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Improving Operational Throughput by Reducing Downtime and Movements in Manufacturing Operations

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Abstract
Unplanned downtime can be detrimental to an organization's productivity and financial performance. Time is a valuable commodity in the business world that can impact customer demand and competitive position in the market. This study focuses on reducing unplanned downtime caused by changeover and/or unnecessary movements in the manufacturing process. Qualitative and quantitative data were collected and analyzed to understand the characteristics of the studied downtime and its impact on productivity and profits. The analysis revealed that the area experienced 44 hours of downtime per month, with 12 hours being planned and 32 hours being unplanned. For example, the Caps and Stack stations experienced around 2.1 hours of downtime per month. However, due to the unexpected interruption, the company experienced a significant decrease in monthly revenue. Eliminating downtime in this area would increase productivity and improve the company's ability to respond to customer orders promptly.
Keywords: Downtime, Downtime Reduction, Changeover, Motion

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1. Introduction

This project aims to apply Lean Six Sigma principles to the helium and vision production line for two main objectives: reducing unplanned downtime and increasing productivity, as well as eliminating unnecessary movement in the production process. There are seven core principles of Lean Six Sigma include customer focus, understanding the value stream, improving process flow, removing non-value-added steps and waste, managing by fact, involving people in the process, and systematically undertaking improvement activities (Burghall, 2014). Two of these principles were chosen for this project to enhance the production line's performance. The ultimate goal is to determine whether implementing Lean Six Sigma principles can improve the line's process, increase productivity, and eliminate motion from the line.

1.1 Research Background

Time and resources are precious in today's fast-paced businesses, like the automotive industry. Downtime can be costly, depleting resources and negatively impacting production, profits, and overall performance (Nwanya, 2017; Ivan Kuric et al., 2021; Zennaro et al., 2018). Companies must respond quickly to changing market demands to remain competitive (Hasan & Serhat, 2019; Inderdeep et al., 2018). Unplanned downtime can hinder a company's ability to meet customer demands on time and does not add value to the product.

According to Mustafa & Cheng's 2017 research and Penuel et al.'s 2013 book, Encyclopedia of Crisis Management, there are two main categories of downtime: planned and unplanned. The impact of downtime depends on various elements, such as duration, reason, affected system, and frequency. This study looks at reducing unplanned downtime during changeovers. Operators often take longer than necessary to switch between models, causing delays. Misplaced tools, excess movements, and operator skill level can cause downtime. Efforts should be made to minimize downtime during changeovers.

1.2 Problem Statement

When a changeover occurs, there is typically a downtime of 1 to 3 minutes, which may be insignificant for a single occurrence. However, when this occurs six times per shift and for three shifts, the total downtime can become significant. This project involves evaluating and eliminating this kind of unplanned downtime and its related unnecessary movement to keep production flowing smoothly and help the company respond to customer demand on time to survive in the market competition.

1.3 Motivation and Objectives

This project primarily aims to conduct research as part of the Lean Six Sigma program. Additionally, we aim to provide solutions by addressing and correcting problems rather than solely focusing on what is already working well. The author's goal in choosing this topic is to demonstrate how unplanned downtime and motion impact the automotive industry's business. The author aims to improve production line efficiency by reducing unplanned downtime and eliminating unnecessary movement during changeovers.

1.4 Literature Review

Several factors can cause production breakdowns, such as human, machine, and the environmental outcomes. Downtime costs money to the company and does not add any value to the product. (Ashary and Jaqin 2015). In manufacturing, a period is called a downtime when the production process stops for an unplanned or planned reason or event. Some other reasons cause downtime, such as material issues, unscheduled maintenance, organization downtime, logistics, changeover, preventive maintenance, reduced performance, quality issues, etc. (Zdeněk Aleš et *al.* in 2019, Vector solution 2022, Peter 2020).

There are various types of downtime in manufacturing based on various characteristics and points of interest, but we can group them into two large categories: planned and unplanned downtime. Planned downtime can be used to clean the machine, calibration, changeover, etc. (Mustafa and Cheng 2017). In their research, Ilenia et *al.* (2018) describe a new type of downtime called micro downtime. This type of downtime is considered the short period where the production line stops numerous times during operation, so at the end of the day, the total micro downtimes end up significantly impacting the overall equipment effectiveness (OEE).

