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Abstract

My aim is to present a few social phenomena linked with an introduction of home computers in the Polish People's Republic during the 1980s. In the communist country under the embargo introduced by COCOM, the computerization was embedded in the discourse of leveling the rapidly growing technology gap and rescuing the collapsing Polish economy. The discourse of computerization was shaped by a group of computer science professionals that were able to gather wide support for their ideas among officials, teachers and journalists. They presented ideas of creating "national" computer industry (in fact this industry was based mostly on the Polish copies of "reverse-engineered" Western hardware) and introduction of computer science in educational programs. Successful fulfilling of their appeals should have led socialist Poland to "digital utopia". However, such plans had little impact on Polish society. The real mass interest in home computers among Poles was caused by different factors. The rise of Polish home computer market wasn't also the effect of activity of hardware and software Western companies (their branches were established mostly after 1989) but rather an effect of blossoming Polish informal economy. Home computers were available on Polish black market since the early 1980s. These computers were brought (also smuggled) from the West Germany and the USA as high-tech Western gadgets. Along with hardware and pirate software brought from the West, social practices linked with the usage of home computers were brought as well. I put forward the thesis that it is possible to distinguish two methods of shaping new computer technologies in communist Poland. This technology was shaped by "computer movement" (I am using this term according to Rob Kling) as a significant factor for the growth of Polish economy, but ordinary users shaped it rather as a platform for entertainment. In this article I examine the impact of institutions and social actors which were shaping these new technological artifacts present in communist Poland.

I. Introduction

During gathering materials on computing in Poland, I was watching a four-hours streamed recording of a conference organized by Polish Association of Informatics on the history of computers in Poland. During four hours and a dozen of presented papers, I have heard a lot of information and anecdotes about Polish pioneers of computing, introducing computers to scientific institutes and building mainframe computers from scratch (materials from the conference in Polish are available on www.pti.org.pl). However, it wasn't a story which could be compared with Levy's narrative on a bunch of computer nerds from MIT (1984). It was rather a story of continuous and frustrating bargaining with state bureaucracy and dealing with the economy of shortages. It was also story exclusively about mainframe computers. Only for a few times Polish model of home computer – Elwro 800 Junior – was mentioned. This conference provided me a lot of valuable information on the activity of small group of professionals who were trying to organize the process of diffusion of innovation in Polish technological infrastructure. However, I was disappointed by the fact that I didn't hear any story about the "computer fever" among Polish teenagers, which was at its peak during the second half of the 1980s.

It was inevitable to confront these papers with my personal memory. During the late 1980s I was about 10 years old. I was reading Polish computer magazine "Bajtek" regularly and dreaming that as a Christmas gift I will receive a ZX Spectrum

or - that was my biggest wish – a Commodore 64[1]. I also remember some discussions with other kids. We were arguing about which home computer is better. But the criterion was quite simple – on which platform better games are available. I also have to admit that during reading of "Bajtek" I was exclusively interested in reviews of games, not in the numerous articles on Polish "computer literate information society", where citizens will be fluent in at least two programming languages.

Polish computerization had also fascinated anonymous journalist from "Frankfurter Allgemeine Zeitung". This West German newspaper regularly published materials on political and social issues in communist Poland. In a reportage on the fast growing of the amount of home computers in Poland - which the author called "Computerfieber" - he described crowds of Polish youths visiting computer market - a unique phenomenon of Polish informal economy. On such markets it was possible not only to buy a computer, but also to acquire all the newest software imported from the West. The "FAZ" Journalist also described Polish kids playing computer games with sympathy. In his opinion it wasn't just waste of time. He mentioned that those kids were playing games based on James Bond and Rambo movies, but also *Raid Over Moscow.* In this game the player's task was to shoot down Soviet fighters and destroy military installations to foil a Soviet plan of nuclear attack. For a German journalist, the use of domestic technology for entertainment – as anything else in Poland during the 1980s – was inevitably embedded in the political discourse. It was a childish (as well as children's) struggle against the communist regime. Somehow similar point of view was presented in Polish computer magazine, where editors warned about *Raid Over Moscow* and other computer games that were a part of Western propaganda policy. "Attraction of the program caused that somewhere in the mind of a player a picture of the Soviet Union as aggressive power remains. This is the goal of those «policy makers»"(Młynarski 1986). In this text Western computer games were named "computer diversion". Home computers became a battlefield of the Cold War. I can just suppose that for Polish kids (just like for their Western counterparts) it doesn't make any difference if they were shooting down Soviet MiGs or alien spacecrafts – they were just choosing highly playable games and *Raid Over Moscow* was definitely one of this kind.

