

APPLICATION OF QUALITY TOOLS AND ROOT CAUSE ANALYSIS

- University of Wales Trinity saint David
- Quality and business improvement
- ACMA4004
- Will Holmes
- 2015755

willholmes992@gmail.com

FSG TOOL & DIE

Contents

1.0 Introduction	2
Context:.....	2
2.0 Findings	2
Review of Techniques	2
Lean principles	2
The Value Stream	3
Muda	3
What is Muda?	3
The Issues.....	3
The study approaches	5
Stage 1: Project Design	5
Stage 2: Data collection	5
Stage 3: Data analysis	7
Improvements.....	7
Stage 4: Action Plan	8
Manufacturing the components.....	9
Stage 5: Data Analysis/comparison of impact of new process.....	9
Stage 6: Results.....	12
3.0 Conclusions	13
4.0 Recommendations	13
5.0 Bibliography	14

1.0 Introduction

Context:

As part of HNC engineering qualification coursework a study was undertaken on quality tools to investigate manufacturing operations; and to support the implementation of continuous improvement measures in the workplace. As part of the practical study, a piece of equipment (machine press) and process were identified from the workplace that had the potential to reduce defects, improve safety and quality standards.

This report includes:

- the literature review undertaken for the project.
- summary
- findings and analysis of the impact of the new process put in place
- changes in productivity and potential improvements to health & safety and
- efficiency measures which have been captured.

The machine study was chosen because several people in the workplace have first-hand experience working on the press. The press is a relatively new piece of equipment which has been installed in the company for around 1.5 years and to date does not have an efficient waste management/ disposal process.

The aim of the study was to review the existing process and introduce a new system which will seamlessly improve all aspects of the press operation minimising hazards and risks associated with the process which are discussed further on in the study, making its use more productive, safe, and efficient.

2.0 Findings

Review of Techniques

Lean principles

From undertaking the literature review and with relevance to the study area and chosen workplace project, several techniques and principles have been identified. These include:

Lean principles, 5s and Six Sigma. According to (Bicheno & Holweg 2016) “lean is about moving ever closer to uninterrupted flow in the sequence of operations that deliver perfect quality”.

The three main principles of lean are:

- Waste reduction

- Value enhancement
- People involvement

These three principles formed the initial focus of the study.

The Value Stream

There are three types of activities in the value stream – one kind adds value, and the other two are “Muda” (the Japanese word for waste)

Muda

What is Muda?

Muda describes a wasteful process or activity is “something that adds no value”

Muda concentrates on any activity that consumes time, resources or space but does not add any value to the production or service. (Womack & Jones, 1996) authors of lean thinking argue that a lean way of thinking allows companies to “specify value, line up value creating actions in the best sequence, conduct these activities without interruption whenever someone requests them, and performs them increasingly efficiently.

This statement leads to the five principles of lean thinking: Value, Value Stream, Flow, Pull and Perfection. The study was initially based on the 3 main principles of lean which informed the first part of the data collection process. In addition, looking at applied Muda principles to the study which increasing output and improving efficiency. Reducing waste is essential in making processes more efficient.

The study examined the waste from the process and according to Muda activities that do not produce value and are unnecessary are classed as waste. These are what need to be reduced and eliminated to make the production line more efficient.

The Issues

The main issue with the press is that there was no procedure in place for waste management when the machine was first commissioned. This resulted in several problems that have not been addressed to date.

Some of the issues that have resulted from a lack of waste management process can be seen in the photograph below:



- Housekeeping standards are hard to maintain when a coil of foil is unravelling onto the floor. The work area is maintained by a single operator on the press. This could potentially lead to hazards, such as excess foil material discarded on the floorspace around the machine and operator.
- Build-up of excess foil also causes jamming and interference with the tooling within the press, causing improper castings and trays. This also results in wastage. This causes production to halt for at least 5 minutes at a time, losing time, money and material as unnecessary waste is pulled through to clear the problem.
- Maintaining a safe working environment is problematic. When clearing the excess as the operator must cut the foil by hand with a knife underneath the press, this is unsafe and undertaken without supervision as it is a sole worker on the press at any one time. Due

to the nature of the material any handling causes potential risk for injury. “Measures to control risk will vary depending on the task. Reduce the risk of injury from hazardous manual handling operations you cannot avoid. Where possible, provide mechanical help” (HSE.gov.uk)

The study approaches

The improvement project was scoped out and permission sought from the team-leader prior to undertaking the study to review the current process and make recommendations for improvement. Below are the stages of the project.

