

Development of automation in Bulgaria in the 20th century

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Abstract: *In the 8th decade of the 20th century, a state program was implemented to automate the entire production in the spirit of scientific and technical progress. More than 160 types of systems for the automation of technological processes have been developed, including individual high-performance machines, industrial robots and manipulators, managed with the most advanced microprocessor technology for its time, subsequently implemented in pilot complex automated workshops and production areas in various economic sites of the country. Prioritizing the production of means of automation of technological processes intensifies machine-building, intellectualizes labor and increases its productivity. Gradually, with our forces and means, experience and a base for further design and implementation of flexible automated production systems in all branches of industry are created. The achieved technical and organizational experience guarantees the membership of Bulgaria in the Permanent Commission on Mechanical Engineering at the SIV and its coordinating role in agreements for multilateral specialization and scientific and technical cooperation in the field of industrial manipulators and robots.*

Keywords: HISTORY, AUTOMATION, ROBOTS, MACHINE-BUILDING

1. Introduction

The proposed report aims to present part of the documentation of the executive power in Bulgaria in the second half of the 20th century, concerning the development of production automation. The object of research are annual reports on the activities of the Ministry of Mechanical Engineering, reports on achieved results in scientific developments and their implementation in production, concluded trade agreements and future intentions for investments and development. The chronological frame spans 20-25 years, beginning in the early 1960s and ending in the mid-1980s. The research does not pretend to present a complete history of the development of automation in Bulgaria, but to show archival documents testifying to a successful policy, thanks to which Bulgarian society is technologically on par with developed Western countries and becomes a leader among socialist countries in the successful transition to an automated economy.

Automation is a qualitatively new, higher stage in the development of technology. Automation of production is a process of developing and implementing automatic means and systems with the aim of freeing man from physical and mental labor and expanding his capabilities to manage machines and processes. On the one hand, the level of assurance of production by automatic means determines the degree of improvement of working conditions and reduction of physical and mental efforts of management. On the other hand, automation affects the technological processes in the direction of their improvement as a result of the possibilities for quick reporting of violations in them and the impact of their removal, to maintain the most economically advantageous mode of operation of the machines and equipment. The economic benefit for society from the introduction of automatic means and systems in production is expressed in the economy of public labor.

2. Solutions

In the 1960s, the General perspective for the development of the Bulgarian economy predicted a 6-7 times increase in industrial production by 1980, which required extensive mechanization and automation of production processes.[1] The new technology, offering more precise management of the production process, leads to great savings in raw materials and to optimal utilization of capacities.[ibid]

The beginning of the organization of the work on automation was set with Order No. 245 of the Council of Ministers of 1.03.1961, which created the Central Development Base for Automation (CRBA). By Decree No. 163 of 27.09.1962. The base grew into the Scientific - Research and Design - Construction Institute of Applied Automation (NIPKIPA).[2]

In 1964 the first automated control system for the four sections of the concrete unit of ZSK Kremikovtzi was put into operation. In the same year, NIPKIPA completes the topics: Automation of the pulping process at the plant in Krichim; Automation of an unloading trolley in the OCZ, Kardzhali; System for automatic regulation of air during cotton processing in DIP "Thracian Cotton" - St. Zagora; Automation of the ore grinding cycle for DPM "Panagyur mines"; Automation of the heating furnaces at the rolling mills of the "Lenin" MZ; Automation of nitric acid production for the Chemical plant in Dimitrograd; Automation of soda production at the plant in Devnya, etc.[3]

In 1965 NIPKIPA presents a study on the efficiency of mechanical engineering for the period 1966-1970, according to which the optimal flow of processes in various productions and the achievement of the best indicators are possible only on the basis of complex automation, the implementation of controlling analog and digital machines and the mass use of measuring, control and regulating instruments and devices. [4]

In 1966 the "Automation of Ferrous Metallurgy" section at the Institute (now NIPIA) works on 8 topics with MH "Lenin" and 1 with MK Kremikovtzi; section "Automation of construction materials production" works on 3 topics; section "Automation of non-ferrous metallurgy" works on 4 topics; section "Automation of the food industry" works on 6 topics; section "Computing equipment" works on the topics: program and address management of electric hoists; program management of electric cars; mathematical description of technological processes in the chemical, metallurgical and construction industries; device for demonstrating program and address control of electric hoists. [5]

