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IMPROVEMENT OF THE PIECE PRODUCTION SYSTEM USING LEAN MANAGEMENT APPROACHES

Abstract: The paper presents a lean management approach to the production system organisation. The scope of the presented work includes problems considered with both production engineering and workflow management in the context of non-time added task. The main applied tools is the 5S method of work scene ordering and visual control of manufactured parts. The utilisation of proposed approach is described basing on the example of the production of industrial boilers in conditions of a piece production. The application of 5S method allows shortening by 3 day the production cycle. It was considered with the workplace ordering and decreasing the auxiliary times. While the introduction of a visual control let to improve the operation of failure detection and instructing employees. Typically this operation occupied 2 days and has been shorten of 25% and 1,5 day for directing employees work instructions . It is also recommended to introduce to the production practice the utilisation of formalized approach basing on written documents.

1. Introduction

The piece production is very specific, taking into account its management and logistic system. Each production system is elaborated one time for the ordered type of an industrial boiler which is individually design each time. In this paper is presented such type of production system. The chosen enterprise is a limited liability company, and its activity can lead to the Polish territory and abroad. The share capital of the company amounts to 100 000 PLN. Main business for the company is production for order oversized water and steam boilers and serial production of other parts used in energy industry which is done by production department. Mostly in serial production they manufacture different types of pressure parts, steam superheaters, water heaters, membrane walls, screens, reducing stations, collectors, slag traps, flanges, cyclones, separators and other custom products. The company also provides services related to the installation and modernization of boilers executed by assembly – repair department. The enterprise currently employs 128 people of which 67 production employees, 4 employees in “tool room”, 11 employees in construction and design department, 8 employees in quality control department, 3 employees in department of

supplies, 9 employees in service department and other administrative and management staff. The company has 2 production halls but nowadays is using just a new build hall where 121 production machine are located in. Old production hall is an unused space where the company is storing temporarily sheets of metal and pipes.

2. The 5S method in Lean Management

The article focuses on the Japanese point of view of 5S because the method was invented by them and is implemented and used with excellent effects. Japanese 5S method is an elementary factor that allowed developing the world production systems. This method is described in five Japanese words: *seiri, seiton, seiso, seiketsu* and *sitsuke*. The introduction of 5S method is concerned with the JiT systems. The objective of a JiT system is to reduce costs by reducing inventory taking into account the whole process of enterprises logistics. It also helps to minimize the production area, which increases the unit efficiency. For such a system it should be made the most possible simplification of individual processes. *The 5 S are the basis - or pillars - of a workplace, where we set the flow of production, visual inspection, standard operations and other JiT components* [1]. The 5S method in Hirano work is based on the five steps [2]: sorting, setting in order, shining, standardizing and sustaining. In the first step, the elements of the production system are sorted. For this purpose, special markers are used to indicate items for which it should be decide about their suitability. Currently, there are three markers: red (useless items), yellow (items possible needed), and green (needed items). In the first step red marked items are eliminated. The second step is to organize other elements of the system (yellow and green) what leads to its simplification. This step is also known as stabilization of the work system after a change. In the third step is realized the implementation of procedures for the permanent "cleaning" of the production system in order to keep it at a high level through sweeping its "contaminations". Then is carried out the standardization of the most desirable changes induced by previous steps by developing appropriate standards of an organization. This allows to make the workplace more "transparent". Finally, according to the last recommendation everyone should always keep the new state of a system.

