



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

CHARGE MAKE-UP

MANUFACTURING PROCESS

– REPORT

Module: Lean Six Sigma Manufacturing Strategies

Module Code: M6X00466

Gareth R Francis (1707331)
1707331@student.uwtsd.ac.uk

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT

Contents Page

Table of Contents

Contents Page	1
1.0 Abstract	2
2.0 Introduction	3
3.0 Consideration of the Types of Waste in the Process	4
Transportation.....	5
Inventory	6
Motion.....	7
Waiting	8
Over Processing.....	9
Overproduction	10
Defects.....	11
4.0 An Analysis of Value From the Customer’s Perspective	12
5.0 An Evaluation of How the Process Could be Leaner.....	14
6.0 A Consideration of Potential Problems, Costs and How the Problems Could be Overcome	16
References	18

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT**1.0 Abstract**

Wall Colmonoy's charge make-up area subjected to Muda, which is a Japanese word for waste or wasteful activities. The reports look at the seven types of wastes identified in the charge make-up area by using the acronym TIM WOOD, which stands for Transportation, Inventory, Motion, Waiting, Overprocessing, Overproduction and Defects. The waste determines the inefficiency of transportation of raw material from one factory to another. The cost associate with holding stocks to the organisation generated £900k of raw material to the Profit and Loss. Motion of physicality of the charge assembly role.

Value added and how the customer perception of what generates value discussed. The value-added process is when a customer is knowing that an organisation has their best interest above all others and that they come first. This is not necessary down to external customer but also internal customers such as subsequence processes.

The use of six sigma tool to eliminate the seven wastes that was identified in Muda. Tools included 5S, SMED (Single-Minute Exchange of Dies) and JIT (Just in Time). Also, introducing an ERP (Enterprise Resource Planning) system. This is not a lean six sigma tool but could potentially eliminate all seven types of waste. All these processes could come with problems such a change of culture whereby people are stuck in their ways and against change, resource of personnel, such as skills to carry out lean methodology resulting in need of external source.

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT

2.0 Introduction

This report will review the different types of wastes identified in Wall Colmonoy's Charge Make-up area, what creates value in the customer eyes, how to make the charge make-up area leaner from the wastes identified and the potential implication of problem identified.

Wall Colmonoy is a global leader in Nickel, Cobalt and Iron based powders and castings manufacturing, which is commonly used in industries such as Aerospace, Automotive, Glass Container, Oil & Gas, Mining, Waste to Energy and many others (Wall Colmonoy, 2020).

Charge make-up is found at the beginning of both the powder and castings processes. The area accommodates all types of raw materials required to manufacture Wall Colmonoy's product portfolio. The chemical composition of all products is deemed a critical requirement as the development on the product defines its properties in both Physical & Mechanical a key characteristic required by the customer for their application.

The Charge Make-Up process is responsible for ensuring that the correct materials and its quantities have been formulated and assembled to meet the chemical composition of Wall Colmonoy's products. The required products needed are scheduled into the production plan via the production scheduler. This role is responsible of ensuring customer orders and demand are met on time and in full to their desired delivery date. The production scheduler is responsible for imputing job orders onto an internal designed software called MAMS (Metal Alloy Management System) this would include product type, number of melts required to meet customer quantity and the route of manufacture. MAMS orders permit the charge make-up formulation operator to begin the formulation process. Thus, means using raw material chemistries and revert type materials such as powder known as Oversize

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT

and Fines or cuts off from the fettling process in castings to reduce the metal cost going in to manufacture cost and to reduce inventory.

