A leading Foundry Burns up *Muda*

Problem Statement:

Bright Foundries, a leading foundry in South India, manufactures castings for pumps, valves, windmills, tractors and general engineering components. Their key competitive advantages **(1)** Adapting the process for new custom-built jobs **(2)** Taking small lot orders at competitive prices, which made them a strong market player.

However, with a rise in competition from imports and increase in price of raw materials their margins started to shrink. They could not change their positioning in the market as this could result in losing their existing long-term customers. Their management felt an urge to relook at their operational strategy in order to enhance operational efficiencies and quality of their product and maintain their position in the market.

The Collaboration:

Bright Foundries decided to join a cluster under the NMCP scheme for implementing lean manufacturing. KIAP was selected to support this cluster and KIAP experts worked with Bright through their 18-month long journey in implementing key concepts of Lean.

The Lean Journey

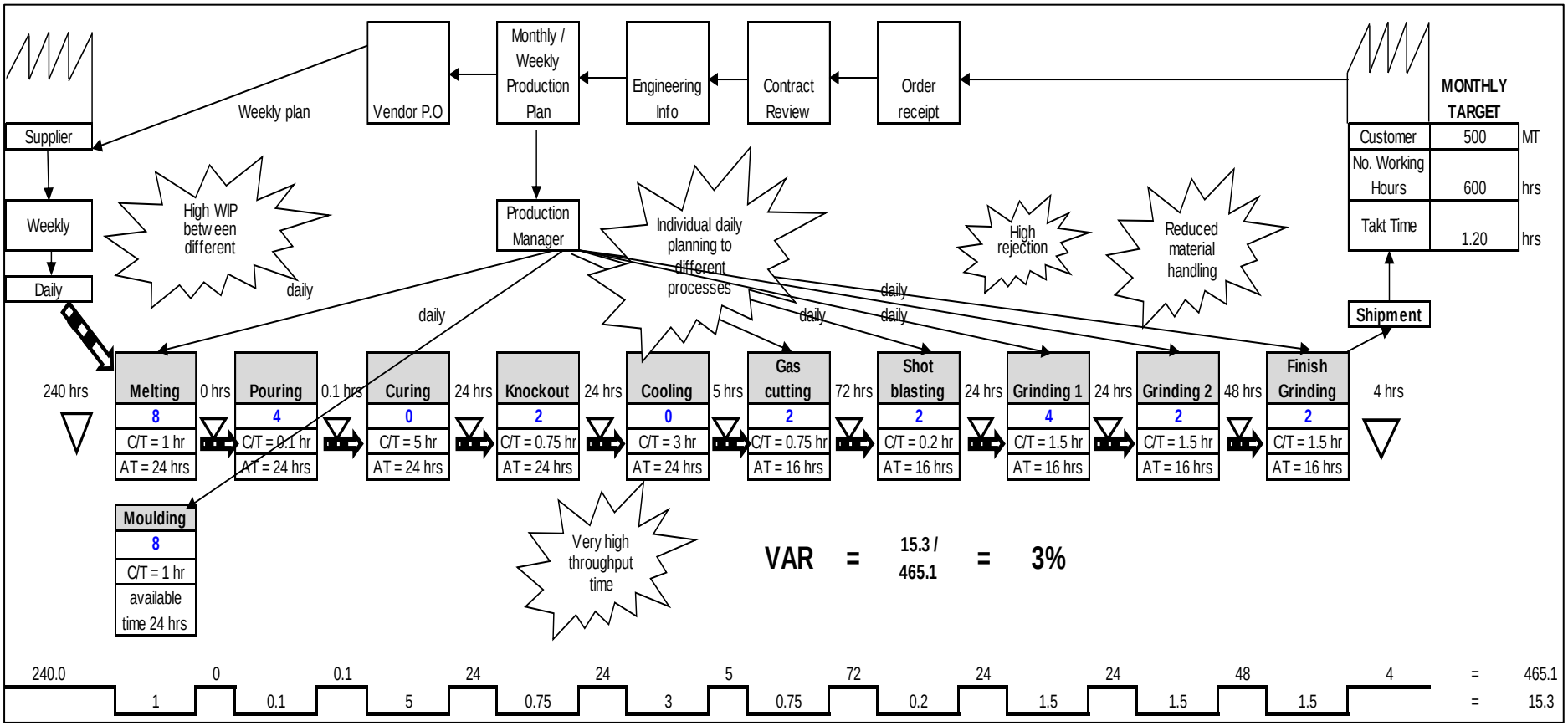
The journey commenced with a diagnostic exercise during which the processes at Bright were observed and studied under Lean paradigms of Zero Waste and Zero Defects. Bright has two major streams differentiated only by the type of mould used – (1) Machine Molding and (2) Hand molding. The overall process flow was initially mapped at the *gemba* using **Value Stream Map**depicted in the next page. As can be seen from the value stream map the **value adding ratio (VAR) was only 3%** mainly due to the high WIP between processes leading to a high throughput time.

