initiatives are in progress, improving and recording protocols can lead to increased uniformity.

Improve

In this phase of Improve we will be analyzing the data collected to determine how much improvement is due to the current state.

Table 8
IFU In Downtime

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

Table 9
Units Lost IFU In

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

Table 10
Improvement

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

- Cycle Time (s): The cycle time of 12 seconds represents the duration required to complete one production cycle.
- Shift Duration (s): The total shift duration is 25,200 seconds, indicating the operational time available for production during a standard working shift.
- Units per Shift: The production process generates 2,100 units during a single shift.
- Downtimes (every 1,100 units): In this scenario there is none.
- IFU Scanning Downtime (s): The downtime associated with In-Field Update (IFU In) scanning is 3,582 seconds.
- Total Units per Shift: After considering the IFU scanning downtime, the adjusted total units produced per shift are reported as 2,100 units.
- $$$ per Shift: The total revenue generated per shift from the produced units is $11,361. This represents the income associated with the units that successfully pass through the production process.
- $$ Lost per Shift: The reported loss due to downtime is $0 per shift, in this scenario.
- Day $$: The total revenue loss for the day is reported as $34,083. This is a cumulative figure that accounts for the financial impact of both produced units and potential losses due to downtime.
- $$ Yearly: The yearly revenue is reported as $8,861,580. This provides an overview of the annual financial performance of the production process.

Results indicate a substantial improvement in financial performance, with an increase of

$1,227,825.46 in revenue and an impressive percentage improvement of 86%. (Refer to Table 8, 9 & 10).

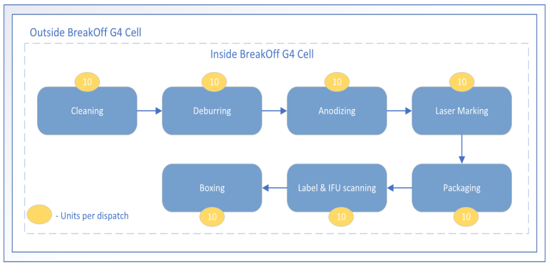


Figure 10
Final Process Flow IFU In

The process flow (see Figure 10) for In-process Instructions for Use (IFU) involving 10 units follows a streamlined approach through various critical steps. First, the components undergo cleaning, ensuring a foundation of hygiene and quality. Subsequently, deburring is conducted to eliminate any sharp edges or imperfections that may affect the final product's functionality and safety. The anodizing phase follows, providing a protective and corrosion-resistant coating to enhance the durability of the units. Laser marking is then applied, incorporating specific identification details or product information with precision. Packaging stage ensures that the products are correctly matched with their respective instructional documents and packaging materials before being dispatched. The labeling of IFU is done systematically, ensuring that each unit is accurately identified and traceable. Upon completion of these fundamental processes, the 10 units proceed to the boxing stage, where they are carefully assembled and packaged.

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	3	
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	4	
Safety	Safety equipment and supplies are clear and in good condition	Y	4	
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	4	
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	4	
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	4	
Procedures	Procedures for maintaining the first three S's are being displayed	Y	4	
5S documentation	5S checklists, schedules and routines are defined and being used	Y	4	
Responsibilities	Everyone knows his responsibilities, when and how	Y	4	
Regular Audits	Regular audits are carried out using checklists and measures	Y	4	
Sustain - SHITSUKE				
5S System	5S seems to be the way of life rather than just a routine	Y	4	
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 recognitition Board				
Display de 5S Documentation & Update Lines of the workstation				
		27	3.4	
	Score:	96.4%	83.9%	

Figure 11
5S Future

Improving a 5S audit score (refer to Figure 11) from 58.9% to 83.9% signifies a substantial enhancement in organizational efficiency, cleanliness, and overall workplace organization. Continuous improvement and a commitment to 5S principles contribute to a workplace that is not only more efficient but also safer and more conducive to productivity. Although standardization initiatives are in progress, improving and recording protocols can lead to increased uniformity.

Control

The organization will initiate a comprehensive 5S implementation strategy in order to emphasize specific areas of improvement, create a simplified process flow for In-process Instructions for Use (IFU In), and apply efficient tactics for scrap reduction. First, a thorough evaluation will be carried out to identify areas that need improvement, with an emphasis on cleanliness, scrap reduction, and organizational effectiveness.

Leadership and employee training sessions will be crucial, emphasizing the importance of 5S principles and their direct impact on optimizing processes, reducing waste, and ensuring product quality. A cross-functional team, composed of representatives from various departments, will play a key role in driving the implementation forward, with each member assigned specific responsibilities aligned with the 5S steps.

Strategies for scrap reduction will be seamlessly integrated into the plan, addressing root causes through enhanced quality controls, employee training, and advanced equipment maintenance practices. Continuous monitoring and improvement mechanisms will be established, featuring regular reviews and feedback loops from employees to ensure the sustained success of the implemented changes.

Conclusion

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.

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