The early history of computers in the Hungarian economy

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Abstract

After World War II. Eastern Europe got under Soviet rule. In the early years of this period the Eastern European and Soviet informatics and computing developments were dominated by political aspects, the development concepts and the technical progress were closely interwoven with the ideology of socialism.

Both superpowers of the bipolar world recognized the military importance of the computer applications, thus the questions of the technology transfer between East and West were dominated by defence aspects also in the later phase when the application of the technology already didn't serve armament purposes. Therefore the civil economic and industrial use of informatics in the communist states suffered a time-lag of several years behind the industrially developed countries.

1 Computer developments in the Soviet Union

In this chapter we overview the early Soviet types of computers which firstly spread in the region of the Eastern Bloc, thus also in Hungary.

The first computer development works started in the 1940 decade in the Simulation and Computer Laboratories of the Ukrainian Academy of Sciences.

In 1953 more prototypes were already completed, some of them went already into quantity production. The type BESM (High Speed Electronic Computer) was built in 1953; this was one of the first Soviet computer types. It was equipped in 1955 already with a 1024 words Williams-valve memory and a 5120 words magnetic drum. It had also a small size - 376 words - germanium diode memory. Its operational speed was characterized by the following data: an addition was carried out in $77 - 182$ μs, a multiplication in 270 μs. The Williams-valves were substituted later by a ferrite-core memory. (GOLDSTINE, H. H. 2004)

The development of the URAL magnetic drum Computer was completed in 1955 in the Scientific Research Institute of the Ministry of Machine and Measuring Instruments Industries. This type was presented, together with the type BESM in the form of a lecture at a conference in Darmstadt in the same year. The machine used 36 bit words, its magnetic drum had a capacity of 1024 words, the time of a multiplication was about 10 ms. It was a prototype for a series of more than 300 pieces.

The type STRELA was another computer of that time using the Williams-valve technology, it had a capacity of 1023 words with a length of 43 binary digits. A lot of more machine types were built in the Soviet Union in that period: PAGODA, M1, M2, M3, MESM, KRISTALL, N12 only to mention some of them.

The technology policy of the era on this field was deflected into a negative direction by some erroneous technical attitudes. By the middle of the fifties' years two approaches showed up in the development of the Soviet computing technology: an "academic" and an "engineering" one. The former urged to build principally universal computers, the latter intended to develop principally specialized, task oriented equipments. In the Soviet Union the "engineering" approach won the battle for long years, while in the Western world the development of the technology followed the concept of the universal machines. This decision or the technical policy based on it endured until the beginning of the sixties in the Soviet Union.

By the middle of the sixties the technology problems of the Soviet economy and military cumulated. The pace of the economic growth slackened, the space research needed more complex technologies and the management

Table 1:

	1^{st} generation	2^{nd} generation	3^{rd} generation
Soviet Union	1952	1961	1972
USA	1946	1957	1965
Average	6 years	4 years	7 years

of very highly complex systems as traffic became ever difficult without computers. As a consequence of this recognition a comprehensive development program for computing got into the centre of interest of the industrial policy.

In 1963 a party and governmental decree enhanced the computing against all the other sectors and many governing and development centres were established.

Several authors published different calculations about the time-lag of the Eastern European and Soviet informatics against the industrialized nations. The expert estimates show that the specific computer generations came up with more years delay in the East (see table 1.) (TAMÁS. P. 1992)

2 The advent of the computers in Hungary

In this chapter we overview the main events of the formation of the domestic computing as a scientific region, we focus only on the circumstances relevant in our judgement.

Computing as a scientific region appeared probably in the 1950 years. The Cybernetics Research Group of MTA (later Computing Centre) started the "development", rather only experience with the technology between 1957 and 1959 with the computer M-3 built by Soviet documentation. Hungary followed by building M-3 the countries having highly developed computing with a time-lag of $10 - 15$ years. At that time for instance in the Soviet Union computers had been operating since six years, in the German Democratic Republic since eight years and the USA had 5000 computers. (SZABÓ A. SZ. 1992.)

At the beginning of the sixties the supply of computers changed for the better. Besides the M-3 other computers also arrived in the country. The types Ural-I and Ural–II came from the Soviet Union and more powerful ELLIOTT-803-B machines came from Britain. It is worth to examine which institutions showed interest for the computers in the sixties: for instance KFKI[1] and KSH[2] obtained Ural machines, the computing Centres of NIM[3] and KGM[4] in turn procured ELLIOTT machines.