In addition, the *gemba* walk threw up several observations of Muda (waste) and Muri (strain).

- The material flow in the entire plant is very haphazard. Multiple handling of material is observed between processes. Fettling involves four operations but every component is handled at least 12-15 times by the time the process is completed.

- Strain during knockout – operators are found working in dusty conditions in uncomfortable posture. Also, they have to move the castings manually at times by rolling or lifting the castings.

Exhibit 1: VALUE STREAM MAP OF BRIGHT FOUNDRIES BEFORE LEAN IMPLEMENTATION



The observations at the gemba and the VSM analysis provided the rationale for prioritizing the following areas for focused improvement.

1. **Fettling Operation** -The VSM shows that fettling, which is the downstream operation just prior to dispatch, is the bottleneck area. Out of the total manufacturing lead time of 8 days, fettling alone accounts for 4-7 days and there is always a huge pile of castings before this process. .
2. **Hand moulded casting** - This is generally used for large castings and has a throughput time of about 3-4 days. Physical observation showed huge inventory of prepared moulds, castings waiting for knockout, empty moulds and patterns all over the floor. FIFO was also not being followed in this area.
3. **Casting rejections** - The current rejection level of 2.6% meant an unnecessary expense of re-melting as well as loss in conversion. Hence, it was decided to focus on eliminating major sources of defects in order to avoid repeated rejections due to same reasons.

4. **Material tracking & Delivery Performance** - Each section of the factory (moulding, melting, knockout, fettling etc.) had an independent production plan. The resultant lack of coordination amongst them made it difficult to track the actual status of the material under processing against a specific customer order/ This lack of clarity meant delays in delivery schedule to the customer.

Project 1: Create Flow in fettling Area

Process description

Fettling is basically a finishing operation to remove the excess material, rough surface and protrusions that remain after removal of runners and riser from the castings. The process includes a series of operations which starts with shot blasting followed by gas cutting and series of grinding operations. The final process is finishing grinding.

Current State Observations & Measurement Plan

Based on the current customer demand, the output planned is 20 melts per day which translates to a TAKT time per melt of 72 mins.

However,it took around 5 hours to complete the fettling operations for one melt. There is a huge amount of WIP (7 to 10 days of production) piled up in between the operations in the fettling area. The key observations made in the fettling shed are listed below.

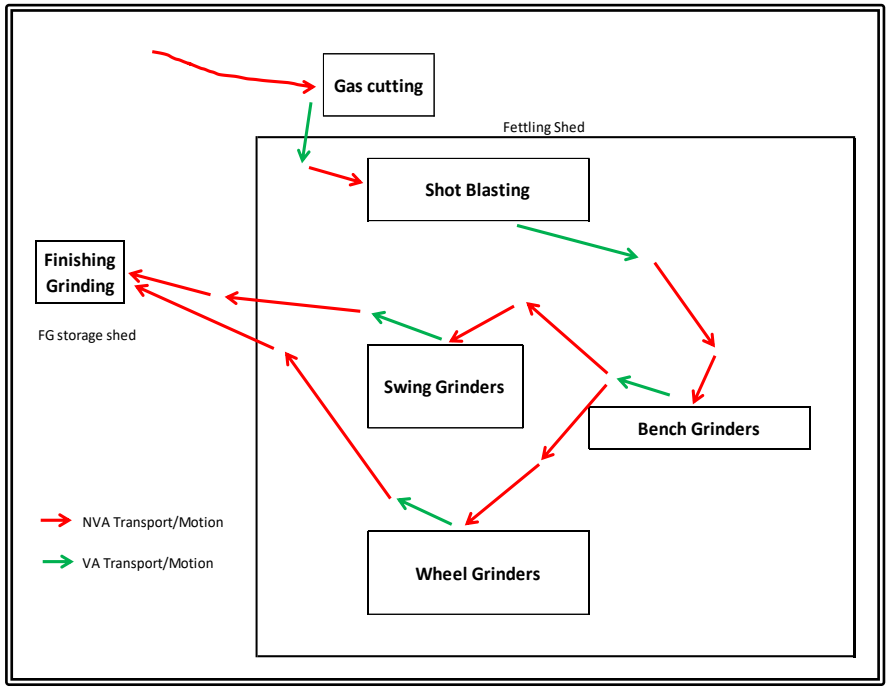
1. The layout and material movement diagram show the multiple handling of material which travels a total distance of approximately 370m.

2. Each process in fettling is working independentof the other resulting in pile up of material between the workstations. The heavycastings are moved manually multiple times between the workstations leading to heavy strain to the workmen.

