

Lean concept transformation of the packaging procedure in the process of final processing

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Abstract: In production where is a possibility that the surface protection process takes place at the same location as the production of semi-finished products, but also at a remote location, internal transport, excessive processing, unnecessary stocks and movement of employees are often singled out as the main types of waste or losses in the packaging process. These wastes have economic and environmental consequences, so Lean transformation was imposed as a methodology for streamlining production flows in the packaging of finished products. The transformation involved a set of procedures that found activities that do not contribute to increased costs in the production process. This contributed to increasing the level of quality characteristics and reduced costs and time of realization of the production cycle. The results of this transformation in production flows are presented in diagrams and tables and serve to assess the economic efficiency and environmental compliance of the activities undertaken.

Keywords: TRANSFORMATION, PACKAGING, INTERNAL TRANSPORT, OVERPROCESSING, LEAN CONCEPT, LOSS, VALUE ADDED CONTRIBUTION

1. Introduction

Engineering prediction of the realization of a production task strives for a constant search for answers to three questions: How faster?; How better?; How about less costs? On this track, the idea came up to streamline material flows by transforming packaging processes where over-processing and internal transport caused increased consumption of auxiliary materials and loss of time. Searching for the results of research on this issue in the automotive industry in Europe, and published papers that could bring the experiences of other companies as empirical data, and engaged in the production of light alloy wheels, could get a clear picture of the defined subject of research.

As each production is a kind of laboratory, it was decided to monitor and record the existing situation, defining the paths of the material and its processing that apply waiting (hot spots), approach to transforming the finishing process Lean concept to reduce total production time and reduce the cost of auxiliary material by elimination and substitution of the storage site.

Lean transformation involves improving the way value is delivered to the customer. Withdrawing and removing non-value-added activities and reducing the time to perform value-added operations. In order to achieve this, it is necessary to identify activities that do not add value and companies to take immediate action to eliminate them. This means that workers need to learn to see waste. The first step in Lean transformation is for people to see waste and become aware that these are unnecessary losses for everyone. [1]

At the heart of the Lean concept is a worker-based system. The success of any Lean transformation depends on the engagement of each employee in the process of continuous business improvement. All employees must be ready and able to solve all complex problems. Those in senior positions, who make decisions that affect everyone, are the most responsible and they have the power and authority to drive change.

The paper will show the steps of transformation of material flows with the "Lean concept", and on the basis of which the production losses were influenced by the rationalization of material flows and the rationalization of production time. This will reduce the cost of the packaging process, and the consumption of wood as a natural resource.

2. Aspects of the packaging procedure in the process of final processing

The surface protection process can take place at the location where the semi-finished product is located, and also due to the specific requirements of customers, the surface protection process is possible at a remote location in relation to the location of the semi-finished product.

The packaging process will be viewed by management from an economic point of view, so packaging costs will be key to making a decision on the transformation of production flows, in order to optimize total costs. From an environmental point of view, the costs of energy consumption, packaging materials and transport will be key to making the same decision.

3. Transformation of the packaging procedure

All employees underwent training in the Lean concept and Lean tools. Also, employed engineers study new ways of thinking and behaving that support the development of a Lean culture, or a culture of continuous improvement. [2] Employees have mastered the PDCA (Plan - Plan, Do - Do, CHECK - Check, ACT - Act) cycle, which, as a discipline that holds all organizational processes together, improves them on a continuous basis.

3.1. Strategic and operational level of application of Lean transformation on the finishing line

Management decided to apply Lean tools that have proven their applicability in similar industrial plants and have gained their confirmation of the benefits provided by their application. The advantages of using 5S tools can be described as follows: 5S is a system for creating an organized workplace in a way that eliminates waste and useless activities, but also that irregularities that occur in everyday work are easily noticed and eliminated. The application of this tool is not only the achievement of a better organization with a one-time action, but the creation of conditions for the newly created packaging organization to be maintained and improved in continuity. This tool contains five groups of rules, ie steps or phases that were performed during the implementation of the observed packaging operations. Figure 1 shows the five phases for implementing the 5S tool. [3]

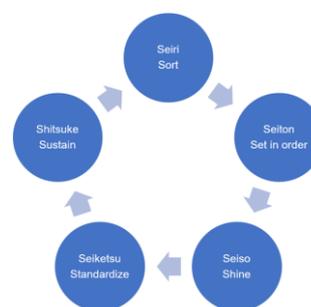


Fig. 1 Five phases of 5S tool [3]

Observing the finishing process, which precedes the surface protection process, it was observed that the semi-finished products are packaged in the same way for both locations where the surface protection process takes place. Due to the need to protect semi-finished products from the adverse effects of transport to a remote location, EPP pad, wooden cover, PET tape and stretch foil are used

for packaging. Also, semi-finished products, which remain in the same location where the production takes place, are packaged in an identical way. All semi-finished products after the finishing process are shipped to warehouse A (remote warehouse), which is used for storage of semi-finished products, from where they are re-shipped according to the surface protection process, according to Table 1.

Table 1: Time consumption by packaging phases before Lean concept transformation

Phase	Time (s)
Taking the pallet and bringing it to the machine	32
Recording in MES (Manufacturing Execution System) + manual completion of the delivery note	172
Installing the EPP pad and cover	43
Clamping with PET tape	159
Clamping with "stretch" foil	136
Transport of packed pallet to warehouse A	153
TOTAL	695

The situation in the plant is such that 58 % of semi-finished products are covered by surface protection at the location where they were produced, while 42 % of semi-finished products are shipped to surface protection at a remote location.

Based on the above, the opportunity to transform the Lean concept of the packaging process in the finishing process was recognized.

