UNIVERSITY OF EAST SARAJEVO

FACULTY OF MECHANICAL ENGINEERING

5th INTERNATIONAL SCIENTIFIC CONFERENCE

COMETa 2020

„Conference on Mechanical Engineering Technologies and Applications“

PROCEEDINGS

26th-28th November

East Sarajevo, RS, B&H

COMETa 2020

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Jahorina, Republic of Srpska, B&H

University of East Sarajevo

Faculty of Mechanical Engineering

Conference on Mechanical Engineering Technologies and Applications

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PREFACE

Faculty of Mechanical Engineering of the University of East Sarajevo is organizing the 5th International Scientific Conference COMETa 2020 – "Conference on Mechanical Engineering Technologies and Applications“ in specific circumstances. Namely, faced with numerous challenges due to the pandemic caused by the spread of COVID-19 virus on a global level, the Organizing Committee decided to hold the Conference COMETa 2020 virtually, in order to ensure the safety of participants and the entire community. Also, the continuity of the event was a significant reason for the establishment of the online model, especially considering the fact that the conference COMETa has been categorized by the relevant Ministry as an international scientific conference of the first category.

The main goal of the conference is to contribute to increasing the competitiveness of national business entities through the presentation and implementation of new scientific achievements in the field of mechanical engineering. In addition, the conference will provide additional support to researchers in the presentation of their results, as well as establishing a higher level of cooperation with leading national and international scientific institutions, universities, public companies and partners from industry.

The program of the conference COMETa 2020 consists of the following thematic areas:

- Manufacturing technologies and advanced materials,
- Applied mechanics and mechatronics,
- Machine design, simulation and modeling,
- Product development and mechanical systems,
- Energy and thermotechnic,
- Renewable energy and environmental,
- Maintenance and technical diagnostics,
- Quality, management and organization.

A total of 193 authors and co-authors from 12 countries are participating in the 5th International Scientific Conference COMETa 2020 where 70 papers have been accepted, including 5 plenary lectures. Round table on the very actual topic “Challenges in the education during COVID-19 pandemic – Online as a solution ...“ is planned to be held.

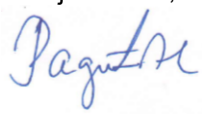
The participation of a significant number of domestic and foreign scientists and researchers strengthens our conviction that the online format of the conference will not diminish its importance. On the contrary, we are sure that together we will gain new experiences, which will further enable us better and more meaningful cooperation in the near future by generating new ideas and establishing modern approaches to solving complex issues in mechanical engineering in the context of challenges that are present in the technical and technological development of an advanced society in the 21st century. In that sense, we want to emphasize that each of your proposals is welcome and will be carefully considered from the aspect of organizing the next conferences.

On behalf of the Organizing and Scientific Committee of the conference COMETa 2020, we would like to express our gratitude to all authors, reviewers, universities, business entities, and national and international institutions and organizations that supported the organization of the conference. We would like to express special gratitude to the Ministry of Scientific and Technological Development, Higher Education and Information Society of the Republic of Srpska, the City of East Sarajevo and local communities.

In the hope that our joint efforts will meet the expectations of the scientific and professional public, the organizer of the Conference, Faculty of Mechanical Engineering, University of East Sarajevo, wishes all participants successful work. Welcome to the online conference COMETa 2020.

East Sarajevo, November 23rd, 2020.

President of the Scientific Committee
PhD Nebojša Radić, Full Professor



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LEAN WASTE IN THE MANUFACTURING INDUSTRY

Ranka Gojković[1], Snežana Nestić[2]

Abstract: In principle, the basic idea of achieving Lean production is continuous waste reduction. This implies a reduction of all activities that do not contribute to the successful operation of the company, and thus do not add value to the product or service. Each wastes significantly affects the production time, price as well as the quality of the product, which makes the company less competitive in today's market. By identifying failures that lead to Lean waste and reducing or eliminating them, the wastes are reduced, which leads to a significant improvement in the production process. Continuous improvement in production through waste elimination has been recognized as one of the most important tasks of socially responsible organizations.

