

Innovative strategy for improving the efficiency of industrial enterprises management

La estrategia innovadora para mejorar la eficiencia de la gestión industrial de empresas

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ABSTRACT:

The purpose of the paper is to test an innovative strategy to improve the efficiency of industrial enterprises management, aimed at improving the production processes organization, applying innovative technology to organize the workplace, reducing the enterprise reserves, minimizing the formation of waste and the manufacturing defects. The results of the research allow better and more targeted to influence the improvement of management efficiency of industrial enterprises through the use of innovative forms of management and can be used in the framework of sector programs developed by ministries and departments aimed at the strategic management of the economy and industry.

Keywords: competitiveness, production organization, lean production, industrial enterprises, efficiency, innovative management strategies

RESUMEN:

El objetivo del artículo es aprobar una estrategia innovadora para mejorar la eficiencia de la gestión de empresas industriales, que se dirigen al mejoramiento de la organización de los procesos de producción, aplicando la tecnología innovadora para organizar el lugar de trabajo, reduciendo las reservas de empresas y minimizando la formación de residuos y productos defectuosos. Los resultados de la investigación permiten de manera más específica influir en la mejora de la eficiencia de gestión de las empresas industriales mediante la aplicación de formas innovadoras de gestión. Además, pueden utilizarse en el marco de programas sectoriales desarrollados por ministerios y departamentos encargados de la gestión estratégica de la economía y la industria.

Palabras clave: competitividad, organización de la producción, producción ajustada, empresas industriales, eficiencia, estrategias de gestión innovadoras

1. Introduction

Prominent Russian enterprises in terms of modern management are actively promoting an innovative strategy for improving the efficiency of industrial enterprises management, based on "religion": Toyota's production system and Lean-Production. Toyota's production system was based on the principles of Taylorism and Fordism, while Fordism is seen as a practical development and application of Taylor's principles. Taylorism involves the labor division, mentoring (instructions), as well as coercion and reward. In addition, when constructing Toyota's production system, innovative forms of work were taken into account, and this is a process orientation, group methods of work, self-organization (Hayes & Wheelwright, 1984; Liker, 2003; Rosa & Machado, 2013; Schonberger, 1982; Schonberger, 1986). At the initial stages of their development, the following tasks were set:

- to reduce inventory resources by using the JIT method (Just in Time);
- to achieve high quality due to the Jidoka principle (autonomization involving the operation of production equipment, which itself signals defects in product quality);
- to reduce the cost by improving production processes.

At later stages other tasks were solved:

- reduction of the production cycle time (drawing products from the previous process, leveling production, ensuring the flow) through the method of "Kanban" ("Cards");
- reduction (elimination) of losses ("Muda");
- standardization of work and processes;
- the release and activation of line personnel activities;
- permanent, including advanced one, improvement of the work performed ("Kaizen");
- implementation of the "foolproof" principle (Poka Yoke), that is, the creation of devices or methods for the elimination of defects and injuries, etc.

Considering modern production systems, one can draw several conclusions.

First, almost all of them are based on the classical principles of the scientific organization of production and labor - Taylorism and Fordism - and also include innovative methods and forms of work (process, group, and self-organization).

Secondly, modern production systems rely heavily on elements of the Toyota production system.

Thirdly, the set of production systems methods and tools is determined by the specifics of the industry, for example, the products' serial production, the length of the production cycle, etc., as well as the culture of production historically established at the enterprise.

Fourth, in building production systems and lean manufacturing, it is necessary to rely on domestic practices from the past, adapted to modern market conditions.

It is necessary consistently to develop a technique for introducing lean manufacturing strategy tools at industrial enterprises, achieving adequate economic estimates of various kinds resources' real consumption (Galimulina et al., 2016; Kudryavtseva, 2015; Masalimova & Nigmatov, 2015; Lubnina et al., 2016; Shinkevich et al., 2016; Zaraychenko et al., 2016; Masalimova & Chibakov, 2016).