3.2. Experimental approach

The goals of this paper are:

- Reduce overprocessing, internal transportation, unnecessary inventory and employee movement;
- Develop and introduce a new packaging process in the finishing process based on the Lean concept;
- Assess the efficiency of the new packaging process based on the measurement of the time required for each individual phase of packaging after the transformation of the packaging process, and in relation to the situation before the transformation shown in Table 1.

3.3. Experiment plan

The experiment is planned in such a way as to eliminate the use of EPP pads, wooden cover, PET tape and stretch foil for semi-finished products, which will go into the surface protection process at the same location where the production of semi-finished products takes place. Also, the use of warehouse B, which is located in a location closer than the location of warehouse A, was considered, and there was an opportunity for adjustments in ERP (Enterprise Resource Planning), MES (Manufacturing Execution System) and WMS (Warehouse Management System) systems that would facilitate the implementation of planned activities.

3.4. Experimental results and discussion

First, the position for storage of semi-finished products in warehouse B was determined. The space was used in such a way that the entire quantity of products covered by the surface protection could be stored at the location where their production is. Then a new way of packaging was designed, which included organizational changes. The number of products per pallet remained the same as before the transformation, as well as the phase of taking the pallet from the warehouse and bringing it to the machine.

A new way of recording products on the packaged pallet was introduced, by eliminating the manual filling of paper records that served as a database of packaged products, and the same was replaced by full registration through the ERP system. EAN-13 (European Article Number) codes were introduced, which were linked to ERP-WMS, and a web application with an article database

was created. Also, what is most important is that the use of packaging material in the new packaging method has been completely eliminated.

The procedure for the new packaging method is as follows:

- Taking the pallet and bringing it to the machine;
- Recording the pallet through the database and printing a label containing the product data from the EAN-13 code and gluing it to the pallet;
- Transport of packed pallet to warehouse B and recording it through WMS.

Table 2 provides an overview of time consumption by packaging phases after transformation.

Table 2: Time consumption by packaging phases after Lean concept transformation

Phase	Time (s)
Taking the pallet and bringing it to the machine	32
Recording (MES – Web application)	70
Transport of packed pallet to warehouse B and recording it through WMS	100
TOTAL	202

4. Analysis of results

Observing from the economic aspect, and based on the data shown in Tables 1 and 2, and Diagram 1, it can be seen that the loss of time and auxiliary material due to overprocessing in the packaging of semi-finished products decreased by 81.18 %, and the loss of time due to transport of semi-finished products, by 34.64 %. Taking into account the reduction of these losses, the efficiency of packaging in terms of saving time increased by 70.94 %. The transformation of the Lean concept optimized the packaging process of semi-finished products that are surface protected at the location where they take place, and by eliminating the use of EPP pads, wooden lids, PET tape and stretch foil, packaging costs were reduced by 89.37 %. From an environmental point of view, the non-use of packaging materials such as EPP pads, wooden covers, PET tape and clamping foil has led to a reduction in wood consumption as a natural resource and a rationalization of material flows, as shown in Figures 2 and 3.

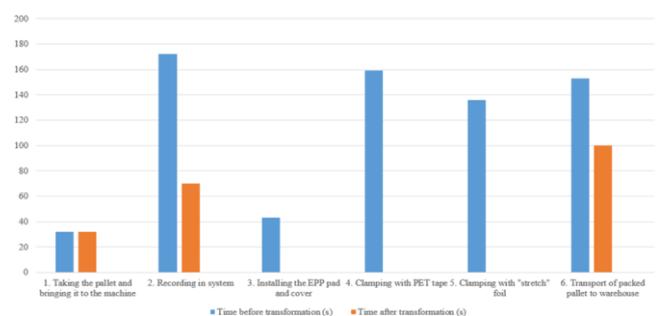


Fig. 2 Comparison of time consumption by packaging phases before and after transformation

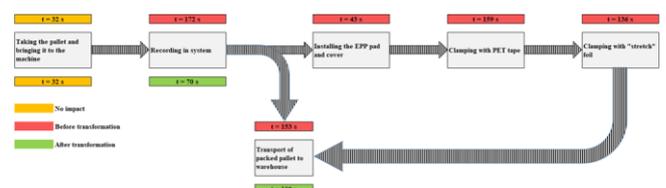


Fig. 3 Flow diagram before and after transformation

5. Conclusion

In a production process, such as a final processing, it often happens that it is possible to undertake a transformation with the

Lean concept, on the basis of which it is possible to eliminate or reduce to an acceptable level certain production costs.

The transformation with the Lean concept, presented in this paper, included activities related to the reduction of key losses in the process of final processing – overprocessing, internal transportation, unnecessary inventory and employee movement.

The following activities have been undertaken:

- The use of warehouse B, which is closer in location to the finishing process in relation to the previously used warehouse A;
- Changes in ERP, MES and WMS systems;
- EAN-13 codes have been introduced that are linked to the ERP and WMS system, and a web application with an article database has been created;
- The use of packaging material, EPP pads, wooden lid, PET tape and clamping foil has been eliminated.

Indicators of the new performance of the packaging process are:

- Reduced duration of the process by 70.94 % compared to the initial state;
- Reduction of stock of packaging material by 66.67 % compared to the initial state use of warehouse B, which is closer in location to the finishing process in relation to the previously used warehouse A;
- Free space for 50.00 % by removing unnecessary equipment and items;
- Reduced number of activities in individual packaging operations from 59.30 % to 100 %;
- Reduced unnecessary movement of employees by at least 63.31 %;
- Reduced internal transport by at least 34.64 %.

It is proposed to the management to define new material flows, a new package of auxiliary packaging material, and to incorporate them into constructive-technological preparation. Technologists and managers of individual production processes should apply the changed procedure, and with managers get used to them until routine application. In addition, quality control technologists should also harmonize their procedures with the new technological process.

6. References

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