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- Open conferences;
- Working conferences.

The flagship event is the IFIP World Computer Congress, at which both invited and contributed papers are presented. Contributed papers are rigorously refereed and the rejection rate is high.

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John Impagliazzo Eduard Proydakov (Eds.)

Perspectives on Soviet and Russian Computing

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Dedication

We dedicate this book to

the men and women who seek to preserve the legacy of the computing profession, particularly those from the former Soviet Union, whose accomplishments and dedication to computing have propelled the work of their colleagues and have enhanced the computing profession for future generations.

Foreword

Eduard Proydakov, the person who has accomplished much to reconstruct the history of Soviet computer technology, asked me to write a foreword for this collection of papers on some historical Soviet projects. Notably, the authors themselves are the participators of these projects and, generally speaking, historical persons as well. I could not refuse Eduard's request but immediately faced an ethical problem. Do I have the right to write about this with the sincerity it should have, and how would the authors of these articles perceive this sincerity?

It fell upon me to work with outstanding people or to meet them. Some of them have died; others are among the authors of this collection of articles. Therefore, I decided to write about my own perception of the professional world in which I lived and continue to live. Certainly, this is a small piece of a larger computer world. However, I perceive it has a vast and instructive value for me, and I would like to write about my own perception of this value.

I'll start from university. Some time ago I was privileged to hear a very interesting talk that explained why our generation preferred to choose the sciences (e.g., physics, mathematics, ...) rather than humanities (e.g., philosophy, history, ...). The reason was an internal freedom, the freedom from falsehood of the communist ideology. You do real work, and you do not need to relate this work with an ideology. Obviously, I could not formulate this when I was 17 years old, but now I think it was the main reason I chose the Moscow Institute of Physics and Technology (MIPT) for my studies. Another important reason was that graduates of MIPT worked in research institutes at the great Academy. The 2010 Nobel laureate in physics, Konstantin Novoselov, had also graduated from MIPT. He said in one of his interviews that no university of the world (including universities of the USA and UK) provided a better level of education than MIPT. I do not believe that he is right, but in any case, MIPT is an excellent technical university. At that time, MIPT had several peculiarities. First, there was a very heavy academic load, especially on physics and mathematics. The total number of academic hours (lectures, seminars, laboratory training) during the first two years of education was at least 52 hours per week. As a result, students received a very broad education. It was not strange that my classmates became specialists in various areas such as in radio engineering, pure mathematics, and theoretical physics. I became a programmer.

The second peculiarity of MIPT was the model of education. Starting from the fourth year, we spent a part of each week at so-called base educational departments within the walls of their respective research institutes where we had lectures and were gradually beginning to participate in real projects as junior colleagues of a research staff. My base educational department was at the Institute of Precise Mechanics and Computer Engineering (IPMCE). The director of IPMCE was the great academician Sergey Alexeyevich Lebedev. I still remember

my first impressions from lectures at Lebedev's educational department. At MIPT, they provided us with stable, traditional, and well-prepared lectures; IPMCE offered us some kind of improvisation. It was not clear what lecturers (even Lebedev) were talking about and why. Later, we certainly had adapted ourselves to such a manner and understood that lecturers saw us as their future colleagues, and they talked to us about problems that they needed to solve. As computer engineering was a very young field, solving each problem was a discovery, and lecturers of the base department told us about their discoveries and about their happiness to explore these new things. In addition, they gave us much freedom to choose a direction of work. I had changed two scientific advisors for different reasons until the sixth year, when I started to work in Lev Nikolaevitch Korolev's laboratory of programming. At that time, I considered programming as a profession for elderly women (30–35 years old; please note that then I was a little over 20 years old). I thought a man should do some other work. However, Korolev provided me with half-pay that was equal to my student grant, and this was the main reason to work as a programmer. Only later during my diploma preparation did I realize the amazing attraction of the profession of a programmer.