2. Methodological Framework

The theoretical basis of the study is the concept of lean manufacturing. At present, the issue of competition on the Russian market in the conditions of the volatility of the world market and

the reduction of enterprises economic stability arises more often. Many enterprises are trying to reduce their costs through the introduction of modern management systems, among which the most prominent place is occupied by the system "Lean Production". Interest in lean production in the Western countries arose in connection with the successful development of Japan's automotive industry after the Second World War. Unlike large American companies that tried to reduce production costs, increasing production volumes within the same series, Japanese enterprises focused on the introduction of flexible production systems that allowed the production of a small series of models on one conveyor, taking into account the requests of individual dealers. Choosing a Japanese car, the consumer received high-quality products for a smaller amount than it was acceptable for an American or European car of similar quality. This was due to the rapid growth in sales of Japanese cars in Japan and abroad. The Japanese experience of production organization is attractive not only because of the possibilities of productivity growth and achievement of a high level of quality, but also due for its application in the conditions of a tight budget constraint. The use of these techniques does not require significant capital expenditure, even in traditionally capital-intensive industries (Solomon & Fullerton, 2007; Womack et al., 1990; Womack & Jones, 1996).

The leading method used in this study is the modeling method that represents this study as a purposeful and organized process to improve the efficiency of industrial enterprise management. By means of modeling the technique of lean manufacture's tools introduction, on an example of the industrial enterprises of Republic Tatarstan is described.

Using the economic-mathematical analysis, multivariate statistical analysis, forecasting methods an assessment of the effectiveness of OOO "Protect" activities is given in 2008-2015, a plan of measures for the introduction of lean manufacturing tools was proposed.

3. Results

3.1. The current state of the introduction of Lean Manufacturing technologies at enterprises of the Republic of Tatarstan

To date, lean production technologies are being implemented at 167 enterprises and organizations of machine building, chemistry, petrochemistry, energy, light industry, agriculture, transport, and health. According to operational data for the year 2016, the economic effect amounted to 4.4 billion rubles.

Among the leaders in this indicator: OJSC KAMAZ - 2938 million rubles, OJSC Zelenodolsk Plant named after A.M. Gorky "- 493.4 million rubles, OJSC "Kazan Engine Building Production Association"- 271 million rubles, OJSC "Kazan Electrotechnical Plant"- 87.5 million rubles, JSC "Network Company"- 80 million rubles, JSC "Chemical Plant named after. Karpov"- 41 million rubles, OGEM (oil and gas extracting management) "Jalilneft"- 37.2 million rubles, OJSC "POZiS"- 31.6 million rubles, JSC "Bugulma Mechanical Plant"- 30.2 million rubles, etc.

Within the framework of the visiting session of the Military Industrial Commission under the Government of the Russian Federation "On the introduction of lean manufacturing systems in organizations of the defense industry complex," a Lean conference was held with the participation of the Deputy Prime Minister of the Russian Federation, Chairman of the Military Industrial Commission under the Government of the Russian Federation D.O. Rogozin.

More than 400 people - mostly representatives of defense enterprises, from 19 regions and districts of Russia, took part in the conference. Within the framework of the conference, an exhibition of "lean" enterprises, excursions to three "lean" enterprises of OJSC KAMAZ (automobile plant, press-frame plant, and engine plant), business games and master classes were held.

In the city of Almetyevsk, on the basis of OAO Tatneft, the International Lean-Conference "Effective Processes - High Productivity" was held with the participation of international Lean

coaches, managers of the largest industrial enterprises of the Russian Federation and the Republic of Tatarstan.

Within the framework of the Lin-conference program, the participants got acquainted with the practice of Lean technologies effective use at the enterprises of Russia machine-building and oil-gas chemical complexes, as well as the experience of implementing Lean projects in Kyrgyzstan, Kazakhstan, Japan and the United Kingdom.