In 2017, Mustafa and Cheng showed that approximately 40% of downtimes are due to changeover and machine cleaning. For instance, machine cleaning and calibration can take more than half of the daily downtime. (Mustafa and Chen 2017). The downtime length depends on the maintenance performance, employees' skills in changeover, and other production/quality issues. Downtime related to the changeover and failure can be controlled and reduced (Wolniak, 2019). In 2019, Wolniak stated that changeover time is the primary factor causing long-term downtime and is a common issue, particularly during line changeover (Wolniak, 2019).

The formula for calculating planned changeover time is as follows:

Changeover time x number of changeovers = standard changeover time

Sometimes the time required for a planned changeover can be exceeded, creating an additional unplanned downtime changeover beyond the required time. This additional time is named over-standard changeover time.

To calculate this type of changeover downtime, we subtract the standard changeover time from the total changeover time.

Total changeover time - standard changeover time = over standard changeover time

In their research, Ilenia et *al.* (2018) described a new type of downtime called micro downtime. This type of downtime is considered the short period where the production line stops numerous times during operation; at the end of the day, the total micro downtime significantly impacts OEE.

However, planned downtimes cannot be avoided because they are necessary but must be minimized as much as possible. Unplanned downtime must be avoided, at all costs, because it is unnecessary. Unplanned downtime can be caused by human errors, equipment failure, incorrect configuration, maintenance, long waiting causes of the inappropriate material handling system, Etc. Material handling in manufacturing is non-value-added activity, which the company should avoid as much as possible because it can be challenging to optimize production. Improving material flow systems and interactions between production lines increases line productivity and facility performance (Mustafa & Cheng, 2017; El-Namrouty & Abushaaban, 2013)

The more micro downtime occurs in the process results in a massive impact on OEE, which can be reduced or eliminated by the operator himself; no management team or maintenance is needed. Another element affecting the OEE is a reduction in production speed; this may not occur frequently but takes longer than micro downtime (Ilenia et *al.*, 2018).

The study of time and motion are the elements that help to standardize the work and increase the productivity index. The study showed work standardization improvement in a printing company with 150 operators where the productivity was 1/2 of the customer demand. After improving standardization in the workplace, 66% of the unnecessary movements were reduced and productivity increased by 63.2%, cycle time was reduced by 18.44%, and turn down overtime to 0% (Arturo et *al.*, 2019).

Unstandardized work increases cycle time and defects rate, waste in the process, delays deliveries, and increases over time and results in insufficient production level and non-compliance with customer demand (El-Namrouty et *al.*, 2013). This can put the entire company in a precarious situation, with serious issues such as losing customer loyalty and market competition. Inefficient handling of material during production can reduce the operator's performance by increasing the cycle time, inefficient labor and space use, and production cost (El-Namrouty, 2013).

Toyota created Lean principles to compete with US car makers. Lean Six Sigma combines Lean's efficiency approach with Six Sigma's data-driven methods to improve quality. Implementing LSS requires continuous improvement and alignment with business goals. This strategy streamlines operations, improves processes, enhances customer experience, and increases profits. It's successful in various industries, but critical success factors must be met (Albliwi et al., 2014. Raja et al., 2017. Antony et al., 2017. Dora et al., 2014)

A study conducted in 2019 by Alkunsol and his team revealed that Jordanian Pharmaceutical Manufacturing organizations have a high implementation of Lean Six Sigma variables, with strong relationships among them. However, there is no connection between unutilized skills and transportation. Additionally, the research shows that Lean Six Sigma variables impact business performance, with the exception of extra processing and waiting time.

Combining Lean Six Sigma and Ergonomics improves productivity by reducing errors and eliminating non-value-adding activities. However, productivity can lead to worker stress, so incorporating Ergonomics principles is important for worker safety and comfort. A proposed model integrates both approaches by creating a diagnostic expert system that identifies risk levels associated with postural movements in workstations on the assembly line (Alsaffar and Ketan, 2018).