In 1966 The institute begins active international cooperation. Six engineers specialized in the USSR, another three - in Denmark and France. A delegation visited the fair in Leipzig, the International Congress in Belgium on Automation of the Pulp and Paper Industry and the International Congress on Automatic Control in England. NIPIA enters into direct cooperation with the Institute of Automation in Kyiv, with CNIKA in Moscow, and with Hungary a permanent working group on automation is established. (ibid)

In 1969 automation has been identified as a major factor in technical progress.[6] There are a total of 241 contracts concluded by section, and the total conditional economic effect of the implemented systems is worth BGN 834,000 (ibid.)

In a report to Prime Minister Todor Zhivkov, presented in 1970. by the Minister of Mechanical Engineering Mariy Ivanov and the Chairman of the State Committee for Science and Technical Progress (SCSP) Prof. Ivan Popov, a concept was laid out, providing for the automation of technological processes in small and medium-scale serial engineering production during the period 1971-1980, which foresees the implementation of systems of metalworking units with digital - program control (CPU), controlled by digital electronic - computing machines (CM - CEIM) [7]

The authors emphasize that due to the significant complexity of CM-CEIM, it is necessary to import it and implement it in production, as well as mastering the production of digitally controlled feeding manipulator and transport devices, necessary to connect the individual machines in complex automation. (ibid).

One of the heads of state of Bulgaria and directly responsible for the development of mechanical engineering, Ognyan Doinov saw in 1968 the first robots implemented in production in Japan by Fujitsu-Fanuk. The Japanese scoffed at the desire expressed by the Bulgarian side for possible cooperation, considering the absolute unpreparedness of Europe to move into this new stage of organization and development of production. In front of Doinov, the Japanese shared about the difficulties they had when introducing robots into the production of a Mercedes-Benz plant. [8]

Despite the mistrust, in 1968 Bulgaria signs an agreement with the Japanese company Fujitsu for the acquisition and production of the first electronic computing machines (EIM) "Facom", which began to be produced in our country by 1970. under the name ZIT 151. [9] High technologies soon fell into the list of prohibited goods for socialist economies, but Bulgaria's ties with the Japanese company were not permanently severed, since in 1980 in cooperation with Fujitsu - Fanuk in our country begins serial production of robots for various purposes. [8]

Since 1974 the transformation of the Bulgarian economy towards subject-technological specialization of enterprises, known as the Multiplication effect, began. According to the Deputy Chairman of the Council of Ministers responsible for mechanical engineering, Ognyan Doinov, the copying of the Soviet model, in which each enterprise tried to produce only everything it needed, in our country led to the overspending of raw materials and the commitment of a lot of manpower and machine time. The result was an increase in production costs and an unsatisfactory quality. [8]

In order to avoid this, it moves to an optimal concentration of the capacities producing basic elements, specialization of individual parts, units and aggregates with a wide range of application with the subsequent possibility to produce a variety of final products in many machine-building plants. (ibid)

On 28.01.1978 The Council of Ministers adopts Decision No. 4 on the creation of a scientific-production association Automation of Production as an organization for the implementation of the processes of research and implementation in production of production automation systems. [10]

With the 39th Resolution of the Court of Justice of August 1, 1978. the association has been assigned the functions of a leading executive organization for the automation of production in the country, of a leading development and implementation organization for complex automation of production in the mechanical engineering industry. (ibid)

At the 84th meeting of the Standing Committee of the SIV on Mechanical Engineering, held in Brno, Czechoslovakia in 1980. issues related to the further development and deepening of the multilateral specialization and cooperation of production, the conduct of joint research and design and construction works on the creation of new types of machines and equipment were discussed. The main place is occupied by questions about the specialization of Bulgaria in the production of robots – manipulators. [11]

