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Development and applications of computer science in Poland during the communist rule

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ABSTRACT

In view of the reluctance with which cybernetics was treated in the Stalinist times in the USSR and other countries of the communist camp, the research on digital machines became possible on a larger scale in Poland only from the mid-1950s. As a result of the work carried out at that time in several scientific and research units, the first Polish computers based on electronic tube technology were created. Their implementation to wider production was entrusted by the central authorities in the early 1960s to the Wroclaw Electronic Works "Elwro". The company also undertook to manufacture digital machines "Odra" of its own design. They were widely used in science, administration, communication and industry – both in Poland and abroad, primarily in the member states of the Council for Mutual Economic Assistance. Then a few more plants were launched, which cooperated as part of the "Mera-Elwro" group. Since the late 1960s, an important impulse in the creation of local IT systems were internships of Polish IT specialists in the USA and the UK, as well as software brought to the country together with the IBM and ICL machines. By the end of the 1960s, about 30 models and prototypes of digital machines had been created in Poland, which gave it a leading position among communist countries. The situation changed in the early 1970s when Poland lost its position among the Eastern Bloc countries by introducing the production of machines from the Unified System Series (ЕС ЭВМ), imposed by the USSR. At that time, Polish exports were mainly based on products from the machinery industry, while the sales of electronic products and software sharply declined. The attempt to create a national IT system, undertaken in the 1970s, also ended in failure. This was due not only to technical or financial problems but also to the government's fears of losing control over information about the state of the economy or social processes. The crisis of the 1980s significantly limited orders for Polish computers, which, during the PC revolution, remained at the stage of specialized digital machines for large enterprises and institutions. The production of Polish microcomputers did not develop on a larger scale due to a shortage of components imported for hard currency, high taxes, and the lifting of restrictions on the import of Western computers. As a result, although Poland carried out large-scale development and production of digital machines until 1989, trained many specialists to work with them and implemented numerous applications, this effort did not bring the expected results.

Keywords: Poland; IT; computers; electronic industry; socialist economy

INTRODUCTION

In the second half of the 20th century, the world saw the beginning of the information technology revolution. The first electronic calculating machine, ENIAC, was put into service in 1946 in the USA. It calculated a thousand times faster than the electromechanical machines used earlier, and yet it was only a harbinger of a new era. The use of increasingly advanced computers quickly changed the global technological and socio-economic reality. The leaders of this rapidly developing process were Western countries, led by the United States. It turned out that the market economy and democracy are able to stimulate modernization processes supported by IT tools much more effectively than the centralized, collectivized and nationalized economy and political system of communist countries dominated by the Union of Soviet Socialist Republics (USSR). Nevertheless, they also took action to design and produce their own computers and to use them in various ways. The following text is an attempt to characterize these efforts and their effects using the example of the Polish People's Republic. It is based on the results of research conducted by the author on the history of the Wroclaw Computer Centre in the years 1959–1989 [9: 61–137].

THE BEGINNINGS OF POLISH COMPUTER SCIENCE

Due to the reluctance with which cybernetics was treated in Stalinist times in the USSR and other countries of the communist camp, research on digital machines became possible in Poland on a larger scale only from the mid-1950s. Their beginnings are primarily associated with the activities

of the Warsaw research and development center. At the Institute of Mathematics of the Polish Academy of Sciences, later transformed into the Institute of Mathematical Machines, work began on calculating machines, first analogue, later digital. In 1955, the first Electronic Automatic Calculating Machine ("EMAL") was built there. It was based on vacuum tube technology and mercury memory, and worked both in the mode of executing program instructions and automatically reading information. Computers based on electronic vacuum tube technology were later defined as first-generation equipment. They worked at a speed of several to several dozen thousand operations per second. Computers of this type were already being produced in the USA, France, Great Britain, Sweden, the Federal Republic of Germany and Japan, as well as in the USSR ("MESM"). Due to the unreliability of the "EMAL" machine, production was not undertaken. Its successor was "EMAL 2" with a drum memory, completed in 1958. Work on it was supported by another unit of the Polish Academy of Sciences, the Computational Center of the Institute of Nuclear Research, later transformed into the Department of Applied Mathematics [9: 68–69].