The M-3 was classable as less up-to-date than the mentioned types, thus the bizarre situation occurred that the team members of the MTA Computing Centre, creators of M-3 and pioneers of computing in Hungary, were fain to work out more complex tasks in other computing centers.

The recovery of the MTA Computing Centre and the comeback of its former glory were hoped from the installation of the machine URAL-II in 1965. Its operation showed soon that this procurement was everything but an optimal solution for the institute:

> "...I think this was meant a bigger leap than it really was. The URAL knew some more but it wasn't a qualitative leap for the M-3. Its performance was two-three times higher, but in computing hundred times means a big leap rather than two-three times ..." (Balázs, K. 1992. p. 87, an interview with Imre Molnár)

As mentioned earlier in chapter 1. the prototype of the machine URAL was introduced in 1955 and it represented the first computer generation[5]. By 1965 the development of first generation computers was already over gone, in countries having advanced computing even the second generation became obsolete. Therefore the machine URAL installed at the MTA Computing Centre tackled however the technical lagging against the other Hungarian institutes, but at the same time it conserved an outdated technology for the long run.

[1] KFKI: Research Institute for Physics of MTA Research Centre

[2] KSH: Central Statistical Office

[3] NIM: Ministry of Heavy Industries

[4] KGM: Ministry of Smelting and Machinery Industries

[5] The first generation of machines used electron tubes (1943–1954), the second generation of machines used transistors (1954–1964), the third generation is represented by machines built with integrated circuits (1964–1971), the machines of the fourth generation have microprocessors (1971–)

2.1 Computer developments in Hungary

The main arena of the computer developments in Hungary was KFKI. The profile of computing emerged from the multichannel analyzers necessary for the nuclear measurements. By the middle of the sixties, following the advent of computers a new demand came up to apply the flexible and multipurpose computers for the research instead of the analyzers. When defining the direction of computing the experts of KFKI vacillated between copying the types ELLIOTT-803 and PDP-8[6]. They chose finally the minicomputer PDP-8, and its adopted version named TPA-1100 was presented to the public already in 1969.

The development of computers in Hungary went on with the plans to create the type TPA-70. The experience of the computing research group at KFKI was confined to manufacture/copy software compatible machines, the basic programs needed to operate the computers had to come from foreign development. In this situation TPA-70 was a really great challenge, because the researchers decided to construct with this type a totally independently developed machine without the infringement of any patents and operating with originally developed own software. Development works of TPA-70 started in 1969 and 8-10 researchers were active in this program. The intention was to introduce the newly constructed machine by the end of 1970 or the beginning of 1971, when DEC planned to put the type PDP-11 on the market. KFKI wanted to rejoin the top international players with this type.

Not only the technical difficulties but also the change of concept within the institute encumbered the fulfilment of these plans. The opposition camp saw the proper way for the further development not in seeking for independent solutions but in the well known technique of copying. This kind of parting of the development team led to parallel developments. Thus when the TPA-70 was ready for the production there was no free manufacturing capacity within the institute, because both the type TPA-i and the type TPA-1140 (a functional copy of PDP-11) were in the production.

Under these conditions the TPA-70 could not be completed to the planned deadline and its introduction on the international market was also impossible. The prototype machine and the basic operating software were ready on schedule however. 27 volumes of material were provided for the TPA-70 in four years and this implied a better supply for it than that of the TPA-1140, because for the latter the translation and adaptation of the programs of the original machine (the PDP-11) took a considerable time. (SCHULLER G. 1992)

Many different computers were built under the label ”TPA”: (for more details see: Appendix)

- **TPA-1140** was a PDP-11 ”clone” with everything the original Digital computers had: 16-bit words, 8-bit bytes, 8 general-purpose registers, multi-level interrupts.
- **TPA/i** Configuration:

  CPU: 12 bit word-length, 5 hardware registers, parallel arithmetic

  Memory: ferrite core memory, 4Kword, expandable to 32Kword in 4K units.
- **TPA-70**:

  CPU: 16-bit word length, 64KB addressing range, hardware stack operations, byte/word/double-word operands, memory protection, programmable real-time clock 11 registers: 4 accumulators, PC, link address register, program status register, memory protection register, error register, real-time clock register, switch register

  Operating systems:

  MINOR: la paper-tape-based system

  MINOR/D: disk (cartridge/fix-headed/floppy) operating system

  DOST: a disk operating system for the SZTAKI graphical system RTE: real-time executive

  Program languages:

  SALT-70: Symbolic Assembly Language

  FORTRAN: editor, linker and debugger for ANSI FORTRAN IV

  BASIC-70: multiuser interpreter environment, that replaces the OSs.

