

THE IMPLEMENTATION OF 5S METHOD IN THE PRODUCTION PLANT WHICH CONDUCTS CASTING OPERATIONS

KUCZYŃSKA-CHAŁADA Marzena, FURMAN Joanna, PAWLAK Szymon

Silesian University of Technology, Faculty of Materials Engineering and Metallurgy, Katowice, Poland, EU,
marzena.kuczynska-chalada@polsl.pl, joanna.furman@polsl.pl, szymon.pawlak@polsl.pl

Abstract

5S method belongs to a group of tools comprising Lean Manufacturing, the proper implementation of which makes it possible to standardize production operations, improve the quality of manufactured products and systematize production and organizational operations which have a direct impact on the effectiveness and capabilities of the manufacturing process. The aim of the article is to present practical aspects related to the implementation of 5S method in the production enterprise which executes casting operations for the automotive industry. The analysis covered a group of activities and the way individual pillars of 5S method were adapted, enabling the provision of real benefits for production enterprises, directed on constant development of product quality as well as ergonomics and safety of work on the selected production position. It was proposed to conduct Kaizen workshops which serve as a useful tool in order to solve problems on workplace and improve operations being executed.

Keywords: Lean Manufacturing, 5S method, Kaizen workshops

1. INTRODUCTION

Lean Manufacturing (LM) is a management concept, the basis of which is constant improvement of production processes and minimization of wastes (Muda) which arise during the production [1].

The enterprise's wastes usually involve seven causes which include the following [2,3]:

- overproduction - various types of products are manufactured which are not in demand, the result of which is the increase in stocks and related financial losses of the enterprise,
- waiting - the production process is stopped due to, e.g. failure to supply necessary components to conduct the operation,
- unnecessary inter-operational transport - failure to define optimal transport paths between production positions,
- over-processing or incorrect processing of selected products - inaccurate activities are performed which do not meet assumed technology,
- too large number of stocks - surplus stock at each stage of production ((all components, work in process, and finished product),
- unnecessary motion - ergonomically inadequate placement of machines, devices, tools in the production hall and production position,
- defects - production process is inadequate and high level of imperfection occur which result in many defects in manufactured products and the need to correct them.

In order to minimize wastes and improve the level of production and work, in most production plants it is worth implementing standardized methods which make it possible to improve selected aspects related with the functioning of the manufacturing process. The application of methods and tools which improve production process make it possible, among others, to lower costs incurred by the production plant while increasing its manufacturing capabilities which have direct impact on the increased market competitiveness of the enterprise.

The proper implementation of selected LM tools has also impact on health and safety of work and enables creation of the environment which favours improvements in everyday production operations.

5S method is one of the basic LM tools enabling the improvement of effectiveness of the executed operations along with the increased safety and ergonomically placed production environment. The growing popularity of 5S method and its direct impact on the improved level of the organization of production process caused that the method is implemented in production plants having different business profile. The article presents the implementation process of 5S method in the production plant which specializes in casting production for automotive industry. Different stages of the implementation process and the impact on the improvement of the organizational parameters were characterized.

2. THE ESSENCE OF 5S METHOD

5S method is often wrongly associated only with the arrangement of objects within the production hall and regular cleaning of the production positions. In reality, however, this method makes it possible to change the enterprise's culture and the way of thinking on the execution of production operations. It is easier to identify problems when workplace and production halls are properly maintained. The implementation of 5S method is a basis for future development of the enterprise and necessary element for the implementation of subsequent tools improving organization of production processes which form LM concept [1]. 5S method defines 5 Japanese words meaning as follows: sort, set in order, shine, standardize and sustain. Words, corresponding to particular activities, describe basic assumptions of 5S method, the execution of which is to enable the effect in the form of standardized environment and general awareness of workers concerning the goal of the method implementation (**Table 1**).

Table 1 Characteristics and the goal of 5S method implementation [3,4]

5S	Meaning	Goal	Result
Sort	Arrangement and selection of all objects located at the area of the workplace	Improvement of work and safety	Effective use of the area of the workplace, shortening of the time of operation
Straighten	Standardization of placement of tools within the production position	Reduction of costs and time of auxiliary activities, improvement of safety and work ergonomics	Facilitating access to tools on the production position, improvement of the safety of work
Shine	Elimination of pollution, wastes and unnecessary objects from the workplace	Ensuring cleanliness, improvement of safety, reduction of the likeliness of the occurrence of machine failure	Facilitating access to tools on the position, determination of the first signs of failure
Standardize	Implementation of standardize process of execution of particular activities included in 5S methodology	Implementation of principles and activities to the basic scope of works executed by the employee	Clearly formulated activities, understandable for the operators and production employees
Sustain	Observance of principles and accurate execution of all activities necessary to maintain implemented 5S method	Maintenance of all principles and activities necessary for the functioning of 5S method	Improvement of safety and work ergonomics, improvement of the effectiveness of production, reduction of production time and reduction of costs

Proper implementation of 5S method and consistent execution of all activities enable reduction or total elimination of wastes, the result of which may be production delays due to machine's failure, general disorder which hinders the work of the operator or the occurrence of quality mistakes in finished products.