In the autumn of 1958, the first Polish digital machine was launched – "XYZ", based on the American "IBM 701" and partly on the Soviet "BESM 6". However, only its improved version called "ZAM 2" was sent for small-scale production in 1961. It still had a tube design, but with an internal cooling system. The Experimental Plant of the Institute of Mathematical Machines designed a whole family of "ZAM" machines, among which the best technical and programming parameters were possessed by the multi-program digital machine for data processing "ZAM 41", manufactured in 1961. However, its production also ended with a dozen or so units. "ZAM" machines were created with the support of the army, which was keen to obtain a digital, electronic calculator for controlling anti-aircraft artillery fire [3: 28-31; 5: 14–18; 11: 2–3; 12: 558–559].

In turn, in 1960, the Warsaw University of Technology created the Universal Digital Machine ("UMC"), made using vacuum tube technology, as well as narrowly specialized machines for geodetic calculations and for recording bioelectric phenomena [3:36-40; 4: 19-20; 12: 559].

In parallel to the efforts to develop and launch the production of Polish digital machines, research on the application of computer science in planning, management and automation of various production processes was undertaken in the country from the beginning of the 1960s. A significant contribution to scientific and research work in the field of creating computer systems for the needs of production management and control was made by Polish universities, mainly polytechnics, university departments of mathematics and engineering and economics. There was also a development of computer science applications in the automation of various engineering, economic, medical and artistic works [9: 71, 77–78; 10: 77–79; 11: 5].

BETWEEN THEIR OWN AND FORCED PROJECTS

The aforementioned research and development units were not able to implement the digital machines they were designing for wider production. The central authorities finally decided to entrust the implementation of this task to one of the existing electronics industry plants at the beginning of the 1960s. It was decided to choose Wroclaw Electronics Industry Plant "Elwro". At the turn of the 1950s and 1960s, Wroclaw had a significant research and development potential in the country, with important achievements in mathematics and automation. Thanks to this, it was possible to undertake in the capital of Lower Silesia not only the production of ready-made digital machine designs, then their further improvement, but also the preparation of their own design studies. "Elwro" engineers quickly began to contribute their own input to the projects of the Warsaw researchers. In December 1960, they completed the design of their first own digital machine, "Odra 1001". Although it was not yet suitable for mass production, the experience gained with it became a premise for giving consent to continue work on digital machines in Wroclaw. While the machines being developed at the same time in the Warsaw centre were still based on tube systems, the next model, "Odra-1002", created in 1961, used mostly domestically produced

transistors. However, since the ministerial authorities considered that this model was still not suitable for production, it was decided that in the meantime, the technologically outdated but proven "UMC-1" machine would be manufactured in Wroclaw. In the years 1962-1964, a total of 25 "UMC-1" machines were produced in Wroclaw. In 1964, it was possible to obtain the ministry's consent to start manufacturing the second generation machine, "Odra 1003". Its production lasted until 1965. 42 units were manufactured, several of which were exported to the USSR, Czechoslovakia and Hungary. The machine's capabilities allowed it to be used, for example, to control technological processes. It was delivered to many institutions, universities and a number of leading production plants in the country. The Wroclaw computer was five times faster than "UMC-1". It performed 500 operations per second. It also had twice the memory capacity, comprising 8 thousand words. It also consumed ten times less electricity, weighed three times less and occupied half the surface [3: 40-47; 4: 15-20; 6: 19-20; 9: 72-74].

Thanks to "Elwro", in the second half of the 1960s, Wroclaw became the main centre of the domestic industry in the field of electronics, automation and measuring devices and digital machines. In 1966, "Elwro" started the production of the "Odra 1013" digital machine, which calculated at a speed of 1000 operations per second, i.e. twice as fast as the previous model, and had, in addition to internal drum memory, fast RAM based on ferrite cores with a capacity of 256 machine words. However, the capabilities of "Odra 1013" were still limited in practice to narrow and specialist groups of issues, such as material management, payroll preparation, transport organisation. By November 1966, the plant had produced 100 digital machines, of which about 1/3 were exported to the countries of the Council for Mutual Economic Assistance [1: 174; 3: 49; 4: 20–21; 6: 20].

In 1967, work on another digital machine – "Odra 1204" was completed. It was the first microprogrammed machine in Poland, i.e. its logical structure was recorded in a module called permanent memory. This allowed for a significant reduction of its central unit and led to a reduction in the price of the construction and an increase in its reliability. It was already a fully digital machine of the second generation, i.e. based on transistors, with three types of memory: ferrite RAM, external memory on magnetic tape and external memory on 4 drums. The input was a reader, and the output – a paper tape perforator. The machine worked at a speed of 50 thousand operations per second, and the capacity of the ferrite memory was increased to 16 thousand words. The external drum memory had a capacity of 130 thousand words. By 1972, 179 units had been produced, 114 of which were for export [4: 22–23; 7: 73; 9: 75–76].