The TPA-project lasted from 1968 to 1989 and 1435 computers were sold during this time. Although the TPAs are often labeled as mere ”clones”, it is important to point out, that most of them weren’t photocopies: 1215 were designed from scratch (most of them was designated to be compatible with something, these were

[6]The PDP-8 microcomputer of the family PDP was manufactured by DEC (Digital Equipment Corporation) between 1965 and 1990 (www.pdp8.net).

re-implementations), 105 were ”card-by-card” clones, and 115 were systems based on original processors. The importance of the TPAs lies in the historical fact, that Hungary was cut off from leading ”western” technologies. Big mainframes were manufactured by the socialist countries (the EC/EBM line, mostly IBM clones), and some original ”big irons” came over too (Siemens, a few IBM machines, etc), but the market for small systems, which were ideal for scientific, educational and business purposes wasn't really big, so none manufactured computers like that. The KFKI filled this gap, and they did it well: the TPAs were of higher quality than many other machines built in the COMECON countries[7].

In 1967 preparative works for the COMECON (KGST[8]) countries' computing integration program named ESZR[9] started. The treaty was signed in 1969, in the same year the Intergovernmental Committee for Computing (SZKB) was established to supervise and coordinate the works provided by the different countries, later also the Council of the Chief Constructors was founded. As a prototype for the program the family of computers IBM S-360/40 was assigned, R-20 was chosen as the own type name. No approbation was requested from IBM.

In order to provide and coordinate the hardware and software development works for the program ESZR a new institute, the Coordinating Institute for Computing (SZKI) was established. The main task of this institute was to represent Hungary in the program ESZR of the COMECON-countries and to coordinate the organizations participating in the program.

For our country the development and manufacture of the smallest member of the ESZR family of computers R-10 was allocated. As the prototype of this machine the French computer CII 10010 was used. Initially the factory EMG[10] was designated for the development and manufacturing tasks, where the production started in 1970 using French components.

The effort for the independent computer manufacturing in Hungary came to an end with this action. Until the late eighties the Hungarian computer manufacturing was confined only to produce functional copies.

After presenting the Hungarian computer developments it's worth to have in insight into the other side of the ”iron curtain” and outline the most important events related to the computer technology during this period of time (1960-1970)[11].

1960:

- Benjamin Curley develops and ships the first minicomputer, the PDP-1, at Digital Equipment Corporation.
- COBOL runs on UNIVAC II and RCA 501.
- Control Data Corporation delivers its first product, a large scientific computer named the CDC 1604.

1963: DEC ships the first PDP-5 minicomputer.

1964:

- BASIC (Beginners All-purpose Symbolic Instruction Language) is created by Tom Kurtz and John Kemeny of Dartmouth. First time-sharing BASIC program runs.
- IBM produces first large scale, real-time, on-line reservation system - SABRE - for American Airlines.
- IBM coins the term ”word processing”.
- IBM announces the System 360, an upward compatible, combination - scientific / business computer.

1965:

- Ken Olsen and Digital Equipment Corporation introduce the DEC PDP-8, first true mini computer.

1967:

- Niklaus Wirth begins development of PASCAL language in Zurich, Switzerland.
- The new 'third generation' computers adopt IC technology.
- DEC introduces the PDP-10 computer.

[7] http://hampage.hu/tpa/e_index.html

[8] COMECON: Council for Mutual Economic Support, the organization coordinating the economic cooperation of the socialist countries (Hungarian abbreviation KGST).

[9] ESZR: Unified Computing System

[10] EMG: Factory for Electronic Measuring Gears

[11] For more details visit the: http://www.columbia.edu/acis/history/ webpage.

