Experience in the use of lean-technologies in organizing a competition at a research institute

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Abstract. The experience of using lean manufacturing tools in organizing of preparations for the participation of the young scientists of research institute in competitions is considered. There are typical features of such competitions and their significance for the development of the young scientists. Particular attention is paid to the most prestigious competitions organized by the Russian Foundation for Basic Research (RFBR). The composition of the processes affecting the efficiency of work created at the research institute and the unit for working with the young scientists is determined. One of the most labor-intensive processes, the process of preparing tender documentation, is described. By analyzing the process under consideration, the losses that occur in it are identified and analyzed. It was established that the main losses are not in the substantial work on the preparation of tender documentation, but in passing it through a significant number of instances within the research institute. The process consists of approximately 50 works and takes at least 25-30 days. A number of steps are proposed aimed at reducing such losses, using the Kanban signal system and 5S system. In particular, a special electronic folder with a navigator has been created, containing all the necessary document templates.

1. Introduction
Created in the middle of the last century, the concept of lean manufacturing, known as the production system of Toyota Automobile Corporation, still finds today new areas of application [1]. In addition to mechanical engineering, its tools have found their place in metallurgy and communications, transport and freight transportation, government, housing and communal services, medicine and education. Almost everywhere, the implementation of lean production is considered as a part of the general policy of involving working employees in the management of organizations [2]. Lean manufacturing approaches are especially effective when combined with a quality management system. We need to remember the main one, as it is sometimes called the “golden” principle of lean production: “The effect becomes the maximum when it is the result of continuous improvement”. It is appropriate to remember also the words of the founder of IBM Thomas Watson Sr., who in 1914, when organizing his company, formulated three principles of its activity, one of which was the following: “It is necessary to achieve perfection in everything”.

2. Methodology
In the article, the authors consider an example of using lean manufacturing approaches in the process of preparing and organizing a competition at the research institute.
The main activity of the institute is the creation of specialized control systems for a number of industries. The solution of urgent and complex scientific and technical problems poses the heads of the institute the task of maintaining a high scientific level of its personnel, maintaining and increasing its competitiveness [3].

Obviously, one of the ways to achieve this goal is constant attention to the growth of scientific qualifications of employees, which is especially related with the young scientists. An important emphasis is placed on their active participation in “external” scientific events, such as conferences, seminars, exhibitions and scientific competitions of various levels (from intra-institute to national and international ones) [4, 5].

Here it is appropriate to recall once again that in accordance with the concept of lean production, all the activities of any organization can be divided into operations and processes that add value to the consumer, and operations and processes that do not add it. The participation of employees in such competitions, may be indirectly, but can undoubtedly be attributed to processes that add value, primarily to the main resource of any organization, its human capital [6].

Among the competitions there are also special ones aimed at young scientists. The adversarial nature of them has a stimulating effect on the scientific activity of young people, forming the future creative potential of the entire research institute from young employees [1, 7].

One of the most prestigious competitions is the competition for young scientists, regularly held by RFBR. In December 2019, another of them was jointly announced by RFBR and the Fund for Supporting students, graduate students and young scientists, “National Intensive Development”. The significance and at the same time the attractiveness of such competitions is in the fact that grants are awarded on a competitive basis based on the results of a multi-stage international independent and transparent examination of projects and collective decisions. They are allocated mainly to small groups, regardless of the availability of academic degrees, ranks and positions of participants.

Typical features of the above competitions are:
• the projects with a duration of about two years and relating to basic research on topics formulated in the announcement of the competition may be nominated;
• the size of the team representing the project is limited to five members under the age of 33;
• the name of the project should not coincide with the name and competition of the planned work financed from the federal budget.

As the young scientists of research institutes usually show considerable interest in such competitions, a special unit was created: sector of young scientists. The main goal of this unit is to attract and train the young specialists, including participating in the above scientific events:
• seminars and conferences;
• competitions of scientific works;
• reviews and exhibitions of research results.

There are a number of important processes in the young scientists sector:
• constant monitoring of publications on holding competitions, the participation of young specialists in which can contribute to the development of the scientific potential of the institute;
• organization of preparatory work for filing applications for participation in competitions;
• systematization of information on the current activities of young employees of the institute, their participation in other scientific events, such as seminars, conferences, etc.;
• comprehensive analysis of the scientific work of the young specialists as a result of their participation in external scientific events;
• analysis of the publication activity of young employees in Web of Science, Scopus, Russian Science Citation Index, etc.