Key words: Lean manufacturing, lean waste, failures

1 INTRODUCTION

Global market changes, new technologies, increasing demands of customers and users are conditioned by new ways of managing business systems. This means that management must find effective and quick solutions. The question asked today by almost all company managers is how to harmonize the requirements of all stakeholders, how to be and remain successful, and what techniques or methods to use. Part of the answer lies in improvements. Only systems that continuously improve their business have a chance to preserve their status, improve their business and market position.

One of the ways that lead to improvement is the reduction or elimination of wastes that occur in the production process. According to Lean manufacturing, there are seven types of wastes, identified by Tachi Ohno and they are: Waiting, Transportation, Defesct, Motion, Overprocessing, Inventory [1]. Later, Liker introduced the eighth waste, which refers to the underutilization of labor creativity - Unused employee creativity [2]. These wastes do not add value to the product, ie they belong to activities that consume resources, but which the customer is not willing to pay. Each of these wastes significantly affects the production time, price and product quality, which makes the company less competitive.

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Elimination of waste represents a huge potential in terms of manufacturing improvements—the key is to: identify both waste and value, develop our knowledge management base, realize that sustainable improvement requires the buy in of the people operating the processes and managing the business, and therefore a culture of continuous improvement [3].

In order to eliminate wastes, it is necessary to perform an analysis of the work process, to identify all the causes that lead to wastes and, based on that, to plan and implement improvement measures to reduce or eliminate these wastes.

The paper is organized in the following way: in Section 2 is presented Lean manufacturing. Lean waste and analysis Lean waste is presented in Section 3. Conclusion is given in Section 4.

2 LEAN MANUFACTURING

The term Lean Manufacturing was first described in the book "The machine that changed the world" [4], which is the result of research work IMVP (International Motor Vehicle Program), where the authors first described differences between the Japanese and Western automotive industries and for the first time used the term Lean for Toyota's mode of production. Lean is less of everything, less plant, less investment, effort and capital.

Lean is a philosophy that, when implemented, shortens the time from customer order to delivery of the finished product, eliminating all sources of waste and waste in the production process. The basic principle of Lean production is to produce exactly what the customer wants, the quality and quantity of the product is directly dictated by the market [5].

Value for a particular product or service is defined by the customer and represents the satisfaction of his needs and desires. The value thus defined is the starting point of successful production and business.

In order to realise value in the production process, the activities in value stream were classified to three types of action [6, 7]:

- value adding (VA) is any operation contributes to the form, fit or function of the final customer required product in the production flow.
- necessary but non-value adding (NNVA) is any operation does not create value but is necessary for streamlining the production process to increase the value of the final product.
- non-value adding (NVA)/waste is any operation that customer will not willing to pay.

The Lean Enterprise Research Centre (LERC) at Cardiff Business School highlighted that for most production operations: 5% of activities add value; 35% are necessary non-value activities; 60% add no value at all [8].

3 LEAN WASTE

Waste is defined as any unnecessary activity that does not create value for the customer. Value is defined as everything that customers are willing to pay for a product or service. Waste prevents the organization from operating in full efficiency [9]. Waste is everything except the minimum of equipment and tools, direct and indirect work, materials, space and energy absolutely necessary to increase the value of a product or service.

Eight types of wastes include:

1. Overproduction - Involves the production of much larger quantities than those required for the next process in the series or the end customer.
2. Waiting - Workers or technological systems are waiting for the completion of the previous process, for the material in parts, for the preparation, information ...
3. Transportation - Includes all unnecessary movements of materials and products through the system.
4. Overprocessing - Means everything that is beyond the limits necessary to provide defined and promised value for customers.
5. Inventory - Represents everything that is outside the estimated amount required for a precisely defined and arranged pull production system,
6. Motion - Includes any unnecessary movements of workers or technological systems
7. Defects - Includes any defects in products or services.
8. Unused employee creativity - Includes ignoring ideas or not hiring workers to create new ideas. Creativity can come from anyone involved in the production process.

Understanding the eight wastes and acting to reduce them can transform an organization. According to Lean thinking, reducing wastes will improve every aspect of a company's business: profitability, quality, employee morale, customer satisfaction [9].

