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IMPROVEMENT OF THE ASSEMBLY WORKSTATION WITH THE USE OF VISUAL MANAGEMENT METHODS

Abstract: The performance of human operators and manually operated processes can be improved with the use of visual management methods. An example of improvement of assembly station is presented. Detailed analysis of the work process has identified some places, in which time losses and reduced efficiency occur. Therefore, a new project of the workstation has been developed. According to lean manufacturing principles, the visual management methods, including 5S, have been used. The detailed design of human workspace was prepared with the CAD software NX 10. The use of digital human models allows 3D visualization and can be used to improve the ergonomics of human workspace. Although, the improved assembly workstation will have much greater productivity, also training for employment is required.

1. Introduction

The development of production companies is directly linked with the need to adapt to the current market. Technological and process improvements make that competitiveness take on a completely different dimension. Thoughtful and effective use of Lean methods in management and manufacturing, makes a company be able to control and manage their resources in the best way [1, 2]. It is also important to the quality of the products and the minimization of the waste generated by the process [4]. Therefore, to ensure the ergonomics of work and avoid human errors, attention is given to the appropriate design of workplaces and human work processes [3]. For this purpose, visual management is used, which is one of the most important elements of the lean management philosophy [1, 5].

Visual management allows you to clearly define the system statuses, so that each employee can interpret the current states. Visual management helps in maintaining a working environment within a certain standard. It is a facilitation for production workers because it is easy to constantly monitor the process. An important advantage of visual management is maintaining safety in the enterprise and minimizing accidents at work [5].

2. Visual management methods

Visual Management is said to be the practice of using visualized information to manage work. Any tool that increases efficiency or safety using visual methods can be considered a desirable visual management action.

Visual management incorporate the 5S method, which includes five areas of improvement [1, 2]:

- Sort (Seiri) - sorting through all items in a location and removing all unnecessary items from the location
- Set in order (Seiton) - putting all necessary items in the optimal place for fulfilling their function in the workplace
- Shine (Seiso) - sweeping or cleaning and inspecting the workplace, tools and machinery being used on a regular basis.
- Standardize (Seiketsu) - standardize the processes used to sort, order and clean the workplace.
- Self-discipline (Shitsuke) - sustain the developed processes by self-discipline of the workers. Also translates as "do without being told".

The examples of visual tools can be as follows [1, 2]:

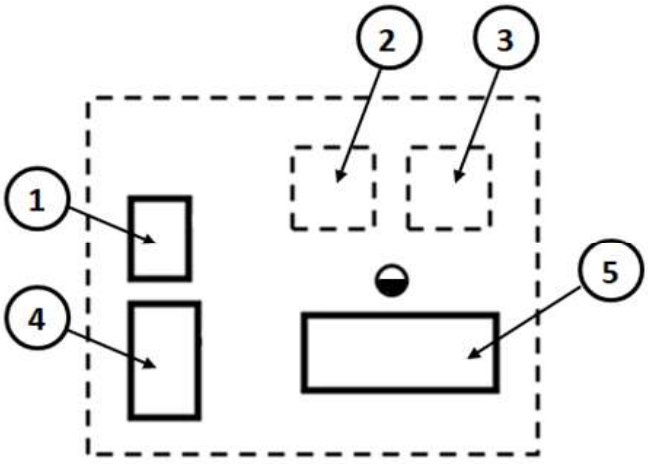
- 1S – a red tag area containing items waiting for removal,
- 2S – simple floor marking,
- 3S – cleanliness point with cleaning tools and resources,
- 4S - use of photos and visual controls to help keep everything in right place,
- 5S – visual team board.

The implementation of 5S method requires [1, 2]:

- Organizing of training sessions,
- Performing regular audits to ensure that all defined standards are being implemented and followed,
- Implementing improvements whenever possible. Worker inputs can be very valuable for identifying improvements,
- When issues arise, identifying their cause and implementing the changes necessary to avoid recurrence.

3. The description of the problem

The problem concerns the improvement of the assembly station in a production company that specializes in the production of automotive components, i.e. shock absorbers [7]. Two main activities are performed on the analyzed station: assembling of the package boxes and packaging of the finished product (shock absorber) to the box. One employee is currently working on the job, who carries out all activities, starting from collecting semi-finished products to packaging the ready-made product on the pallet. The layout of the actual workstation is presented in the Figure 1.



1 Shelf for semi-finished packages

2 Place for products to package

3 Palette with finished products

4 Desk with tools

5 Workbench

Fig. 1. Actual workstation layout [6]

The worker's responsibilities include (according to the photograph of the working day) [6]:

- Organizational activities,
- Preparation of the workplace,
- taking of the semi-finished products from the warehouse - the employee downloads semi-finished products needed to execute the order, such as cartons, sets of metal components, sets of plastic components as well as glue and necessary tools,
- taking the right number of products from the warehouse according to the order - front and rear shock absorbers,
- assembling the boxes by the employee and packing the finished goods into the box, then putting the finished product on the palette,
- After the production batch ends, transporting the ready-made pallet to the finished product warehouse,
- Sorting the workplace,
- Filling the documentation, submitting a report to the supervisor at the end of the shift

The main problem is that the shock absorbers differ in dimensions and components with which they are packed. The front shock absorber is larger and contains a different set of components attached to the packaging (a washer and a nut made of plastic). The rear shock absorber is smaller, and the set of components included in the package is a metal washer and a nut. When performing his work, the employee must check on the order card whether the item requires packing additional components. Such system creates the possibility of mistakes when packaging the items.