The Ministry of Industry and Trade of Tatarstan Republic together with the Academy of Informatization of Tatarstan Republic and the Academy of Sciences of Tatarstan Republic conducted the International Scientific and Practical Conference "Productivity and Lean Production". The conference was devoted to the problems of production systems productivity increasing based on the effective use of Lean Production principles and tools, the production preparation management at engineering enterprises, and the role of the interaction between the states, public and commercial structures in raising the productivity of domestic enterprises and organizations.

3.2. Improving the technology of introducing lean production tools

Analysis of enterprises production activity based on key performance indicators allows us to identify problem areas of the enterprise with a view to the more targeted use of lean manufacturing tools. To do this, we group the key performance indicators of the enterprise's production activity in accordance with the functional areas of the lean production tools' impact.

Table 1

The technique of lean production tools implementation based on key performance indicators

KPI	Lean production tools	The effect of lean production tools' implementing
1. Management efficiency evaluation of production activities and enterprise resources management		
1. Percentage of gross profit,%. 2. Implementation of the plan for gross profit, %. 3. Implementation of the financial plan by the volume of product groups sales, %. 4. Share of costs for inventory management in the total value of logistics costs, %. 5. Inventory turnover ratio. 6. Inventory turnover in days. 7. Profitability of reserves,%	JIT - Just in time; Kanban (information cards); Resources Management Pulling System, PDCA - Organizational Management Cycle	increase of management efficiency of the enterprise production activity; increase in production profitability; improving the efficiency of inventory management; decrease in the volume of stocks at the output; Determination of the optimal volume of stocks, etc.
2. Evaluation of products quality		
1. The share of claim, %.	Poka Yoke (error protection)	improving the quality of products;

<p>2. Percentage of permanent defects, %.</p> <p>3. The share of finished products recognized as industrial defect,%</p>		<p>reduction in the output of defective or non-quality products;</p> <p>reduction of errors in the production of products, etc.</p>
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3. Efficiency and quality evaluation of the enterprise technical equipment

<p>1. Absolute load's factor of the equipment.</p> <p>2. Downtime due to inoperability and repair of equipment, h.</p> <p>3. Unit cost of equipment operation, rub.</p> <p>4. Frequency of equipment failure, times</p> <p>5. Number of launches of new products, pcs.</p>	<p>TPM - Total Productive Maintenance;</p> <p>Jidoka (autonomation);</p> <p>SMED - quick changeover</p>	<p>reduced downtime due to equipment malfunction and repair;</p> <p>reduction of costs for equipment operation;</p> <p>improving the quality of technical equipment;</p> <p>the speed increase of readjustment of equipment, etc.</p>
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4. Estimation of efficiency of the enterprise logistical activity

<p>1. The share of transportation costs in the total value of logistics costs, %.</p> <p>2. Share of logistics costs in revenue, %.</p> <p>3. The share of costs for inventory management in the total value of logistics costs,%</p>	<p>Mapping the cost creating stream</p>	<p>reduction of production costs;</p> <p>reduction of losses throughout the production cycle;</p> <p>reduction of products production time;</p> <p>search and exclusion of production processes that do not create value for the end user, etc.</p>
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5. Evaluation of staff activities effectiveness, in the context of the workspace organization effectiveness

<p>1. Work output per one production worker, t / person.</p> <p>2. Revenue per employee, rubles / person.</p> <p>3. Capital productivity of non-current assets, rubles / rub.</p> <p>4. Share of costs in revenue, %.</p> <p>5. Rates of growth (decrease) of industrial injuries cases,%</p> <p>6. Growth (decrease) in rationalization proposals,%</p>	<p>5S - organization of the workplace;</p> <p>kaizen - continuous improvement;</p> <p>U-shaped cells - organization of workspace</p>	<p>Efficiency increase of industrial operations performance at the enterprise;</p> <p>reduction in occupational accidents;</p> <p>leveling the rhythm of production;</p> <p>increasing the speed of products production;</p> <p>reduction of costs in all</p>
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Having considered the technique for developing key performance indicators of the enterprise, as well as the essence and types of lean production tools, we will offer the stages of introducing lean production tools based on the problem areas of the enterprise.