3. THE IMPLEMENTATION OF 5S METHOD IN CASTING PRODUCTION PROCESS

Casting production process includes many complex operations, the proper execution of which enables acquisition of product which satisfies the client's expectations. Each casting should be characterized by proper, strictly precise quality and utility parameters, which are analyzed and compared with primary technological assumptions. All assumptions concerning casting technology depend on the client's needs and must be documented in the form of: casting drawings and finishing work, process technological parameters and material card [5]. The basic stages forming casting process of selected elements, the proper execution of which enables acquisition of casting which is characterized by proper parameters, includes (**Figure 1**) [6]:

- Loading of input to the furnace
- Melting of input, slag retraction
- Drainage and pouring
- Cooling
- Mechanical and heat treatment

The execution of each activities which form manufacturing process must be executed under optimal conditions which are foreseen and described in technological documentation defining process parameters and methodology of its execution. Methods constituting Lean concept - including 5S are increasingly introduced in order to improve the organization of the production process and all non-procedural activities.

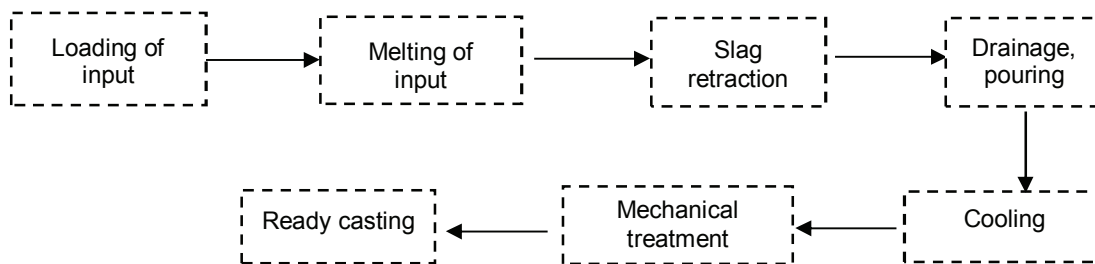


Figure1 Casting production process [6]

Table 2 Scope and results of 5S method impementation

Process	Scope of the implementation	Results of the implementation
Loading of input to the furnace	Separation of storage areas for input raw materials maintained in clear conditions	Provision of proper input material loading (to avoid mistakes), elimination of potential pollution having an impact on chemical composition
Melting of input	Identification of safety zones, execution of routine and cyclical activities connecting with cleaning of the workplace	Improvement of the safety level, possibilities to identify errors and elimination of possible pollution in furnace chamber
Drainage, pouring	Identification of danger zones and ergonomic placement of moulds, tools and objects used in merging process	Improvement of the safety level and standardization of placement of tools and moulds in a manner which facilitate work and, therefore, shorten the time of the operation
Cooling	Identification of cooling areas for filled casting moulds	Improvement of the safety level for production employees
Mechanical treatment	Design of the workplace in terms of ergonomic movement of employees	Improvement of work convenience, work capacity, shortening of the time of executed operations

The implementation of 5S method may be executed in most stages which form casting process and the potential effect of their application will be the improvement of the process organization which has an impact on the shortening of the production time, elimination of potential casting defects and improvement of safety in

positions executing specific technological operations. **Table 2** presents operations which form casting production process and proposes organizational solutions aimed at improving organizational level of the manufacturing process.

The key factor which have an impact on the results of 5S implementation is to engage all employees, understanding of principles of this methodology and support on the part of supervisor. Thanks to this, during daily production operations, the operators may identify failure areas and then propose solution to avoid potential wastes. These can be minor improvements which (there are many of them) may contribute to improve safety, tools capabilities or facilitate the work of employees [7-10].

Practicable solution in this regard is the ability to conduct Kaizen workshops together with the operators (5S technique is one of Kaizen pillars). By means of Ishikawa Diagram it is possible to formulate the major problem which occurred during the execution of tasks and then identify major causes of its creation in 5 categories (man, machine, material, method, management/environment). Then, the employees define precise causes in each category and categorize causes in terms of their impact on the problem (category A means high impact on the problem, category B - moderate impact, category C - low impact). The next stage of Kaizen workshops is the analysis of 5Why for causes which are marked with category A, generating solutions for the problem. It is simple tool which in a quick way can be executed in the workplace together with the operator, engaging him in the improvement process which makes him responsible for the quality of work. **Figure 2** presents an example to solve the problem in the analyzed enterprise by means of Kaizen workshop.

