

Applications of automotive lean production tools on die casting industry

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It is seen that waste-free processes created by lean manufacturing techniques provide advantages in competitiveness. According to those observations and advantages of it, usage of lean production tools which is already used in automotive world gets wider during last years in metal casting industry. In fact, one of the important step is applying this lean production tool before industry 4.0. In order to do this, companies must systematically operate the Man, Machine, Method and Material components called 4M. This harmony can be likened to the gearwheel of a watch. The main purpose is to ensure that the clock performs its task regardless of whether or not each wheel is large or small. All productivity targets are planning and commissioning to ensure gearwheel working properly. The whole of this compliance is called the system. The correct identification, fast control and access information were required to system work properly. A simple but effective follow-up and identification format has been created to meet the customer needs of the process. This form is also defined as the main chain link that connects all the lean production tools. This main chain is called "Process Requirement Tablo". In this study, the contribution of a simple but effective table to the production system was observed.

KEYWORDSS: AUTOMOTIVEM, LEAN MANUFACTURING, DIE CASTING, INDUSTRY 4.0, PROCESS REQUIREMENT;

INTRODUCTION: NEED OF PRODUCTION SYSTEM IN DIE CASTING INDUSTRY

In the researches, the concept of lean manufacturing techniques has become widespread with the Toyota production system and it has been observed that the companies have become more systematically more efficient with the implementation of the applications. It is seen that waste-free processes created by lean manufacturing techniques provide advantages in competitiveness. According to those observations and advantages of it, usage of lean production tools which is already used in automotive world gets wider during last years in metal casting industry. In fact, one of the important steps is applying this lean production tool before Industry 4.0. In order to do this, companies must systematically operate the Man, Machine, Method and Material components called 4M. This harmony can be likened to the gearwheel of a watch. The main purpose is to ensure that the clock performs its task regardless of whether or not each wheel is large or small. All productivity targets are planning and commissioning to ensure gearwheel working properly. The whole of this compliance is called the system. Prometal has experien-

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ce more than 20 years in die casting industry. Prometal was able to provide this experience as mold technology and machine dominance, but had difficulty providing the same experience throughout the supply chain. In fact, it is known by business people that this situation does not belong only to Prometal, which is a common problem of the sector and businesses. There is a large working area and increasing request in diecasting industry especially for zamac and aluminium enjection. Investments in machinery and materials have provide Prometal to grow steadily since its foundation. In this growth process encountered in every business, the work of 4M, which we call the system, was getting harder in direct proportion to the growth. The deficiencies in the system during growth and the increase in the disrupted parts of the supply chain due to these deficiencies cause serious problems for the customer.

ZERO ERROR ZERO ACCIDENT

In casting companies; machinery, raw materials and molds can be supplied easily with capital power. It is seen that the first thing to do for entry into the casting industry is to bring this trio together, and it still continues to be seen in many companies. It is an attractive trio that is readily available if you have the capital and is deemed sufficient to set up the process. However, when we start production, many problems arise and are expected to arise. But there is a very serious risk involved! Loss of customers...

The constant change of the operator using the machine, the production numbers that cannot be completed on time due to the operation or operations that the operator skips on the machine and the mold and does not know, and the deteriorated production plan creates great chaos. This chaos causes accumulated balance problems and loss of customers as a result. This loss is very difficult to recover. Because they fall into the situation of factories with bad performance in their customer portfolio. This situation is experienced in every business, but the risks increase according to the size of the customer portfolio. Of course, in order to eliminate this situation and to ship the product on time, organizations and opportunities focus on producing parts in terms of logistics. Efficiency is being ignored and overtime is increasing rapidly even though customer orders are not increasing. In order not

to experience this situation, the number of operators will increase and the automation process, which is Industry 3.0, will be ignored. As customers expect ZERO DEFECTS by completing system installations that take 10-15 years in their own structure, quality standards will increase and previously accepted errors will be defined as rejection. In this case, bad scores come from quality ratings in addition to logistics ratings. Systemlessness would have reached an unsustainable point.

These events were seen within Prometal and the need for a system installation, like many companies, started to be emphasized by the senior management. Within this system requirement and board, the company management declared 2018 as the year of transformation. It is obvious that the lean production system should be established in the casting sector as well as in the automotive and other sectors. Prometal quickly took steps in this direction for competitiveness and sustainability and decided to present its strong machinery, molds and knowledge to customers within a system.

