The use of a database to visualise the sequence of Lean methods implementation steps in Job-shop production

Introduction

Customer requirements are becoming more and more specific and the business environment must be adapted to these requirements. Variability of customer requirements is mostly reflected in Job-shop production, which is commonly associated with smaller - local companies. Especially small sized companies must be flexible enough to meet variable requirements of the market. And here, the authors see the space for the application of Lean concepts and the use of some Lean methods designed for companies with Mass production. Specifically for the methods such as Teamwork, Kaizen, Visual management, 5S and TPM which are suitable for businesses with a Job-shop production. Implementation of Lean manufacturing methods can help to eliminate waste, reduce production costs, and optimize the production process in order to remain customer requirements. Only theoretical knowledge in the literature is not enough, therefore the article is also focused on providing information about the implementation of Lean methods into practice through the use of information database. The main aim of the article is to familiarize readers with the current state of using Lean methods in practice, especially in companies dealing with Job-shop production, as well as to visualize the implementation of Lean methods through the use of information database.

Methods

A survey was conducted in V4 countries focused on knowledge and the level of use of Lean methods in industrial companies. Within this questionnaire, 605 respondents were contacted from industry. 162 organisations answered the questionnaire, which represents a return rate of 26.8%. 39% of the respondents were large companies with a staff of more than 250, 35% were small companies employing up to 50, and 26% of medium-sized companies, where the number of employees ranges from 51 to 249. The questionnaire was generally focused on the use of Lean methods in industrial companies dealing with all types of production (Job-shop, Serial and Mass production.) Subsequently, companies dealing with Job-shop production were separated based on the collected data and ABC analysis. The questionnaire evaluated the usage of the fundamental concepts of Lean manufacturing methods usable in the production system, namely: KAIZEN, Teamwork, Bottleneck management, KANBAN, Visual management, VSM (Value Stream Mapping), 5S, Production cells, TPM (Total Productive Maintenance), SMED (Single Minute Exchange of Die), EPE (Every Part Everyday) [1].

The Figure 1 shows the frequency of companies which use the exact method and belong to the group of companies dealing with Job-shop at the same time. The methods are ranked from most used to least used in Mass production in order by frequency: Teamwork, KAIZEN, Visual management, 5S, TPM, Bottleneck management, EPE, KANBAN, Production cells, SMED and VSM. Methods suitable for Job-shop production are marked with blue colour and methods not suitable for Job-shop are marked in red (Figure 1).
After examining the use of Lean methods in the V4 countries it is possible, in the next step, to continue with the application of methods suitable for Job-shop production. While proposing the sequence of implementation steps in practice, authors arrived at activities which aimed to implementation of methods suitable for Job-shop production. These activities are described in the next part of this paper.

**Results**

The research results can be divided into two parts. The first part is focused on the sequence of Lean methods implementation steps suitable for Job-shop production and the second part focused on providing information about the sequence of Lean methods implementation steps to public through the use of information database in order to support the interest of self-help application in companies.

The most frequent method suitable for Job-shop according the survey is **Teamwork**. This method is focused on employee’s cooperation in order to achieve a synergistic effect of all employees. The sequence of its implementation steps is shown in Figure 2. Teamwork implementation, like other methods, requires the selection of people who will deal with this process. Teamwork is the way of work organization in teams from 4 to 15 people [2]. The most important step in Teamwork implementation is the determination and allocation of the processes in the way that processes can be operated by one team.
KAIZEN (see Figure 3) is designed to capture the improvement from all the corporate employees. Its principle is continuous improvement in small increments, as opposed to large capital-intensive innovative changes. The sequence of its implementation steps is shown in Figure 3. The most important part is the onset of cycle which consists of employee’s proposals, through the approval process to motivation of employees for further activity.