Stage 1: Project Design

In this step collecting data on the production process and waste management system of the press.

This includes:

- Build-up of foil causing improper shape to the foil tray
- Skips used to dispose of waste foil
- Foil waste cut by hand
- Clean-ups due to foil being dispersed across the floor
- Regular maintenance issues, jamming/alignment problems
- Time wasted due to machine stoppage caused by foil build up

Stage 2: Data collection.

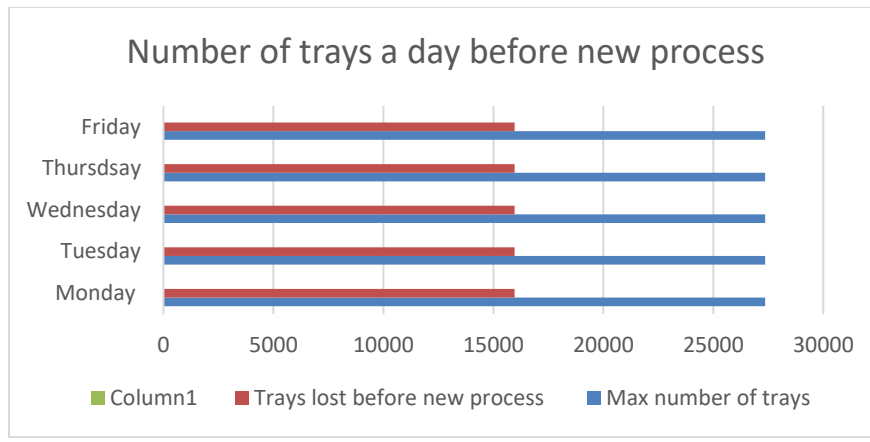
After observing several issues and interviewing the other operators to obtain qualitative data to inform the study; this was combined with the desk research on the quantitative data research. The study was carried out over a one working week (5 days) with four operators, the results are shown below:

Data Table 1 (initial study)

Equipment	Worker	Mon Am-Pm	Tue Am-Pm	Wed Am-Pm	Thurs Am-Pm	Fri Am-Pm
Press machine pushing foil trays	A	    				   
	B		   		 	
	C		 	  		   
	D	  			  	 

Key for Data table 1

Hazards/issues	Description	Value of each symbol
	Build-up of foil causing improper shape to the foil tray	1
	skips used to dispose of waste foil	1
	foil waste cut by hand	26
	Clean-ups due to foil being dispersed across the floor	1
	Regular maintenance issues, jamming/ alignment problems	1
	Time wasted due to machine stoppage caused by foil build-up	(40 mins per day)



Stage 3: Data analysis

The data shows, That the skips are changed 3 times a week, the amount of times foil is cut by hand 260 times during the 5-day period, regular maintenance and problems occur 3 times a week. Foil build-up causing issues such as stopping the machine or improper trays happens 7 times a week and shopfloor clean-ups occur 8 times a week. The data also captured the number of trays which were lost due to being defected therefore not recorded. Compared to the maximum trays possible within a working week.

Each time the foil is cut, it takes an average of 10 seconds. This multiplied by 260 times over the 5-day period is 2600 seconds or 43.33 minutes every week and a total of 37.5 hours over the year.

Improvements

Many aspects of the system can be improved upon, for example the number of skips used per week. If the waste material was compacted more material could fit in each skip, therefore saving the number of skips used per week.