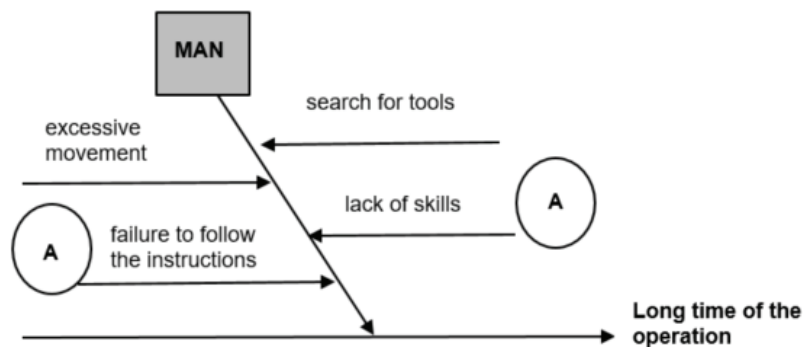


Figure 2 The part of Ishikawa Diagram for major cause 'MAN'

Figure 2 presents the part of Ishikawa Diagram for the identified problem which was the long time of operation execution by the operator. Moreover, several precise causes marked with categories were identified. It was stated that the major impact on the problem have causes related with failure to follow the instructions or lack of skills. For this causes the analysis of 5Why was executed (**Table 3**).

Table 3 5Why analysis

Problem: Long time of the operation				
Major cause: MAN				
1 Why	2 Why	3 Why	4 Why	5 Why
Failure to follow the instructions	The employee failed to notice the instruction	The instruction is located in a place which inaccessible for the operator	Lack of supervision on the part of supervisors	Lack of awareness in terms of wastes
Lack of skills	Lack of position training	Lack of supervision on the part of supervisors	Disregarding the scale of the problem	Lack of awareness in terms of wastes

Following the analysis, it was suggested to execute trainings for the operators and managing staff as well as introduce visual management principles in the production hall and workplace. Systematic 5S audits made it possible to reduce the occurring problem.

4. CONCLUSION

The basic advantage of Lean Manufacturing is that it can be applied in each production industry. The proper application of LM tools makes it possible to reduce production costs and minimize the time of operation along with the growing level of the quality of produced elements. The article presents basic benefits from the application of 5S method during casting process. During the analysis of operations conducted under casting production process the results of its application were verified. The analysis showed that the application of 5S method may contribute to improve the capacity of work, reduce machine failures, shorten the time of operation and improve the safety and ergonomics in the selected production positions. Moreover, the application of 5S method give necessary basis for further improvement of processes in the form of the implementation of different LM tools, as e.g. Kaizen, TPM or SMED. During the application of 5S principles it is advisable to apply solutions which make it possible to easily and quickly eliminate wastes during the process (Kaizen workshop) - with the participation of the operators.

REFERENCES

- [1] FURMAN, J. 5S a modern method of the production management in the steelplant, *Acta Metallurgica Slovaca*, 2008, vol. 13, spec. no. 5 1335-1532, pp. 476-480.
- [2] KUCZYŃSKA-CHAŁADA, M., FURMAN, J. The process of improvement with the application of lean manufacturing in a steel company. In *METAL 2016: 25th Anniversary International Conference on Metallurgy and Materials*, Ostrava: Tanger, 2016, pp. 1894-1899.
- [3] KACZMARSKA, K. 5S - zrób to sam, Wydawnictwo Etena, Poznań 2013, pp. 5-6.
- [4] The Productivity Press Development Team, 5S na hali produkcyjnej, Wydawnictwo ProdPublishing.com, Wrocław 2008, pp. 11-18.
- [5] POLOCZEK, Ł., KIEŁBUS, A. Wpływ czynników technologicznych na jakość odlewów ze stopów aluminium, *Zarządzanie Przedsiębiorstwem*, 2016, vol. 19, no. 2, pp. 15-16.
- [6] REGÓLSKI, K., Doskonalenie procesów wytwarzania odlewów staliwnych poprzez organizację przepływu informacji i integrację wiedzy. Praca doktorska. AGH, Cracow 2010, p. 25.
- [7] ANTOSZ, K., PACANA, A., STADNICKA D. Narzędzia Lean Manufacturing, Oficyna Wydawnicza Politechniki Rzeszowskiej, Rzeszów 2013, p.125.
- [8] BENDKOWSKI, J., MATUSEK, M. Logistyka produkcji. Praktyczne aspekty. Część 1, Wydawnictwo Politechniki Śląskiej, Gliwice 2013, p. 89.
- [9] LEAN CENTER. Available from: www.leancenter.pl (cit. 20.04.2017).
- [10] MASAOKI, I. Kaizen. Klucz do konkurencyjnego sukcesu Japonii, Wydawnictwo MT Biznes, Warszawa 2006, pp. 35-41.