Another qualitative leap was made in the same year 1967, when the Wroclaw plants began cooperation with the British company "ICT". This was the implementation of the idea of building a computer in Poland that would accept Western basic and application software. Despite the embargo that existed throughout the Cold War period, aimed at limiting the possibility of purchasing technologies useful for military purposes by socialist countries, the relevant agreement was accepted by both the authorities of the Polish People's Republic and Western countries. Under the agreement, "Elwro" obtained the logical documentation of the "ICL 1904" machine and tapes with full basic and application software. Thanks to it, in 1970 "Odra 1304" was developed. A total of 90 units of this machine were produced [3: 47–52; 4: 23–24; 6: 20–21].

The successors of the "Odra 1304" were, from 1972, the third generation digital models "Odra 1305" and "Odra 1325", based on integrated circuits. A total of 587 copies of the "Odra 1300" series machines were produced by 1983, a significant part of which was exported to the countries of the Council for Mutual Economic Assistance (CMEA), mainly the USSR. A military version with increased resistance to shock, vibration and temperature was also produced. "Odra 1305" performed 150 thousand operations per second, had a RAM capacity of 1 million characters and an external memory with a capacity of 100 million characters with the possibility of expansion. It worked in time division, had a modular structure, adapted to work in multi-access and multi-machine systems.

In turn, “Odra 1325” already worked at a speed of 200 thousand operations per second. It was a multi-program, multi-processor, multi-access machine working in real time, and its software was compatible and interchangeable with earlier models. The career of the machines from the “Odra 1300” series was possible due to good performance, rich software, and a whole set of external devices – printers, drawing devices, tape memories, readers and perforators. In the country, they were used in activities aimed at computerization of the economy, including construction and railways, as well as administration and universities. A whole generation of Polish computer scientists were educated on them. Using the “Odra 1305” technology, the Faculty of Military Technology “Elwro” in cooperation with “Tesla” from Pardubice designed the “RODAN” series of computers for the needs of the anti-aircraft defense systems of Poland and Czechoslovakia. They were also used to build the first multi-access subscriber system in the CMEA [4: 36–39, 52–53; 9: 103].

However, a proper assessment of the development of Polish computer science at the turn of the 1960s and 1970s should be made against a broader background. In the USSR, which had the greatest potential in this respect among the countries of the communist bloc, production of the “Minsk-22” and “Minsk-32” computers was undertaken at that time, which found wide application in industry. The GDR produced the “Robotron-300” machines, Czechoslovakia designed the “Tesla” computer, Bulgaria acquired a Japanese license, and Hungary a French one. While in 1965 there were 60 digital machines of various types and purposes installed in Poland, while in Czechoslovakia 55 and in the GDR 45, by 1970 Poland had indeed increased its possession to 170, but Czechoslovakia had already increased its possession to 300, and the GDR even 360 machines. The comparison of Poland with highly developed countries was dramatic. The computer saturation rate in Great Britain was 18 times higher, and in the USA even 70 times higher than in Poland. In 1970, Poland had only slightly over 0.1 % of all computers installed in the world, although its share in world industrial production was 2 % [2: 53–54; 8: 273–281; 9: 77].

The awareness of being behind, in terms of technological advancement, in relation to the Western designs currently in use, prompted the USSR authorities to attempt to make a technological leap. In February 1968, under their pressure, the countries of the CMEA undertook to base their computer systems on a compatible series of machines, the so-called Unified System of Electronic Digital Machines (RIAD). Their initial design and software were based on the “IBM 360” – the first representative of the third generation computers, built on integrated circuits and reaching speeds of up to 1 million operations per second. They were equipped with fast internal memories and large external memory and allowed for the construction of multi-access systems. A copy of it was developed in the USSR, based on information obtained by intelligence methods. As part of the division of labor, the Polish side was awarded the production of medium-sized machines marked with the symbol “R-30” [3: 53–54; 4: 39; 6: 21].