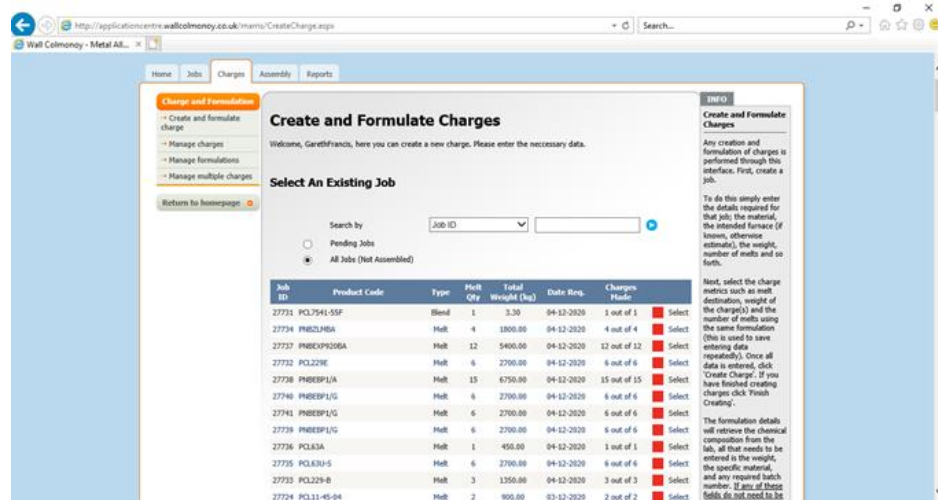


Figure 1 - Metal Alloy Management System

3.0 Consideration of the Types of Waste in the Process

A review of the charge make-up area is found to have many types of wastes inherent in the process. By using Lean Six Sigma name Muda, which is a Japanese term for “waste” or “wasteful” activities, which contradicts the value addition of a product. Organisation such as Wall Colmonoy should aim to eliminate all unnecessary wastes. However, these are some necessary wastes like transport, minimum inventory etc. These necessary wastes should be identified and minimized, targets should be set for upper limit and tracked.

To identify the different types of waste found in the charge make-up process, the use of tools such as TIM WOOD, which is an acronym that considered the seven types of wastes. This translated to, Transportation, Inventory, Motion, Waiting, Overprocessing, Overproduction and Defects. The adoption of this tool considers all types of potential wastes currently being carried out on a day-to-day basis of the manufacturing process for the assembly of powder and castings charges.

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT

In the below sections each key types of wastes will be categorised, and example of the current process being adopted by Wall Colmonoy within the Charge Make-up department.

Transportation

Wall Colmonoy have three plants in different locations but located on the same industrial estate. Darren House is located 500 meters from the main building on Canal Side. This is where the Precision Components department is located. The charge make-up department is situated on Canal Side, which is the main building that houses the powder and castings departments and the good inwards area. Opposite the main building, which is separated by a public road is the brazing products and maintenance department. This building is known as Riverside. The significance to these buildings is the fact the charge make-up department store all its raw material in the Riverside plant.

The poor storage location of Raw Material comes to fruition when the Charge Assembly comes to the end of the desired raw material quantity. For example, when Nickel is delivered at good inwards, they transport the raw material over to the Riverside plant via a Forklift and store over there. However, the next time Nickel is required for replenishment and to assemble the next charges, the operator must use the forklift and drive to Riverside factory.

Due to having the raw material in the opposite factory whereby the material is being used, there are multiple wastes within the process occurring. The losses include significant loss of manufacturing output, as a person is required to travel significant distance to retrieve desired raw material. The charge assembly operator is also conducting multiple trips from Canalside to Riverside without any loads. The raw material has the potential to be damaged on return to the factory, as this material can be subjected to poor weather conditions such

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT

as rain or cold temperatures. The damage can include moisture ingress to raw materials causing potential defects in castings such as out gas porosity and damaged packaging resulting in loss of material being scattered across the public highway. Additional factors not included in the process waste is that a person is driving a forklift on a public highway, which has significant safety concerns as the forklift shares the public road with automobiles.

Inventory

Wall Colmonoy hold significant Raw Materials and Revert stocks, that are not always required for use. This is due to several reasons, this includes, poor sales forecasting, fluctuating sales demand, poor inventory & re-order systems and obsolete raw material purchase as part of poorly managed new product introduction.