II. Computers and the Cold War

In vast literature on the history of Cold War development of new civilian technologies is mentioned only briefly. Lysenko case and the story of "bourgeoisie" cybernetics in the Soviet Union are well recognized but these are rather exceptions. The most important books in the field of the history of technology are dealing with the issues of technology transfer across the Iron Curtain and COCOM regulations (Sutton 1968-1973; Bertsch 1988; Mastanduno 1992, Cain 2005, for the case of technology transfer to Poland in the 1970s see: Fallenbuchl 1983). I can point out only few academic books dealing with the social impact of technologies in the Soviet Bloc (Fleron 1979; Graham 1990, Mackrakis & Hoffman 1999). In these volumes reader can find theoretical studies on the issues of Marxism and technology (especially Feenberg's text in Fleron 1979, for the issues of links between technology and ideology see: Abbinnett 2007, Engerman et al. 2003) and case studies of particular industries. Domestic technologies were also analyzed in some texts in two volumes edited by Reid and Crowley (2000; 2002).

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[1] Finally on Christmas in 1989 – a few months after June 4th turnover - Santa Claus brought me Commodore 64, tape recorder, joystick, and about 600 pirated games. My dreams became true only in democratic Poland.

The problem of the computerization in the Soviet Bloc is analyzed very briefly. There are numerous works dealing with development of computer technologies on the second side of the Iron Curtain, obviously mostly in the USA (to name just a few most significant books: Ceruzzi 2003, Campell-Kelly 2003, Edwards 1996). Contrary to this, the literature on the computing in the Soviet Bloc is described in only a few articles on some aspects of the professional usage of these technologies. I can point out the issue of „IEEE Annals of the History of Computing" (Vol. 21, No. 3, Sep. 1999), with articles on computing in Central- and East European countries. I can also mention a few texts on computers in the Soviet Union (Adirim 1991, Gerovitch 2008, see also Ceruzzi 2003: 11) and Poland (Marczynski 1980; Lukaszewicz 1990). Another important text was published exclusively in Polish (Madey, Sysło 2000).

The isolation of the Soviet Union and the lack of publications on the shaping of computer technologies in communist regimes led to the creation of some stereotypes about special treatment of computer technologies behind the Iron Curtain. I can quote a story presented by Leslie H. Gelb, a well-known "The New York Times" correspondent, in *Cold War* documentary movie:

"I had a meeting in Moscow with Marshall Ogarkov, Chief of the Soviet armed forces and he said: you know, all modern military capability is based on the computer. You have little kids in America three years old who know how to deal with the computers. It takes years here to train Soviet recruits in the military to use them, because they never used them before. We are afraid of the computers. If we start deploying computers, it's going to mean the loss of political control for the Soviet leadership." (*Cold War*: Vol. 22, *Star Wars 1981-1988*, dir. Tessa Coombs, USA 1998)

A quite similar declaration of another Soviet official was cited by Graham:

"Evgenii Velikhov, a Vice president of the Soviet Academy of Sciences, admitted that personal computers have been subject to unusual restrictions in the Soviet Union due to the fact that Soviet citizens were so politically immature and vulnerable to western propaganda that they should be protected by censorship." (Graham 1990: 12)

After these stories one could have an impression that beyond the Iron Curtain computers were simply forbidden fruits just like cybernetics few decades ago. On the other hand I can quote a story about legendary technologies developed in a remote world behind the Iron Curtain:

"There were tales of Russian-designed machines built into DEC consoles that outperformed their Western equivalents by several orders of magnitude - Volkswagens with V8 engines; tales of ternary logic computers for which there was no Western counterpart (MIR); and finally, a tale of a winking monster - a Cold War supercomputer - that occupied an entire floor. It was rumoured to have thousands of flashing console lights, was operated in near darkness in the heart of Siberia, and was said to be the last working version of the legendary Besm-6 supercomputer." (Swade 1993)

Stories about endemic models of Volkswagen clones with V8 engines and Soviet supercomputer are at least quite exaggerated, but it is hard to dismiss accounts on Ogarkov's and Velikhov's words. However, available sources show that the program of computerization of the Soviet Union was developed. In fact the Soviet Academy of Sciences in 1987 introduced the program of "computerization of the Soviet society" (Adirim 1991: 651). In Polish computer magazines ("Bajtek" and "Komputer") one can find a lot of reportages on the activity of Soviet youth in computer clubs and

successful implementation of informatics in the Soviet economy. Probably such reportages were exaggerated, but the fact that a discourse of computerization was present does matter. In planned economy where shortages were part of everyday life, this computerization was present mostly on paper, but during the 1970s and 1980s it was perceived as a crucial agent of modernity. I can quote a memoir of Lev Manovich on his course in informatics in the Soviet Union during the 1970s.