APPLICATION OF LEAN MANUFACTURING IN PROMETAL

First of all, it was emphasized that the lean system is not a transformation project to be carried out within 1 year by outsourcing, but that lean transformation is a cultural transformation, it will be a process that will take many years and the support of the top management is absolute. For this reason, it was first started by appointing a leader with the right person policy for the right job. The change studies started rapidly and as a result of long-term studies, it was determined that there were noticeable improvements in quality first.

In this successful ongoing transformation, dozens of tools and behavioral management methods have been used and these methods continue to be used increasingly. One of the first starting points was the use of the process requirements table, which is one of the cogwheels of the clock, which is one of these transformation tools.

Correct identification, fast control and access information are required for the system to work properly. A simple but effective tracking and identification format has been created to meet the customer needs of the process. This form

permanent deformation on the product should be defined as an operation.

Operations Performed by The Postal Operator (Serial jobs, frequency jobs, PPS activities...)

All activities performed by the existing human being in the working area are written in a sequential manner.

Two main groups are considered here:

- Activities in the stream
- Non-flow activities

All activities done by the person in charge of the mail are first tracked. During this follow-up, the employee is asked to take notes of all the work he has done. Any work with this note is sorted and observed on the spot (1).

Important Note (1)

How to perform all operations performed by both machine and human should also be standardized. At Prometal, we carry out this work using the standard operation sheet and thus, we provide the link of the process requirements table with other lean production tools.

While all the defined jobs are described in detail with the standard operation sheet (SOF), the issues to be considered during the execution of that job, customer special requests, important key points that may have a negative impact on quality, cost, time, environment or occupational safety if not done are defined in the next column.

Here, activities in the flow, ie operations that have a direct impact on the product, are often written. However, the frequency activities, which we call non-flow and mostly for the operation of the system, are skipped. However, it should be noted that the performance of activities that affect the product in the flow is directly related to the accurate and complete definition of the non-flow activities.

Examples of non-flow activities:

- Filling the oil drum at the beginning of each shift
- Lubrication of the mold at each machine stop
- Autonomous maintenance activity
- Cleaning the machine

- Anomaly notification
- Filling out the work area document
- Notification of relevant persons in case of abnormality
- Filling the suggestion form

Key Points for Product and Process, Customer and Business

"Operations Performed by Machinery, Device or Automatic Systems" and "Operations Performed by Operator (Serial jobs, frequency jobs, PPS activities ...)" defined in the first two columns on the Process Requirements Table (PRT), are defined as key points that are effective in terms of product, process, customer and business.

The key point concept is defined as the issues that cause harm in terms of quality, cost, time, environment or work safety when not applied to the business or personnel.

This part should be taught very well, especially to the employees. It is very important to make sure that it is learned and to verify that it is understood in certain periods.

The first two lines in the PRT are the subjects that should be emphasized during the training of a new employee in the field of work.

Standard Requirements for Performance and Quality

It has been deemed appropriate to define the basic process characteristics in order to meet the customer demands in the work areas and to eliminate the waste afterwards. If this definition is missing, the equipment in the work area cannot be controlled, the human resources unit cannot be connected to the system when a new operator is needed, and 5S cannot be made for visual and financial management.

In the absence of this section, instead of the management of period and processes according to the standard, a variable management model comes into play according to the wishes and competencies of the people.

Tools Used

In the process requirement table, the operations and activities performed by machine and human in the first two stages are defined.

When you do not define the equipment required for the operations in a working area, it cannot be said that the operation is carried out at the desired time with the desired quality and efficiency. In such a case, the sorting activity, which is the first step of the 5S activity, is not performed correctly. In such a case, the sorting activity, which is the first step of the 5S activity, cannot be performed correctly. The decision-making mechanism is left to the individual to distinguish the equipment and material required in the work area from the unnecessary. With this incomplete definition, it is a fact that there is a risk of serious occupational accidents, even experienced. This situation is explained as follows.