Wall Colmonoy generated sales turnover of £34 Million for 2019. Currently the forecast for 2020 is approximately £27 Million due Covid-19 pandemic, which is down £9 Million for budget and £7 Million down from 2019. The focus of inventory such as raw material, consumables and finished stock has come under the microscope. Wall Colmonoy current have £5 Million on their books of non-moving material. Charge Make-up currently hold £900k of raw material and this is even with large volume orders on consignment basis. This value has been determined from the November stocktake.

There is clearly too much raw material inventory at Wall Colmonoy and as December is a low volume month due to reduce working days and shipping restrictions, the costs to the business will go into the new year of 2021. Only essential raw material is to be purchase now. This is down to no formal minimum and maximum order levels and total inventory control. This is even with a stocktake each month. There also no FIFO (First in First out) process, this could result in damaged material. There is no process of ordering raw material.

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT

It is down to the Production Scheduler to sort out the stock on hand and determine how much and what type of raw material is required to meet customer demand. This can increase lead time to the customer or even lose orders due to not being able to meet desired delivery time set out by the customer.

Motion

The charge make-up area is a relatively manual handling area, with gantry cranes being used to support with lifting of large quantities of powder hoppers, that is used as revert and to transport the charges to Atomising area. Forklifts or Power Pallet Trucks are used to move castings charge to the foundry area. However, there is a significant burden on charge assembly operators in terms of manual handling. Raw Materials are purchased in many forms such as pellets, billets, cathodes, sheets and so on. The larger quantities of raw materials such as Nickel, Nickel Boron, Silicon, Chromium, Carbon and Cobalt are “hand balled” out of large hoppers via shovels or bucket. This leads to bending and stretching resulting on many strains to body parts.



Figure 2 – Silicon Containing Hopper and Decanting Tools

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT**Waiting**

The charge make-up department is at the beginning of the powder and castings manufacturing process. The powder manufacturing process has four atomising towers and castings having numerous furnaces for their Investment, Centrifugal, Sand and Vacuum Castings processes. All these methods melt down raw material and transform into saleable finished product. However, all these processes have different capabilities and allowable furnace quantities. However, they do share a common issue which is downtime.

Planning for the desired number of charges at the right time is challenging at times. There is little system to support the usage of raw material and its remaining quantities available on the shop floor. Due to this, downtime can occur, as charge assembly operators must replenish low stock levels. There are however knock effect to the powder and castings department due to this.

Downtime can vary from 20 minutes or 16 hours. For example, Nickel can be replenished in 20 minutes during the daytime working hours of 7am to 3pm. However, if Nickel runs out past 3pm, the Riverside plant is closed, due to their working hours. This can result with a 16-hour downtime. This can be mitigated if a select few of the maintenance department personnel are on site, that can open the factory up to permit entry for charge make-up operator to retrieve raw material.

Downtime is a significant problem and as it is associated with cost, due the production scheduling plan being developed to meet customer demand. By having downtime this can result in not meeting external customers required delivery time, not only on the material that was awaiting charges but the complete furnace campaign, the internal customer.

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT

Over Processing

The powder sieving manufacturing process has a relatively low yield process. Wall Colmonoy on average produce products with yield of approximately 40%, thus meaning 60% of the product produced is revert, that is then re-melted due to not meeting customer Particle Size Distribution requirements.

Re-Melting of the products therefore reduces the manufacturing costs, as up to 90% of revert can be used to assembly a single charge, with the remaining 10% made of raw material. Due to this, there is a significant focus on re-using as much revert on hand as possible. However, this burden, leads the Charge Formulation operator to use as many revert material as possible, meaning there could be only one revert material added. This is desirable to both manufacture throughput and capacity and reduce the potential of defects. However, there are instances whereby eight to ten different types of materials are being used to assembly a charge. This results with slow cycle time due to the number of materials added to create the charge and due to time taken to complete the relevant Melt Specification Sheet document that is required to be filled out correctly and accurately. The documentation includes requirements such as batch numbers, quantities and person responsible for assembling charge. Additional to the manually inputting of data onto the Melt Specification Sheet the operator inputs the same information on to MAMS (Metal Alloy Management System) to confirm the charge has been completed.