At the end of 1971, the Wroclaw plant took over all matters related to the production of the “R-30”. However, during the work it turned out that it was an unreliable machine, mainly due to the poor quality of external devices, especially disk drives. Developed by the Soviet scientific research facility from Yerevan, it was larger than its Polish counterpart from the “Odra-1300” series. It was less technologically advanced and more expensive to operate. In connection with this, on the discreet order of the management of the “Elwro” plant, based on newer technologies used in the production of machines from the “Odra 1300” series, a significant modification of the Soviet design was made. The model, called “R-32”, programmatically compatible with the other machines of the Unified System, was put into production in 1973. Its technical parameters were significantly better than both the Soviet original and all other “RIAD” machines of its category produced in the CMEA, than which it was smaller and faster. A total of 153 machines of this type were produced. They were sold mainly to the COMECON countries, including the USSR. The introduction of the “R-32” into production in 1974-75 meant a gradual reduction in the production and export of "Odra" machines.

Transactions of the “Elwro” plant, transformed in 1976 into the Center for Computerized Automation and Measurement Systems “Mera-Elwro”, were increasingly limited to peripheral devices and the expansion of already operated systems [1: 174; 3: 79–87; 4: 39–41; 6: 21].

In the 1970s, the IT markets of Western countries were already dominated by microcomputers. They were much less complicated, smaller, cheaper than previously used machines and thus allowed for a rapid increase in the number of users among small companies, as well as private buyers. In Poland, they also undertook to produce their own microcomputers. Initially, it seemed that it would be an innovative machine, the “K 202”, characterized by excellent parameters. However, because most of the materials, components and tools for its production had to be imported from Great Britain using the scarce convertible currency in the Polish People's Republic, and this computer did not belong to the Uniform System introduced as a standard, its production was discontinued. In its place, the production of “Mera” microcomputers began at the Minicomputer Systems Plant “Mera” in Włochy near Warsaw. They had worse parameters, but were based on domestic components and were compatible with the Uniform System. Although unreliable, they were the first Polish office computers. By 1979, about 1,500 of them were produced, some of which were exported to the CMEA countries [3: 91–106; 9: 105].

In 1972, an innovative concept of creating a National Information System was created in Poland. It was to be a publicly available network connecting various computer centers and user terminals through automatic data transmission. It was to encompass all the main areas of central control of the state, i.e. not only the economy, but also statistical and financial information, culture, education, sports and recreation, social and health care, science, technology, communications, transport and communication, cooperation with foreign countries and planning. However, individual components were not launched for systemic reasons. This was due not only to technical or financial problems, but also, as we can assume, the authorities' fear of losing control over information about the state of the economy or social processes. Only those systems that could provide the authorities with information about citizens, such as “PESEL”, which was patronized by the Ministry of Internal Affairs, were developed [3: 110–121].

THE CRISIS OF THE 1980S AND ITS CONSEQUENCES

The socio-economic and political crisis in Poland, which had been intensifying since the second half of the 1970s, reached full scale in the 1980s. The export of Polish electronic devices and computers still went mostly to the CMEA countries, but cooperation with Western countries ceased almost completely for several years. The production of the “Mera-Elwro” plants was slowed down by problems with obtaining materials that were scarce in the country, as well as foreign currency for foreign purchases. In the meantime, PC computers began their career in the world, which, thanks to rich software, high quality and ease of use at a relatively low price, conquered the market of home and office computers in an avalanche way [2: 82–83; 3: 187–188].

In the meantime, the Polish computer industry was still at the stage of producing narrowly specialized digital machines for large enterprises and institutions, based on technology from the turn of the 1960s and 1970s. Their production, carried out on a relatively small scale, was not automated and was based on outdated technological solutions. In 1986, the “Mera-Elwro” Plants ended the production of “Odra” series 1300 and “R-32” computers. Their successors were supposed to be only the “R-34” Uniform System computers, which were already outdated, unreliable and expensive to operate when production was launched. Although the administration and national economy plants were doomed to them anyway, they were purchased in smaller and smaller quantities [3: 197–198; 4: 51–53; 9: 121].