The support program for the young scientists is constantly expanding, which, in turn, requires the optimization of all the processes for preparing and conducting the above-mentioned competitions. Despite the high labor costs for organizing the participation of employees in such competitions, they are necessary because they develop the initiative and independence of the young scientists, increase the status of the research institute and also provide material support to the organization and its employees [8]. At the same time, the task arises of minimizing labor costs in the process of preparing for the above-
mentioned competitions, which allows increasing the value of this process, and for the participants concentrating more on the substantive side of preparation for the competition. This process was chosen as easily formalized, fairly typical and often repeated in comparison with other processes [9, 10]. If the process in question is compared with the main activity of the institute, of course it refers to auxiliary processes, however, during the period of competitions it often begins to occupy leading positions. This is especially true in relation to those who declare their participation in the competition.

3. Results
A preliminary study of the process (table 1) revealed the main stages that must be completed during the typical process of preparing one of the competitions. At the same time, the time expenditures were consolidated. These data are obtained as average, based on a survey of employees involved in such work.

| Main stages of the process |
|----------------------------|
| Analysis of the information received from the announcement of the Competition |
| Distribution of responsibilities for organizing participation in the Competition among employees of the young scientists sector |
| Dissemination of information about the Competition at the research institute |
| Appointment of the coordinator of the Competition and responsible for the units on the announced topics of it |
| Development of a plan for the participation of projects of the young specialists in the Competition |
| Preparation of a meeting of the young specialists who announced their participation in the Competition |
| Formation of the commission of the Scientific Council of the research institute for the consideration of applications of the young specialists |
| Collection of applications for the young specialists to participate in the Competition |
| Consideration of applications of the young specialists for participation in the Competition by the commission of the Scientific Council of the research institute |
| Registration of applications approved by the commission and execution of documents for sending electronic applications to the Competition organizers |
| Organization of sending hard copies of applications to the organizers |
| Progress report |

A phased analysis of the process revealed significant losses, which, in accordance with the classification adopted in lean manufacturing, can be attributed to such types as:
- overproduction: making copies of necessary documents (just in case), duplicating information in documents moving in a package, preparing intermediate documents that are not on the list of necessary documents, holding meetings that do not add value to the main process;
- excess stocks: storage of documents that have lost their value;
- unnecessary processing: excessive number of approving signatures, consideration and discussion of intermediate works and documents;
- superfluous movements: irrational organization of workplaces for employees of the young scientists sector and search for necessary documents;
- transportation: movement of documents that do not add value to the institute's management levels to obtain secondary approvals, direct “loss” of documents;
- downtime: waiting for “interim” signatures of employees, for subsequent obtaining approval from the leadership of the institute;
- defects: errors that occur when preparing or entering information into documents, transferring documents for approval by an incomplete “package”;
• irrational use of human capital: workload of employees unequal in time and volume of work, related to a lack of qualifications for some and to assigning highly qualified employees jobs that do not require high qualifications.

The total time spent was determined on the order of 25-30 days. For the subsequent optimization of the process, it is necessary to analyze it step by step, for individual works, of which about 50 were identified in the 12 stages considered. To identify the main losses in this process, classify and find ways to eliminate them, it was decided to turn to lean manufacturing approaches and main tools. Having decomposed the process into separate works, the presence of significant losses became apparent. The analysis showed that the most common losses are (in frequency of occurrence): expectations of numerous approvals and signatures - about 40% (19 operations) and excessive processing of documents (numerous edits) - about 20% (10 operations). Among other losses there were noted: preparation of documents, without which the value of the process does not deteriorate and excessive movement of employees inside the research institute. The most significant part of the time loss has the work carried out with the participation of the institute's heads (numerous approvals of the texts of documents and their signatures). In this regard, it can be assumed that the process of preparing and submitting applications for participation in the competition, which has developed over several years at the institute, has significant reserves for optimization. For this purpose, a map of the current state of the process was built, on which optimization cycles were identified, that is, those works on which a lot of losses are concentrated and their elimination or reduction will reduce the duration of the process as a whole. The analysis showed that according to the classification of losses adopted in lean manufacturing, the largest share relates to such losses as “downtime” and “excessive processing”. The main share of such losses relates to: dissemination of information within the institute, preparation, non-systematic storage of all the initial information necessary for the preparation of documents, numerous approvals and expectations of the signing of documents by managers. The main efforts were directed at reducing precisely such losses [11].

