DEVELOPMENT OF THE PROCUREMENT PRINCIPLES AND MANAGEMENT SYSTEM OF THE «LEAN PRODUCTION» TECHNOLOGY

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ABSTRACT

As a result of continued study as to the Lean Production application, a set of principles was proposed for application of this technology in the machinery production; and a new principle of standardization and flexibility was developed and introduced into such set of principles. In implementing any business processes, this principle allows to focus on standardization of the operations and actions that contributes to the cost reduction unification when implementing these operations. Flexibility enables management of personnel, load of the used equipment, efficient application of the existing facilities (equipment, area). Flexibility of the production processes becomes even more possible and expressed if unified standardized operations exist. Application of this principle was demonstrated on the example, how the machine tool's lubricating-cooling fluid was changed in the production.

Procurement management system with a reorder point system was developed; it should be implemented in ZF KAMA, LLC. In the reorder point system, the procurement volume becomes optimal, and it remains unchanged later. The minimum aggregated stock holding and repeated order costs become the optimization criterion. The order is given when the current stock reaches a threshold level. It is assumed here to consider the security stock, which covers the need for the period of alleged delay in delivery.

Key Words: *Lean Production Principles, Procurement Management, Reorder Point System, ZF Production System*

INTRODUCTION

ZF KAMA, LLC is a strategic partner of KAMAZ, JSC in the production of gearboxes for KAMAZ trucks. ZF KAMA assembles a 16-speed Ecosplit and 9-speed Ecomid gearbox, and it also has its own production of shafts and gears for these gearboxes, including heat treatment of parts. In introducing the lean production, the ZF KAMA, LLC personnel has undergone both quantitative and qualitative changes (http://www.zf.com/russia/ru_ru/corporate/company_corporate/zf_in_country_corporate/zf_kama/index.html).

The need to develop and implement projects aimed at improving the efficiency and increasing the productivity is associated with the need to ensure the modern enterprise's high competitiveness and to enhance the global competition in traditional sales markets (Kuzmin, 2007). One of the effective tools to achieve such goals is the ZF Production System (hereinafter referred to as the "*ZF PS*") – the production system of Zahnradfabrik GmbH. In 2011, as part of the project "*Go 4 ZF*" implementation of the unified production system ZF Production System started. The aim of creating the unified production system for all ZF locations is to combine the

best experience of all production systems, as well as to create a common standard that is the basis for improvement.

The study undertaken and submitted in the work aims to justify the new principle of Lean Production application and development of the reorder-point procurement management system in ZF KAMA, LLC as part of the Lean Production application.

METHOD USED TO STUDY

Purpose of work: to improve the Lean Production application through development of a set of principles and implementation of the reorder-point procurement management system (as exemplified by ZF KAMA, LLC). The study was conducted through literature review and analysis of articles, conference proceedings on the application and implementation of the Lean Production application in enterprises of different industries in different countries. The analysis allowed to understand and to develop a set of principles for the Lean Production application and a reorder-point procurement management system.

STUDY RESULTS

Based on the study, the following set of principles was proposed for ZF KAMA, LLC; it relies on both the existing and newly developed principles.

1. The "Exception of defects" principle states that it is necessary to exclude the possibility of production, delivery and acceptance of defective parts. The reasons for possible defects are found out immediately, and they are systematically eliminated through effective solutions. An example would be a Poka Yoke solution - in Japanese it means "error prevention" (BNP Media Staff, 2008). This principle is aimed at developing some production process implementation tools and methods, by which it would be possible to eliminate the errors often occurring due to the human factor.
2. The "Innovation and continuous improvement process" principle. It states that all processes should be constantly reviewed as to the presence of losses and, therefore, improved. The principle allows moving away from losses throughout the business process chain and implementing the team ideas. The Idea Management System (system of supply, accounting and awarding of improvement proposals) backed by all employees at all levels and positions that no idea would remain unnoticed is one of the tools to support this principle at ZF KAMA. This principle tells us that the value stream optimization can take place through a combination of innovative solutions and low-cost improvements (Kaizen solutions) (Womack, 2004, p. 473; Sheree Hanna, 2014; Safronova, 2012, pp. 431-435; http://www.emsstrategies.com/dd110105article.html)
3. The "Process-oriented modelling of customer-vendor relationship" principle means that each next process in the chain of processes is the customer of a previous one. And this customer should be in the spotlight. Therefore, each process is both a vendor and a customer.
4. The "Personnel and teamwork" principle means that the focus is on an individual - the main key to success. The managerial staffs are interested in the knowledge and experience of employees at all levels to make good decisions. The company holds regular open conversations and meetings with the personnel aimed at increasing the level of independence in organizing the labour process (Akbar Javadian Kootanaee et al., 2013, p. 9).
5. The "Just in time" principle means that the required part and information should be at the right time, in the right quality and quantity and in the right place. The Zug system (or MilkRun in English) that is translated from German as a train concept may serve as an example of a tool that supports this principle. It allows making arrangements for a smooth flow of materials, thus, only that is delivered what is actually used or required (Michael A. Cusumano, 2016).
6. A new principle for the Lean Production application is proposed to introduce - the "Standardization and flexibility" principle. It states that each local improvement becomes a standard for all employees, and this new standard, in turn, becomes a basis for continuous improvement in the future. Thus, ZF

