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Organizational and economic modeling in the organization of production in the epoch of digital economy

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Abstract: Statistical methods of production quality management are an integral part of the theory and practice of production organization. It is told about the history of creation and the results of the Center for Statistical Methods and Informatics (currently - Institute of High Statistical Technologies and Econometrics of BMSTU).

Keywords: production organization, organizational and economic modeling, digital economy, Institute of High Statistical Technologies and Econometrics.

Introduction

Let us clarify the terms used in this paper.

Organizational and Economic Modelling (OEM) – scientific, practical and educational discipline devoted to the development, study and application of mathematical and statistical methods and models in economics and national economy management, primarily industrial enterprises and their associations. In Bauman Moscow State Technical University there was a textbook published on organizational and economic modelling in three parts [1 - 3], Master's Degree Students of the faculty "Engineering Business and Management" study the same name discipline.

According to the regulatory document of the Higher Attestation Commission: "Organization of production (by the industries) is a field of science and technology that studies the problems of formation, effective functioning and improvement of production processes, scientific, organizational and practical methods and means of solving such problems at all levels. The specialty includes the development and improvement of scientific, methodological and system-technical principles of organization of production, the creation and application of monitoring methods and tools, research and analysis of various organizational, technological and technical solutions at all levels of the organization of the processes of creating competitive products and production services based on the widespread use of new information technologies. The solution of these problems improves the level of organization of production activities of enterprises in various industries and helps to accelerate their scientific and technological progress "(specialty passport 05.02.22 "Organization of production (by industries)"). In accordance with the widespread definition,

the organization of production is a set of measures aimed at a rational combination of labour processes with the material elements of production in space and time in order to increase efficiency, i.e., achieve the tasks in the shortest possible time, with the best use of production resources. A textbook on the organization of production is published in Bauman Moscow State Technical University [4]. The history, present, and prospects of science of the organization of production are considered in [5]. The work [6] is devoted to the evolution of industrial enterprise management concepts.

The author of this work in the field of production organization is most interested in the following areas of research, in which we have issued numerous publications:

- statistical methods of product quality management;
- environmental management system at the enterprise,
- analysis, assessment and risk management,
- inventory management (material and technical resources).

All these research areas are included in the passport of the scientific specialty 05.02.22 "Organization of production (by industries)."

By *digital economy* we mean the development and application of information and communication technologies in economics and management [7]. The current digital revolution is manifested in fundamental changes in technological and organizational-economic processes (the number of changes goes into quality), which entails the need for changes in economic theory, in particular, overcoming the market economy and the transition to a solidary information economy – i.e. the revival of Aristotle's ideas [8].

1. Quality Management: past in the present and in the future

Despite the explosive nature of the digital revolution, a significant share of the intellectual life of specialists of former times remains relevant now. There is nothing surprising. A person still has two arms, two legs and one head. We give a few remarks in the framework of the subject of this paper.

Many sections of books of N.F. Czarnowski, which were written a hundred years ago, are still relevant. For example, the section "Remuneration systems" of his textbook [9, p. 217 - 248], published in 1914.

In 1983 - 1984 the Department of "Economics and Organization of Production" of Bauman Moscow State Technical University was headed by the largest scientist in the sphere of standardization and organization of production - Vasily Vasilievich Boytsov (1908 - 1997) - the creator of the modern system of state standards in Russia and the first Chairman of the USSR State Committee for Standards. Unfortunately, in subsequent years, the standardization system was destroyed dramatically. As a result, serious problems appeared with the quality of products, including consumer goods. To restore order in this area, obviously, an analysis of Soviet experience is needed, first of all.

The purpose of the standards is to capture best practices, proven rational methods of action. As an example, we point to Integrated product quality management systems (IP QMS) - the result of a large scientific and methodological development, the beginning of which dates back to the late 60s of the twentieth century. "It was carried out on an initiative basis by VNIIS scientists (at that time VNIIS Standardization). The developers had direct organizational and methodological support from the State Standard of the USSR and from its chairman, Doctor of Technical Sciences, Professor Vasily Vasilyevich Boytsov.

