UDC 338.36:005:658.51

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Reducing the costs of the military-industrial complex enterprise with the involvement of personnel in the concept of lean manufacturing

The paper deals with the process of participation of production, service and support personnel in the implementation of lean manufacturing methods and tools at the enterprise of "Almaz – Antey" Air and Space Defence Corporation, Joint Stock Company "SOP Obukhovsky plant". The results of this implementation are presented, the economic effect on the scale of the enterprise is estimated.

Keywords: lean manufacturing, improving proposals, kaizen, continuous improvements, industrial environment, industrial enterprise, military-industrial complex

Introduction

Continuous changes in the external and internal environment of an industrial enterprise of the military-industrial complex (MIC) require a flexible management approach in order to maintain production efficiency and reduce output costs. Certain MIC enterprises cannot apply the principles of flow-line manufacturing, because they specialize in small-batch or, more often, single-part production of heterogeneous items.

In the context of the need to change MIC enterprises' production, the task of reducing the costs associated with this process is of paramount importance. Prompt change-over of production spaces, equipment, redistribution of working personnel, development of accessories and purchase of tooling for various production activities will promote completion of a state defence order within the shortest time.

All products manufactured by JSC "SOP Obukhovsky plant" can be subdivided into two large groups: batch and single-part. Lean manufacturing technologies were applied to all of them, but with some peculiarities. Flow-line manufacturing method was applied to batch products, within its framework the following processes were implemented:

- adjustment of warehouse work with synchronization of value streams;
- implementation of optimum accessories supply logistics;
- optimum successive arrangement of work areas;
- team work;
- cycle-wise work implementation with clear tasks distribution.

Implementation of a flow-line manufacturing method resulted in a reduction of time expenditure for the manufactured products from 50 % to 250 % [1].

Single-part production is arranged as follows. Working personnel is assigned to a separate multi-purpose area. The plan varies from month to month, and workers have no permanent working area, but they have large sections. In this sector, the effect was achieved through production planning, which resulted in a reduction of losses caused by workers stand-by and overproduction by more than 50 % [2].

The above indicators of batch and single-part production were reached due to application of lean manufacturing technologies, which are often associated with companies manufacturing products in large batches and in bulk quantities. This stereotype was repeatedly disproved by the results achieved through implementation of projects at the enterprises having single-part and small-scale production load [1]. This includes lessons learnt by JSC "SOP Obukhovsky plant", where the employees developed their own approach to improvement projects implementation [1].

The effect from lean manufacturing projects implementation is the achievement of everyone who participated in such kind of events, from top management to workers. One of major elements of JSC "SOP Obukhovsky plant" lean manufacturing system is work on improvements,

which involves all plant employees. In order to support the plant employees creative initiative, the Regulation for Improvement Activities Arrangement was introduced by Order of the General Director No. 412 dated April 10, 2018 [2]. This article gives an overview of the results achieved over a year of proposal reviews and assessment of their economical effect.

Introduction into the process of continuous improvement

The accepted viewpoint on the lean manufacturing organization generally includes four major principles [2]:

1) immediate response to changes in the product production chain;

2) continuous investments in training and management of the personnel in order to increase product quality and labour efficiency;

3) self-improvement of workers activity at the production site;

4) continuous improvement of production processes through minor changes.

If an organization follows these principles, then hypothetically different types of losses will be excluded from all processes and operations in practice. Real processes include a lot of losses (at least 50 % of the total time of value creation, based on [1]), which can be eliminated.

In order to comply with all lean manufacturing principles and create effective organization, it is necessary to take advantage of workers' latent creative potential through implementing a system of submission, collection, and implementation of improvement proposals from the employees.

The Lean Manufacturing Implementation Technology (LMIT) Department of JSC "SOP Obukhovsky plant" considers proposals from all employees; therefore, everyone can take part in developing improvements of a workstation, a bureau, a department, a subdivision, a discipline, and the enterprise as a whole. Every flow, process, and operation provides vast possibilities for improvement.

An improvement proposal (IP) is a proposal from one or several employees aimed at improving certain technical, organizational, management, and production processes, workstation equipment, logistics, office and other processes, with the purpose of reducing costs, increasing efficiency, ensuring quality, and obtaining economic benefit, as well as improvement of labour conditions and safety.