It is necessary to outline the main stages of the lean production concept introduction at the enterprise:

- Evaluation of key performance indicators by aggregated groups:
- the effectiveness assessment of production activities management and the enterprise inventory management;
- an estimation of produced products quality;
- The efficiency and quality evaluation of the enterprise technical equipment;
- the efficiency evaluation of the enterprise logistic activity;
- Evaluation of staff activities effectiveness, in the context of the workplace organization effectiveness.
- The identifying of the company's production activities problem areas based on the results of a comprehensive assessment.
- Using of the appropriate production lean tools to eliminate the problems of the enterprise.
- Monitoring the effectiveness of proposed activities implementation.

It is appropriate to propose the approbation of the proposed measures for the introduction of lean production strategy at the enterprise on the example of the enterprise "Protect" LLC.

3.3. Approbation of the technique of lean production tools implementation at the enterprise

We will consider the practice of introducing lean production tools at LLC Protect. LLC "Protect" is the leader in the development and manufacture of bundles for electronic tachographs, both foreign and domestic production, as well as for the navigation equipment of the ERA-GLONASS system. The profile of the enterprise is the production of electrical harnesses in Naberezhnye Chelny, Kazan, Samara and Ufa for the satisfaction of specialized enterprises interests. LLC "Protect" is an approved supplier of OJSC "KAMAZ" and provides with its production the main assembly conveyor of these enterprises.

The technical service of the LLC "Protect" takes an active part in the implementation of the advanced developments of the Research and Technical Center of JSC "KAMAZ" and delivers wiring harnesses for the experienced and exhibition models of KAMAZ vehicles.

The company specialists also develop original wire harnesses for LLC "TRANSMASH", JSC "TatElektromash", LLC "Shturman-Credo" and LLC "Raritek" in Naberezhnye Chelny.

The production site of the company is equipped with advanced modern equipment of leading foreign manufacturers such as KOMAX, MECAL, TYCO / AMP, Strunk GmbH, Brady.

As a part of the manufactured products, high-quality components of foreign manufacturers such as AMP, Schlemmer, Deutsch, as well as similar products of Russian manufacturers are used, which allows to ensure a level of quality that meets the requirements of European and Russian standards.

Problems identified during the study, on the basis of KPI indicators calculation:

- shortage of production and storage areas;
- high dependence on the customer of finished products;
- high rhythm of production;
- absence of automated technologies for managing the warehouse and production complex;
- lean production tools' partial introduction into the production process;
- lack of an integrated activity estimation system using key performance indicators - KPI;
- uneven loading of production personnel, employees of the Quality Control Center and the picker;
- lack of accounting for costs for logistic functions.

3.4. Draft proposals for production and warehouse activities

1) Workshop №1 in the storage areas for components and semi-finished products (the storage zone for the wire - "Zone 3") to use the zoning system for various wire modifications, indicating the inscriptions to these zones, which will allow for each modification of the wires to determine the place of temporary storage - this, in its turn will ensure the economy of time for search for necessary modification of wires for picker and other workers of the workshop. Each storage zone by modification of wires should have corresponding inscriptions, as a means of visualization, which allows you quickly to determine the storage location.

2) The use in the warehouse of gravitational racks.

Gravitational racks are rack systems that are used to store products on roller tracks that are located at an angle of 3-5% to the horizon. They are used to store a large volume of goods with a high turnover in the industry. Gravitational racks are widely used in production warehouses.

3) In workshop number 2 on the harnesses assembly desks (2. The harness assembly area of the 548 serial, 3. The harness assembly area of the 740 serial, 4. Assembly area of ABS harnesses; 5. Zone assembly of frame bundles) to arrange boxes with accessories directly on the assembly workplaces, the number of components will be issued by the picker at the beginning of each shift according to the scheduled task for the shift. Thus, workers will not spend time going to parts storage sites.