In the three-shift system, when the operator working at the injection machine is putting the part into the mold, because of the tight fit;

1. The shift operator pre-places the part in the mold and starts the injection activity by hitting it with a metal hammer

- a. Since the metal hammer is not defined, the use of unnecessary equipment increases the cost and carries a safety risk.
- b. By hitting the part with a metal hammer, the risk of geometric deformation of the part on the mold increases.
- c. There is a risk that the part will go to the customer as a quality defect and be recalled.
- d. In case the hammer accidentally hits the mold surface, it causes deformation on the mold, resulting in cost loss.
- e. A defined area is required for the hammer.

2. The shift operator pre-places the part into the mold and places it by hitting it with the help of the same part. In this case;

- a. There is a risk of deformation of both the part in the mold and the part used for striking.
- b. The piece is used out of purpose by using a hammer.
- c. There is a risk of occupational accident due to the risk of being cut in the hand while using the hammer.

3. The shift operator pre-places the part into the mold and

presses it down to make sure it fits with just his hand

These activities are carried out in this way during the period when there is no PRT (Process Requirements Table). However, thanks to PRT, the operations to be performed by the operator in the work area are specified and the equipment, if any, to be used for these operations are defined in the "tools used" step.

In this way, we can define and monitor the tools and equipment that should be in a work mail during the project period. Thanks to this definition, there are no missing tools and equipment in occupational safety risk analysis, and we make the first step of 5S activities according to this definition. Thanks to this column, the process requirements table provides the information and standard that other lean production tools need.

Required Environmental Conditions

It has been observed that environmental conditions are the subject that is often neglected while performing operations in the process. In the quality control work area, the operator performs visual control. In this visual inspection, it has been determined that the light intensity of the environment is important so that the operator can make a healthy control on the part. Excessive light intensity will tire the operator, and insufficient light will deteriorate the control quality. While starting the lean transformation, these standards did not form an idea about how the environmental conditions should be.

The process requirements table is prepared separately for each work area.

As environmental conditions:

- Ventilation
- Audio
- Ergonomic conditions
- Cleaning
- Definitions are made.

Figure 2 shows the sample form for lighting. With this definition, the occupational safety risks of the business area are minimized and it is possible to create a risk-free process that will respond to quality standards and customer requests.

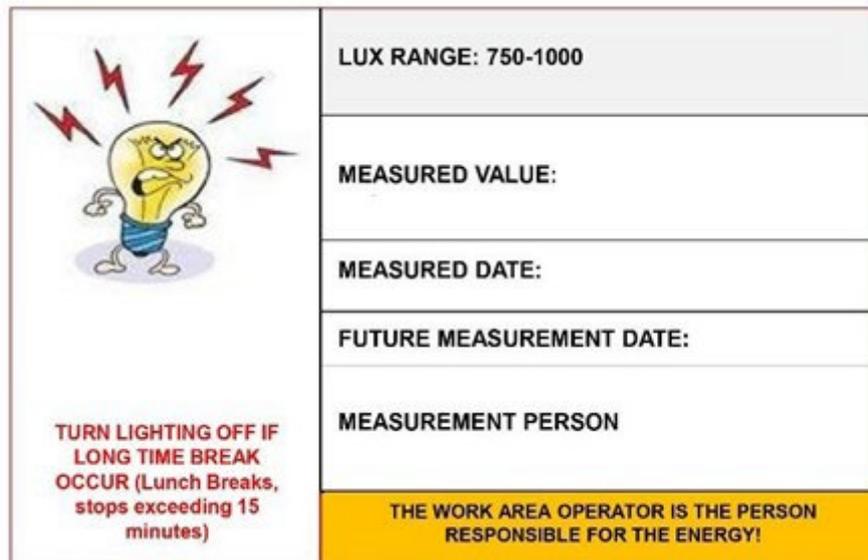


Fig.2 - Work Area Lighting Standard.

Process Inputs

Basically, each process is created in the "input - processing - output" logic. Thanks to PRT, by defining the inputs, 5S, which is a visual management tool, was made more effective and the quality level on the product was increased. This situation is explained as follows.

CNC machined parts are sanded. However, this type of sandpaper is not defined anywhere. For this reason, the sanding sand depth may vary and quality problems are experienced on the product depending on this variability. However, this is an entry for that workspace and must be defined. However, in the current system (before the lean production system), there is no section where this is defined.

By defining the type of sandpaper (600 grit diameter 75) in the process inputs section of the process requirements table, quality problems are prevented and stock follow-up becomes possible.