After graduating from MIPT, I continued to work at Korolev's laboratory. S.A. Lebedev created at his institute an amazing professional and humanistic climate. There was absolute openness and kindness among members of staff. I was able to go up to any person whose work was interesting for me and I always received a well-intentioned and exhaustive explanation. Sometimes, even in a smoking room I would suddenly think of a solution for a task that I could not solve for several days. We young folk perceived such an atmosphere as the norm and we tried to follow these established practices. (By the way, an organic perception of this humanistic and professional culture came to me only over time.) We often got together with older friends outside the institute: drinking vodka, visiting ice rinks and swimming pools, and attending hockey and football matches. Some conflicts probably existed, but they were at higher organizational levels and they did not affect the staff members or us. Once again, we had great freedom to choose a topic of research. Here is one example. We were making preparations together with engineers for tests of the BESM-6. I was responsible for several large pieces of the D-68 operating system and time was very tight. However, I had become interested in debugging and was developing a multiuser interactive debugger; it looked like a time-sharing system. I was writing and debugging the system mostly on non-working days. I do not think that Korolev was delighted with my immersion but he did not exhibit any discontent even in a subtle manner. It seemed that our life was determined forever. Engineers designed another machine (certainly, we participated in a design of its architecture) and we, programmers, developed all the system programs for it. This was perfect. I wished to live this way forever.

Just after graduation from MIPT, I started to lecture in various universities. Themes of lectures did not confuse me: programming in Algol-60, computer architecture, operating systems, compilers, databases; one time I even lectured

about the IBM/360 for a full year. Over time I had my own students and relations with them were based on Lebedev's practices. Then my own subordinates appeared, and it became possible to perform larger projects. Again, despite the fact that I lectured in working hours, my boss Korolev only welcomed this activity. I should note that generally many staff members were teaching at universities. It was the norm. Today we call it an "integration of sciences and higher education". Many years later, I realized that one kind of output of the academy (probably the most important one) was humans, experts with the highest qualification.

Here is one more very funny illustration of the openness that predominated. Within the institute, two groups designed competing computers: the group of Melnikov and the group of Burtsev. These heads did not like one another too much but we, as members of these groups, openly exchanged ideas and any available information. Certainly, the bosses knew about this but they did not try to stop it.

The circle of my acquaintances gradually went beyond the boundaries of the institute. These new places included Academgorodok (Novosibirsk), Kiev, the Computing Center and the Institute of Applied Mathematics at Moscow, and the Spaceflight Control Centers. Again, I met with the same openness, the same kindness! What clear minds, what famous names! There were many conferences and winter schools on various specific topics.

Of some discomfort was the access to foreign journals and magazines; access was difficult, with significant delay and always scarce. Certainly, the openness within our informal professional society was a great help. We always exchanged fresh interesting papers. Andrey Petrovitch Ershov played a great part in this scene; he organized international conferences and workshops with the participation of leading Western scientists. We were always interchanging fresh interesting articles. At that time, I did not have personal contacts with Western colleagues because I had access to secret information as early as at the second year of education. Moreover, it was only in 1984, after my election as a corresponding member of the Academy of Sciences, that I had the possibility to communicate and to participate in foreign conferences.

I turned down many proposals to change my job. The job at IMPCE was a fantastically interesting job and the environment was very comfortable. However, the time had come in 1980 to leave IPMCE. It happened as follows. V.A. Melnikov had left the institute and joined one of the institutes of the Ministry of Electronic Industry. All my projects related to computers were designed by him. I promised to join him and I did. Some key engineers of Melnikov's laboratory (my very intimate friends) had decided to stay at IPMCE; I was incredibly sad about this. I remember that for many years I physically perceived a strong nostalgia when I passed by the institute. In addition, I had learned that another, rather uncomfortable, climate existed. The environment was depressive and it was not always possible to detach yourself from it. One more circumstance was unpleasant: administrative overloading. I became a head of two departments – the department of system programming (it was normal) and the department of computer CAD/CAM – with 150 employees in total.

Many years have passed since then. During the last 17 years, I have directed the Institute of System Programming. During this time, our country has changed radically. Values have changed; moral criteria transformed wildly. All relationships between industry, education, and science have been destroyed. The industry of high technology is significantly disrupted. The academy and universities are degrading. It seems sometimes that this state of affairs is improving; perhaps this perception is a result of expectations and wishes for improvement. Yes, something has changed, for instance, the brain drain has decreased. However, these days are generally not the best for the academy and universities. The Soviet social respect of scientists and professors was eventually diluted. Government and society barely demand science. Western multinational corporations dominate the domestic market of information technology. This is the today's reality.

