Technological preparation of production for product quality management according to IATF 16949:16 requirements

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Annotation. The article analyzes the content of the EU CCI in the conditions of Soviet enterprises. The tasks and additional procedures in the project of preparation of production and release of a new product that allow for the production of machine-building products in modern conditions of competition between domestic enterprises and international machine-building corporations are highlighted.

Introduction. In our country, the development of the automotive industry began with the purchase of factories from G. Ford for the production of its own models of cars. The state, as a total owner, set the task for enterprises to set up production in as large volumes as possible. All other tasks, such as environmental friendliness of production, were secondary. In order to achieve this goal, the industry people's Commissariat has standardized the activities of all plants in the industry in terms of standard organizational structures, maintenance and repair of equipment, unification of technical documentation, and normalization of labor intensity and resource consumption; conducting end-to-end quality control. Eventually, by the 70th codes of the twentieth century, a well-developed, well-documented system of production activities had developed.

It was focused on the production and delivery of products that meet the established requirements within the specified time frame. Accordingly, a standardized system of preparation of production prescribes requirements for the execution of the engineering works. Their main characteristics are shown in table 1. The high degree of standardization significantly simplified the tasks of engineers.

Table 1 – Tasks and content of technical preparation of production at Soviet enterprises

| №  | Planned features                  | End result                               | Planned procedures                   | CCI                        |
|----|----------------------------------|------------------------------------------|--------------------------------------|----------------------------|
| 1. | The purpose of the production preparation | Ensure the planned volume of output in the calendar period | Development of a feasibility study |                            |
| 2. | Set of customer requirements     | Standardized                             | Approval of the technical task. Preparation of the delivery contract |                            |
3. Degree of impact on the natural environment
   Compliance with current legislation
   Activities on a separate plan

4. Personnel security level
   Compliance with current legislation
   Approval of project documents with Supervisory authorities.
   Development of instructions.

5. Assessment of competitors' capabilities
   There is no competition
   Since the 1980s, verification of product characteristics with the world's best samples according to the comprehensive product quality management system (CPQMS)

6. Consideration of stakeholder requests
   Standardized maintainability analysis.

7. Production preparation time
   Meet the standard
   Development and correction of the work schedule. Monitoring the progress of work.

8. Pre-production verification
   Signing the acceptance certificate
   According to a standardized procedure.

9. Metrological support
   To ensure the objectivity of control and measurement of products
   Metrological examination of technical documentation.

10. Information support for quality management
    Standardized sets of design and process documentation
    Development and standard control of sets of documents.

Theoretical part
Specialists had to develop and approve a set of technological documentation, which was used as a set of criteria for product quality control and control of compliance with technological discipline. There were no specific requirements for the depth of presentation in the documentation of the content of operations. The documented requirements remained unchanged. They could not be used for flexible management, for regulating processes.

Unfortunately, this system has been in effect for many decades, while since the mid-twentieth century, all the world's leading corporations are constantly improving the management of their pre-production projects. Long-term experience in a constant system of requirements prevents the transition to effective management of modern projects for pre-production and new product release (table 2).
Today’s commercial product is a product of much higher quality, and its production technologies should be many times more stable. In addition, it is necessary to constantly minimize the impact on the natural environment, as well as the consumption of energy carriers and other types of natural resources [1-3], to increase the information content of the measurement process in order to use the data obtained for diagnosing the state of technological systems [4-5]. Apply statistical methods to improve product quality [6-8]. To increase the degree of identification and tracking of the causes of defects of a commodity product by stages of its life cycle [9]. Thus, the list of works is significantly expanded (table 2).

There are also completely new procedures for specialists to approve production by the consumer and assess the acceptability of measurement processes. Accordingly, the requirements for the effectiveness of management processes have increased.

Much more information is needed. To get current data, it is necessary to plan processes for monitoring and regulating characteristics and production operations, associated product lifecycle operations, and equipment lifecycle. Therefore, the old scheme of work of specialists in specialized services is no longer suitable for project management.

### Table 2 - Tasks and additional procedures in the pre-production and new product release project

| № | Planned features | End result | Planned CCI procedures |
|---|------------------|------------|------------------------|
| 1. | The purpose of the production preparation | Ensure that the planned profit is received | Analysis of legal restrictions, development and monitoring of business plans, sales monitoring, project team management. |
| 2. | Set of requirements for the customer | Ensure that all requirements are met | Identification and ranking of the full set of requirements for deliveries. Creating a register of special characteristics. |
| 3. | Degree of impact on the natural environment | To minimize impact | Analysis of legal restrictions. Planning and managing the lifecycle of associated products. |
| 4. | Personnel security level | Prevention of industrial accidents | Monitoring of safe working conditions. |
| 5. | Assessment of competitors’ capabilities | Minimizing the risk of loss of income | Monitoring the actions of competitors, development of improvements. |
| 6. | Consideration of stakeholder requests | Avoid negative perception of the organization and developing improvements. | Monitoring the perception of the organization and developing improvements. |
| 7. | Production preparation time | Perform in a reasonably short time | Organization of effective work of an inter-functional team of specialists. |
| 8. | Pre-production verification | Ensure the customer’s confidence in the product quality and stability of deliveries | Passing the RRAR procedure. |
9. Metrological support
Ensure that measurement and control processes are acceptable. Development of measurement methods. Assessment of the acceptability of measurement processes.