Scientists' designs were tested in a large-scale production experiment in Ukraine in the Lvov region. Based on the results, which were obtained during an industrial experiment, the experience in creating integrated product quality management systems was approved by a special decision of the Central Committee of Communist Party in August 1973 and it was recommended for widespread implementation.

What is the characteristic of the IP QMS, in what is its significance, what it has in common with previous systems, which has contributed to the international bank of best practices, which was summarized in the ISO 9000 series of standards?

First of all, let's say that the IP QMS is the result of a scientific generalization of the accumulated by that time domestic and foreign experience well-known to our scientists in developing and implementing quality systems. It accumulated in itself all the best, all progressive that sequentially accumulated in previous systems: Saratov BIP (defect-free production of products), Gorky KANARSPI (quality, reliability, resource from the first products), Yaroslavl NORM (scientific organization of works to increase motor resources), etc.

The IP QMS was developed already consciously on the principles of a system-integrated approach, based on standardization. The IP QMS was based on the principles of a general management theory and the principal product quality management model developed by that time [10]. Examples of the IP QMS are the Integrated Quality Management System of the Yaroslavl association Avtodiesel [11] and the Moscow City Product Quality Management System [12].

As A.V. Glichev notes, IP QMS, ISO and TQM (Total Quality Management) – are the milestones of world experience - product quality management. “At the same time, the ISO standards of the 9000 series, in our opinion, in some cases are inferior to the contents of the IP QMS. First of all, this concerns the connection in the quality loop of the stages of the product life cycle with some functions. Another methodological disadvantage is the fuzzy determination of the composition and content of special product quality management functions” [10].

It is very important that “... TQM is to a large extent the turn of the dialectical spiral that brings us back to the Saratov BIP system, when quality management was focused primarily on the person and on his role in the production process” [10]. Simply, the IP QMS is by no means outdated, the experience of the 70s and 80s must be used in modern conditions, based on the ideas of one of the heads of the IBM-2 department, prof. V.V. Boytsov.

There is nothing more permanent than popular errors. Currently, they are widespread no less than decades ago. At that time, it was necessary to clarify that the statement “reserves should be minimal”, but true: “reserves should be optimal,” is still true (I mean the classical Wilson optimization model of inventory management proposed by Harris 19 years before Wilson). As he explained then that the distributions of real statistics are usually abnormal, it is necessary now (as a result, any reasoning based on the assumption of a normal distribution of the observation results resembles a search under the lantern for the keys, which are lost in the bushes, in the dark). As ignoramus advised checking normality using Kolmogorov's and omega-square criteria that time, so it is now. And so on, and so forth.

New is the digital revolution unfolding before our eyes [7, 8]. To ensure the correctness of decisions aimed at the future, it is important to analyze the past, highlight the valuable in it.

2. The first years of the Institute of High Statistical Technologies and Econometrics (IHSTE)

The term “high statistical technologies” is included in the name of our latest monograph [13], used on the base web-sites <http://orlovs.pp.ru/> and <http://ibm.bmstu.ru/nil/biblio.html>, including in the titles of textbooks on the forum <http://forum.orlovs.pp.ru/>. It is often indicated that published articles have been prepared at IHSTE of Bauman Moscow State Technical University. Therefore, it is advisable to provide basic information about IHSTE.

2.1 History and background of IHSTE

The Institute of High Statistical Technologies and Econometrics (IHSTE) was organized by ourselves in 1989. It is engaged in the development, study and implementation of high statistical technologies on an initiative, contractual and state budget basis, i.e. – in the development of the most modern technologies for the analysis of technical, economic, sociological, medical data oriented for the usage in modern production and economics. The main interest is the usage of high statistical technologies for the analysis of specific economic data, i.e. in econometrics.