KAMA should use identically designed standard forms as in other ZF locations. The only difference will be the language.

What standards and instructions are today, we will examine as exemplified by the instructions for changing the machine tool's lubricating-cooling fluid (hereinafter referred to as the "LCF") in the production. The operator's instructions for changing the LCF include 16 standard A4 sheets of paper filled with small text on both sides. In detail, with technical terms and exact names of the assemblies taken from the equipment documentation, the instructions describe all equipment specifications and LCF parameters and explain in detail and step by step the processes that occur in the equipment. They describe, similarly in detail, the process of LCF changing and recovering with the parameters and chemical reactions, as well as occupational hazards when dealing with the LCF and this equipment. These instructions are hard to be used, since it is difficult to digest this information. But these instructions are required as a means of protection. A worker in real conditions does not use these instructions or reads it once, when he/she put his/her signature in becoming familiar with this document.

The most acceptable option of the instructions is offered to ensure the correct operation and safety measures; it is presented in Table 1.

Table 1
FORM OF INSTRUCTIONS FOR CHANGING THE LCF

1.	Turn off the machine; disconnect the main power supply circuit.
2.	Turn on the LCF system's supply circuit.
3.	Open the valve to supply the LCF from the accumulator tank.
4.	Turn on the supply pump.
5.	Wait until the pump creates pressure in the system (number 3 on the scale, pressure is necessary to prevent air from entering the system).
6.	The pressure is controlled by a single gauge.
7.	Upon reaching the required pressure, open the return valve for LCF recovery.
8.	Wait 12 minutes, according to its own measurement, this is the period required for the full LCF replacement in the system.
9.	Close the return valve for LCF recovery.
10.	Turn off the supply pump.
11.	Close the valve to supply the LCF from the accumulator tank.
12.	Turn off the LCF system's supply circuit.
13.	Connect the main power supply circuit, turn on the machine.

These instructions should be placed in a visible place for their use. According to the Lean Production technology, such standards decrease the risk of injuries, equipment failure, downtime, etc., which results in reduced unanticipated costs and allow the use of the released funds for other needs.

The ideal situation to be pursued is when all carry out the most important operations in an equal way; that is what provides the results of all controlled areas. Correct actions lead to the correct results. All operations, corresponding methods, quite simple and natural things should be spelled out and standardized. This is not an error but an ugly reality. Performance of the simplest actions should be explained, demonstrated and controlled. This is a normal procedure in the Lean Production technology. It is necessary to achieve the predictability, so the standard items should describe the correct actions eliminating the maximum number of the problems discovered during

observations or reduce their impact on the process. The same performance of employees with different work organization, skills and equipment is not achievable; therefore, it is required to bring these factors to a common denominator. This is the goal (Rabunets, 2014; Womack and Jones, 2005, pp. 37–49; Rabunets, 2014; Harbour, 1981; Alesinskaya, 2009, pp. 38-39) that the standardization pursues.

Flexible personnel and load management also involves certain difficulties in the absence of standardized operations. Not knowing the exact time required for a job, it is possible to overload or under load a production sector. The standardized work - a basic description of a work assignment - provides repeatable, predictable processes. It becomes the learning basis, and it is used as a planning tool. The standard should consider five main positions:

1. Safety (injury prevention);
2. Quality (flaw prevention);
3. Method (comfortable work, appearance and feel);
4. Cost price (optimal use of materials);
5. Performance (working speed and efficiency).