Lean Six Sigma plays a significant role in the reduction of unnecessary addition steps (activities) that add zero value to the final product. "The issues need fixing for long-term solutions. However, solutions do not necessarily add significant gains, and organizations often require solutions. Organizations are being prevented from making meaningful changes due to problem-solving techniques. It has been shown that Lean six-sigma can be used for solving problems and making improvements" (Hamad, 2014)

Ivan Kuric et *al.* (2021) demonstrated that there is a relationship between downtime and production quantity; when downtime decreases, productivity increases. The downtime due to changeover depends on the changeover type, human skills and ability to change, how many tools or settings need to changeover, and so on. When the tools are misplaced, it increases the duration of downtime due to unnecessary movement; the operator does to bring or reach the tools.

To reduce or eliminate unpredicted downtime, Pharaon, in his research in 2022, suggested investing in human development, whereas the company trains the employees on TPM (Total Productive Maintenance) principles.

2. Methodology

This project aims to reduce downtime due to the changeover and eliminate unnecessary movement during the changeover. *Downtime* is a period that refers to the time that a machine, process, or equipment is not operating and/or is unavailable to use. This situation can be caused by fault, failure, cleaning, or planned maintenance. It is a parameter of the process that affects the uptime and productivity rate of the plant negatively (Inyiama & Oke, 2020; Schaschke, 2014)

Changeover is a term used in manufacturing to describe the time and activities needed to change or convert a line or machine from processing one product model to another. These activities and the time required are necessary and cannot be eliminated, but can be minimized as much as possible.

2.1 Principle and Modeling

DMAIC is a framework businesses used to improve operations. It has five phases: Define, Measure, Analyze, Improve, and Control. The Define phase clarifies the issue; the Measure measures it; the analyze determines the root cause; the improvement phase implements solutions, and Control ensures lasting changes. This research uses mathematical modeling to achieve the objectives. Mathematical modeling is a powerful tool that uses mathematics to analyze complex systems in different fields. It uses qualitative and/ or quantitative data to predict real-world phenomena and make informed decisions. Creativity and problem-solving skills are crucial for solving modeling questions (Karen et *al.*, 2014).

The significant categories of data used in this study are qualitative and quantitative, and both types of data are chosen because:

a) This project applies lean six sigma techniques, so we need quantitative data to perform some statistical calculation.

b) Qualitative data are for better understanding the effect and potential of changeover downtime and unnecessary movement in the production line. Combining these two methodologies provides more benefits than a single methodology, even if combining them requires more skills and time. The mixed method increases the validity and reliability of the study's findings (Nur, 2019).

2.2 Specific considerations and assumptions

Several assumptions drive our study:

1. Most automotive companies in Michigan have a culture of innovation and improvement that encourages employees to share their ideas, which gives the hope that the study will achieve its objectives.
2. Collecting sufficient data to meet the study's objectives through the production data recording system will be easy and possible.
3. All participants are expected to answer survey or interview questions truthfully and accurately and return the questionnaires.

Using a representative sample can save time and resources in data gathering for research studies. Careful determination of the sample size is important for effective conclusions. (Memon et *al.*, 2020)

It can be quite challenging to arrive at an appropriate sample size for data collection within a limited 30-day period. To tackle this issue, we employed two distinct methodologies. Firstly, we utilized data forms at I/L and caps & stack stations. Additionally, we conducted a comprehensive questionnaire with the participation of 2 production managements, 3 supervisors, and 9 offline operators. These measures enabled us to collect the necessary data effectively and efficiently.

Primary data was collected through two methods to achieve the objectives of this project. The first method involved collecting quantitative data from the production floor. Operators were asked to fill out a form when they stopped or slowed down the line. The second method involved collecting qualitative data through questionnaires. The production management team, team leaders, and some offline operators were interviewed.

The collected information was analyzed using statistical software such as Microsoft Excel. This involved using formulas, tables, and graphs to provide straightforward data visualizations and explain the current situation.

3. Results and Discussion

3.1 Analysis

In order to determine the scope's characteristics, it is essential to calculate the planned downtime and subtract it from the total time. This will give us the planned operating time. The table below shows the data for planned downtime in that area.