"At the end of the two-year course, we are taken – just once – to a data-processing center, which normally requires clearance to enter. I enter my program into a computer, but it does not run: Because I had never seen a computer keyboard before, I used the letter O whenever I need to input zero." (Manovich 2001: 3)

It is possible to find similar stories about technological mythologies and crude reality in other socialist countries. I can point out some narratives about authorities reluctant to computer technologies and geniuses whose inventions were wasted only due to political reasons. There is a legend about Jacek Karpiński – designer of K 202 - "the world's most advanced computer" in the 1970s, but he was disliked by the communist authorities and the production of his supercomputer was cancelled.

Another issue is the usage of computers by Polish political opposition during the 1980s. Spectacular action of jamming the state TV signal with a homemade device based on ZX Spectrum constructed by a group of Polish astronomers became famous in computer users communities all around the world (Goldstein 2008: 113; Bloombecker 1990). It is possible that this story was the basis of the myth that "Solidarity" was a movement where computers were used on daily basis and that the members of this organization were using diskettes for the transfer of *samizdat* instead of paper. (*Of Systems, Solidarity, and Struggle*, in: "Datamation", 1 Nov. 1987). As far as I know home computers were used in "Solidarity" only rarely for DTP tasks in 1988 and 1989.

Such stories show how complex and fascinating the issues of computer technologies beyond the Iron Curtain are. One of the most significant issues is the problem of putting such technologies into political discourse. The second issue could be called "computer underground" but instead of political dissidence this term describes huge high-tech black market. Due to the lack of organized market with local branches of hardware and software companies, computer market in communist Poland was based almost exclusively on small scale import and smuggling – an example of informal economy flourishing in Poland during the 1980s.

Both issues mentioned here are strictly linked with the transfer of technology. In the first case technologies became a part of political discourse toward modernization. In fact it was the import of material artifacts that were later reverse-engineered, but also an import of knowledge. On the one hand, vision of modern, computerized and rationalized socialist society was partly imported from the Soviet Union. On the other hand, Polish "digital utopia" - rational and efficient centrally planned economy was mixed with visions from Toffler's *The Third Wave* (1981). The second phenomenon – computer black market - was exclusively based on private import of hardware and software from the West Germany, USA, UK, Austria and Sweden.

My aim is to present which institutions and social actors participated in shaping computer technologies in a socialist country on the case-study of Poland. Such analysis could help understanding how technologies crossed the Iron Curtain during the Cold War period. On the other hand, it could bring us some information about processes of computerization in periphery countries with a complex set of economical, social and political factors. As a conceptual framework I am using the definition of technology proposed in a classic work by Mackenzie and Wajcman: "technology has three layers of meaning: the artifact, the surrounding human activity,

and human knowledge" (Wajcman & Mackenzie 1999: 56). According to this brief and very useful definition, I would like to study the import of material artifacts (hardware) along with the practices of knowledge, which encompass software, programming skills, but also scenarios of using hardware platforms and peripheries. David Bell in his accessible study of social shaping of technology proposed term "practices of computing" (Bell 2006: 6), which corresponds with my approach to the research of cultural, social, and economical practices linked with the usage of home computers. As we will see below, these forms of social actions often overlapped (for a study of overlapping economical and cultural practices see: Berghoff & Vogel 2004).

My main thesis concerns the strict distinction between social actions linked with the activity of "computer movement" and the individual users. In the first chapter I will show more or less coordinated actions of computer science experts and state institutions based on the ideology of "digital utopia". A term "computer movement" was proposed by Rob Kling (1995) to describe activity of this particular kind of social movement which encompasses scientists, interest groups, and enthusiasts of technology. Such groups try to propose (or oppose) legislative and economical regulations toward usage of computers, but also they try to create social shape of this technology in public discourse. Mostly this shape is a positive one, the core of ideology of computer movement is based on the direct correlation between computers and social and economical development (Anti-computer movements were also present, see: Roszak 1986).

Kling's works on computing (especially 1996, see also Rosenberg 2004) provide us with sophisticated theoretical framework and numerous information about empirical studies as well. This author focused on research on micro-scale level, for which the term "ethnography of computing" can be used. Such research shows very complex practices of computing developed by social actors. In the chapter on Polish computer movement I will try to present the most significant social actors and their actions toward implementation of a unique socialist "digital utopia".

In the second chapter I am describing social and economical practices linked with acquiring and using computers which were developed by single users. Most such practices were based on informal economy (I am using this term according to Castells & Portes 1991). The main source of origin of computers, programs but also literature was black market. Software and knowledge about computers were spread mostly through personal networks among computer owners but also potential users.