Every detail matters in the process of system generation, from submission to implementation of improvement proposals from JSC "SOP Obukhovsky plant" employees, hence, during IP principle generation, the simplest mechanism of handling it was developed and tested, which includes the following:

- financial and non-financial recognition of the authors;
- involvement of management;
- simple process structure;
- additional communication aspects (project work, competitions, awards to the best, etc.).

Today, every large subdivision (total number of employees – over 20) of the plant has an IP information stand with all necessary information on the IP system.

This stand provides for communication between the author and workers, as well as experts in this IP, which eliminates such obstacles as a line manager and minimizes fading of a worker's creative initiative. The stand visualization makes the IP system operation illustrative and transparent for all enterprise employees.

This stand includes complete information on the IP handling, particular attention being paid to the IP roadmap, from submission to implementation, as shown in Fig. 1.

Beginning – IP submission. A container with clean forms is placed near the stand with the information on the IP submission. It is the application form that initiates IP generation and description. If an author is unable to independently document his/her idea, he/she should apply to the officer in charge of IP in his/her subdivision, the information on the responsible officer being indicated on the IP stand with the photo and contact phone number. After documenting the IP, an employee should put his/her application in a box on the information stand.

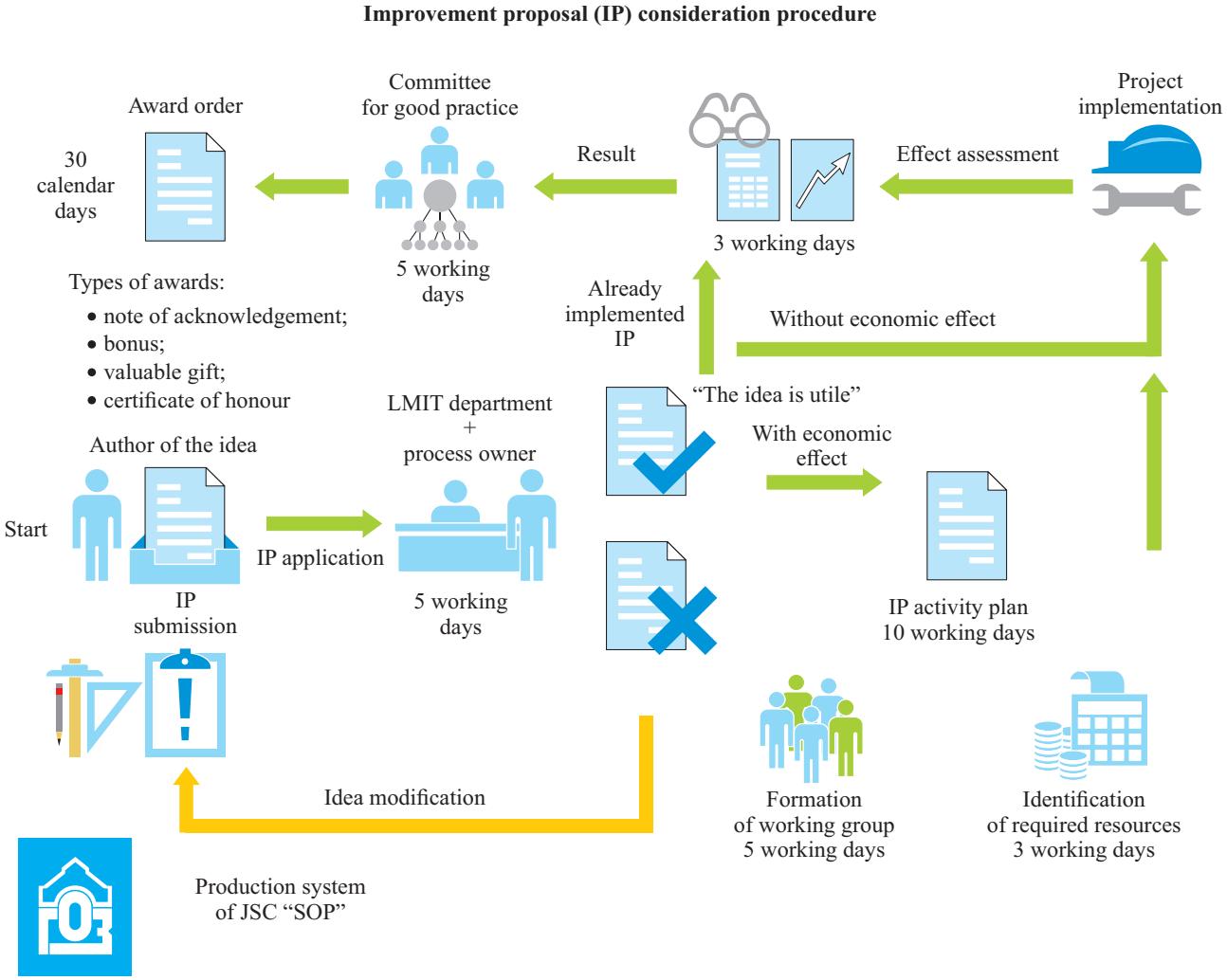

Fig. 1. IP roadmap from submission to award

First stage – utility measurement. From the box, IP applications are forwarded to a responsible person in the LMIT Department, who registers every application. Within two working days following the registration, this employee checks correctness of the application and IP relevancy.

If the IP satisfies all criteria, it will be agreed with the head of IP-originating subdivision. Then, the application is sent to an expert, i. e., either to the subdivision head within his/her competence or to the owner of the flow, process or operation being improved. After receiving an IP application, the expert, within three working days, checks this IP for compliance with the criteria described in detail in IP Regulation, and renders a decision. If the IP is found utile, the application is forwarded to the next stage, the author receives the first material award in the amount of 300 rubles. If the IP fails to satisfy the criteria of IP Regulation, then it is returned to the author for correction with justification. It should be noted that an IP is considered utile and accepted for implementation if such implementation produces economic or other positive effect.

Second stage – selection of category, implementation, awards. Then, the accepted applications are forwarded to the second stage for determination of their category (see Fig. 1) – whether a measurable economic effect from IP implementation is possible. The distribution criteria are as follows.