10. Information support for quality management
Provide information support in the project lifecycle. Development of flow maps, management plans, work instructions, monitoring of equipment, product quality.

All these tasks should ultimately ensure that the project receives the planned amount of profit. The new organization of pre-production work requires the creation of an inter-functional team that provides management throughout the project lifecycle. It is also important that each significant decision of the specialists pass a certain approval procedure (by the customer, the company’s management, or the team). It is impossible to achieve quality without the depth of study of the content of world-class technologies that is unusual for our specialists. The necessary level of understanding of the content of managed technologies implies a high level of employee motivation, and in the current economic situation, this is an extremely difficult task for the company’s director. In [11-13] methods have been developed to ensure the final results of additional CCI procedures in accordance with the IATF 16949:16 requirements.

Conclusions
In general, this approach to production preparation in Russia implies a new approach to training specialists:
- it is necessary to master the skills of working in a team. Developing a focus on achieving the planned result;
- it becomes mandatory to develop skills to identify key specific process characteristics in operations that affect the management of product characteristics;
- be sure to understand the need for careful planning of measurement processes as the main method of obtaining information, as well as the development of modern measurement methods;
- it is important to constantly improve the information culture in their activities in terms of forming requirements and obtaining and analyzing data on the values of product characteristics, as well as the willingness to work in accordance with the requirements of the documentation.

The current educational standards of Russian higher education still direct specialists to solve the problems of the last century. Of course, the task of changing standards should be set at the state level. But the state must also do everything to ensure that enterprises have the opportunity to sell modern products in large volumes and to stimulate exports, and to ease the tax burden, and to establish a system for training a reserve of managers and chief specialists.

Reference
[1] Safarova L R, Kasyanov S V and Safarov D T 2019. Planning of wastes generation and development of life cycle technology in preproduction of a new product. Paper presented at the IOP Conference Series: Earth and Environmental Science, 272(3) doi:10.1088/1755-1315/272/3/032076
[2] Safarov D T, Kondrashov A G, Safarova L R and Glinina G F 2017. Energy planning in production shops with numerically controlled machine tools. Russian Engineering Research, 37(9), pp. 827-834 doi:10.3103/S1068798X17090209
[3] Safarov D T, Kondrashov A G, Glinina G F and Safarova L R 2017 Algorithm of calculation of energy consumption on the basis of differential model of the production task performed on
machines with computer numeric control (CNC). *Paper presented at the IOP Conference Series: Materials Science and Engineering*, 240(1) doi:10.1088/1757-899X/240/1/012060

[4] Safarov D T, Kondrashov A G and Khafizov I I 2019 Four-point technique development for measuring spherical surfaces of machine parts. *Paper presented at the IOP Conference Series: Materials Science and Engineering*, 570(1) doi:10.1088/1757-899X/570/1/012084

[5] Safarov D T, Kasyanov S V and Kondrashov A G 2019 Informative value of measurements for quality management of auto parts doi:10.1007/978-3-319-95630-5_177

[6] Safarov D T and Kondrashov A G 2019 Bevel gears monitoring methods development in the total contact patch terms. Paper presented at the *IOP Conference Series: Materials Science and Engineering*, 570(1) doi:10.1088/1757-899X/570/1/012083

[8] Safarov D T and Kondrashov A G 2020 Methods of quality control manufacturing gears of the differential satellites doi:10.1007/978-3-030-22063-1_28

[9] Safarov D T, and Kondrashov A G 2019 Improving the quality of manufacture of the differential pinion gears through the integrated application of statistical methods of quality management. *Paper presented at the Journal of Physics: Conference Series*, 1260(3) doi:10.1088/1742-6596/1260/3/032034

[10] Safarov D T and Gimazetdinov A I 2019 Application of blockchain computer technology to trace the causes of defects in the supply chains of engineering products. *Paper presented at the 2019 International Multi-Conference on Industrial Engineering and Modern Technologies, FarEastCon 2019*, doi:10.1109/FarEastCon.2019.8934435

[11] Safarov D T, Fedorov, K A and Ilyasova A I (2016). Algorithms development of making special techniques in APQP manufacturing process of automotive components. *Paper presented at the IOP Conference Series: Materials Science and Engineering*, 134(1) doi:10.1088/1757-899X/134/1/012036

[12] Kasjanov S V and Safarov D T 2018 Mathematical modeling of the technological accuracy index deviation structure of the automobile parts. *Paper presented at the IOP Conference Series: Materials Science and Engineering*, 412(1) doi:10.1088/1757-899X/412/1/012039

[13] Kasyanov S V, Biktimirova G. F. Technological documentation as a basis for the competitiveness of the manufacturer of automotive components in the world market // *Automobile industry* No. 6, 3013-p. 30-33 2.

[14] Kasyanov S V, Biktimirova G. F. formation of rrar according to ISO / TS 16949: 2009 in the process of technological design // *Certification #4*, 2013-p. 31-38