To link these two chapters and show differences between the two processes of computerization, I am using concept of "boundary object" introduced by Star and Greisemer (1999). This framework was briefly described by Star and Clarke: "The basic social process of translation allows boundary objects to be (re)constructed to meet specific needs or demands placed on it by the different worlds involved. Boundary objects are often very important to many or most of the social worlds involved and hence can be sites of intense controversy and competition for the power to define them" (2009: 121). "Computer movement" is an example of such social world that tried to impose set of scenarios of using new technology on society. Computer experts from this movement were able to successfully convince some officials to support computerization that led to some specific actions in economy and education. Computer experts defined computer as a crucial tool for the development on "national economy" and leveling rapidly growing technology gap between West and East. However, they were not able to impose their vision on ordinary computer users who chose other scenario – usage of computer as an entertainment platform. Members of computer movement were very suspicious toward computerization based on mass private import of Western home computers. In numerous press interviews they were complaining that these computers were used mostly for playing computer games instead of more "useful" purposes. They also pointed out the

problem of black market and mass piracy linked with the import of home computers. In some cases, the users chose knowledge presented by this movement for their own purposes. For example programming skills gained from Polish computer magazines were used for removing copy protection from games. Scenarios of using home computers could also be negotiated in computer clubs, where children and teenagers were learning programming skills and sometimes playing computer games as well.

III. Polish computer movement - national and socialist computing

Discourse of computerization presented by Polish computer movement was a mix of ideology imported from the United States based on visions of "digital revolution", and "information society" and from the Soviet Union, where issues of leveling technology gap, modernization of industry, social planning were raised (for Soviet discourse of computerization in the 1970s see: Hoffman 1979). In Polish newspapers and popular magazines we can find numerous articles on successful implementations of computers in science, economy and administration in Western countries and in the Soviet Union as well.

There were also interviews with computer experts from Poland and from the Soviet Union. This was one of the communication channels used by computer movement to promote its ideology (Kling 1995). The core of the computer movement encompassed a group of computer science professionals. Milieus of such academics were linked with Polish polytechnic universities and research institutes created mostly in the 1960s and 1970s. (see: Syslo, Madey 2000, Marczynski 1980).

During the 1970s topics of usage of computers were already present in Polish press. Some reportages about implementation of computers in Polish industry were published as a part of discourse of modernization in period of Edward Gierek – the first secretary of Polish communist party (1970-1980) - who promoted the transfer of Western technologies to Poland. According to "Trybuna Ludu" ("People's Voice") – official press organ of the Polish United Workers' Party – topics of computing were mentioned during the meeting of Political Bureau of party in 1977. In a short report from this meeting we can read:

"Fast development of the computer industry and progress in the production of electronic devices and peripheries are our advantages. Due to collaboration with kindred socialist countries we are able to gather digital devices with superior capabilities." (Korejwo, 1977)

In this text two crucial issues of Polish discourse of computerization were mentioned. According to this propaganda text Polish computerization should be based mostly on Polish electronic industry. For political and economical reasons main partners for collaboration in technological development were exclusively other socialist countries, especially the Soviet Union.

In 1981 Polish computer experts created Polish Association of Informatics (Polskie Towarzystwo Informatyczne) - institutional platform used to promote their ideology. In one of the first bulletins founders of this organization stated their main goals:

"We are convinced that the country which is unable to develop autonomous systems for gathering, processing and making available information could not become a rightful member of modern civilized community. We are seeking for the public understanding of the necessity of state patronage over usages of informatics." (TPI Bulletin No. 10/1982, http://www.cs.put.poznan.pl/archiwumpti/)

Activity of this organization was supported by the popular science journal "Młody technik" ("Young Technician"). Similar role in the Soviet Union was played by the journal "Technika Mołodioży ("Technology of Youth"). In 1985 "Bajtek" - the first Polish computer magazine was published (all scanned issues of this magazine are available on website http://retroreaders.makii.pl/) under the auspices of the Association of Polish Socialist Youth (Związek Socjalistycznej Młodzieży Polskiej). Aside from interviews with computer experts, basic instructions for using a computer, tutorials of programming, program listings and manuals on hardware modifications were published in this very popular magazine. In the first editorial we can read:

"Bajtek is popular magazine dedicated to all issues linked with information processing. Our aim is to help everyone who owns, or would like to own a computer. There is no point in talking about the significance of development of microcomputer technologies for all societies. [...] We would like only to add that this cause is CRUCIAL FOR THE PROSEROUS FUTURE OF OUR COUNTRY. Our ambition is to fight against computer illiteracy. We seek the help of all who have some experience in fighting for the cause of informatics." ("Bajtek", No. 1/1985: 2)

How did Polish computer movement try to use computers for prosperous future of Poland? According to the opinions of computer experts presented in numerous interviews, articles and TPI bulletins, they were calling for two things: implementation of informatics in compulsory educational programs and necessity of creation of Polish computer industry.