Initially, the Institute worked as the Center for Statistical Methods and Informatics (it was created in 1989), later as the All-Union Center for Statistical Methods and Informatics of the Central Board of the All-Union Economic Society (1989 - 1992), then again as the Center for Statistical Methods and Informatics (1992 - 1993) In 1993, it was transformed into the Laboratory of Econometric Research of the Moscow State Institute of Electronics and Mathematics, and since 1997 it operates under its current name - Institute of High Statistical Technologies and Econometrics of Bauman Moscow State Technical University. IHSTE works on the basis of the IBM-2 department "Economics and Organization of Production" in symbiosis with the Laboratory of Economic and Mathematical Methods in Controlling of the Scientific and Educational Center "Controlling and Management Innovations" (Head of the Scientific and Educational Center is Doctor of Economics, prof. S.G. Falko).

IHSTE also has a background. The commission "Statistics of objects of non-numerical nature and expert estimates" of the Scientific Council of the USSR Academy of Sciences" worked actively in 1978-1985 on the complex problem "Cybernetics.

2.2 The next stage of the IHSTE background - is the Working Group on streamlining the system of standards for applied statistics and other statistical methods

Since the beginning of the 1970s, our country began to develop state standards using statistical methods. Due to the fact that outrage mistakes were detected in 1985, we organized the "Working Group on streamlining the system of standards for applied statistics and other statistical methods." In this work 66 specialists took part, including 15 doctors and 36 candidates of sciences. In accordance with the recommendations of the Working Group, 24 out of 31 state standards for statistical methods were cancelled in 1986-87.

In 1988-89 the most active part of the Working Group (10 doctors and 15 candidates of sciences) created the "Avanproject of a set of methodological documents and software packages on statistical methods of standardization and quality management" (about 1600 pages).

2.3 Center for Statistical Methods and Informatics and Institute for High Statistical Technologies and Econometrics

Unfortunately, State Standards Committee of the USSR expressed reluctance to finance the implementation of the Avanproject, which was ordered by it. So it was decided to act independently. Thirty years ago, during the meeting at the Polytechnicum Museum on February 20, 1989, the Center for Statistical Methods and Informatics (CSMI; at the moment - the Institute for High Statistical Technologies and Econometrics) was organized (pro bono).

As an independent organization, the All-Union Center for Statistical Methods and Informatics (VCSMI) of the Central Board of the All-Union Economic Society was established by the Decree of the Presidium of the Central Board of the All-Union Economic Society, dated December 25, 1989.

By the middle of 1990, 7 basic software products were developed at the VCSMI - interactive systems for modern statistical methods of quality management, namely, SPK, ATSTAT-PRP, STATKON, AURORA-RS, EXPLAN, PASEK, NADIS. This work was done by 128 specialists. In the future, new groups of scientific and technical workers joined the All-Russian Center for Contemporary Art, by the end of 1991 there were more than 300 of us. Information on software products and other activities of the Center was constantly published in the magazines "Zavodskaya Laboratory" and "Reliability and Quality Control". Software products developed by the VCSMI were acquired and used in more than 100 organizations and enterprises. Amongst them, there are the production associations "Uralmash", "AvtoVAZ", "Plastic", and Bardin Central Research Institute of Ferrous Metallurgy, Steel Research Institute, All-Union Research Institute of Elastomeric Materials and Products, Research Institute of Applied Chemistry, Central Research Institute of Chemistry and Mechanics, "Orion" Research and Production Association, Nuclear Safety Research Center, All-Union Scientific Research Institute of Economic Problems of the Development of Science and Technology, All-Union Scientific Research Institute of Oil Refining, RUT (MIIT), Kazakh Polytechnicum Institute, Ulyanovsk Polytechnicum Institute, Donetsk State University and others.