Among the tools of lean manufacturing, at the first stage of implementation, we selected: workflow optimization, Kanban system, individual approaches of 5S system, etc. To this end, it was decided to start by training employees in the basic approaches and tools of lean manufacturing and to use them in the practice of preparing for participation in the competition. A series of institute-wide seminars were held, in which the participation of the young scientists in the sector was included for them in continuing education programs. For them, the main task of the training was formulated as follows: what can be done to reduce losses in the preparation of tender documentation and improve its quality. The first step in the training was to become familiar with the general philosophy of Kaizen, as the main way to improve any process, both production and management. In the annual work plan of the young scientists sector, such training seminars were built directly on the eve of the deadlines for the preparation of competition documents, which allowed transferring purely theoretical training to the plane of directly solving practical problems. In the learning process, a map of the current state of the value stream was built, the quality of which was determined as a complete package of tender documentation adopted by the organizers of the competition. As this traditionally happens in lean manufacturing, the map showed most clearly all losses and their magnitude, made it possible to find optimization ways, and then build a plan to reduce losses and build a map of the future state of the process [12].

The implementation of lean manufacturing tools was started with the introduction of elements related to 5S system. There was implemented one of the most important principles of lean manufacturing: to start with yourself and your workplace.

The dynamic nature of the work of employees, frequent communication with visitors and the holding of even often short-term but frequent meetings created difficulties to maintain cleanliness and order in the premises, which could not but affect the numerous losses and delays in the performance of individual work processes. Implementing the approaches of 5S system, the following tasks were set and implemented:

1. To get rid of unnecessary things on the tables, leaving only the documents necessary to carry out the current work;
2. To equip workplaces with special racks or hinged shelves, organizing them systematic storage of documents equipped with signal labels for quick location;
3. Continuously maintain cleanliness and order in the workplace;

4. The improvement process is constantly kept in the focus of attention of employees, spreading the best individual solutions to all employees, thereby improving the overall corporate culture.

The implementation of only the above, in fact elementary measures allowed:

• to reduce to a reasonable minimum the number of unnecessary movements when searching for the necessary documents and objects, cleaning interfering objects;
• to reduce the time losses arising from the preparation of meetings by reducing the time spent on cleaning workplaces and selecting documents necessary for the meeting;
• to reduce duplication (overproduction) of documents due to losses previously prepared, causing the need to search and print additional copies.

In the future, all the measures considered are supposed to be included in a special standard of the enterprise, categorized by type of competition, which will allow, among other things, abandoning lengthy meetings to coordinate those documents on the organization of competitions that have a “standard” structure and purpose.

The next step aimed at improving the efficiency of the process under consideration was the introduction of daily morning, very brief meetings, which take no more than 10 minutes, at which the work for the current day and the problems that arise are clarified, ways to resolve them are identified and responsible people for their resolution are appointed. Such “planning meetings” allow quickly optimizing the workload of employees, to get rid of excessive duplication of work. Decisions made on such meetings are recorded in a special journal, but not in the form of a verbose protocol, but in the form of short tabular records of direct instructions: issue considered - decision made - person responsible for the implementation - result of the implementation. It tightly controls decisions, excludes minor polls from the discussion and always has the necessary source material for reporting [13].

We note that an attempt was made to hold such meetings “in Japanese way” while standing up, but it was quickly abandoned as an unusual for the Russian people.

Then, a “Kanban board” was developed and introduced for the process under consideration, which allows tracking where a particular document is located and adherence to the time frame for its passage at any given time using special stickers. The board is located in the corridor near the sector of the young scientists and is available to inform all employees. The board has three main sections corresponding to the current period of time: “Tasks” - planned work; “In progress” - work in progress and “Done” - completed work. Information is divided into three sections: administrative information, preparation and organization of events and reporting documents. Inside the second and third sections, color marking is provided according to the traffic light principle: green means timely passage of the document, yellow means one working day is left before the deadline, red means the deadline for the completion of the document has expired. Responsible for maintaining information is one of the sector staff. Thus, the process is monitored, and downtime points are identified in a timely manner.

Then, a special electronic system folder was developed and launched on all employees’ computers, equipped with a “navigator” and containing templates of normative documentation, with the right of access to it for all employees who may need it when preparing an application for the competition. The presence of templates can dramatically reduce the time for preparing documents, since it provides only for filling in standard columns. The folder contains three standard sections: scientific events, reporting and administrative documents, and two catalogs: all types of competitions and typical samples of competitive documentation for each of them. This catalog contains all the regulatory documents applicable within the institute for preparing for competitions and regulating this work; regulatory documents on the work of the sector of the young scientists, templates of all possible options for memos that accompany preparation for various competitions.

The introduction of the named “folder” made it possible to: standardize a number of documents, easily find the necessary documents, reduce the time for organizational issues related to participation in competitions and remove some internal, intermediate documents from the process.