4) PDCA cycle implementation on workplaces for employees' rationalization proposals introduction and the management decisions adoption based on them (Kaizen Tool in Lean Production Methodology) (Kaizen, 2014).

5) For more even load of plots' workers and the finished products control department it is necessary to expand the functional duties of the picker. It is assumed that he will not only the necessary materials and components, but also take the finished products to the Point of the finished products Quality Control as they become ready, thus, the workers of the station will be relieved of this function, paying more attention to their functional duties.

It is necessary to consider the cost of implementing barcoding in the enterprise. The introduction of barcoding involves the purchase of software, a scanner, a thermal printer, and supplies.

The purchase of the software "1C: Trade Management 8" is supposed, which allows in a complex to automate the tasks of operational and management accounting, analysis and planning of trade operations, thereby ensuring the effective management of a modern trading enterprise.

The analysis of the equipment market for the barcoding introduction allowed us to find out that the barcoding introduction involves the purchase of software (costing from 20,000 rubles), a scanner (from 5,000 rubles), a thermal printer (from 15,000 rubles), and consumables with a minimum total cost of 40,000 rubles.

The technology of barcoding allows achieving the following advantages:

increase in the throughput of the warehouse from 10 to 20%;

3 times reduction of the standard operations average time;

A 40% reduction in the storage reserve;

Till 25% reduction in the staff;

Paperwork is reduced to a minimum.

For goods (materials) movement effective account in an organization, a technology is needed that allows each product to be assigned a unique code, and to ensure rapid code reading with minimal errors. It is precisely these conditions requirements are met by the technology of

goods bar-coding, which has long been successfully applied by Western firms.

The next element that increases the efficiency of production management at the enterprise is the introduction of the 5s system "The rational organization of workplaces" at LLC "Protect".

5S is a lean production tool, a system for organizing and rationalizing the workplace.

Step 1. Preliminary work

Stages of preliminary work:

To identify the person responsible for 5S in order to facilitate the administration of the system

To teach each employee the basics of the concept;

to divide the enterprise into zones (workplaces) and to appoint responsible persons for each zone;

To fix the current state of workplaces with the state pictures "before" and "after" the vision;

5S points must enter the goals and KPI of each employee.

Step 2. Sorting

Sorting is storing only what is needed to create value for the customer, when nothing else can be removed. Items needed in the workplace are separated from unnecessary items, which are then removed.

Stages of sorting:

To look around at the work site.

To start sorting things that should be there. All objects of the working environment are divided into three categories: the necessary (daily need); not needed urgently (monthly need); unnecessary ones.

To use the process of red tags for urgently unnecessary items .

To dispose unnecessary items (move / to waste).

To keep the necessary items near the place of use.

To follow the principles of frugality.

Step 3. Compliance with order

At this level, the place for each necessary object and the location of these objects in the zone are determined, so that basically everything has its place, and everything is in its place. In addition, as a key element of this level, it is important to identify sources of pollution and eliminate the main reasons for this to ensure the required conditions and avoid undesirable elements or undesirable situations.

Stages of the rationalization of workplaces:

To make sure that everything has its place.

To make sure that all items needed on the workstation, such as tools, raw materials, finished products, empty containers, have their own place, like other additional items, such as cabinets, detergents, lockers and hangers for outerwear.

To make sure that everything is in its place.

To identify sources of pollution.

To find the main causes of pollution source for the main problems.

To place visual materials with a normal state.

Identification and delineation of materials / areas – to determine minimum / maximum levels, to identify personal protective equipment for the working site and other visual materials needed to manage abnormalities.

Step 4. Compliance with cleanliness

At this level, there is a need for general cleaning, bringing the zone to its original state, and maintaining a neat workplace.