3.1 Analysis of Lean waste

One way to reduce or eliminate wastes is to analyze all wastes by determining the causes or failures that lead to these wastes. This paper gives an example of the analysis of failures leading to overproduction in the manufacturing industry.

Overproduction belongs to the most important category of waste because, in addition to being considered waste itself, it increases the possibility of other waste. Overproduction often leads to two other wastes: increased inventory and excessive work in progress (WIP).

Overproduction tends to lead to excessive lead and storage times. As a result defects may not be detected early, products may deteriorate and artificial pressures on work rate may be generated. In addition, overproduction leads to excessive WIP stocks which result in the physical dislocation of operations with consequent poorer communication [10].

Identifying failures at the level of the production process that can lead to wastes that are defined in Lean manufacturing are determined based on the assessment of decision makers, data from the relevant literature, benchmarking results, surveys and interview techniques.

The Ishikawa diagram was used to graphically represent the failures that lead to wastes in the production process. Because of its appearance, it is also called a "fishbone diagram" or Cause-and-effect. This diagram makes it easy to see the causes and consequences of production problems in one place.

The process of constructing a diagram consists of defining the consequence (adverse event). Then there is the process of defining possible causes (equipment, labor, material, methods of work) - construction and further development of diagrams to the selection of a smaller number of samples.

The Figure 1 shows the Ishikawa diagram. The diagram shows the failures that lead to overproduction. These failures are: Imbalance of production lines, Inadequate

use of automation, Poor assessment of market demands, Poor application of just in case logic and Low knowledge and skills of employees.

Balanced production lines where workstations at all stages have uniform labor requirements is almost impossible and represent one of the failures that lead to overproduction. Inadequate use of automation often causes overproduction. In the case of a high degree of automation, they produce large series that often do not represent the real demands of the market, while in the case of a low level of automation, we have overproduction to meet delivery deadlines. Poor application of just in case logic leads to overproduction and represents production for each case and before there is a need for the same, all in order to use human and material resources. Poor assessment of market demands due to inadequate analyzes can lead to overproduction, especially due to reduced demand. The knowledge and skills of workers have a high impact on all failures in the production process and the risk factor is present in the implementation of all tasks.

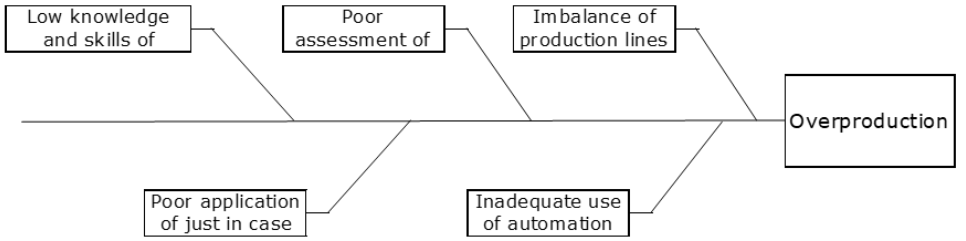

Figure 1. *Cause-and-effect/Ishikawa/fishbone diagram*

Eliminating or reducing failures directly affects the reduction of wastes which leads to a significant improvement in the production process. In this case, the elimination of failures will reduce or completely eliminate overproduction, which is one of the most important wastes and the realization of which generates other Lean wastes.

4 CONCLUSION

Improvements are the key to success, progress and survival, and are related to the application of adequate methods of improvement. This paper gives an example of the analysis of Lean wastes, ie the identification of failures that lead to Lean waste in the manufacturin industry. Identifying and then eliminating or reducing the impact of failures at the level of the production process that can lead to wastes is a preventive action in order to prevent the occurrence of these wastes. This is one way to increase the efficiency of both the production process and the company as a whole.

When the waste is reduced in a process, cost will eventually be dropped because the process becomes more efficient.

The problem of eliminating failures requires the expenditure of both material and other resources. In order to optimize the use of resources and increase the efficiency of problem solving, it is necessary to determine the order of taking adequate management measures. One of the ways the authors suggest is that the order of action be based on the rank of failures.

Eliminating failures leads to the improvement of the production process, which leads to the improvement of the business of the entire company, and thus to the achievement of business goals.

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