An alternative to RIAD computers could be Polish microcomputers. Among the machines produced in Poland, these included the “Mera” 60, 100, 200, and 9150 computers, as well as the SM series. The “Mera–Elwro” plant developed and began producing the “Elwro–500” microcomputers

in 1983, based on a copy of the Intel 8080 microprocessor. However, this model, like its slightly smaller successor "Elwro–600", was produced in quantities of only a few hundred pieces per year. In the mid-1980s, other state-owned companies also began small-scale production of microcomputers, offering copies of Western products. However, it also did not develop on a larger scale, both due to supply problems and too high taxes imposed by the Ministry of Finance. In 1987, the Wroclaw IT tycoon received an order from the Ministry of Education to deliver 75 thousand "Elwro-800 Junior" microcomputers. However, its production was not without problems. It was too difficult for young people and teachers to use, and it was unreliable and lacked the necessary application software. By the end of the 1980s, only a few were produced, not several thousand as planned. In such a situation, schools increasingly often bought or accepted as donations imported computers. Until the mid-1980s, the authorities tried to stop attempts to import Western computers. Later, the import restrictions were lifted, and microcomputers such as "ATARI XL/XE" appeared in state commissions or on already legal computer equipment exchanges. Among their buyers were also state-owned companies. In 1988, around 3 % of Poles already had home computers. However, these were practically exclusively imported devices [3: 155–156, 169–187].

CONCLUSION

Despite many efforts, plans, resolutions and actions, even at the highest level, the Polish People's Republic did not become an IT powerhouse. Although it undertook the design and production of digital machines on a significant scale, educated a multitude of specialists to operate them and implemented numerous applications of IT techniques in the socio-economic and cultural spheres, they did not bring the expected modernization impulse, as in the case of Western countries. However, the blame for this lies not with the technology, programs and concepts themselves, but with the systemic inability of the Polish People's Republic to effectively uses innovations. The Soviet Union's imposition of the main directions of technological and economic development on the countries of the communist camp, which resulted in incapacitation, also played a role.

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Розвиток і застосування комп'ютерних наук у Польщі за часів комуністичного правління

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АНОТАЦІЯ

З огляду на те, що в сталінські часи в СРСР та інших країнах комуністичного блоку кібернетику сприймали з насторогою, дослідження цифрових машин у Польщі стало можливим у ширших масштабах лише з середини 1950-х років. Внаслідок роботи, проведеної тоді у кількох науково-дослідних установах, було створено перші польські комп'ютери на основі електронних ламп. Їх впровадження у більш широке виробництво було доручено центральними органами влади на початку 1960-х років Вроцлавському заводу електроніки "Elwro". Компанія також взяла на себе зобов'язання виробляти цифрові машини власної розробки під назвою "Odra". Вони широко використовувалися у науці, адміністрації, зв'язку та промисловості – як у Польщі, так і за кордоном, передусім у країнах-членах Ради економічної взаємодопомоги. Пізніше було відкрито ще кілька заводів, які співпрацювали в рамках групи "Mera–Elwro". З кінця 1960-х років важливим імпульсом для створення місцевих ІТ-систем стали стажування польських ІТ-спеціалістів у США та Великій Британії, а також програмне забезпечення, яке було привезене в країну разом із машинами IBM та ICL. До кінця 1960-х років у Польщі було створено близько 30 моделей та прототипів цифрових машин, що дало країні провідну позицію серед комуністичних держав. Ситуація змінилася на початку 1970-х років, коли Польща втратила своє становище серед країн Східного блоку, впровадивши виробництво машин єдиної серії електронних обчислювальних машин (ЕС ЕОМ), нав'язаної СРСР. У той час польський експорт був зосереджений переважно на продукції машинобудування, тоді як продажі електронної продукції та програмного забезпечення різко скоротилися. Спроба створити Національну ІТ-систему, зроблена у 1970-х роках, також зазнала невдачі. Це було обумовлено не лише технічними чи фінансовими проблемами, а й побоюваннями уряду щодо втрати контролю над інформацією про стан економіки або соціальні процеси. Криза 1980-х років значно обмежила замовлення на польські комп'ютери, які залишилися на етапі вузькоспеціалізованих цифрових машин для великих підприємств і установ в епоху революції ПК. Масове виробництво польських мікрокомп'ютерів не розвивалося через дефіцит частин, імпортованих за іноземну валюту, високі податки та в результаті зняття обмежень на імпорт західних комп'ютерів. Зрештою, хоча до 1989 року в Польщі розробка та виробництво цифрових машин здійснювалися у значних масштабах, велика кількість фахівців була підготовлена для їх обслуговування, а також впроваджено численні зразки ІТ-техніки, Польща так і не стала важливим гравцем у цій галузі. Це було обумовлено системною нездатністю комуністичної держави ефективно використовувати інновації в економіці.

Ключові слова: Польща; ІТ; комп'ютери; електронна промисловість; соціалістична економіка