Agile Development in Foundry to improve Quality

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Abstract

Agile development is a group of development methods based on iterative and incremental development, where requirements and solutions evolve through collaboration between self-organizing, cross-functional teams. It promotes adaptive planning, evolutionary development and delivery, a time-boxed iterative approach, and encourages rapid and flexible response to change.In Foundry, Die casting is a versatile process for producing engineered metal parts by forcing molten metal under high pressure into reusable steel molds. These molds, called dies, can be designed to produce complex shapes with a high degree of accuracy and repeatability. Parts can be sharply defined, with smooth or textured surfaces, and are suitable for a wide variety of attractive and serviceable finishes. This Paper Focuses on Applying Agile methods in a Foundry to improve Reliability and Quality.

Keywords: Agile, Die Casting, Foudry.

1.Introduction

The basic die casting process consists of injecting molten metal under high pressure into a steel mold called a die. Die casting machines are typically rated in clamping tons equal to the amount of pressure they can exert on the die. Machine sizes range from 400 tons to 4000 tons. Regardless of their size, the only fundamental difference in die casting machines is the method used to inject molten metal into a die. The two methods are hot chamber or cold chamber.

A complete die casting cycle can vary from less than one second for small components weighing less than an ounce, to two-to-three minutes for a casting of several pounds, making die casting the fastest technique available for producing precise non-ferrous metal parts.

Die castings are among the highest volume, mass-produced items manufactured by the metal working industry, and they can be found in thousands of consumer, commercial and industrial products. Die cast parts are important components of products ranging from automobiles to toys. Parts can be as simple as a sink faucet or as complex as a connector housing.

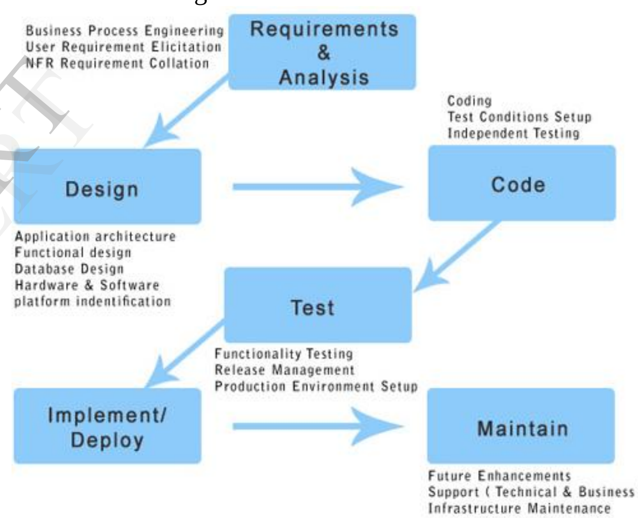

Figure 1: Agile Method

As depicted in Figure 1, the first step is Requirements & Analysis,In our Research we are referring it to Casting Requirements and specifications to be manufactured.The second step is Designing ,Here we are referring it to designing the flowchart of manufacturing process.Third step is coding, here we are referring it to manufacturing the casting as per specifications collected in step 1.The Fourth Step is Testing, Here we refer it to sink test and quality test of casting.The Fifth Step is Implement/Deploy ,i.e.Manufacturing of castings in our research.The Sixth Step is maintaining ,here we refer it to Inspections and Controlling Rejection Rate.

2.Research Methodology

Initially for 15 days, training period for understanding whole process was allotted, From Raw materials till finished Goods, every process was analysed and after understanding of complete process are preceded for fettling operations. The rejected items again used as scrap metal for melting. There are ‘n’ numbers of series operations in fettling process. After fettling process, the items are finally inspected in foundry. The accepted items are moved into the RC store inward. The rejected items are categorized into re-melting and rework items. The re-melting items are used as scrap metal for melting. The rework items are sent for fettling process again. The accepted items are later moved from RC store inward to RC store outward for further machining process. There are ‘n’ numbers of operation in machining process similar to fettling process. After the machining process is completed, the items are inspected finally in machine shop. The accepted items are given to the finished goods. The rejected items are categorized into re-melting and rework items. The rework items are sent for machining process again. The re-melting items are used as scrap metal for melting. The accepted items are the finished goods. The finished goods are sent for packaging and labeling then shipped to the final customers.