3. Improvements of the analysed production system

After many visits and conducted interviews with employees in the company, the biggest weakness that have been observed was disorder in production hall and especially in "tool room" (place of storage of tools used mainly for the repair of production machines). Non value added time was established based on the analysis of the production process of the recovery boiler OS-5. The production hall does not have a sufficient quantity of suitable signs to help employees with their work. The company does not use any containers for the storage of scrap metal and other production waste, also tools and other items needed in manufacturing process are deposited at random racks or random places ate production hall. That is the main reason why it is difficult to find a desired element in a short period of time during manufacturing process. The "tool room" lacks of specialized tooling cabinets, lockers, shelving and tables designed to maintain order. Most of the tools are stored in unmarked boxes. Each workstation has a redundant tools that should be stored in the "tool room". Employees need to be very careful because of moving gantry transporting boiler elements,

since production hall does not have a clear path for walking (fig.1). In the production hall there is only one theoretically safe zone marked with yellow paint, and often in the separated area there are various cables, cans, gas cylinders and other items.

Fig.1. View of the production hall - current status

Work instructions and all other information concerning manufacturing process, for example: amount of raw materials needed for production or how to make an item are transmitted orally. There is no documentation relating to the procedures of manufacturing of the parts. The place where the complete 5 S method will be introduced is a "tool room", the production hall will be sorted and unnecessary tools and other parts will be transferred to the "tool room". The introduction of 5S will be held in the following steps:

- *Sorting* – initially the tools and other necessary items must be extract. Damaged tools and components must be separated and removed, best way for the company is to sold them as metal scraps. The selection was done using red, yellow and green labels and after that selection protocol was created.
- *Setting in order* - list of all objects in the "tool room" was created to determine their permanent storage places. The inventory was hanged on the information board in the workspace. To help with the cleaning the company purchased needed cabinets and blackboard tool (fig. 2). Each tool was allocated to the appropriate place.

Fig. 2.Types of used cabinets and blackboard tool

- *Shining* – at the end of each working day employees are required to clean their workplace and leave all the objects arranged by inventory list according to the schedule.
- *Standardizing* – there are always two people working in "tool room" during each shift. Each employee needs to know what are his responsibilities and when to do them.To help employees, liability schedule was created, describing all the duties, person responsible for them and dates. The schedule was put on the information board in "tool room".

- *Sustaining* - employees were trained on the importance of maintaining order in the workplace and monthly control of employees and their workspaces were introduced using appropriate filling control protocols of the current state.

The visual control method was implemented in the entire production hall. First marked floor of the production hall using top floor marking adhesive tapes type AT8, designed to function in the industry (yellow - transition - do not block, green – work stations, blue - storage areas for raw materials, red – test workstation "hydrostatic test", black - space for production waste). Because the company does not use forklift trucks, established minimum paths between machines and other devices with a width of 1 meter for two-way traffic (accordance with the applicable standards). Finished goods are stored outside, therefore, there was no space in the hall marked for storage. Table of signs must be hung on information board in production hall, and the staff must be familiarize with the new order. Also introduced illuminated signs indicating the course of production process and each work stations provided with a special tablet that contains 4 buttons with colors corresponding to the certain states during production (green, blue, red, yellow). Information from the tablets are send to construction and design department, which provided with a light board with every workstation can solve the occurring problem. If the work proceeds without interference automatically green light (production is working fluently) is on, and if e.g. machine failure occurs than the red button is pushed informing about the problem allowing to quickly eliminate it. The blue light informs about lack of raw materials and yellow light tells that production of the item has been completed. Information signboards were placed on each machine. The signs help to informed about the risks relating to the use of the device, and contain basic technical specification. Also work instructions are delivered to each employee in the form of paper from the start of production of the new order. The sheet will contain basic guidelines for manufacturing the item for each workstations.

4. Conclusion

Analyzed manufacturing process of the recovery boiler OS–5 and based on conducted measurements and observation established duration of the production cycle which was min. 73,55 and max. 79,8 days depending on used mode of transport. Non value added time was 30,5 days including 3 days needed for searching tools, 2 days wasted on failure detection and 1,5 day for familiarizing employees with work instructions. Those are 3 wastes that can be easily eliminated using 5S and visual control methods. Introduction of selected methods does not exposes the company to significant cost and can be achieve relatively quickly. The company should establish a timetable for the implementation of changes to correctly and quickly implement new solutions.

References

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