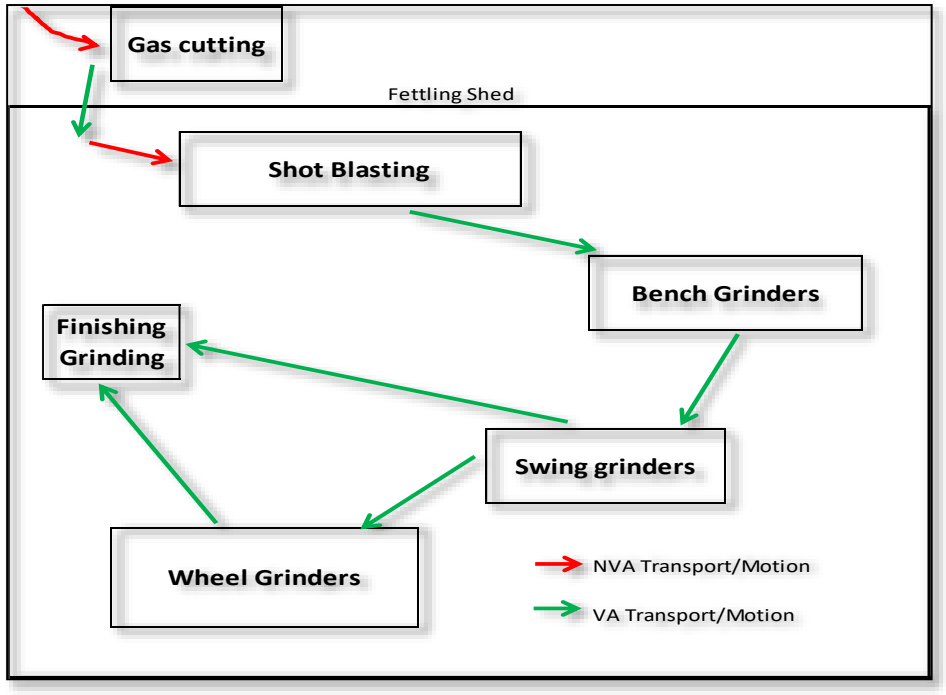
3. The operators are often seen waiting to start work because the input castings have to be transported from pervious process, As a result there is a loss in capacity and increase in lead time.
4. Components waiting for a particular process are not taken up for processing based on FIFO. Due to this, components of a particular heat are not processed together resulting in material being mixed up and not moving heat wise or order wise.

Improvement Plan

1. The layout in fettling area was modified as shown.Workstations were located next to each other thereby eliminating multiple material handling. Material handing was reduced and single piece flow was established with this layout.
2. Area was demarcated between workstations in order to have control of WIP between workstations – in box / out box concept
3. 1S was carried out in the fettling section leading to release of large amount of space.
4. The number of machines and operators was decided based on the product being processed and the cycle time of various operations in fettling. The supervisor was trained to carry out dynamic line balancing.



Layout –Earlier



After Lean Implementation

Outcomes

The throughput in fettling area increased to 350 kgs per hour against an earlier throughput of 150 kgs per hour (5 hours to complete a melt of 750 kgs)/ The establishment of flow in fettling also reduced the throughput time in fettling as well as the WIP in fettling.

Parameter	Before Lean	After lean	Remarks
Throughput time in fettling	4-7 days	1 day	82% reduction in time
WIP in fettling	7 days	2 days	72% reduction in WIP

Project 2: Reduction in rejection

A Pareto showed that a few components contribute to the bulk of the rejection rate. One of the components which had a rejection rate of 25% was picked up for improvement

Root Cause Analysis

Root cause analysis of the component was carried out. For this purpose, various parameters like pouring temperature, ladle number, compression strength etc. were monitored. Based on the rejected components and the corresponding parameters measured. According to Pareto Principle the 80% cause for the rejection should be contributed by 20% of the cause. It was observed that **lower green compression strength was the major root cause of the problem**.

Countermeasures

Accordingly process control measures were taken of regular monitoring of the compression strength within a range for the particular component. Further certain modifications in gating and cleaning were implemented

Conclusion:

The effect of the above countermeasures was a reduction in the overall rejection rate for the component from 25% to 15%.. The team was now equipped to carry out root cause analysis and work on other individual products whose rejection percentages are high.

Project 3: Production planning System implementation

Current State Observations

Production planning was not centralized. Each section carried out its own planning resulting in lack of coordination amongst the processes. There was also no system for tracking the delivery performance of the unit at the purchase order level for various customers.

Improvements made:

A consolidated database was created for all pending purchase orders. A system was then put in place for updation of every new purchase order as well as updation of every invoice / dispatch. The database was now in a position to provide the pending order list in real time and it further facilitated tracking of delivery performance of the plant.

1. Based on the database of pending orders and committed dates of dispatch, production planning was done only for the molding section which was identified as the pacemaker process.
2. FIFO system was introduced in moulding and knockout section which enabled sequencing of knockout in line with molding sequence. This eliminated the accumulation of WIP in between sections.
3. Route card was implemented for customer order tracking on the shop floor.
4. OTIF – On Time in Full system for measurement of delivery adherence was established. It is the system of tracking of comparison between dispatch date and customer commitment date.

Result

The OTIF data is a good measure of delivery dherence and the calculation of OTIF was implemented from Jan 2017.