1968: Integrated Electronics (Intel) Corp. is founded by Gordon Moore and Robert Noyce.
1969:

- IBM unbundles hardware and software; introduces a minicomputer line, System/3.

- Intel announces the 1KB RAM chip - highest capacity ever.

1970:

- DEC ships its first 16-bit minicomputer, the PDP-11/20.

- IBM ships its first System 370, a fourth generation, computer.

3 Computer applications in Hungary (1950-1970)

In this study we overlook only the period in which the first three of the well known computer generations were present in the different areas of science, engineering and industry. One can draw a very important conclusion from the above overview of the computer types and developments available in Hungary in the early times. The determinative personalities of that period were enthusiastic researchers and amateurs who established this scientific area in Hungary even without components, proper quality documentation and knowledge. We have to mention that also Hungary was influenced by the political sights dominating all the communist countries: computing was considered as a "bourgeois pseudo-science" at the beginning. Thus the Hungarian pioneers of computing had to tackle also the incomprehension of the government and the Academy of Sciences both lacking of proficiency on this area.

Because of the determinative political reasons of the era Soviet computers were the first to appear in the country, these could be characterized by imperfect documentation, unreliability and low memory capacity.

In the mid sixties an opening occurred in the East-West trade also on the field of computing. IBM, Honeywell, Control Data and other firms rivalled for the markets of the socialist countries. IBM tried to have advantage over the competitors by lower prices and a very good service network. Thus since the sixties also machines of IBM have been being used in Hungary and this made also the range of the application areas wider.

3.1 Computers in the engineering

The questions of the application possibilities of computers were first dealt with between 1959 and 1960 in Hungary. The first applications were connected with different scientific areas augmented by the fields of interest of the mathematicians programming the machines.

The scientific activity of the institute MTA SZK[12] was organized by departments. Beside mathematical, biology, linguistics and engineering matters also applications having economic character became dominant.

The applications areas were established by the fruitful cooperation of different institutes, scientists and disciplines. The economic-mathematical applications took off in those years in Hungary. This matter was dealt with at the first time at the beginning of 1959 on a meeting of GGTM[13]. (BALÁZS K. 1992 p.78).

Computational linguistics research was very current in that period. The research group had an own publication called "Computing and Linguistics" already in 1965, some editions of which were cited in Western publications, too.

Biological applications played an important role at that time. The primitive model of the logical structure of the central nervous system became an emerging science.

The diversity of the topics is shown by the fact that the computer aided automation of the traffic and some production technologies but also computer aided music composing was studied.[14]

Perhaps the novelty of the technique and the variegation of the interested persons explains that they tried to apply computers initially on many areas of the natural science, engineering, humane studies and economic science. Imre Molnár remembers these happenings as follows:

[12] MTA SZK: Computing Centre of the Hungarian Academy of Sciences
[13] GGTM: Scientific Team for Economic Planning and Economic Governance
[14] Miklós Havass wrote a diploma piece titled "Computer aided music composing" in 1963.

"*. . . if for instance a geologist wanted to put something on the machine, he came to us saying we were the computing people and this was our speciality. He gave us a 400 pages technical book which of course used his terminology. The job was to put that book on the machine. The mathematician had to read it in order to comprehend it an then to program the great many formulae depending on the aim . . .*" (BALÁZS K. 1992, p.79)

At the beginning of the sixties the M-3 was the only computer type available in Hungary, thus all researchers interested in computing gathered around this machine in the SZK.

The first engineering design tasks reached this machine in 1960-61. The static designs of the new Erzsébet-bridge were calculated here. To solve the nonlinear system of equations describing the problem took half a year and was acknowledged as a professional feat, because this computer was not capable to solve such a great task and its operation was rather unreliable. Chemical problems were also dealt with, e.g. the partial oxidation of methane, the dimensioning of corrugated heat exchangers or the dissipation. (ORBÁN M. 1973)

The researchers made considerable success on some application areas. The structural engineers engaged early in the computing work by calculations necessary to the statics of girders. These developed into the programs providing the engineering calculations for the Blaha Lujza square and Baross square underpasses in Budapest. (SZABÓ A. SZ. 1992. p 270.)

Procedure units for the chemical industry were also calculated, these tasks were solved mainly by professionals coming from corresponding planning institutes but many mathematicians were also involved.