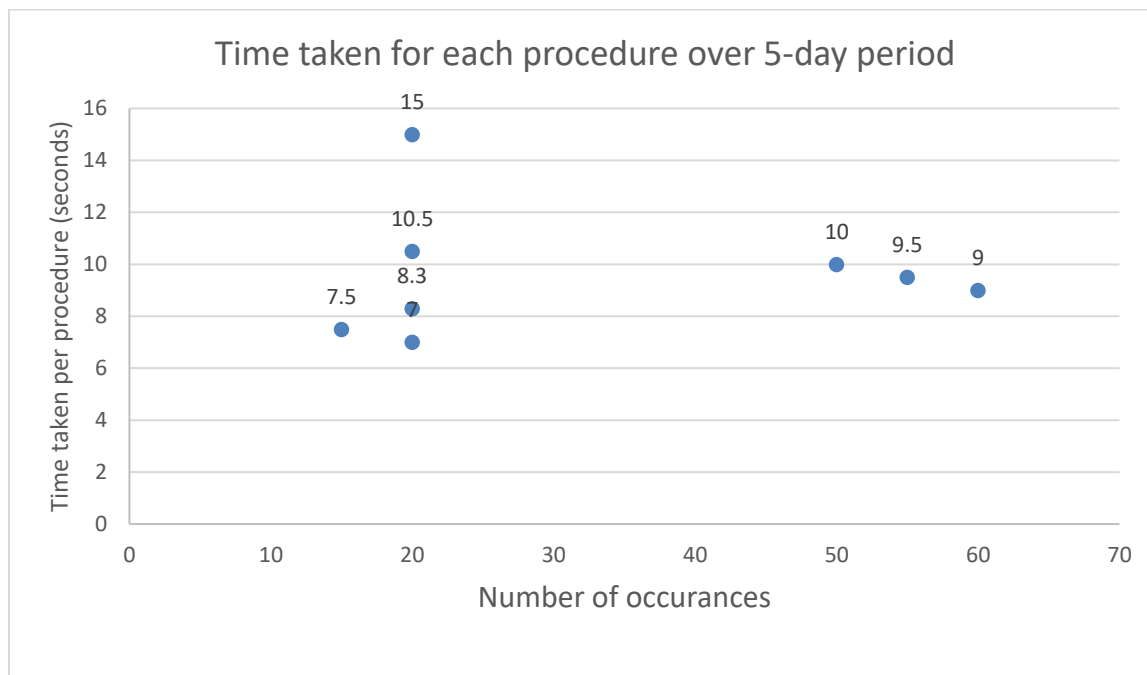
A very unproductive process is the cutting of waste material by hand which is very effective but inefficient and unsafe whilst also having a health and safety risk.

The data shows this process is repeated 26 times every half shift. This can also have other negative effects on the production of the press as it can cause time being wasted due to machine stoppage caused by foil build up. On average 40 minutes per day are spent solving this problem alone.

The number of clean-ups which occur day to day due to foil waste being on the floor, and build-up of foil causing the incorrect shape to the foil trays.

Other problems which have been noted are the number of times the machine has been stopped for regular machine maintenance which occurred on Monday morning by Worker A, on Wednesday afternoon by worker D and Friday afternoon by worker C. Although this does not show any pattern it indicates a deeper problem causing the machine to have these maintenance issues regularly.

Another significant issue identified from the data is the amount of wasted production time and material due to not having an effective process for the disposal of the waste material coming out of the press. For example, build-up of foil causing improper shape to the foil tray occurs twice through the 5-day week. And time wasted due to machine stoppage caused by build-up of foil, which occurred 5 times during the 5-day week.



Scatter graph showing number of times foil was cut by hand and the time it took to complete the task in seconds.

Stage 4: Action Plan.

- Researching possible designs to have a variety of ideas to ensure the best possible solution is selected and used as the working process on the machine press. Also researching the different types of material which would be suitable for such a design and what was available in the workplace.
- Drafting up several drawings of different designs and sizes

- Finalising the design, material, and dimension size.
- Creating the design, acquiring all the necessary materials and equipment,

Manufacturing the components

- Plates were machined which would act as stops for the material. This was done by fly cutting two pieces of PTFE until the two pieces identical in width, following this machining a bar of aluminium and drill and tapped both ends so it could attach my stops and a handle. This was machined on the lathe using an aluminium cutting tip and regular steel series drills, then going onto machining two smaller rods to act as rests so the component could freely rotate allowing the bar and stops to do their jobs. The last step was creating two V blocks for holders to ensure it would not slide off or come out of its fixed position. This was achieved by firstly sketching out my v shape with a marker and a scribe. Then using a 45-degree set-piece and stop, Machining could begin. Using an aluminium cutter, taking the cutter to my marking out and repeated the same procedure for the other v block. Once all components were finish machined, using some grub screws to hold the rods and bar together and a cap head screw on the end of one side and a handle which was used from an old machine on the other side.