3. Die Casting Process

“Die casting is a metal casting process that is characterized by forcing molten metal under high pressure into a mould cavity”

Steps in Die casting

1. Pouring
2. Knockout
3. Removing Casting
4. Coating
5. Rearrangement

Pouring operation refers to pouring the charge into dies, where the temperature of charge is 1100-1300 degrees Celsius depending on the alloy.

Knockout operation refers to hitting of hammer to the pin of die, so that the charge takes shape of the die when cooled. Removing casing, as soon as the knockout operation is performed the casting needs to be removed from die, and needs to be kept in casting stand for cooling.

Coating operation refers to graphite coat on dies and pins to bring the temperature of dies and pins down, as well as o avoid sticking of charge to dies and pins.

Rearrangement refers to arranging dies with pins on to the die casting stand after coating operation and keeping it ready for the next die casting cycle process to begin.

The following readings were taken under closer supervision of the process.

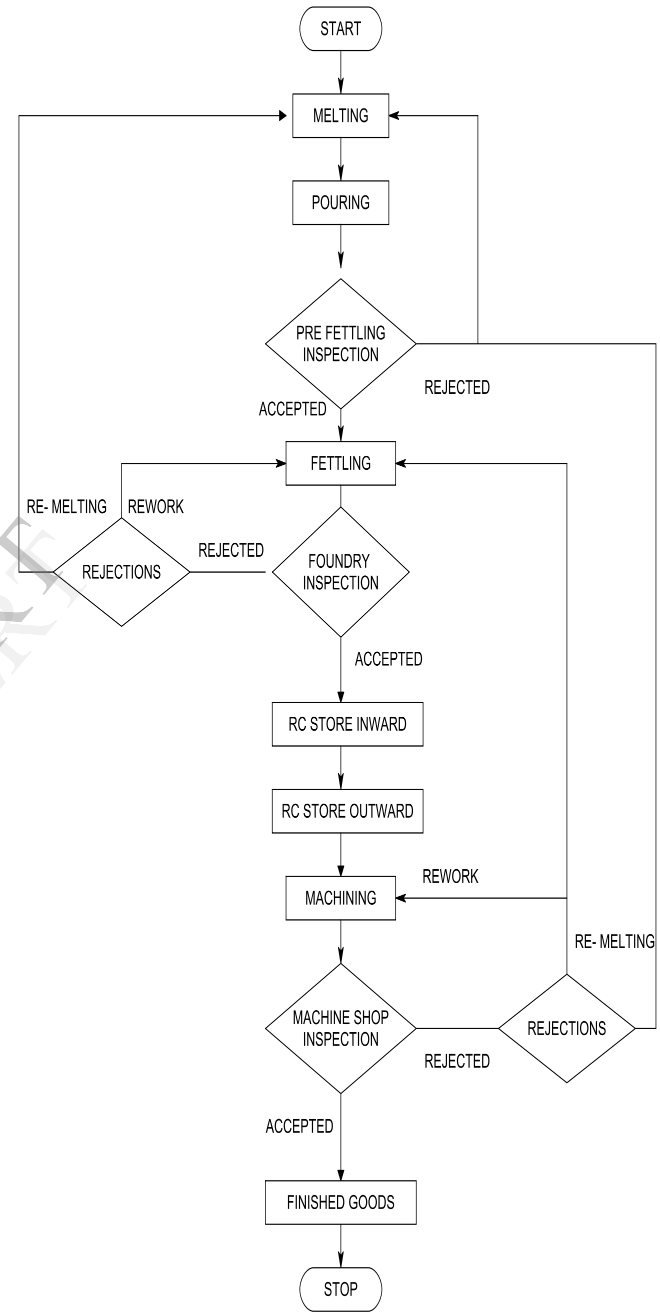

Figure 2:Flow chart of manufacturing of bushes

The process starts with melting operation. The scrap metal is put into the furnace for melting. Then the molten metal is poured into the dies or sand casting to obtain specific shape and size. Once the molten metal gets solidified then it is removed from die or sand cast. Then the item is allowed to cool for some hours. Before the item is given to fettling operations, pre fettling rejections are done. The accepted items