On the field of electronics the computer aided design of filters was on the agenda since 1964. The design of filters was the peak performance of communication engineering at that time, as it was practically impossible to design a good filter manually. Since the seventies another electronics applications came to the fore, e.g. designing of electronics instruments or printed circuit boards, building up automatic manufacturing process control systems. It is no wonder that electronics as the industry manufacturing the computers themselves recognized the possibilities of computer aided design and control of manufacturing much earlier than other industries.

3.2 First attempts to computer applications in the Hungarian industry

In the decade beginning with 1960 the trend of the "unmanned factory" became widespread in the USA and Western Europe. In the background of this phenomenon were automation, the development of computing and the high demand on man-power and the implied increase of labour costs. The essence of the matter was to automate the whole manufacturing process by computer aided process control, and human work had to be eliminated as much as possible.

The use of computing in the socialist countries had a time-lag behind the industrialized capitalist countries, but the progress started up based on a partly own partly imported technique. The applications in Hungary showed a lag even behind the other socialist countries in the number of both the machines used and the application areas. The number of computers in the country was less than 20 in the sixties and these were of 9 types. The domestic equipment park was yet located almost without exception at governing organizations and education, research and data processing institutes at that time. Computing in the production was confined to the Nitrogen Works Pét, MOM[15] and MÁV[16].

In the followings we shortly review the period endeavours of Duna Petroleum Industry Works (DKV) to introduce computing.

The dominant point of view was at that time that computing must and could be used in a plant basically for process control. But this was not enough to fully exploit the computers, therefore the free capacity could be used for solving management and administrative tasks.

Besides the technical background also the presence of professionals should be touched on. In 1965 when the first plans to establish a computing centre at DKV were drawn up it was almost impossible to hire experienced computer professionals. The university education of applied mathematics started in Szeged in 1962, the first graduates were available only in 1967. The number of the different computing courses was also limited. Thus as employees of the prospective computing centre almost no graduates of computing could be found, only newly graduated engineers or mathematicians interested in computing. By the end of 1969 the staff of the computing centre had near 20 fellow-workers, later increased yearly by 10-15 people and reached in 1971 80 employees. (SCHULLER G. 1992. p. 262).

[15] MOM: Hungarian Optics Works

[16] MÁV: Hungarian State Railways

The computing centre focused on carrying out mainly the following tasks:

1. To confirm the possibility of process control by engineering calculations.
2. Organization of the production using linear programming; preparing yearly, quarterly and monthly plans.
3. Production programming, production scheduling, preparing and modifying detailed daily plans.
4. Production reckoning mainly in an administrative and data processing manner.
5. Material management tasks.
6. Reckoning of maintenance, management of maintenance.

Let's study one of the mentioned projects in more detail to show the practical difficulties in the first phase of computer applications.

The main method for production planning was linear programming. The task was to generate a matrix taking into account the specific variables and restrictions, the coefficients of which gave an optimum. Two big problems arose in solving the task.

The cause of the first problem was that the team over-estimated its capacity. The members had enough experience in generating and solving matrices in the range of 60×40 elements and thought that matrices having 300×200 elements needed proportionally more work but were in principle not different. The latter task should need therefore maximum 25 times more work than the former and they believed the difference to be only in the difficulty not to make up the matrix on a desk but on a big table on the wall. The first big problem caused by the size of the matrix was the high amount of data errors resulted from the manual writing. At that time free-handed writing was a common practice, generating programs were not yet available. In a later phase the problems caused by the manual writing were more and more obvious, but the delay to the schedule was so high that all capacities were bound by the error corrections and there wasn't any time and effort available to create a generating program.

The other problem was caused by the fact that the different partial tasks had to be programmed for different type computers even without knowing what types would be purchased. Plans were made considering IBM machines but to procure Western computers became troublesome by that time and the use of ESZR machines came to the fore. The last permission in the country to buy an IBM computer was obtained by DKV and a contract was concluded to deliver a computer type 360/40 with a deadline of 31^{st} December 1971.