Vision of computer education was based on learning of programming languages and supporting education in natural sciences. Computer experts supposed that from early childhood one should have an access to computer and start learning programming languages; at the beginning LOGO (for information about this educational language see: Harvey 1997), later BASIC, and finally other more professional high-level programming languages (HLL). The ultimate goal of this project was to create a generation of highly skilled IT professionals to compete in "technology race" with the West. The second goal of this project was the development of so called "mathematical thinking" among children. Similar educational projects in the discourse of "digital utopia" in the United States were mentioned by Roszak (1986, see also: Papert 1980). To provide an easy access for programming languages Polish experts developed localized versions of LOGO and BASIC languages. In these compliers all abbreviations of English verbs were replaced with counterparts in Polish[2].

Computers were also perceived as an educational help during lessons of physics and mathematics. According to educational proposals in "Bajtek", computers were used merely to solve simple mathematical formulas (i. a. quadratic equations). Such usage of computers was criticized even among members of computer movement due to the fact that in Polish primary schools every pupil learned how to easily solve such tasks with pen and paper. The plan to use computers during lessons of history is also worth mentioning – pupils were supposed to solve simple computer quiz with historical dates (for Western projects of using home computers in education see: Haigh 1985). Postulate of educational program on informatics was partly fulfilled. In 1986 in selected schools obligatory programming courses were implemented (Sysło; Kwiatkowska 2008) but it is very difficult to judge practical effects of such program.

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[2]According to information provided by Helena Durnová, there were no such projects in Czechoslovakia, even national programming language "Karel" was based on English abbreviations

The second postulate of computer movement was the creation of "national" computer technologies. Production of Polish computers should have solved the problem of dependency of Polish industry on the import of hardware from the West limited by COCOM regulations and lack of convertible currencies in Polish economy. Computer experts presented a vision of Poland as a potential technological power. As the most important advantage of Poland they pointed out high quality of polytechnic universities. Polish computer industry should provide state-owned companies and bureaucracy with necessary new technologies but also could produce hardware that could be exported to the Third World countries.

During the 1980s at least a dozen or so personal computers and two home computers were produced in Poland, mostly only in experimental series (full list and technical details of all models and peripheries available on: http://www.elwro.zafriko.pl). For the purposes of my text I mention only two models of home or rather "educational" computers: Meritum and Elwro Junior. These two 8-bit hardware platforms were developed to provide educational help in primary and high schools. Information on the beginning of production of Meritum were published in Polish newspapers and also in press bulletin "Polen Gegenwart" published in German for journalists from the West Germany, where only the most significant information from the point of view of state propaganda were published. Production of Polish home computer became a part of foreign information policy:

"Management of "Mera Elzab» company declared that during upcoming year it will produce 1000 Meritum 1 computers that will be available on every polytechnic university. Computer company «Mera Elzab» had already started a production of a home computer which is very trendy for a few years all around the world." (*Computer für die Schulen*, in: "Polens Gegenwart", No. 8, April 1984: 14)

In the context of this conference it is worth to mention foreign aspects of making of this "national" computer. Meritum was based on U880D – GDR-made reverse-engineered copy of very popular Z80 processor (used a.o. in ZX Spectrum). The whole architecture of Meritum was based on TRS 80 – one of the first home computers which hit the market in the United States in 1977. What is more interesting, the designers of Polish computer openly admitted reverse-engineering of TRS 80 in "Bajtek".

"We liked the idea of our own microcomputer. We started to look for a prototype. We begun developing MERITUM 1 in 1982. As a prototype we used TRS 80 model II. At that time ZX Spectrum was more and more popular. Why TRS 80 then? It was the computer that was most suitable for the conditions of our industry." ("Bajtek", No. 5-6/1986: 4)

It was the usual approach to design of computers in the whole socialist Bloc. For example Elfimov (2008) described mass cloning of ZX Spectrum and endemic hardware modifications of this platform in the Soviet Union.

More obscure issue of reverse-engineering of software is also worth mentioning. In "Komputer" we can find an interview with programmers from one of the first Polish software companies (for the development of software industries in Eastern Europe after 1989 see: Dyker 1996). They openly admitted how they developed Polish word processor and spreadsheet:

"At the first stage of our development process we based our programs on Western products. [...] In the first version of projected Tekst-CSK we used WordStar; the first version of Bank was based on dBaseIII. We weren't strong enough in programming

databases, we were just trying to produce databases with graphic interface, where about 40 % of structures were adopted from dBaseIII." ("Komputer" No. 5/1987: 12)

On the next page interviewer simply asked these programmers of their losses due to mass piracy in Poland. Such hypocrisy was a significant trait of Polish computer movement. If Polish engineers made a copy of Western hardware or software that could be used for purposes present in the discourse of "digital utopia", it was good[3].. But when thousands of teenagers were making pirate copies of Western games on computer markets, it was bad. Almost everything that wasn't improving development of Polish technologies, but also simply linked with high-tech black market, was condemned by the computer movement.