Other problems were identified as:

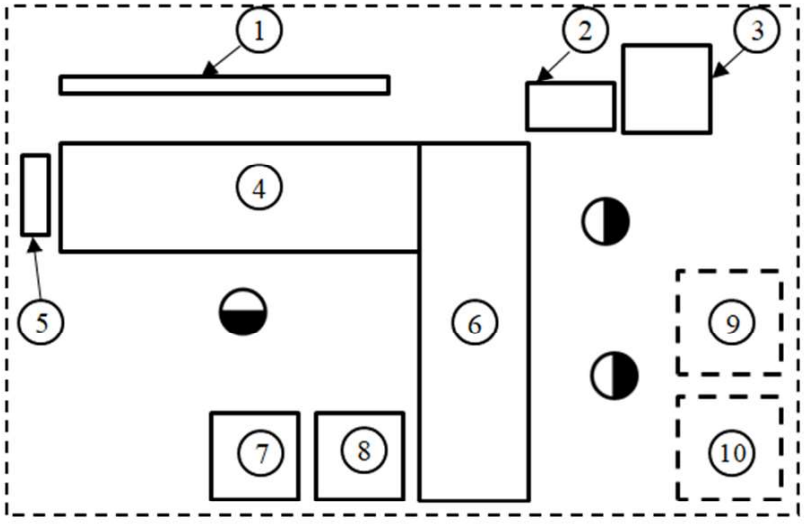
- Excessive transport,
- Bad layout - excessive worker movement,
- Lack of 5S – not effective work,
- Possibility of employee error,
- Bottlenecks in the production process.

4. Project of improved workstation

Due to the increased demand for products from customers, various options to improve the assembly station with the use of visual management methods were considered. The main improvements include:

- Increasing the position cast and division of labor,
- Shadow board being a part of the work station, that allows assigning tools and elements necessary for the position of appropriate places,
- Layout of the workbenches in the L-shape,
- The division of the table surface into zones,
- Placement of containers for packaging in an easily accessible place under the table top,
- Extracting storage locations for two types of products,
- Removal of unnecessary elements.

Basing on the proposed improvements, a new layout of assembly station was designed, and is presented in the Figure 2. There are three workers and each of them has different task. The first worker is preparing the package boxes, and the two other workers are mounting shock absorbers with components and packing into cartoon boxes. Each one of them is working only with one product type in order to prevent human errors.



1 Shadow board
2 Components trolley
3 Pallet for absorbers
4 Workbench 1
5 Waste bin
6 Workbench 2
7 Cartons for
8 Cartons for
9 Pallet for finished
10 Pallet for finished

Fig. 2. Layout of the projected assembly workstation [6]

The detailed design of the assembly station was created in the Siemens NX program, which enables 3D visualization. Three employee models were added in order to visualize the complete workstation and to evaluate work ergonomics. One employee is preparing the boxes for packing and the second and third one, are packing different sort of products into boxes in order to avoid mistakes.

With the use of visual management, it is possible to train employees faster. It is estimated, that the proposed improvements will reduce time losses and increase production efficiency at the analyzed assembly station by about 300 percent.

The general view of the workstation is shown in Figure 3.

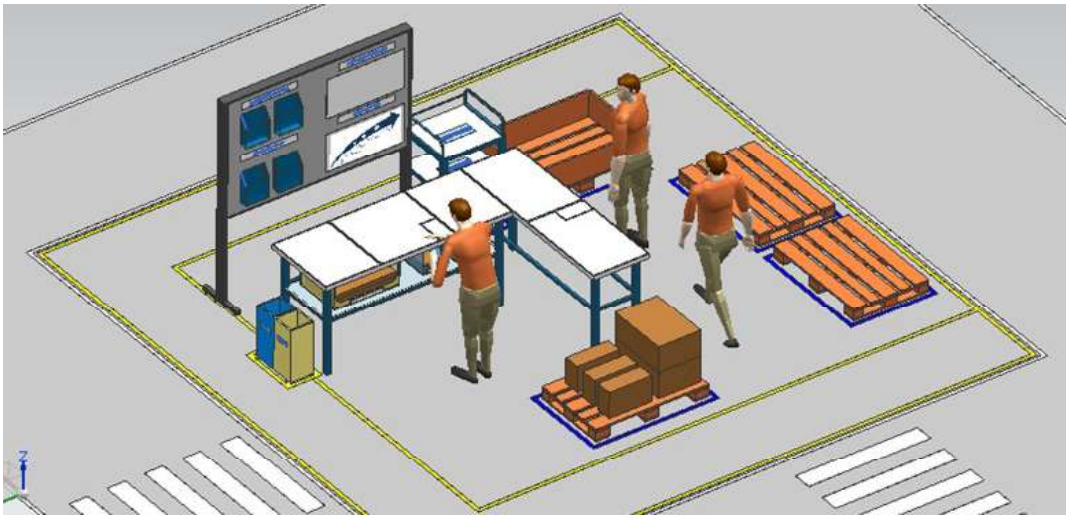


Fig. 3. Visualization of the projected assembly workstation in NX10 [6]