This design is easy to use ad can be setup and taken down and stored within a couple of minutes.



Stage 5: Data Analysis/comparison of impact of new process.

After reviewing the performance of the product and collecting the new data we can see the difference between the old and new process. Below is a table of the same data collected for the first process.

Data Table for new process

Equipment	Worker	Mon Am-Pm		Tue Am-Pm		Wed Am-Pm		Thurs Am-Pm		Fri Am-Pm	
Press machine pushing foil trays	A										
											
	B										
	C										 
	D										

Key for Data table

Hazards/issues	Description	Value of each symbol
	Build up of foil causing improper shape to the foil tray	1
	skips used to dispose of waste foil	1
	foil waste cut by hand	26
	Clean-ups due to foil being dispersed across the floor	1
	Regular maintenance issues, jamming/ alignment problems	1
	Time wasted due to machine stoppage caused by foil build-up	(40 mins per day)

After implementing the improvement for a full working week (5 days) we can see that the problems that occurred daily for worker A-D have significantly reduced. This shows that the improvement that was put into place had a positive impact on the hazards and issues at hand whilst operating the machine press.

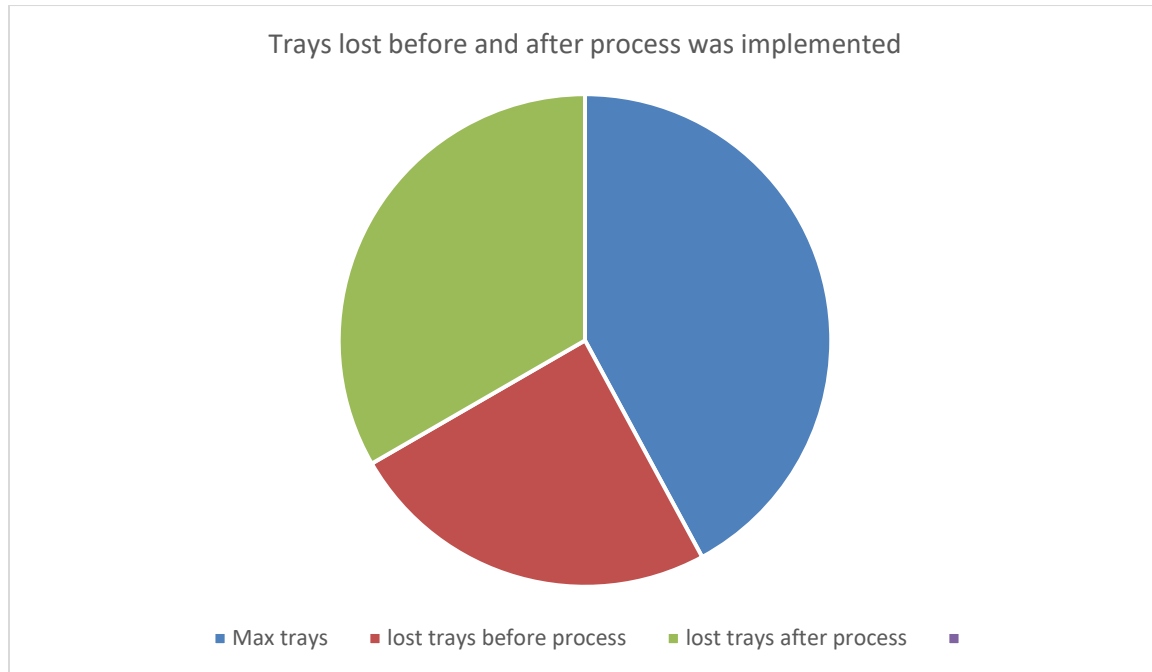
The number of skips used during a working week has reduced from 3 to 2 as the way the waste is compacted saves space each time a deposit of waste material is deposited into the bins. With new systems place skip usage is reduced by 33.3%