Computer experts were also suspicious about the whole idea of a home computer, which was perceived as computer "pop culture", which was used mostly for entertainment. In an interview in "Bajtek" director of PTI warned:

"I am afraid that «computer pop culture» will obscure the real computer science. In Poland people have the first and the last contact with informatics merely because of «computer toys». This could be the decadence that we cannot allow." ("Bajtek", Sep., 1985: 4)

Issue of shaping potential computer users was a serious problem for the members of computer movement. Contrary to their actions, Polish youths were mostly buying computers for entertainment. I can put a thesis that computer games were "killer apps" for home computers in Poland. The complex problem of shaping computer users within milieus of computer experts and manufacturers of Polish hardware and software should be described in full-length article. Such reflection could be based on well-known text on shaping computer users wrote by Woolgar (1991).

As a conclusion of this chapter I can summarize that the ideology of "digital utopia" was successfully spread by the group of experts and enthusiasts that established wide "computer movement" and gained significant support in other institutions (introduction of courses of computer science in schools and support of companies for computer clubs). In my opinion such computer clubs were the most important effect of computer movement activity. Computerization was also widely publicized in Polish media. Probably due to this media campaign computer enthusiasts that wanted to found computer clubs had no problem with sponsors. Hardware, but also space, for clubs was offered by state-owned companies, local authorities, boards of education and housing associations. In interviews with users, computer clubs were indeed often mentioned as an opportunity to experience the first contact with a computer.

At the end it is also worth mentioning unique collaboration of Bajtek" and radio station run by Polish Scout Association (Związek Harcerstwa Polskiego). During the late 1980s this FM radio was simply broadcasting programs. It was possible to record such program on audiocassette used as mass memory storage and load it into computer. Contrary to information given by Elfimov (2008) these were only simple programs in BASIC, not freshly imported Western pirate computer games.

IV. Computer users and black market

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[3] It is also worth mentioning that Polish computer magazines were re-publishing numerous articles from Western magazines (i. a. "Byte") probably without permission.

Polish computer industry was able to produce merely a thousand of Meritum 1 and a few thousands of Elwro Junior. This computer was produced in 1988 and had capabilities similar to ZX Spectrum (in 1988 this platform was obsolete due to the next generation of 8-bit computers represented by Commodore 64). Even if someone was lucky and found Elwro Junior in state-owned shop, this computer was priced similarly to Commodore 64 on black market. Polish computer industry made only a few programs for Elwro Junior. It was also a significant factor why young Poles chose Commodore 64 with very good graphic and sound capabilities and thousands of games as well.

In Poland during the 1980s various informal economy activities flourishing (see: Wedel 1992). One of the most important and colorful places of black market were flea markets where one could buy consumer goods brought from the West: Coca-Cola cans, chocolate, washing powder, issues of "Playboy", microwave ovens, video recorders but also home computers and software. Journalists from "Bajtek" were reluctant to such method of computerization. In one of articles describing "computer pathologies" we can find a colorful picture from such flea market:

"There is a wide range of offers on flea market in Warsaw. From microcomputers and peripheries through various software to services like repairs and hardware modifications. There is no problem with the availability of literature. [...] Among computers for sale the most popular are ZX Spectrum and Commodore 64. [...] Obviously there is also software. The cheapest program could be purchased for 100 Zł, the most expensive costs below 500 zł. There is a large choice of everything", (Poznański 1985, average monthly salary in 1986 - about 25.000 zł)

We can easily observe that social actors from the world of informal economy provide their clients not only with technological artifacts, but also with all possible services and useful literature (manuals, programming textbooks). Similar computer markets in Hungary and the Soviet Union were described by Polgár (2008: 94-96) and Swade (2003). Private entrepreneurs offered whole consumer infrastructure, which was not provided by state owned companies. I am using the term "infrastructure" according to Edwards (2003). This text provided me with suitable theoretical framework to describe ethnographic dimension of technology usage. It is also worth mentioning that it is possible to use theory of diffusion of innovation (Rogers 2003) to analyze development of such grass-roots infrastructure linked with domestic technologies.

At the beginning of the 1980s first home computers were imported to Poland from the West Germany and the United States by "Gastarbaiters" – illegal Polish workers returning to Poland (see: Miera 2007; *Die Polnische Emigration seit 1980* 1988). Amount of money they brought to Poland after few months of work was a fortune due to extremely high black market exchange rate. But importing any domestic electronics from the West and selling it in Poland was even more profitable. During the 1980 8-bit computers were excluded from COCOM embargo and private importers only have to pay custom duties.