Event description	Planned downtime min/day	Planned downtime min/month (26 days)
Meeting/day	5	
Machines' Calibration	12	
1st break	10	
Lunch/day	30	
2nsd break	10	
5s	6	
One shift PD	73	
All shifts PD	219	5694
Uptime	1221	31746

Table 1: Secondary sources, planned downtime

As shown in Table 1, this production area has 73 minutes of planned downtime each shift, which makes 219 minutes for all three shifts per day, and 5694 minutes per month with 31746 minutes as uptime or planned operating time.

Data analysis has identified eight primary reasons for downtime in the helium and vision line; some are planned, and others are unplanned downtime. Only setup, calibration, and cleaning machine reasons are classified as planned downtime.

1. Maintenance/ machine down
2. Setup/ calibration/ cleaning machine
3. Caps-Changeover/no caps
4. Changeover-couple/ no couplers
5. No part (cores)
6. Wrong parts
7. Quality issues
8. Safety issues

Below is a table summarizing downtime data for four weeks in the helium and vision line.

Time (min)	Maintenance/ machine down	Setup/ calibration/ cleaning machine	Changeover caps/no caps	Changeover couplers/ no couplers	No part (cores)	Wrong parts	Quality issues	Safety issues	Total/ average
1	1		5	3	2				
2	8	6	9	8	5		7		
3	10	4	7	6	10			3	
4	4	3	10	11	8				
5	18	14	9	4	15	5		2	
6	4	7	1				1		
7	5	2			1				
8	2	4		1	1		2		
9	2	2							
10	45	39	4		17	1	6	*9*	
11	1	1							
12	5	2			1				
13		7			5				
+14	13				5				
Total number of downtime	118	91	45	33	70	6	16	14	**393**
Total in minutes	949	728	175	109	481	35	96	109	**2682**
Average length of each downtime in minutes	8	8	3.9	3	7	6	6	8	**7**
Planned operating time	31746	31746	31746	31746	31746	31746	31746	31746	**31746**
Mean Time Between Failures in hours	4.48	5.81	11.76	16.03	7.56	88.18	33.07	37.79	**1.36**

Table 2: Primary source downtime in the helium and vision line in the period of 4 weeks

As shown in the above table, this line faces numerous downtimes, up to 2682 minutes or 44.7 hours per month, where 12 hours are coming from planned downtime while 32 hours are unplanned downtime. This is a severe problem that needs emergency correction action. Data shows that the line stopped running approximately 7 minutes each downtime. The mean time between failures is the average time between two or more failures, and it can apply to a non-repairable system or item. For non-repairable items, instead of saying the mean time between failures, they say mean time to failure, which represents the time an item should operate before the first failure (Kosky et *al.*, 2015; Ali, 2017). The table shows that the line stops running 3.9 minutes every 11.76 hours due to changeover on caps and stack station, and an average of 7 minutes of downtime every 1.36 hours due to all downtime reasons in that area.

A Pareto chart was used to analyze the data collected on the reasons for downtime in the production area.