The Minister of Mechanical Engineering, Toncho Chakarov, insisted on signing a contract in 1981. for the specialized production of 65 types of robots - manipulators, intended for servicing 8 main groups of machines and technological processes. In addition, specialization was adopted in 4 new positions of manipulators and robots for transport and warehouse work. With this, the Bulgarian production specializes in a total of 50 positions or over 75% of the specialized nomenclature. We are followed by Poland with 40 positions, Czechoslovakia with 30 and Romania with 22 positions. NRB emerged as the main exporter of working manipulators for the period 1981-1985. (ibid)

At the beginning of the 8th decade of the 20th century, two documents trace the ongoing development of automation in our country: Development for the development of metal-cutting

machines and robotics by applying the multiplication approach in the period 1981-1985. and Automation VIII Program.

The two documents define the main nomenclatures in the production direction, the directions of their technical development, the principles of the international division of labor, as well as the activities of the reproduction process in the industry, aimed at increasing the social productivity of labor to obtain a multiplier effect in the country's economy.

Program "Automation VIII" envisages unification, specialization and supplies of components and building elements, which are of decisive importance for the creation of high-performance and precise machines on the one hand, and supplies of finished products and complexes based on industrial manipulators and robots, on the other. With building elements of this type, as well as with the newly created high-performance and precise machines and industrial manipulators - robots, Bulgaria began in 1980. its participation in the international specialization and cooperation within the SIV.

It is established, at the highest state level, that we already have the necessary technical and organizational experience in building automatic technological lines and modules. Created before 1980 lines are based on Bulgarian transport and supply systems - conveyors and manipulators. In the field of industrial manipulators and robots, Bulgaria has also declared its readiness to fully participate in the international division of labor, which is also confirmed by its coordinating role in agreements for multilateral specialization and scientific and technical cooperation in the field of industrial robots and manipulators. [12]

The years 1981-1985 were devoted to automation in production. In connection with this, the National Program Automation VIII was developed. The main directions in it are 3: 1. creation of the necessary conditions and accumulation of experience for the design and implementation of complex automated workshops and plants for discrete production; 2. creation of technical means and systems for automation of production and management in other branches of the national economy;

3. increasing the level of automation and electronicization of individual machines and equipment, of complete equipment and lines produced by our engineering for the food industry, heavy engineering, construction equipment, etc., intended for newly built sites and for the modernization of existing factories. [13]

The extremely ambitious task for its time was set to put into operation over 2,000 CNC machines, 500 aggregate machines, over 3,000 industrial robots and manipulators, about 100 automated enterprise management systems (AEMS) and 20 automated dispatching systems and 10 automated production sections and workshops in OZZU - St. Zagora, NPKR "Beroe" - St. Zagora, "Dinamo" - Sliven, ZMM - Nova Zagora, KPM "Georgi Kostov" - Sofia, KHI "Hydraulika" - Kazanlak, etc. It is estimated that the total economic effect of the program amounts to BGN 320 million (ibid.)

The implementation was particularly successful in Stara Zagora, where a number of basic means of automation such as hydraulics, industrial robots and manipulators, metal cutting machines, control devices for robots and manipulators, disk drives, technological lines, etc. are produced. The main efforts to implement pilot complex-automated workshops and sections and systems for automation of engineering work are directed there. At the end of 1982, the Minister of Mechanical Engineering, Toncho Chakarov, presented a report to the senior state leaders on the development of NPKR "Beroe" - St. Zagora. [14]

By means of BGN 29 million of basic funds, facilities were built and operating in the plant, ensuring an annual production of 1,000 units of robots. The production is on the basis purchased in 1980.