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT**Overproduction**

Overproducing of charges occurs regularly with the castings department due to poor management of product requirements and not planning what furnaces are to be used.

Therefore, what type of raw materials is required to manufacture the desired product.

Charges are formulated due to a formal request on MAMS (Metal Alloy Management System), whereby a date required is entered to when the charges are required by castings.

The below figure was taken on an afternoon shift where castings charges are visible, waiting for melting.



Figure 3 – Castings Charges Hold Area

There are five hoppers visible in the figure above containing 300Kg, waiting for melting down to the required product. There is also a pallet holding six kegs, all of which are containing 20Kg each. The overproducing of these charges comes to fruition as the castings department do not melt during the afternoon shift, thus resulting in 1,620Kg of raw material being produced without the capability of melting due to no manning. Charge make-up operates five days a week to fall in-line with either castings or powder departments.

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT

Defects

As previously highlighted, charge make-up is a manually orientated process, which is heavily reliant on human interaction. There is little in the way of systems such as barcoding or “go, no go” to support an operator. There are however many procedures and work instruction that the operators must follow, but defects do occur. Many of the defects occur undetectable until the powder or castings has been analysed in the Laboratory, which is a significant problem, as this results in customer dissatisfaction, cost implication due to manufacturing, people and re-creation of material.

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT

4.0 An Analysis of Value From the Customer's Perspective

Value added (VA) is a process that adds value to a product or service that customers are prepared and willing to pay for. Non-Value Added (NVA) is an activity that does not add value to the product that a customer is unwilling to pay for. However, is essential for an organisation to complete the value-added tasks (Gupta, 2005).

The perception of what creates value to the customers is knowing that an organisation has their best interest above all others and that they come first. This is not necessary down to external customer but also internal customers such as subsequence processes (Lean Sensei, 2020).

Value-Added Activities can be categories into many types. However, to be considered as genuine value-added activities a modification from raw material into a finished product. This can be a problem for the organisation selling if poor process control result in defects, therefore, re-work can reduce bottom line for the organisation. However, the customer is still paying the same price for product. Value for money is another factor, customer need to feel that what that they are paying matches the quality they are receiving.

An incorrect perception of value-added step is Inspection. Inspection is a Non-Value Added process but deemed a necessary requirement to ensuring reduce risk of defect. For example, at Wall Colmonoy there is a laboratory inspection conducted of incoming raw materials. This must meet the defined internal purchase specification. The properties requirements include the form and dimensions of raw materials and its chemical composition. This part of inspection is deemed critical to quality to Wall Colmonoy's processes of manufacturing both powders and castings. Without this inspection process being carried out, Wall Colmonoy would not be able to control the inputs in terms required

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT

chemical composition. The resultant output could result in finished product failing to meet customer requirements. Even though the incoming raw material is deemed critical to quality for Wall Colmonoy, this activity is still deemed as Non-Value Added, as the customer does not pay extra for carrying out this requirement. The necessity is part of the control function of Wall Colmonoy's processes to ensure compliance to the customer requirements.

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT

5.0 An Evaluation of How the Process Could be Leaner

After identifying the seven types of wastes inherent in the charge make-up area, there is an argument to present the findings to the departmental manager and senior leadership team, that the charge make-up area can become more leaner in its operational function.

Using lean tools such as SMED (Single-Minute Exchange of Dies) could significantly improve the Waiting and Inventory wastes. SMED is a system that reduces the changeover time of processes and equipment to a single digit. For example, less than 10 Minutes. The introduction of a successful SMED program would benefit charge make-up due to the requirement to use smaller batch sizes. The improvement would include the following:

- Lowering the inventory.
- Improve the responsiveness of customer demands due to scheduling flexibility.
- Lower manufacturing cost due to faster change overs.