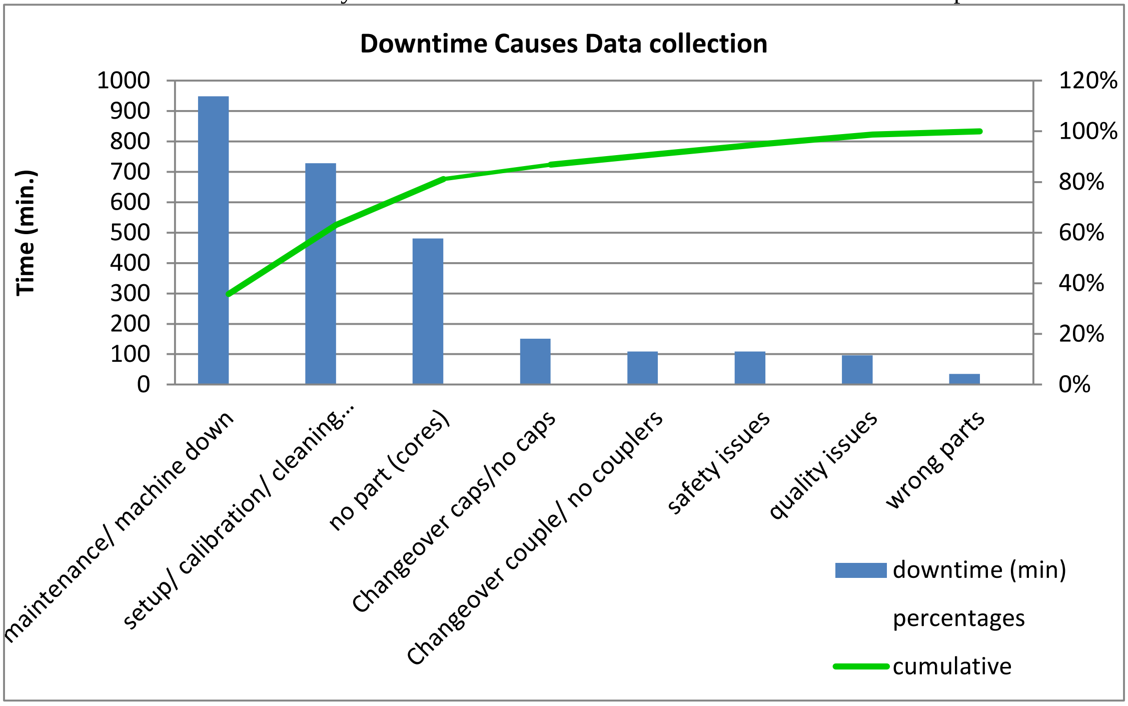

Figure 2: primary source, Pareto chart of downtime causes in the helium and vision line in the period of 4 weeks

Machine downtime and maintenance are the leading causes of downtime, accounting for 35.4%. Planned downtime, such as setup and cleaning, contributed 27.2%. Parts unavailability causes about 17.9% of downtime. Due to time constraints, we focused on the problem of changeover caps or no caps, the fourth issue on the Pareto chart.

Using a tree analysis diagram can help identify the cause of downtime in a specific location. The root cause analysis tree shows the connection between events and their causes; by examining the probabilities displayed in the root cause analysis tree, it is simple to prioritize which problems to address initially. The diagram can also assist in process redesign to optimize efficiency. (Sahoo, 2021; Utomo et *al.*, 2020).