As another case, there is the "human" factor as the input of the work area. However, although this person is directly affected by the quality and efficiency of the work done in that work area, it is undefined in many organizations. The activities to be performed by the machine and human defined in the process requirements table and the basic features sought in the human profile to manage the equipment to be used are defined in this section.

For example:

- 20-35 age range
- Vocational high school graduate
- Just woman
- Height below 1.90
- Maximum weight of 100 kg

Thanks to this definition, it is ensured that human resources find suitable personnel for the job and that polyvalence studies are managed more effectively.

Required Warnings During Working In the Working Area

In the work area, the points to be considered for the customer and efficiency are defined both in the operations performed by the machine and the operations performed by the operator while the operator is performing his activities. Thus, customer protection activities for each operation are defined, ready to be taught and made available for inspection.

Examples for this part:

- Pieces should not be left untidy during breaks
- The parts should not be mixed on the table
- Only plastic hammer should be used in the work area
- Part temperature must be at least 25 degrees

Basic Competencies Of The Operator

He explained its importance as 4M in the process. In this 4M, one of the two most important subjects that we can-

not buy with money is "human".

It is essential that the employee who will ensure efficiency in the work area and fulfill the customer requests can perform the activities specified in the transaction requirements table, and that the information and trainings that the employee who will observe the standard conditions and fulfill the requirements must have.

Thanks to this definition, the trainings to be given and the competencies to be gained should be defined before placing an operator in a work area. With this definition, the trainings that should be prioritized in the annual training plans of human resources have been determined. At the same time, the follow-up of the basic and compulsory trainings that should be given to the employees, especially the laws numbered 4857 and 6331, and the giving of the trainings are made easier to monitor.

Examples of basic competencies that the operator should

have:

- Work area risk analysis
- Ergonomic activities in the workplace
- Visual management in the work area 3S+2S
- Workplace regulations
- Workplace training

Relation of Processing Requirements Table with Prometal Production System Tools

The senior management had a full determination that the first condition for competitiveness was the necessity of system installation by increasing productivity at Prometal. These studies are carried out in large corporate enterprises in 10-15 years, accompanied by large investments and organizations.

If these studies are not considered as a whole, it will reveal a single-ring chain and its effectiveness will be weak. For this reason, firstly, the transaction requirements table was prepared and its integration with other tools was ensured.

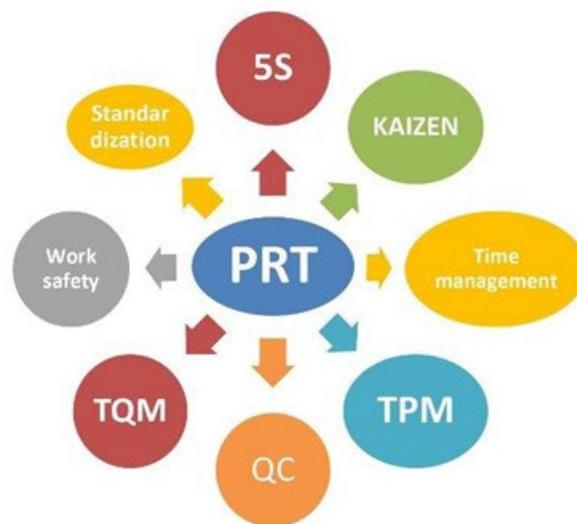


Fig.3 - Relation of Process Requirements Table with Prometal Production System Tools.

CONCLUSION

When all these substances were applied in the enterprise, it was observed that there were noticeable improvements in quality. Thanks to the serious reductions in the 8D analyzes made by the quality unit due to the decreasing complaints, the stress decreased and the motivation increased. A 50% improvement in quality in the first 7 months continues as a zero error in a 1-year period as a result

of the studies that were commissioned and continued. On the one hand, the company has experienced improvement in quality, and the quality level of seat belt parts, which are of great importance for human life, has been appreciated by the customer and paved the way for new investments and collaborations. Thanks to the tools and systems commissioned during the development of the system, serious improvements were experienced in logi-

stics and production processes, and the balance problem decreased from 200% to 0.0001%.

As a result of these studies, customer satisfaction was observed in customer visits and business volume growth was achieved by obtaining high (VDA...) scores in supplier audits carried out before new projects.

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