license from the Japanese company Fanuk, with which Bulgaria has traditional ties. Two types of robots are mastered, with hydraulic and pneumatic drive. In order for our country to maintain its lead in the framework of international specialization, it is necessary to build additional capacities to reach an annual production of 5,000 units of robots. Since mechanical processing constitutes 60% of the labor intensity, it is necessary to search for solutions for complex automation. Currently, socialist countries lack the experience and

equipment to create automated production systems at a high technical level, and cooperation with Western companies is being sought. The highest indicators for the complex construction of an automated workshop for the mechanical processing of the main details for the robots were offered by the FANUC company, thanks to which the processing of 60% of the details for the electromechanical robots was achieved with the service of 24 workers. 9 units were delivered from Japan. lathe machines and 21 pcs. machine centers served by robots and automated transport carts, 2 automated warehouses – for blanks and finished parts, as well as a computer system for managing the complex. The automated workshop also includes 6 lathes and 4 machine centers, manufactured by NRB, and Mashproekt is included in the engineering project. (ibid)

With the project for the expansion of NPKR Beroe, the total production funds increase to BGN 70 million, and conditions are created for the production of commodity products for over BGN 150 million. On March 25, 1982, a joint meeting of the collegiums of the MME and the Ministry of Instrumentation, Automation and Control Systems in the USSR was held in Moscow. Issues regarding the expansion of scientific and technical cooperation, the expansion of cooperation in production, the development of joint activity in the field of automated control systems, the expansion of contacts and the establishment of direct scientific and technical ties were discussed.

An Industry Program for the development of specialization and cooperation in the field of instrument making, automated control systems and computer technology for them until 1990 was signed. Possibilities for expanding cooperation in the automation of design activities, the creation of distributed systems for the automated management of discrete and continuous technological processes and the development of an automated section using robots and manipulators were discussed. [15]

In 1982, accelerated implementation of advanced technologies and technological complexes of machines and systems in agriculture began. For this purpose, a program for accelerating the complex mechanization and automation in the agricultural sector was developed and adopted by the Council on Agriculture under the Council of Ministers with a period of 1986-1990. [16]

The execution of the tasks is largely related to the staffing of the automation activity. 3500 are the specialists who are concentrated in the engineering and design organizations under the umbrella of the Ministry of Electronics and Energy alone. To increase the qualification of management and executive staff on automation issues, a departmental training center was organized at the National Institute of Civil Engineering, and a regional robotics training center was established in Stara Zagora. Together with the Scientific and Technical Union (NTS), educational centers with automation and electronicization laboratories have been established in eleven district cities. Together with the Ministry of Education, a comprehensive program for the training of personnel in microelectronics was developed and adopted, which also foresees the creation of a center for postgraduate qualification in microelectronics in Botevgrad. [13]

The production of means for the automation of technological processes led to the intensification of production and the intellectualization of labor in Bulgaria in the 60s, 70s and especially in the 80s of the XX century. During this period, statistics report a sharp increase in the social productivity of labor in the economy. The production of means of production automation is characterized by features that create completely new working conditions.

Such are the low seriality of the products with a large nomenclature in terms of modifications; the continuous increase in the complexity of the technique and increase in the concentration of the operations performed by one machine; the use to the greatest extent of the latest achievements of pneumatics, hydraulics, electronics and electric drives; the constant increase in requirements for higher operational reliability and accuracy of machines.

The new working conditions also increase the requirements for personnel service: a high degree of literacy and technical intelligence in order to be able to respond to the frequent change of

nomenclature and modifications; ability for high internal mobilization and concentration, ensuring in a short time the study and understanding of constantly changing and complicating relationships in the production of new products; high mental and physical endurance; high erudition and wide specialization as a result of the use of the latest achievements of pneumatics, hydraulics, electronics; ability for quick thinking activity and analysis of the influence of imposed changes and programs on the final manifestations of the behavior of the machine organs and processing processes; an opportunity to effectively exercise professional knowledge and skills in a foreign place, in an unfamiliar work environment. [17]

Conclusion

At the end of the 80s, Bulgaria was among the 30 most developed countries in the world and took third place in the export of industrial robots for welding, painting, assembly and palletization. In conditions of tightening of the COCOM regime to limit the access of new technologies for Eastern European countries, Bulgaria offers production that is vital for the development of socialist economies. The economic policy led by the state leadership does not pursue spectacular display actions and demonstrations, but higher efficiency in the utilization of resources and greater labor productivity, which results directly from the automation of the means of production. As a result, a rapid increase in the national income and an increase in the standard of living of the population were achieved.

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