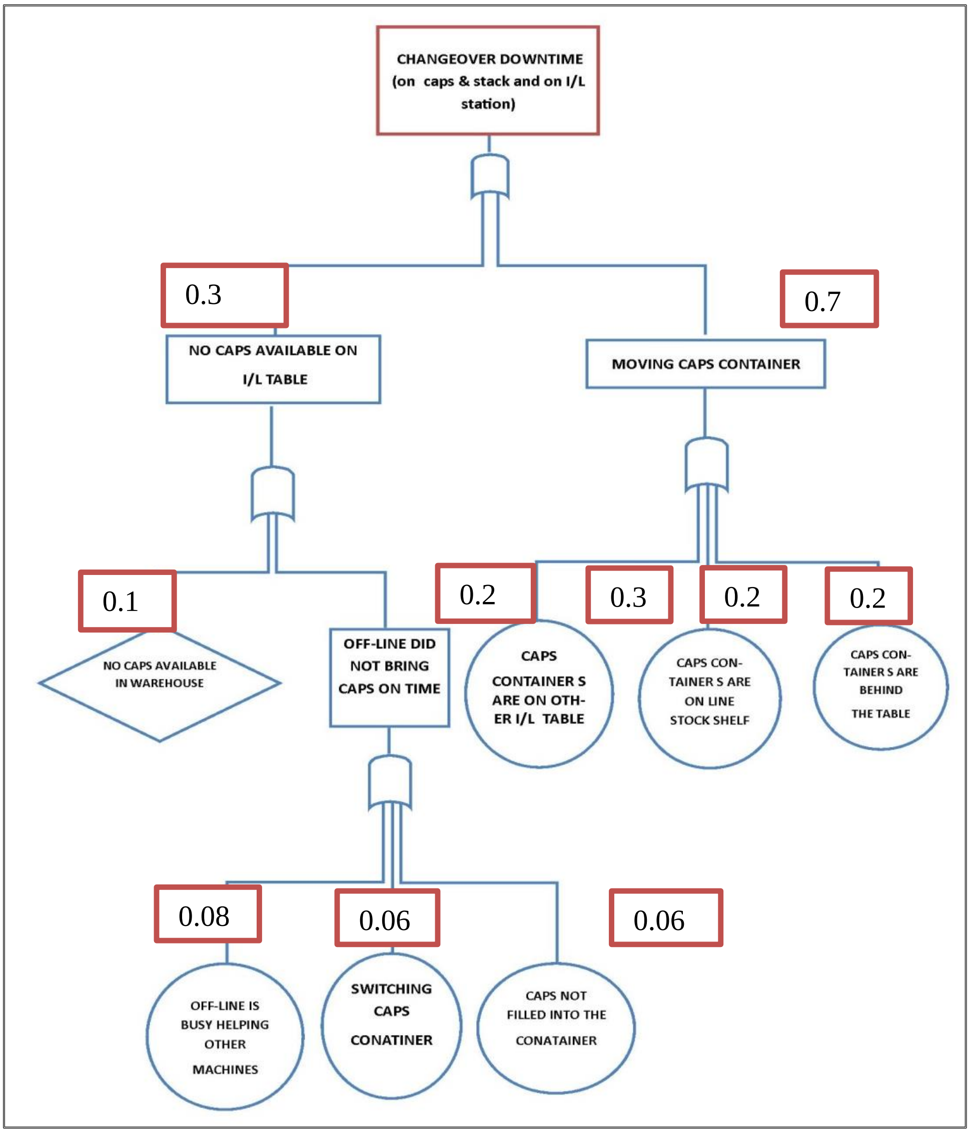

Figure 3: The root-cause tree analysis

The image above displays reasons for downtime caused by caps and stack changeover activities. The chance of downtime from missing caps on the I/L table is approximately 30%. This can occur if caps are in the wrong place or not brought to the station on time by the offline operator. The leading cause of unplanned downtime is moving caps containers to the station table, with a likelihood of up to 70%. This happens because containers may be on other tables, and need to be transferred from the line stock shelf, or are located behind the table. According to Radosław Wolniak, in 2019, the primary cause of long-term downtime is the changeover time, especially during the considered period. If the time taken for changeover exceeds the expected time, it leads to unplanned downtime. To clarify and classify this type of downtime, the author interviewed operators in the field. The table below presents a summary of their responses.

Respondent	How many times do you changeover a day/ machine?	How Long it takes to changeover on helium Mc?	How long it takes to changeover caps to the I/L table	Have you ever stopped doing something to get caps to the I/L table	Have you ever switched the caps containers	How long it takes to switch the container (empty it and fill different caps)	Do you think offline is a busy and challenging job?	On a scale out of ten, how much is the challenging offline job
1	5	1	1	yes	yes	3	yes	7
2	6	2	2	yes	yes	2	yes	8
3	4	1	1	yes	yes	3	yes	9
4	4	2	1	yes	yes	4	yes	7
5	5	2	1	yes	yes	4	yes	8
6	3	2	1	no	no	1	yes	5
7	3	1	1	yes	yes	3	yes	9
8	2	3	2	yes	yes	2	yes	10
9	4	5	1	yes	yes	3	yes	8
Total	36	19	11	NA	NA	23	NA	71
Avg.	4	2.1	1.2	NA	NA	2.6	NA	7.9

Table 3: Primary sources, offline interview responses

Helium machine has four changeovers per day, but it can increase to 6, leading to a higher risk of downtime. Completing one changeover takes 2.1 minutes. Offline work is challenging, and respondents suggested strategies to improve it. Changeover on caps & stack station takes 1.2 minutes. Any downtime is identified by comparing the times to the required changeover time.