Another factor of the success story of the DKV computing centre is the establishment of an organizational structure corresponding to the character of the work. DKV in general had a stable hierarchical structure as characteristic at that time for all companies, governing organizations and research institutes as well. The task oriented team system was substantially less used than necessary and possible. Following the recommendations of IBM a different structure was formed in the computing centre than in the whole of the company and instead of a subtle system of connections of different groups and divisions a team system was established. Thus no separate organizational and programming groups were created, a hardware and a software manager, different project managers and the team-work itself were adequate to the effective operation

Despite the difficulties of the preparatory works the company successfully achieved the first goal, the computer aided solution of production control (production planning, programming and reckoning). The complex system formed later was stepwise incorporated into the whole process of petroleum processing spreading from the arrival of the crude material until the delivery of the ready-made products.

Computing has been being applied from 1972 step by step also on other areas of the company's activity, among others in maintenance, investments, development and pay-roll.

4 Summary

The 20 years long period (between 1950 and 1970) reviewed in this study was characterized by the establishment and expansion of the computing culture. The era can be divided into three sub periods: the first one brought the discovery of the scientific area, the second one was dedicated to the searching of computer development and application fields and in the third one computing started to go on the way of industrial integration.

5 Appendix

List of PDP computers:

Table 2:

MODEL	DATE	PRICE	BITS	NUMBER	COMMENTS
PDP-1	1960	$120,000	18	50	DEC's first computer
PDP-2	?		24	?	Prototype only?
PDP-3	?		36		One built by a customer, not by DEC.
PDP-4	1962	$60,000	18	45	Predecessor of the PDP-7.
PDP-5	1963	$27,000	12	1,000	The ancestor of the PDP-8.
PDP-6	1964	$300,000	36	23	A big computer; 23 built, most for MIT.
PDP-7	1965	$72,000	18	120	Widely used for real-time control.
PDP-8	1965	$18,500	12	$\sim$50,000	The smallest and least expensive PDP.
PDP-9	1966	$35,000	18	445	An upgrade of the PDP-7.
PDP-10	1967	$110,000	36	$\sim$700	A PDP-6 follow up, great for timesharing.
PDP-11	1970	$10,800	16	$>$600,000	DEC's first and only 16 bit computer.
PDP-12	1969	$27,900	12	725	A PDP-8 relative.
PDP-13	?	?	?	?	Bad luck, there was no such machine
PDP-14	?	?	?	?	A ROM-based programmable controller.
PDP-15	1970	$16,500	18	790	A TTL upgrade of the PDP-9.
PDP-16	1972	?	8/16	?	A register-transfer module system.

The following PDP-8 compatible or semi-compatible machines were made and sold by European countries:

Table 3:

MODEL	DATE	MAKER, NOTES
TPA1001	1969	Hungarian KFKI product, transistorized.
TPA1001/i	1971	Hungarian KFKI, IC version of 1001.
TPA/i	1971	Hungarian , KFKI, renamed TPA1001/i
TPA/l	1979	Hungarian KFKI, enhanced TPA/i.
TPAl/128H	1985	Hungarian KFKI, TPA/l with 128K memory.
TPA/s	197?	Hungarian KFKI, based on Intersil CPU chip.
TPA Quadro	1983?	Hungarian KFKI, comparable to a DECmate.
Electronica-100	1985	Russian discrete transistor technology.
Electronica-100I	1985	Russian, probably a PDP-8/I clone.
Electrotechnica-100I	?	Yugoslavian, PDP-8/I? Possibly same as above.
Saratov-2	?	Russian, built like a PDP-8/M but bulkier.
SPEAR u-LINC 100	?	SPEAR, Inc, Waltham Mass (a LINC clone!)
SPEAR u-LINC 300	?	SPEAR, Inc, Waltham Mass (a LINC clone!)
DCC-112	1970	Digital Computer Controls PDP-8/L clone.
DCC-112H	1971	Digital Computer Controls
MPS-1	1974	Fabritek , PDP-8/L clone
MP-12	1974	(is this just different numbering of above?)
6100 Sampler	1976?	Intersil, their IM6100 promotional kit
Intercept I	197?	Intersil, based on IM6100
Intercept Jr	197?	Intersil, based on IM6100
TLF MINI-12	1977	Based on IM6100, in an elegant package.
PCM-12	197?	Pacific CyberMetrix , based on Intercept bus
PCM-12A	1977	Pacific CyberMetrix , fixed to clock at 4MHz
SBC-8	1984-1988	CESI Based on IM6120? SCSI bus

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