An important part of the workstation is the shadow board presented in the Figure 4. It is a device for organizing a set of tools; the board defines where particular tools should be placed when they are not in use. Shadow boards have the outlines of the work station's tools marked on them, allowing operators to quickly identify which tools are in use or missing. The boards are commonly located near the work station where the tools are used. Shadow boards are often used in the manufacturing environment to improve work process with the5S method.

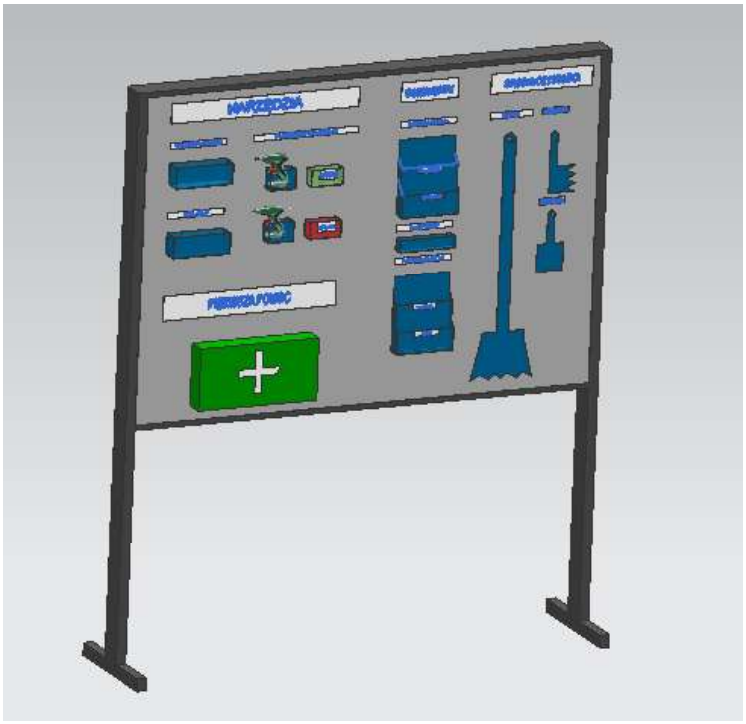


Fig. 4. Shadow board - rear view [6]

The assembly operation begins on the first table (Fig. 5). This position is supported by one employee.

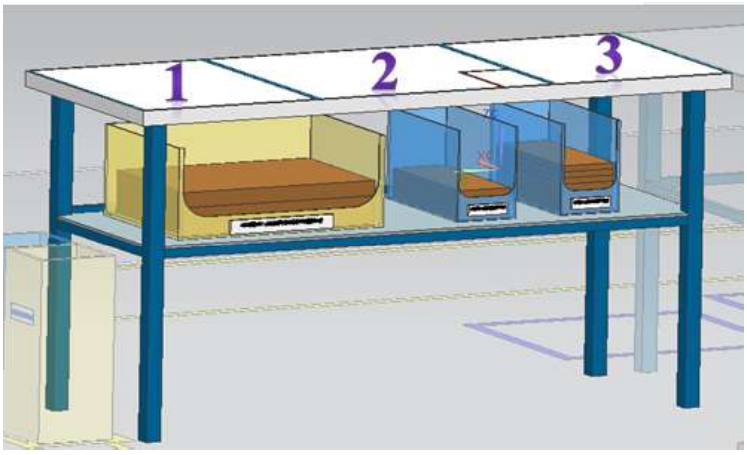


Fig. 5 Mounting table with three designated zones [6]

Three zones have been designated on the tabletop in which the employee performs certain activities including; 1 - zone of packaging distribution, 2 - zone of gluing, 3 - buffer. This arrangement is conducive to maintaining order in the workplace.

5. Conclusions

Lean manufacturing is not only a way to make improvements that can be observed based on a comparison of the past states with the future state. In order to obtain the best results, the way of working and thinking of employees should be changed through appropriate training.

Well-used visual management allows to quickly recognize the occurrence of errors or wastage. Identified problems are easier to eliminate from the process thanks to the applied standards. Visual management can be related not only to the arrangement and standardization of certain elements on the site, but also to the management of employees. According to lean philosophy (Gemba Kaizen) small improvements of each workstation can bring large positive effects to the whole enterprise.

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