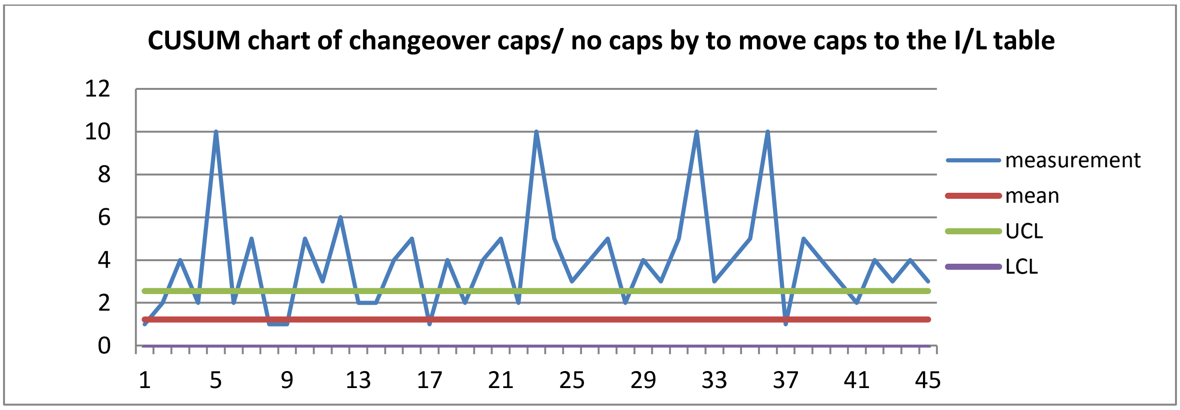

Figure 4: Changeover downtime control chat

Based on the graph above, it is evident that the recorded downtime during production exceeds the estimated or required time for the changeover on the I/L station. Most recorded times exceed the upper control limit, indicating that changeovers take longer than necessary and result in unplanned downtime. Table 1 indicates it takes around 3.9 minutes to change over on caps and stack or I/L station. However, Table 3 interview data suggests it only takes 1.2 minutes to switch over on caps and stack, which is equal to the changeover cycle time. This means the time to change over to I/L could be shorter. To calculate the actual downtime, required changeover time was subtracted from the total actual changeover time. Downtime = time used to changeover – required time to changeover *(Eq. 1)*

Downtime each changeover = 3.9 - 1.2 = 2.7 minutes

To calculate the total time the line lost during the data collection period, you must multiply the number of changeovers by the downtime for each changeover.

Total downtime = the number of changeovers times downtime for each changeover (Eq. 2)

Total unplanned downtime due to caps-changeover = 2.7 x 45 = 121.5 minutes/30 days

3.2 Discussion

3.2.1 Motions' impacts

Motions in a company's operations are non-value-added activities that employees perform during work, such as excessive handling of products, long walks, or searching for tools and materials. They do not contribute to the production or delivery of goods and services. Unnecessary movements waste time and energy, reducing productivity and increasing labor costs. This leads to missed deadlines, lower output levels, and decreased efficiency, ultimately impacting profitability. In labor-intensive industries, excessive movements can lead to significant costs, such as time, material, and energy wastage. This can also result in low morale, decreased motivation, and higher employee turnover. Companies must implement Lean principles, optimize workflows, and streamline processes to improve profits. Investing in employee training and adopting automation technologies can also minimize negative impacts and create a more efficient operation.

In this case, the process of changing caps causes more downtime, puts a strain on the offline operator, and negatively impacts their performance. This, in turn, makes it difficult for them to deliver the necessary parts to the station on time, leading to a decrease in productivity. Additionally, the offline operator is responsible for inspecting the quality of the products before they are sent for the final assembly. The excess movements in the process slow down the operator, making it harder to conduct a thorough inspection as required.

3.2.2 Downtime impacts

Organizations can be affected by downtime in various ways, such as decreased productivity, financial losses, damage to reputation, and disruptions to the supply chain.

Employee productivity can suffer due to downtime. When systems are down or operations are halted, employees cannot perform their regular tasks effectively. As a result, the output is reduced, and inefficiencies occur. Even after the systems are restored, it may take time for employees to catch up and return to their optimal productivity levels.

In this case study, 12 helium chambers lost 121.5 minutes. Each chamber can test one part per minute, so the total productivity lost can be calculated using the following formula:

Productivity lost = downtime x total estimated productivity rate in one minute (Eq. 3).

Using this formula, the total productivity lost equals 121.5 minutes x one part, equivalent to 121 parts per month. Over 30 days, the line experienced a loss of 121 productivity units due to changeovers on the I/L and caps-stack station. To better understand the impact of this downtime, we can convert the lost productivity into labor hours. Thus, to recover the lost productivity due to caps & stack changeover, each machine must operate for an additional 30.38 minutes (overtime) every month.