Computers were also brought by so called "trade tourists" that used available opportunities of foreign travel to making business due to differences of consumer goods prices in particular countries. Such practice was described in another press article on "computer pathologies":

"During tourist tour to Hamburg a person buys a single piece of ZX Spectrum 2 for 120 DM, He brings it for computer market just to earn 250.000 zł. From hand to hand, no formalities, no efforts. After calculations according to black market currency exchange rate this person could earn 190.000 zł , a fourfold profit. Even if on needs

to subtract cost of tour, such travel brings a substantial profit." (Szperkowicz, 1987, author also stated - according to Custom Bureau - that only in 1986 on Warsaw airport import of 4590 home computers was declared by private persons)

There were also more professional and organized entrepreneurs who were selling imported computers for state-owned companies for which it was the only way to get new hardware. In 1986 militia crackdown on a group of students of informatics that were importing personal computers from West Berlin and later selling them to state-owned companies and research institutes (i. a. Institute of Informatics at the Warsaw Polytechnic University). Students were importing also hardware under COCOM embargo. Phenomenon of such professional import requires deeper analysis also based on court files.

Another phenomenon within informal economy was an import of electronic parts which were used to assemble computers in small semi-legal workshops. Import of computer parts instead of already assembled computers was a method to avoid custom fees but due to the huge difference between price of parts and computer, assembling of computers and selling them was very profitable business. Such practices were described in an article published in "Dziennik Polski" – newspaper published in London by Polish émigrés.

"Many directors of the biggest industry companies appealed to the prime minister to stop harassing smugglers of electronic parts and owners of workshops where computers are assembled from these parts. For state-owned companies it is the only possibility to acquire computers. They also stated that such homebuilt computers are better quality than those produced in state-owned factories." ("Dziennik Polski", 14 July 1987)

Another interesting issues linked with computerization were strategies of users. My future analysis of this problem will be based on interviews with a few particular groups of users. At this moment I could present some interviews conducted by members of Polish retro-computing community available on websites http://atarionline.pl; http://www.ppa.pl/; www.c64power.com. Such interviews could provide us with valuable information on scenarios of using computers and social practices linked with such usage. I put a thesis that in Poland aside from informal economy, social networks (colleagues, cousins) were used as primary method of gathering access for computer and software. In most interviews the first contact with a computer was experienced because of social networks:

"I had my first contact with a computer due to my neighbor, who brought home computer from abroad. It was about 1982-1983. I remember it was a ZX Spectrum clone. During that period I was „ill" quite often, I was asking my mother to borrow this computer. Later, in 1985 my brother brought C64 and this computer became my whole world." (Marek Hyla, www.ppa.pl)

"Physically I was able to touch this «wonder» which belongs to a friend of my parents. He was quite rich and probably he bought Atari merely as a curiosity. He used computer to get rid of me and my brother during visits of our family." (Dariusz Bartoszewski, http://atarionline.pl)

"I was about 10 when my grandpa took me for a party to his friend. His son owned Commodore 64. I went crazy. It was love at te first sight." (Benedykt Dziubałtowski, http://www.ppa.pl/)

Unfortunately I don't know any monographs about such social practices in Western societies, so it is very difficult to compare such aspects of computing on both sides of

the Iron Curtain. In available interviews entertainment was often mentioned as the primary form of computer use.

"At the beginning I had some experience with ZX Spectrum possessed by my colleague. When I saw this «wonder» and played in a few games: «Jet Set Willy», «Three Weeks in Paradise» or «Knight Lore», I knew I was lost. I was so obsessed with playing computer games that I couldn't sleep at all." (Marek Siewior, http://atarionline.pl)

Such sources show clearly that home computer was a "boundary object". It was defined by computer movement as platform for educational and professional usage, but ordinary users defined this technology primarily as entertainment platform. Simple programming and other forms of hobby computing were rather secondary activities.

Another important issue of Polish computerization from the point of view of West-East relations was the rise of computer oriented subcultures (see also: Wasiak, 2010). These subcultures – so called "cracking-" and later "demoscene" (for brief introductions for these phenomena see: Polgár 2008; Reunanen 2010, Silvast & Reunanen 2009) were active in Western Europe, mostly in the West Germany and Scandinavian countries during the second half of the 1980s. Members of cracking scene after removing copy protection from games were implementing short animation, so called "crack intro" or "cracktro", where they presented some statements but also private addresses which could be used for establishing correspondence exchange.