At the same time, the values that I adopted at IPMCE, the values that had become my own values, not only continue to exist for me but have become even more important. I am probably too categorical but I cannot believe that our country has worthy chances for the future without the academy, without technical professionals, or without their high professional and humanistic ethics. I really believe that all these values, the academy, and the professionals will be in demand again. In addition, this is not just a passive expectation; my colleagues and I carry on serious practical activities within the institute and at universities. In the institute, more than 100 undergraduates and doctoral students take part in projects together with their senior colleagues. Certainly, a significant part of these projects consists of outsourcing, which we may consider industrial research, that is, the development of new technologies. I hope that fraction of outsourcing will decrease with time thanks to an increase in domestic orders for the development of new technology. As it happens, we may efficiently use the model of IPMCE – composition of basic research, development of new technologies, and education – in the new environment also. Talking about the current new generation, this generation seems to be better, more talented than my generation. I enjoy learning about their results, their articles, their new courses of lectures. I wish to believe they have a future here in our country.

So it goes. However, this is only one part of the landscape. In Soviet times, an industry of programming did not exist as an independent branch of industry. However, in post-Soviet times this industry was formed. It is very important that the formation of this industry in Russia occurred without any government control and participation. Certainly, this industry has not appeared from scratch. People from the defense industry, the academy, and the universities generally founded these companies. Many successful non-government companies work in the market of software products and services not only in our two capitals but also in the provinces. Some of these companies are high-technological enterprises that successfully compete in the world market. There are very interesting processes going on in this branch of industry. Several associations have been established that involve private and government organizations. These associations form general strategies of the industry and successfully lobby its interests

through government structures. A serious business cooperation of these associations has developed. The first sprouts of interaction between the industry, the academy, and education have appeared. All this holds forth a hope to form a sound ecosystem. I would like to conclude this foreword on this optimistic note.

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Preface

These proceedings represent a collection of papers derived from the first conference on Perspectives on Soviet and Russian Computing, also known as *SoRuCom*. The conference took place in July of 2006 in Petrozavodsk, Karelia, Russia. Over 170 participants from the former Soviet Union, the United States, the European Union, and Cuba attended the event.

These proceedings reflect much of the shining history of computing activities within the former Soviet Union. Despite the existence of several publications in this history, they often tarnished reality. The primary reason for this blemish was the mode of privacy and secrecy that existed in the former Soviet Union during the early days of computing. Indeed, many archival materials were lost in the so-called reorganization of the former union. Additionally, it is important to note that the government during that time had given little value to the preservation of historical artifacts.

In recent years, however, this position gradually began to change for the better. Now, many new museums exist at private and educational institutions. For example, for the last 15 years, Eduard Proydakov's Virtual Computer Museum (www.computer-museum.ru) has collected and preserved numerous documents such as material on the history of computing, material on outstanding domestic scientists and engineers, and the memoirs of computer developers and pioneers.

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The preparation of this book has taken a very long time. The basic difficulty was that the vast majority of its authors do not speak English and painstaking translations and transcript verification was necessary. Moreover, in recent years, computer facilities and terminologies have changed. Each change of new devices resulted in some rewriting that may have modified the intent or the meaning of terms. Here it is necessary to express words of gratitude to John Impagliazzo, who has devoted much time and work to edit the articles in this book.

* * * * * *

In looking at computing history in the USSR, it is possible to identify six stages of its development. We explain these periods in the following discussion.

1. Origins (1948–1960) – The Creation of the First Lamp Computers

As with the United States in the 1950s, many people in the former Soviet Union believed that the country needed only ten computers. Therefore, the country delivered only seven "Arrow" machines, the first serial computer in the country. Its operation was under the personal control of the head of the state, I.V. Stalin, who spoke about the value received from the given work. They used the first computers for military decision-making problems and for research purposes.

Therefore, in 1956 in Moscow there appeared the first machine translation systems. It is clear that it was an attempt to solve a problem at different levels of complexity, but it has been shown that the given problem was very difficult and was accomplished only in Russia on the basis of artificial intelligence techniques; today's systems provide comprehensible translation quality. By the end of the 1950s, it became clear that computers could solve a much wider range of problems. Hence, it was necessary to organize the manufacturing industry to develop and expand professional training for this new machine.