Stages of cleaning:

- To prepare for the event of general cleaning.
- To have cleaning products and other items necessary to bring the equipment into the original conditions, as well as a list of upcoming maintenance work.
- 3. To evaluate the availability of racks, containers, fasteners for tools or other items that require replacement.
- To carry out a general cleaning with the task of bringing the equipment and the zone to its original state.
- Thorough cleaning and cleaning of equipment, fixing of malfunctions.
- Identification of places which are difficult to access for cleaning and controlling, as well as sources of problems and pollution.
- Troubleshooting and development of measures to prevent them.
- Development and implementation of measures to clean up hard-to-reach places, eliminate (localize) sources of problems and pollution.
- Developing rules for cleaning, cleaning equipment, checking, lubricating and tightening fasteners.
- Drawing up a cleaning schedule to maintain standards and identify abnormalities.

Step 5. Standardization

Standardization is the inclusion of the practices of the first three S's in daily work, it is the definition of the standard who, what, when and how does he do at all job sites. The 5S standards for all plant zones are installed and maintained using visual images of the standard state. To maintain a good 5S state, everyone should know that he is responsible for the execution, as well as what, why, when, where and how to do it.

Step 6. Improvement.

In this phase, the goal is to maintain the 5S system and create an evaluation system to ensure efficiency. It is necessary to ensure disciplined compliance with the 5S rules and procedures to prevent violations. Following the rules to maintain the standard and keeping improving every day are also needed.

To summarize, it should be noted that the history and practice of industrial thought led to a simple conclusion: there are no trifles in production, and regardless of the degree of automation and robotization of production, the success of the enterprise, like a hundred years ago, directly depends on the employee and the organization of his workplace. An employee who follows the standards of production and keeps his job place in order will be able to work much better with modern equipment and demonstrate a 100% quality level.

4. Discussions

The positive results of lean production tools introduction show, in our opinion, that domestic companies, first of all the representatives of big business, found a foothold for making new

strategic decisions aimed at overcoming the crisis. One can note that Lee Quarterman (Lee, 2015; Ford, 1922), who studied the experience of major automobile companies such as Ford, Toyota and Harley-Davidson, believes that there are several reasons to consider the crisis the best time to move to lean production.

First, in his opinion, the crisis makes the transition to the required paradigm of business easier and faster. Secondly, lean production programs are easy to self-finance and do not require additional infusion of money. And, finally, the target cash flow is achieved quickly enough.

Despite significant positive aspects, there are certain difficulties and limitations that need to be overcome to create a system of lean production in the enterprise:

- the need for significant organizational changes and staff's readiness for them;
- retraining and training of personnel;
- the need for close interaction with suppliers, customers, and the ability of suppliers to deliver products of appropriate quality at a strictly defined time;
- long terms of implementation.

At the same time, in the presence of a large amount of theoretical and methodological material, a unified methodology has not yet been developed for the introduction of lean production tools at domestic industrial enterprises.

5. Conclusion

The paper contains the results of analytical studies that showed that the main stages of the production organization development in an explicit and implicit form pursued one goal - a continuous reduction in consumed resources and an improvement in the quality of products through the introduction of more effective innovative tools and methods of production. It is shown that, firstly, in enterprises it is necessary to create an atmosphere of trusting relations that ensure the mood of employees to manifest their creative potential; second, it is necessary, and now especially, constantly to train specialists in the field of lean production and quality improvement, so that enterprises can use their competitive advantages, thirdly to develop a system of key performance indicators in order to apply tools of lean production more accurately (Kaizen, 2014; Fiume, 2007; Chiarini, 2013; Cunningem & Fiume, 2007).

The principles of production organization are exemplified by the works of Frederick Taylor, Henry Ford, Tahiti Ono (Taylor, 1911; Ono, 2012; Ford, 1926). The paper proposes approbation of the technique for introducing lean production tools based on the key performance indicators of LLC "Protect". These conclusions can be useful for enterprises that actively implement the tools of modern production organization, and also become the basis for further work on the impact of effective resource management methods on the development of production organization based on innovative production management systems, in particular, the concept of lean production.

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