The "Standardization and flexibility" principle focuses on the enterprise's ability to change an activity, while maintaining the maximum unification of certain operations and activities; ability to reduce the production costs associated with implementation of standard and unified operations, actions.

Based on the proposed set of principles for the Lean Production technology application, it is proposed to develop a new reorder-point procurement management system. Determining the reorder point is the first task to be solved when using this stock management system. In the reorder point system the procurement volume should be optimized because the costs of delivery of the ordered product unit also include the costs of storage, and that is 5% of the order value. This optimal size is not changed subsequently. The minimum aggregated stock holding and repeated order costs should be the optimization criterion. In the reorder point system, an order is given when the current stock reaches a threshold level.

In addition to the current stock, it is also expected to have the security stock, which allows, in calculations, to cover the need for the period of alleged delay in delivery. Possible delay in delivery means here the maximum possible delay (Pavlovskaya, 2014). The security stock is restored during subsequent deliveries through the use of the second calculation parameter of this system - the stock threshold. The stock threshold determines the stock level, at which the next order is made. The threshold is calculated in such a way that an order enters the warehouse when the current stock is reduced to the security level. In calculating the threshold, any delay in delivery is not considered.

The system's third main parameter is the desired maximum stock (DMS). Unlike the previous two parameters, it does not have a direct impact on functioning of the whole system. In order to make any changes in the situation and to achieve the desired stock size, a single increase in delivery is required from vendors. This action will allow supplementing the stock to the maximum desired level, and in this case, the system will function as expected.

According to calculations of parameters (reorder point system), orders are issued and sent to the vendor for approval (Nerush, 2001, pp. 315-318). The vendor confirms the delivery of goods: it indicates the date of goods delivery and payment schedule. After order confirmation (before delivery) or after delivery of goods, a payment request is issued and approved. At delivery of the goods, receipt of the goods at the warehouse is recorded. The vendor's financial

documents may be issued and submitted to the enterprise later. For effective management of the reorder-point procurement system, all functions are assigned to the external logistics service, in which authorities are clearly delegated (see Table 2). ZF KAMA should have such department.

Table 2
DELEGATION OF THE EXTERNAL LOGISTICS SERVICE'S AUTHORITIES

Name of position	Number of employees	Specialists' powers and responsibility in the implementation of the project
Head of Service	1	Incoming parts quality control
Chief Logistics Specialist	2	Logistics department work coordination
Chief Customs Specialist	1	Execution of financial documents on customs procedures
Senior Logistics Specialist	2	Ordering and order coordination with the vendor
Senior Customs Specialist	1	Customs declaration of the goods transported across the customs border; provision of documents to customs authorities
Logistics Specialist	3	Calculation of procurement (stock) parameters

The introduced system enables to obtain the following performance indicators during the 2-year life cycle of the project and investment of RUB 1,680,000: IRR = 80%; NPV = RUB 663,657; Pay-Back Period (PBP) of 10 months.

CONCLUSIONS

The study resulted in a proposal to supplement the existing set of principles through a new "Standardization and flexibility" principle of the ZF PS system. Each local improvement becomes a standard for all employees, and a new standard becomes a basis for continuous improvement in the future. ZF KAMA will use identically designed standard forms, procedures, actions as in other ZF locations. The only difference will be the language.

The material flow of ZF KAMA, LLC was analysed. The enterprise's procurement data management process was described. To minimize the production costs, introduction of a system of improving the procurement management system is proposed as part of the Lean Production technology. To this end, (reorder-point) calculation of parameters, ordering and sending an order to a vendor for approval were developed and implemented. Based on the identified defects, a project on implementation of the reorder-point procurement management system of components was proposed for improving the ZF KAMA, LLC activities with its vendors; for minor investment, it enables to significantly reduce the current production costs.

SUMMARY

Improvement of the Lean Production technology application does not have any certain limits in time, as time contributes to the activities the new factors, prerequisites, terms and facts that cannot be avoided or ignored. The proposed principle for application of the well-known

technology and new reorder-point procurement system allow addressing the fundamental economic issue - more efficient use of scarce resources - only partially, for a specified period, and it cannot be the absolute truth. Therefore, this issue is studied, until the object of study – the Lean Production technology - is relevant in the activities of economic entities.

ACKNOWLEDGEMENT

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

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