1. If the accepted IP has no explicit economic effect and, at that, it has neither been implemented nor assumed (by the author) to be independently implemented, then the LMIT Department responsible officer, after receiving expert conclusions, prepares a plan of improvement

implementation actions. After IP implementation, all required data, including the resulting effect, is sent to the Discipline Deputy General Director, who confirms the IP effect within three working days.

2. If the accepted IP has no explicit economic effect and, at that, it is implemented by the author independently without a drawn-up and approved action plan of its implementation or it has already been implemented, then, after IP implementation, the author receives additional award in the amount of 1000 rubles. Within five working days after IP acceptance and determination of its category, an order is prepared and, within 30 calendar days, the award is paid to the author.

3. If the accepted IP has an economic effect, then the LMIT Department responsible officer, within five working days, forms a working group for the action plan and required resources preparation. Implementation is carried out within the time frames defined by the IP implementation action plan. Upon IP implementation, the data is forwarded to the Department for Finance and Economics, where the economic effect is calculated within three working days. Within five working days after reception of data from the Department for Finance and Economics, the LMIT Department responsible officer submits the result obtained within the framework of the project and the calculated economic effect to the Chairman of the Committee, who approves the amount of award to be granted to IP author (Table 1). The award amount is divided between all authors according to the award distribution pattern that they defined at IP submission.

Table 1

IP with economic effect

Result	Payout amount
10–50 thous. rub.	10 %
50–200 thous. rub.	6 % + 2 thous. rub.
200–700 thous. rub.	4 % + 6 thous. rub.
700–1 mln 500 thous. rub.	3 % + 15 thous. rub.
from 1 mln 500 thous. rub.	2 % + 30 thous. rub.
from 5 mln rub.	1.5 % + 55 thous. rub.
from 10 mln rub.	1 % + 110 thous. rub.

Since the signing of the Regulation for Improvement Activities Arrangement, the LMIT Department has received 125 applications with improvement proposals, of which 91 were found utile. The economic effect has been gained after implementation of 14 IP, and one proposal resulted in the economic effect exceeding 20 mln rubles a year. Their distribution upon reception and linear trend forecast for 2019 are shown in Table 2.

Table 2

Quarterly submission of applications with IP to the LMIT Department

Number of applications	2018			2019	
	II	III	IV	I	II
Total submitted, of which:	3	38	50	34	30
found utile	2	29	41	19	20
with economic effect	–	4	6	4	5
without economic effect	2	15	20	10	10
without economic effect, not implemented independently	–	10	15	5	5

The data obtained during a year of work allow to make a forecast of annual economic effect from implementation of technologies in a “bottom-up” initiative-based manner and compare its effectiveness with implementation of “top-down” approach described in [1].