2. Origin of the Computer Industry (1961–1970)

The development of serial computers and the involvement of computers as a part of the arms systems, particularly in air defense systems, characterizes this period. The 1960s showed the beginnings of the expansion of manufacturing factories for computers and the new constructions in Minsk, Kazan, and other cities. The country initiated an enormous program to develop a robust semiconductor industry. Due to the conditions of the cold war, the USSR was compelled to undertake these branches independently. At that time in the USSR, we saw the development of new original architectures for computers such as N. Brusentsov's figurative computer and the computers in residual classes by I. Akushsky and D. Yuditskiy.

3. The Copying Period: Formation of the Computer Industry (1970–1980)

The manufacture of computers in the former Soviet Union was gaining momentum. However, by the mid-1960s it became clear there was a build-up from the West. While the introduction of computers in military systems, technological equipment, and scientific research developed quite well, their introduction into the economy was greatly hampered by excessive regulation and lack of internal process incentives. To reduce the gap with the West, the government decided to release computers that were compatible with IBM mainframes and with DEC minicomputers for industry. This decision had both positive and negative consequences. Positive aspects consisted of cooperation in the manufacture of computers with countries of Eastern Europe; between them, there was a division of labor in the field. They began issuing computers in the tens of thousands a year as well as organizing the preparation and retraining of personnel. Negative consequences consisted of the companies financing their own work; funds were severely lacking and, as a result, the situation did not provide the possibility to develop breakthroughs and strategic directions in the field of computer architecture. The situation had placed the country in a position of constantly trying to catch up with the United States.

4. The Beginning of the Microprocessor Era (1980–1990)

Small companies worked out their own problems. The appearance of the first domestic eight-bit microprocessors had provided an opportunity to develop the microcomputer within the limits of the small companies, institutes, and enthusiasts. Personal computers of different types became very popular and were in short supply. However, the more advanced companies and institutes bought personal

computers both from the Soviet manufacturers and from imports. Nevertheless, the situation allowed the large state computer centers to gain in strength, becoming compatible with Western centers; however, they often modified the machines to have various accelerators for new types of computers developed for the solution of special problems. This was a time of the greatest achievements of Soviet science and technology.

5. Crises of the 1990s

The restructuring of the former Soviet Union and the withdrawal pains from a new social order in the field of information technology caused stagnation in technical development, except for software development. Russia began to use imported equipment. However, private information and communication technology (ICT) companies actively engaged in system integration development. They began with the development and installation of simple local networks that eventually led to the construction of large-scale network systems. This became the dawn of a full integration into a worldwide system that would utilize segmented efforts of labor.

6. The Modern Period

Russian ICT grew substantially, especially in the field of custom-made programming; the developments became part of a global system of labor. Companies conducted their own work in small volume. However, there was a huge shortage because millions of experts in the field of high technologies departed abroad, which caused many economic problems. Nevertheless, in a declaration by D.A. Medvedev, the president of Russia, a new modernization of the Russian economy led to one of the five basic directions, namely, the development of ICT. Efforts were carried out through the center of innovative development of "Skolkovo" in cooperation with the leading Western ICT companies such as Intel, Microsoft, Cisco, and Nokia.

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We now express our gratitude to all those individuals who made the SoRuCom conference of 2006 a reality. They include the authors of the papers contained within these proceedings, the presenters, the participants, the Soviet computer pioneers, the students of those pioneers, and the organizations (acknowledged herein) that provided financial support to make the event possible. In particular, we thank Ruzanova Nataliya Sokratovna, Vice-Rector of Petrozavodsk University, for her many efforts and unrelenting belief in making the conference possible. We also thank Iurii Bogoiavlenskii of Petrozavodsk University for helping to shepherd the process to make the event come to fruition. In a modest gesture, SoRuCom recognizes John Impagliazzo for initiating and organizing the event and journalist Eduard Proydakov for soliciting many contributors to the conference. Indeed, SoRuCom was a memorable event.

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We realize that this book does not resolve the total history of the development of computing in Russia and in the former Soviet Union. However, we hope that it has captured and preserved parts of Soviet computing history and that it will be useful to historians and to readers who maintain an interest in this subject.

June 2011

John Impagliazzo
Eduard Proydakov

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