Table 1:Time taken for each operation in seconds

S I.	Pouring time(sec)	Knockout time(sec)	Remove casting(sec)	Coating (sec)	Rearrangement (sec)	Cycle time(sec)
1	62	4	8	40	192	306
2	56	4	12	37	5	114
3	52	4	8	26	20	110
4	55	5	12	30	5	107
5	53	4	7	30	10	104
6	55	7	8	35	6	111
7	58	4	8	34	54	158
8	83	4	9	38	23	157
9	56	4	12	33	127	232
10	76	6	10	34	54	180
11	105	5	14	27	28	179
12	110	12	6	30	35	193
13	83	7	16	34	6	146
14	59	4	14	46	59	182
15	58	6	6	52	90	212
16	64	5	6	80	20	175
17	60	4	6	50	51	171
18	66	4	15	55	5	145
19	55	7	14	43	15	134
20	58	6	5	62	68	199
21	53	7	6	54	38	158
22	50	7	10	45	12	124
23	77	8	5	40	4	134
24	51	4	16	21	4	96
25	67	6	15	30	10	128
26	86	6	13	30	18	153
27	50	6	13	35	3	107

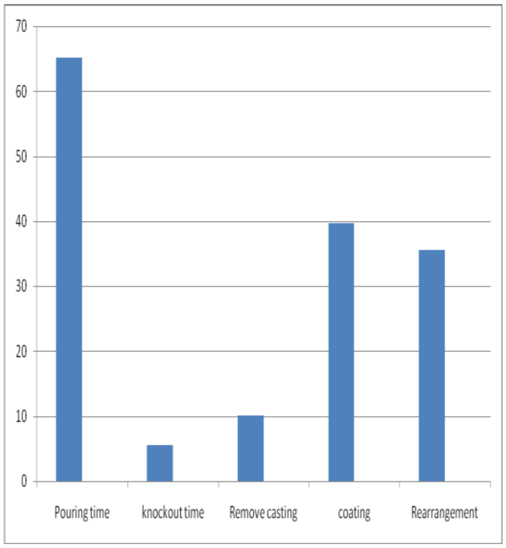

Figure 3: Die casting Processing Time Taken in Each Operation

It can be observed from the Table and above Figure , the coating time and rearrangement time can be focused upon to decrease the cycle time .
There are variations in Pouring, coating, rearrangement time, the following cause and effect diagram explains us various reasons for it.

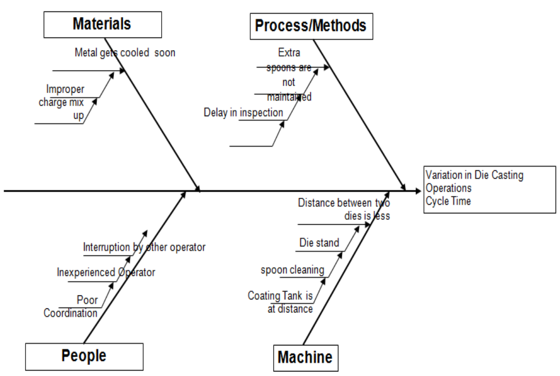

Figure 4: Causes & Effect for Varying Time of Each Cycle

Figure shows the various causes for variations in cycle time, categorized into caused by people, machine, Materials and methods.
All the causes and effects were analysed later to improve the process of manufacturing.

Conclusion

By contionously monitoring,controlling of castings manufactured,Quality was ensured at each step and we noticed some early defects which could have resulted in Rejection of castings after machining.By adopting agile methodology clear understanding was developed amidst intermediate departments.The Causes for varying time were targeted and enough measures were taken to control the same.

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