Additionally, all seven wastes could be eliminated with purchasing of new system such as ERP (Enterprise Resource Planning) that operates throughout the organisation. This will optimise production planning to fulfil customer needs, to improve stock management, eliminate overproduction when material is “ordered” but no requirement.

However, JIT (Just in Time) could also be a beneficial method that minimises inventory and increases efficiency. This method would also help with cost of inventory as Wall Colmonoy would not hold any stock, thus meaning no money is tied up in inventory, regaining storage space over in the Riverside plant and reduce the potential for damaged material to occur to no FIFO method being adopted and to increase quality of finished product due to not

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT

needing to be transported in differing climate conditions. JIT can be categorised by two types:

- Pull System – Which is a system of controlling material that is used to signal to the maker or provider that more material is required.
- Push System - A system of controlling materials makers and providers make or send material in response to a pre-set schedule, regardless of whether the next process needs them at the time.

Transportation of raw material to the Riverside factory that is located opposite to the charge make-up area provides significant inefficiency. The inefficiency can increase other types of wastes such as waiting, due to downtime and increasing cycle times resulting in a bottleneck. Therefore, to make the process leaner, the use of Process Layout would be worthwhile and improved production scheduling of material required, yet JIT could eliminate this requirement.

Motion is difficult to eliminate as charge make-up is a manually orientated processes. Most of equipment to do the tasks are in the location. However, 5S exercise would be beneficial to Sort, Straighten, Sweep, Standardise and Sustain the area. This process will ensure the correct tool are always available to carry out required task. 5S auditing would be a beneficial if completed to ensure area be sustain to desired levels.

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT

6.0 A Consideration of Potential Problems, Costs and How the Problems Could be**Overcome**

The main issue with making the charge make-up area leaner would be cultural and resource. People become complacent and set in their ways. To change the way of working would need significant evidence. To overcome these problems the use of the DMAIC methodology would give a clear plan of defining the waste, measuring the efficiency of the process, analysing the effect of the process, how to improve the process and to control the process. The benefit is ultimately to benefit both internal and external customer. By becoming leaner and agile in day to day running of an organisation, this will drive cost down, improve cycle time therefore increasing capacity and increasing job security.

The other issue highlighted is resource, this is down to personnel, systems and cash. Wall Colmonoy do not have many trained personnel familiar with Lean Six Sigma methodology. To get this type of resource either an investment is required internally to train personnel to gain an understanding or to outsource personnel such as consultants implement change. All these requirements need capital investment.

Wall Colmonoy are in serious need of an ERP system. This is not necessarily a lean 6 sigma tool. However, this type of system would eliminate many of the issues highlighted in the charge make-up area. Basic introduction of barcoding and “go no go” scanning method that permits material from being added into charges would revitalise the area. This would support the operator, reduce defects and improve quality. However, the cost of an ERP system is around £750k, therefore a significant capital investment. Could a justification to purchase this system come from using the Muda and the seven waste?

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT

Just in Time would be a great addition to Wall Colmonoy. However, this relays heavily on building good relationships with supplier to ensure when required, the raw materials would arrive “just in time” when a product is required to be manufactured. This method would be desirable to the finance director but could be a logistical nightmare for the purchasing manager.

CHARGE MAKE-UP MANUFACTURING PROCESS – REPORT

References

Gupta, P. (2005). A Statistical Guide to Optimizing Results. In P. Gupta, *The Six Sigma Performance Handbook* (pp. 435-436). New York: McGraw-Hill.

Lean Sensei. (2020, December 1). *Value Innovation: Value from the customer's perspective*.

Retrieved from Lean Sensei: <https://leansensei.com/2013/08/value-innovation-value-customers-perspective-2/>

Wall Colmonoy. (2020, October 05). *Product Capabilities*. Retrieved from Wall Colmonoy:

<https://www.wallcolmonoy.com/products-capabilities/surfacing-alloys/>