Poles and Hungarians were able to watch lot of such animations in imported pirated games. Quickly some young computer nerds have started similar activities: making such animations and "demos" – visual art presentations in separate executable files. In 1988 in "Illegal" – well-known zine published by members of German cracking scene - brief note about contacts with Eastern European groups was published:

Have you ever heard of groups like "H.I.C." or "F.B.I."? Well, these crews are from Hungary! [...] There is also an eastbloc-scene like in West Europe. I got demos from POLAND and U.S.S.R." (THE EAST IS COMING!, in: „Illegal", Vol. 31)

It is the first proof that Polish and Hungarian computer oriented subcultures not only were present, but also had contacts with their Western counterparts. In some interviews Polish members of these subcultures mention how they established contacts with Western groups simply sending their own productions on addresses found in Western "demos":

"We were surprised because we even received some responses. When we have seen the quality of Western demos we were depressed by our own productions". (Interview with "Polonus", www.riversedge.pl)

Polgár stated that in communist Hungary it was forbidden to send diskettes abroad, but crackers were somehow able to avoid this limitation (2008: 95). There is no information about similar restrictions in communist Poland. In the Eastern Europe these subcultures were mostly made by youth dealing pirated computer games on computer markets. In very detailed Commodore 64 Scene Database available on http://noname.c64.org/csdb/, 107 game cracks and "demos" were made in Poland before 1st January 1990 are present.

Cracking games and making "demos" also required knowledge of programming in machine code language instead of HLL. Using this language was not

present in computer movement vision of programming education (This language was perceived as far more difficult than HLLs). In fact, popularity of programming in machine code that provided user with direct access to hardware, had roots exclusively in the cracking scene. Knowledge of machine code was necessary for removing copy protections. Later, the use of this language was spread as the most efficient way to program advanced visual effects in "demos".

As I mentioned above, in Polish computer magazines mostly tutorials of LOGO, BASIC and other HLLs were published. It was very difficult to find knowledge of machine code programming. According to some interviews it was possible to buy photocopies of Western textbooks and primitive Polish translations (a kind of computer *samizdat*) on computer markets. Some youths were dealing with the lack of such knowledge by using their social contacts to gather Western magazines and textbooks:

"Everything I liked (copy protections, intros, demos) were written in 100 % machine code. It was necessary to learn it, so I started this on my own. I was learning on cracking copy protections. If someone from my neighborhood travelled to the West Germany, I was asking about current issues of 64'er, INPUT64 and Magic Disk. We also had single issues of American Compute! i Compute!'s Gazette".(Interview with "Silver Dream", in "Commodore & Amiga Fan", Issue 5, http://ca-fan.pl/)

If we compare the case of such subcultures with Mackenzie and Wajcman definition of "technology", we can clearly observe that along with technological artifacts and knowledge a set of social activities was imported. In my further studies I would like to describe mechanisms of transferring knowledge and such social activities through the Iron Curtain. Making of this subculture was described by Raukonen (2010) as "re-invention of computer" by subcultures. We could say that the process of mass computerization of Poland during the second half of the 1980s was based on the import of technological artifacts, knowledge and social practices, but computers were also re-invented just like in few countries in the Western Europe.

V. Conclusions

I have presented only brief descriptions of the most significant social phenomena linked with use of home computers in communist Poland. First chapter shows how socialist ideology of modernization was implemented on visions of "digital utopia" presented by American futurologists. The second chapter shows that in fact the whole process of computerization in Poland was based mostly on private import from the Western countries not merely technological artifacts but the whole "technology" according to Mackenzie and Wajcman: computers and software, programming textbooks but also know-how, for example private repair services. Such practices of small scale import were present even in early 1990s. In popular "Commodore & Amiga" magazine in 1992 guide how to buy a computer during travel to Berlin was published (Niemiec 1992).

Creation of "national" technologies failed because of problems with making any computers within economy of shortages, but also because of the lack of interest in making any software and infrastructure. All necessary things were provided by informal economy along with imported Western home computers. Due to such factors, to understand processes of transfer domestic technologies across the Iron Curtain we need to use theoretical frameworks developed by STS, history of economy, but also consumer culture- and subculture studies.

All issues which were mentioned briefly in my paper will be analyzed more deeply in my future publication on computing in Poland. As I stated above, I am especially concerned on conducting research on state and non-state social actors

and institutions involved in the import and use of computer technologies,. According to the subtitle of ToE conference: "Technology & East-West Relations" I aim to show the role of non-state actors in shaping computer technologies during the late Cold War.

On the other hand, studies of technologies developed by socialist countries, mostly based on reverse-engineered Western technologies, are badly needed. History of technology is mostly history of winners. In the field of computers it is obvious that technology race was ultimately won by Silicon Valley and Far East hardware manufacturers. Yet the studies of endemic socialist technologies, that for some reasons were dead ends, could be very fruitful for further development of social studies of science and technology.

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