Visual management consists in the labelling of selected parts or processes, that the orders arising from this kind of labelling are immediately apparent. This is an indirect managing. The importance of Visual management is not sufficiently quantifiable, but its benefits of improved safety and developed knowledge are not negligible. Figure 4 shows the sequence of Visual management implementation steps. The diagram (Figure 4) shows the connection of Visual management to TPM and 5S. Visual management is closely related to these methods. The implementation consists in marking items according to the diagram.
The next most frequently used method in terms of industrial practice needs is 5S. The method is oriented to increase the work efficiency at workplaces through its proper organization. The diagram shows the different stages of implementation (pink rectangles), divided into processes that describe in detail the 5S implementation (see Figure 5).
TPM – this method is utilised to maintain the constant working pace without unexpected failures. Diagram of the sequence of TPM implementation steps is shown in Figure 6. The TPM implementation is a lengthy process but the initial success can be seen in a short time. Two phases of TPM implementation as phase of process approval and phase of the TPM implementation itself can be seen in the diagram of the sequence of steps. Authors also refer to Visual Management use in the diagram. Its tools are used in the case of TPM either [2].
The second part of the paper is focused on visualising the implementation through the use of information database. Information database serves as a support for decision-making on the implementation of Lean methods and also as a guide for self-help implementation of Lean methods, especially for companies dealing with job-shop production and for companies that are not financially efficient enough to outsource this activity. For this reason it is necessary to pay regard to database price. Number of the companies involved in the implementation of lean methods is not low, but the price is too high for small companies. With regard to the development of small companies is necessary to publish this database on available free sites. Otherwise, the success of the project is not guaranteed.

Free access to the project is not so convenient. Therefore, it is always necessary to ensure economic return / feedback through the use of advertisement (see logo in the upper left corner in Figure 7). The database should include, for the correct understanding of lean methods implementation, following items:

- logo / the creator contact; (STU MTF)
- name of the method; (KAIZEN)
- the implementation diagram for the better orientation; (Diagram)
- diagram legend (keys); (Legenda)
- description of the activities shown in the diagram; (Popis činností)
- inventory of tools and documentation that will be used in implementation by company; (Pomôcky a podklady)
- theoretical foundations of the potential use of the method; (Teoretické podklady)
- switches for the better orientation in the structure of the database. (Vyber)

The advantages of this database consist in its availability, after the subsequent placement on the website. An example of the information database use before its placing on the website is shown in Figure 7 (form for KAIZEN).

![Figure 7 Form of sequence of Lean method implementation steps (example). Source: Own.](image-url)
Conclusion

The paper was focused on implementation of Lean methods to companies dealing with Job-shop production. Based on the survey conducted in V4 countries, the methods suitable for Job-shop production were selected, despite the intention to use the lean concept only in serial production. Selected methods have the indirect effect on the production process but their contribution is not negligible. These methods are very good value for money for their implementation to the final effect of methods. Therefore, the methods are also suitable for self-help implementation in small companies, where they can increase their competitiveness and attractiveness in the market. Another part of the paper was focused on providing the information about the implementation of these methods to the public through the use of information database. The first condition for the use of this database is its free availability. Otherwise, the implementation can be discouraging. Article is built on the previous research focused only on the implementation of Lean methods in general.

Abstract

Methods of Lean production primarily designed for companies with mass production are commonly used in other types of manufacturing as well. Whereas the concept was not proposed for these companies, it is possible to use only a part of the procedures and achieve a partial improvement in the specific areas. The paper is focused on the implementation of Lean methods in companies with Job-shop production, visualised through the use of an information database. Diagrams of Lean methods implementation suitable for job-shop with their labels and display in the database create the basis of this paper. A survey in the V4 countries was conducted to collect information on the use of lean methods in practice. Based on this survey, the critical methods which are not suitable for companies with Job-shop production were determined. These methods are consequently visualised through the use of an information database that allows visualising the sequence of activities required to implement the Lean methods for the entity itself in a transparent manner. An information database serves as a support for decision-making in the implementation of Lean methods and also as a guide for self-help implementation of Lean methods, particularly for companies with Job-shop production.

Key words: Lean concept, Job-shop, Database, Sequence of implementation steps.

References