3. All-Union Statistical Association

Together with the performance of work under contracts with organizations and enterprises, the CMSI and the VCSMI conducted work to unite statisticians. In April 1990, the Constituent Conference of the All-Union Organization on Statistical Methods and their Applications was held in the Great Assembly Hall of the Moscow Energy Institute. At the Founding Congress of the All-Union Statistical Association (ASA) in October 1990 at the Moscow Institute of Economics and Statistics, this organization became part of the ASA as a section of statistical methods

In accordance with the real structure of statistics, the ASA is divided into 4 sections: 1) practical statistics, 2) statistical methods and their applications, 3) reliability statistics, 4) socio-economic statistics. The section names recorded in the ASA documents are not entirely true. The first section consists of Goskomstat employees, the majority of the second and third section members are engaged in practical activities, including in the socio-economic field, and the fourth section consists of teachers of statistical disciplines. The second section (in collaboration with the third) "generated" the Russian Association of Statistical Methods in 1992, and in 1996 - the Russian Academy of Statistical Methods.

According to the Charter, the decision to dissolve the All-Union Statistical Association can be taken only by its congress. There was no such solution, i.e. All-Union Statistical Association continues to exist. In 1992, after the collapse of the USSR and the virtual termination of the work of the ASA, the Russian Association of Statistical Methods (RASM) was organized on the basis of the section of statistical methods of the ASA, and then the Russian Academy of Statistical Methods, which exist at present time. Several hundred people participated actively in the events of the statistical methods section of the ASA and RASM. The main topics of the work of many of these specialists are statistical methods in certification (quality management).

The basic business-idea was as follows: CSMI and VCSMI develop statistical methods, software and methodological products, ASA and RASM distribute and implement them.

A lot of work was done in 1980 - 1990 to analyze the situation in the field of theory and practice of statistics in our country. In CSMI and RASM, uniting the majority of leading Russian specialists, a unified approach to the problems of applying statistical methods in certification and quality management was developed through collective efforts, i.e. a *new paradigm* of statistical methods (mathematical statistics, applied statistics, econometrics,

organizational and economic modelling, mathematical research methods). A “social order” was formulated - to develop a series of textbooks in accordance with the new paradigm. Up to date, it is completed.

Conclusion

From 1993 to the present time, the Institute developed econometric methods for analyzing of non-numerical data, forecasting the inflation index and gross domestic product (the research was done for the Ministry of Defence of the Russian Federation), a methodology for constructing and using mathematical models of taxation processes (for the State Tax Service), a methodology for assessing the risks of implementing innovative projects of higher schools (for the Ministry of Science and Technology of the Russian Federation). The Institute evaluated the impact of various factors on the formation of the tax base taxes (the research was done for the Ministry of Finance of the Russian Federation), worked out the prospects of applying modern statistical and expert methods for analyzing data on scientific potential (for the Ministry of Science and Technology of the Russian Federation), developed methodological, software and information support for risk analysis of chemical and technological objects (for the International Scientific and technical center), conducted marketing research (for Promradtechbank, companies selling instant coffee, software) and performed other works .

In 2010-2012, the Institute, together with the Volga-Dnepr Group of Companies and Ulyanovsk State University, participated in the development of ASPPAP, an automated system for forecasting and preventing accidents (in accordance with Decree of the Government of the Russian Federation No. 218).

The Institute conducted and put into practice fundamental scientific researches, in particular, state budgetary research at Bauman Moscow State Technical University. The main publications are concentrated in the magazines "Factory Laboratory. Diagnostics of materials" (more than 80 articles for 1989-2019, it is indicated that they have been created in IHSTE), "Controlling", "Innovations in Management", "Management of Large Systems", in the "Scientific journal KubSAU" and others.

The Institute provides scientific and methodological support for teaching the below disciplines: "Applied Statistics", "Applied Statistics", "Statistics", "Econometrics", "Organizational and Economic Modeming", "Risk Controlling". Also, the Institute provides support in the implementation of final qualification works (including MBAs) and dissertations.

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