Since the greatest losses in the process under consideration were recorded during the passage of documents from the institute’s heads, these operations were subjected to the most thorough analysis. So the first event that was implemented was the part of the decision-making functions on participation in
competitions delegated to the level of department heads, which allowed drastically reducing the time of the approval process and waiting for heads signatures. This event required the development of a regulatory document (intra-institutional position), guided by which the heads of departments were able to make the above decisions.

The next implemented measure was the allocation of so-called “zones of responsibility” in the prepared application documents. In those “output” documents where concordant signatures remained, blocks were identified for which the heads of individual functional services were responsible. Thus, each leader was responsible for his part of the information and he did not need to read the entire document before signing. The head of the highest level of management in this case could sign the final version of the document, focusing on the availability of such matching signatures. Drawing an analogy, this approach became similar to the process of signing the so-called “leave certificate”, which clearly defines which company service is responsible for what. For example, an employee of a scientific and technical library signs only for the absence of “debts” from the resigning employee of the library and is not responsible for other sections of this document. At the same time, each document is supplied with a special card containing information similar to that which is placed on the Kanban board, where the entire path of the document is marked, including the time the document entered the department and the time it left the next stage of the process. The cards themselves are also standardized.

Thus, as a result of improving the process of preparing for participation in tenders, it was possible to reduce the duration of work that incur losses by about a third, and the number of document approval transactions with managers at different levels has been reduced by half.

At the final stage, it was proposed to introduce an indicator in the form of the ratio of the number of supported competitive projects to the total number of applications submitted as one of the performance indicators of the thematic departments of the research institute.

4. Discussion
The introduction of the use of lean manufacturing tools in the institute contributes to the development of the creative skills of its employees in solving scientific problems that form the basis of their activities. First of all, this applies to the young employees, since they are usually easier than their senior friends to master new organizational methods associated with various kinds of restructuring. Thus, in addition to the obvious economic efficiency, consisting in a significant reduction in losses in the process under study, we can confidently talk about the social effect. So one of the main advantages of philosophy and practice of lean manufacturing methods, which makes them socially attractive, is that with skillful implementation they are of great educational value, and this provides a wide range of their application.

The young specialists of the institute, having gone all the way of the process of preparing for participation in the RFBR competition, gain valuable experience in using lean manufacturing tools and master management literacy approaches. In fact, the described organizational work contributes to the growth of general and professional competencies of young specialists of the research institute, since participating in such processes they acquire new knowledge and practical skills. Many of them will be able to see the possibility of applying this experience in various life spheres. In addition, the involvement of the young scientists in organizational and managerial processes allows the leadership of the research institute considering some of them, the most successful ones, as the personnel reserve of the future managers of the institute. Many of them became a kind of “agents of change”, about which many of those who created and spread the ideas of lean manufacturing wrote about. In addition, the institute had, at first glance, a side effect: there was an increase in interest in lean manufacturing among the main contingent of scientific and support staff, and therefore, a number of training cycles were planned for all employees who showed interest in such training in the near future. The main interest here is manifested in the elimination or reduction of all types of losses, the application of most lean manufacturing approaches in the organization of scientific research and in the so-called office processes. For such training events it is planned to attract a number of the young scientists as teachers, who have shown both their interest in lean manufacturing and good command of its tools. This is the basis of the social effect of applying philosophy and lean manufacturing tools to improving not only the problems considered in this work, but also many other processes taking place in the research institute.
It is supposed to discuss the results of the implementation of lean-technologies in the considered process at the Scientific Council of the research institute and, if the discussion is positive, organize the training of employees described above (a kind of Kaizen event) with the aim of introducing the gained experience into other processes, as the main ones related to performing research both in organizational and managerial processes. The leaders of the research institute understand that all this work should be based on three fundamental points:

- Objectives - how to best meet the requirements of research customers;
- Processes - how to organize the most effective value creation flows;
- People - how to involve employees of research institutes at all levels of activity in this work.

5. Conclusion

The heads of the research institute are clearly aware that when introducing lean manufacturing tools into the daily work, top managers of departments who will have to solve a number of additional organizational and administrative tasks should head the following work:

- organization of workplaces in accordance with 5S system;
- optimization of most processes in their units, with the aim of increasing the share of procedures that create value in them;
- elimination or minimization of the number of processes that do not create value, moreover, regardless of what levels of the hierarchy these processes occur;
- development of a comprehensive system of indicators for assessing the effectiveness of the quality of ongoing organizational activities.

Managers understand also that the main task is to change the mentality of employees, which is not an easy task, given the considerable age of many employees, who constitute the main scientific potential of research institutes.

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