Experiencing downtime can significantly impact a company's financial performance, both in the short and long term. This is because it can lead to a reduction in revenue and missed sales opportunities. If a manufacturing company's production line experiences downtime, it cannot sell the planned products, resulting in lost sales and revenue. It may seem surprising, but downtime can increase costs, especially if the company needs to expedite repairs, pay overtime to employees, or hire external experts to fix the issue quickly.

To understand the economic impact of this downtime, we can convert it into monetary value. A full radiator's average market price is approximately $2250. The number of lost parts should be multiplied by the cost of a single unit to calculate the monetary value of the loss. Therefore, the money or revenue lost was determined by multiplying the number of parts lost due to changeover downtime by the value of a single unit, as shown in Equation 4**:**

Money lost = the number of parts lost due to changeover downtime X value of one unit. (Eq.4).

Thus, the total money lost or revenue lost in this case was 121 parts x $2,250, which equals $273,375. This calculation does not include the cost of non-produced parts, such as the salaries of 12 employees (three employees on each machine) who were paid for 30.4 minutes while awaiting caps changeover each month, the energy consumed by the machine during the changeover, etc.

When a company faces downtime, it can harm the satisfaction of customers. If the company cannot fulfill orders or meet service expectations during this time, it can result in lost trust and customers switching to competitors. Negative experiences shared by customers can spread quickly through word-of-mouth and deter potential clients and partners. A damaged reputation can be time-consuming to repair and affect the company's ability to attract new customers and secure profitable business opportunities. Downtime in one company can also affect its suppliers and customers in the supply chain. If a company's downtime affects its ability to supply goods or components to other businesses, it can cause disruptions throughout the supply chain. These disruptions can lead to delays, additional costs, and lost opportunities for all involved. Companies that suffer from frequent or prolonged downtime may be perceived as less reliable or trustworthy in the market, which can affect their long-term growth prospects and profitability.

The researcher recommends creating a new caps-stack station with two holders for caps containers, one on either side of the table. This new station can accommodate up to 16 caps containers, compared to the current station, which can only hold 2. The new holders will be capable of rotating 360 degrees, allowing the operator to access any of the 16 containers without leaving the station. With this improvement, operators can retrieve necessary caps more efficiently and conveniently, reducing changeover downtime and eliminating unnecessary movement related to caps changeover.

4.Conclusion

To ensure efficient production, monitoring and optimizing processes to reduce unplanned downtime and eliminate motions is essential. One effective way to achieve this is by prioritizing the implementation of Lean principles and continuous improvement strategies. Investing in employee training, ergonomic design, and automation technologies is also essential to minimize the negative impact of downtime and motions on profits. The respondents also suggested different ideas to reduce unplanned downtime due to caps changeover, such as preparing in advance, maintaining a full inventory, increasing the number of containers, and ensuring caps are easily accessible. Contact the line if falling behind.

4.1 Achievements

Efficiency is crucial in business; eliminating any activities that waste time without adding value is essential. A study on the impact of I/L changeover downtime in manufacturing found that eliminating this downtime could save the company revenue, increase revenue, and meet customer demands. The helium and vision department experiences high unplanned downtime of 32 hours per month, with 2.1 hours due to caps stack changeover. The area loses more than 121 parts per month due to caps changeover activities, translating to approximately $273375 per month.

The new I/L and caps stack design will increase the number of caps containers on station from 4 to 8 or 16 containers based on the station the way the operator could reach all caps under 5 seconds. By implementing the improvement plan, the line will eliminate unnecessary movement the offline operator and others used to do during changeover time by 100%. Eliminating the motion will increase offline performance and line productivity. This project will help the line to save more than 1458 parts per year and increase the company revenue about $3,280,500 per year by eliminating 90% of the root causes of unplanned downtime due to caps stack changeovers.

4.2 Limitation

The approval process for survey forms and questionnaires was slow, causing delays in the project's execution and completion beyond the planned schedule. Additionally, during downtime data collection, operators sometimes failed to correctly complete forms due to a lack of motivation or misunderstanding of the project's objectives. To address this issue, ordinal worksheets were used.

4.3 Future work

There is room for further improvement by reducing or eliminating other factors contributing to downtime. Reducing maintenance or preventing machine downtime in the automobile industry can increase productivity and revenue. It currently accounts for over 40% of all downtime, but reducing it to 20% or less would have a significant positive impact.

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