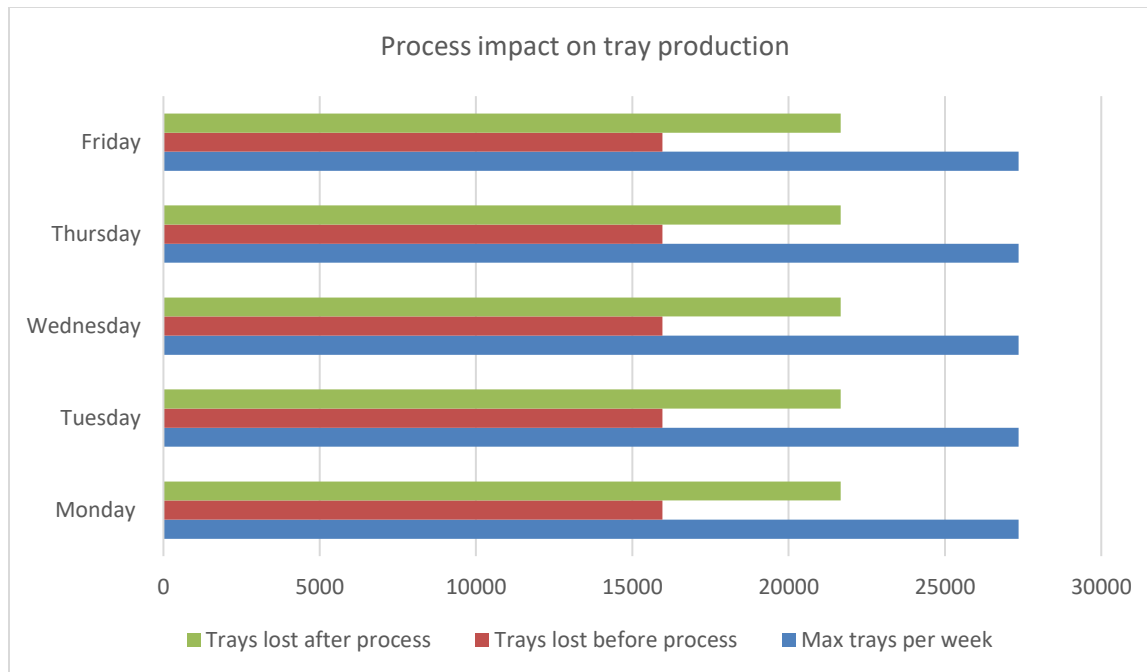
The process of cutting the material has been eliminated as it has been replaced by the improvement which saves time and reduces the risk of any injuries such as cuts and trips due to sharp edges and debris on the floor. Time being wasted because of machine stoppage caused by foil build up and foil build-up causing improper shape to trays has also been eliminated as the new improvement eliminates the problems of foil waste causing any further issues other than being waste.

Problems such as regular maintenance issues are inevitable as these problems are with, the system itself or the software within the press.

The number of clean-ups has also been reduced due to no excess material being stranded all over the floor, which has reduced the clean-up to Monday morning and Friday afternoon.

Stage 6: Results.





3.0 Conclusions

After collecting all the necessary data for the study, being able to see the impact on having an end-to-end process. From the data you can see that after the new process was implemented, the number of issues documented by the 4 workers was significantly reduced. As seen in the second chart the number of trays that were lost in production were lowered dramatically going from 11,400 to 5,700. The health and safety risk has also reduced as no manual handling is done within the new process. To conclude the result shows that all areas have been improved upon this includes:

- Reduction in waste
- Elimination of manual handling
- Improved productivity/ efficiency
- Less product failures

4.0 Recommendations

From the findings of this study the recommendation would be to implement the solution proposed to minimize waste and therefore improving efficiency, as outlined by “Muda”. Further improvements include, re-thinking the design and incorporating an automatic feed, such as a limit switch. This will ensure when the waste material is slack the feed wheel will turn on and reel the foil in and once it is under tension, turn itself off. Continuously reeling the foil without causing any interruption to the production line.

5.0 Bibliography

John Bicheno & Matthias Holweg (2016)

The lean toolbox 5th edition

Published by Production and inventory control, systems and industrial engineering (PICSIE) books

Womack and Jones (1996)

Lean thinking

Published by: Simon and Schuster, New York

James.P.Womack, Daniel.T.Jones and Dr.Daniel Roos (2007)

The machine that changed the world

Published by: Simon and Schuster

Liker J (2004)

The Toyota way Published by:

New York: Mc-Graw Hill

HSE.gov.uk, 2021, Manual handling at work. <https://www.hse.gov.uk/msd/manual-handling/reduce-risk-injury.htm> 15/1/21