One of the most efficient IP submitted by the employees of one of the subdivisions should be noted. Within the framework of this proposal, an improvement project “Heat treatment of stainless steel of grades 03Kh11N8M2F and 08/12Kh18N10T as part of a supply” has been opened, which resulted in an actual significant economic effect. This fact proves the effectiveness of IP system application, as well as enhancement of the employees creative potential and “bottom-up” development of the initiative system. “Top-down” and “bottom-up” systems work simultaneously, since improvements are initiated by both employees and management. Subdivision heads are usually the owners of processes being improved. A supervisor from amongst the heads is appointed for each project to provide it with resources and perform

Table 3

Total economic effect of lean manufacturing projects implementation

Results	Project			
	Organization of manufacturing flow of product "Tipping part. Metal framework"	Organization of manufacturing flow of product "Platform. Metal framework"	Organization of manufacturing flow of product "Cover"	Heat treatment of stainless steel of grades 03Kh11N8M2F and 08/12Kh18N10T as part of a supply
Actual economic effect – reduction of losses, mln rubes a year	22.24	25.3	10.75	20.2
Potential economic effect, mln rubes a year	2.140	2.43	1.040	1.45

monitoring at reference points. From the moment of project opening and till its completion, the process owner is responsible for the same, as well as for achievement of preset goals and indicators.

Reduction of IP-based projects costs

The total economic effect from lean manufacturing projects implementation is shown in Table 3.

The total economic effect from lean manufacturing technologies implementation at simultaneous implementation of "bottom-up" approach amounts to 20.2 mln rubles, and at implementation of "top-down" approach at JSC "SOP Obukhovsky plant" – 58.29 mln rubles. [3, 4]. Consequently, "bottom-up" approach makes one third of the economic effect from implementation of the "top-down" approach.

Thus, the trends change, workers potential in modelling of improvements grows and is brought out. According to forecasts for 2019–2020, the economic effect from "bottom-up" lean manufacturing technologies implementation will be close to the results achieved from the "top-down" approach, and will exceed the same by the forecast amount of applications submitted by production personnel in the long run.

Let's make a forecast of effect from lean manufacturing technologies implementation in the long run, including through submission of IP. Fig. 2 shows a flow chart of percentage ratio of effect from lean manufacturing technologies implementation and revenue.

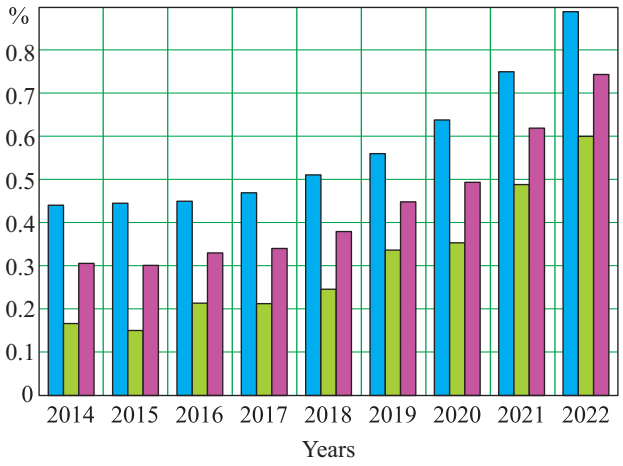

Fig. 2. Percent of revenue linear trend forecast through lean manufacturing technologies implementation: – optimistic scenario; – pessimistic scenario; – average scenario

The enterprise-wide economic effect from lean manufacturing technologies implementation for 2018 amounts to approx. 0.5 % and subject to the current system of application submission and growing revenue, it will continuously increase (see Fig. 2).

Conclusion

1. The ultimate aim of the system of lean manufacturing technologies implementation is production costs reduction and, as evidenced in practice, the effect is comparable to "bottom-up" implementation approach, and may exceed the same in the long run.

2. The total cost reduction achieved at lean manufacturing technologies implementation both "top-down" and "bottom-up" within the enterprise revenue can reach several percent in the long run.

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Submitted on 08.07.2019

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Сокращение издержек предприятия оборонно-промышленного комплекса при вовлечении персонала в концепцию бережливого производства

Рассмотрен процесс участия производственного, обслуживающего и вспомогательного персонала во внедрении методов и инструментов бережливого производства на предприятии Концерна ВКО «Алмаз – Антей» – АО «ГОЗ Обуховский завод». Приведены результаты такого внедрения, оценен экономический эффект в масштабах предприятия.

Ключевые слова: бережливое производство, предложения по улучшениям, кайдзен, непрерывные улучшения, промышленная среда, промышленное предприятие, оборонно-промышленный комплекс.

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