

# Anatoly Kitov - pioneer of Russian informatics

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**Abstract.** Anatoly Ivanovich Kitov (1920-2005) is one of the most outstanding representatives of the first generation of scientists who had created Russian cybernetics, computer engineering and informatics. Due to political reasons his many-sided scientific and organizational activities were hushed up. Only recently publications adequately estimating his role appeared. The report represents biography and summary of main scientific achievements of A.I. Kitov as well as short description of his scientific school and his collaboration with IFIP and other international organizations.

**Keywords:** Anatoly Kitov, cybernetics, informatics, programming languages, management information systems, Computer Centre № 1, M-100 computer, Red Book project, computer-aided control systems, TC-4 IFIP, MEDINFO, IMIA.

## 1 Introduction

This report is about Anatoly Ivanovich Kitov - pioneer of cybernetics, informatics and management information systems (MIS) in the USSR and Russia.

Anatoly Kitov was brightest outstanding personality who devoted his life to development of cybernetics, computer and software engineering, programming languages, information retrieval systems and management information systems as well as to their practical implementation in various fields of human activity: national economy, military defense, health care and medicine.

A. Kitov was the real pioneer, words "the first" and "for the first time" can be applied to all stages of his scientific career. In the USSR A. Kitov is the author of the first positive article about cybernetics, the first thesis on programming, the first Soviet book about computers and programming, the first research and articles on non-arithmetic usage of computers, the first project of all-national computer network, the first national textbook on computer science, the first scientific report on management information systems (IMS), etc. He created the most powerful in the USSR computer at his time, the Computer Centre № 1, associative programming theory, standard industrial management information system (MIS) (in the Ministry for Radio Engineering Industry), the first Soviet management information systems for health

care, two new high-level programming languages (ALGEM - for solving economic tasks and NORMIN - for working with text information), etc. The total amount and innovative quality of his scientific works are really impressive.

The Chairman of IFIP Congress 1974 and IEEE Computer Society Computer Pioneer academician Victor Glushkov stressed the outstanding role of A. Kitov: "The real implementation of cybernetical ideas in the USSR takes start from the Kitov's first positive article "Main features of cybernetics". Kitov's book "Digital Computing Machines" was the first Soviet book on this topic".

Alexey Lyapunov, also the IEEE Computer Society Computer Pioneer, called A. Kitov "the first knight of Soviet cybernetics".

## **2 The Beginning: World War II and Learning at the University**

Anatoly Ivanovich Kitov was born on the 9th of August 1920, in town of Samara in Volga region. During the Civil War (1918-1920) his father Ivan Stepanovich Kitov served in White army as a junior officer what could have negative consequences those times. So in 1921 Kitov the elder, with wife and son, moved to Tashkent (Uzbekistan). Anatoly Kitov graduated from secondary school in 1939. For excellent results in study and brilliant abilities he was awarded a gold medal. In the same year he entered the Tashkent University but after three months was called up for military service. Since he again demonstrated outstanding talents the army commander in chief field marshal Kliment Voroshilov personally ordered to enlist Kitov into High Artillery School in Leningrad. With outbreak of the war with Germany, in July 1941, Anatoly was dispatched to the South front as an artillery platoon commander. In the battle for Stalingrad Kitov was seriously wounded. He spent all four war years in anti-aircraft artillery, where he himself steadily continued study of mathematics and physics using every free minute.

With the end of war, in 1945, A. Kitov entered the Artillery Engineering Academy in Moscow. Formidable knowledge obtained during his excellent studies enabled Kitov's beginning of own scientific research already before graduation. Being still a student he received a patent (the USSR "Author's Certificate") for devised by him "jet cannon" and the Ministry of Defense reported about it directly to Joseph Stalin. A. Kitov graduated from the Artillery Engineering Academy in 1950 with the Gold medal.

In 1952 Kitov successfully submitted dissertation thesis "Programming for ballistic problems of the long-range rockets" and received scientific degree "Candidate of technical sciences". It was the first Soviet thesis on programming. In 1952-54 he created and headed the first computer department at the Artillery Engineering academy.

The task of the national importance was carried out by A. Kitov in 1954 when he created and became a chief of the Computer Centre № 1 of the USSR Ministry of Defense. Kitov managed to form the team of scientists and engineers, to teach his colleagues, he founded the main directions of scientific research of this pioneer computer center. In two years the Computer Centre № 1 became the most important scientific research and engineering center in the USSR. In the middle 1950-s 160

programmers, 85 information analysts, 40 mathematicians (specialists in mathematical modeling), several hundreds specialists in computer engineering worked on specialized and universal computer projects.



**Fig. 1.** Colonel Anatoly Kitov, scientific head of Computer Centre № 1 of the USSR Ministry of Defense (1959).

Under the Kitov's leadership in Computer Centre № 1 such important tasks were solved as: calculation of orbits of all Soviet space stations and artificial satellites of the Earth, including space flights of Yu. Gagarin and other first Soviet astronauts; creating specialized computers for military use, tasks of the Soviet Army including special tasks of Main Artillery Department, Main Intelligence Department, Strategic Missile Department, modeling different military combat situations with the use of tanks, airplanes and artillery, working with large amounts of information, and many others. In the Computer Centre № 1 Kitov created departments which worked out central processors, computer memory and storage for new computers, department of mathematical linguistics, etc. The most important research included theoretical programming issues and working out complex computer systems with unique software. In the Computer Centre № 1 Kitov regularly held scientific conferences and seminars, edited the scientific journal. The well-known Soviet scientist colonel Vladimir Isaev remembers: "If we make parallels with, very popular then, space researches, Kitov was in position some half-way in-between academician Mstislav Keldysh (leading theorist) and academician Sergey Korolev (main designer of Soviet spaceships). That's my personal opinion. At the Computer Centre № 1 he was the most initiative one, always generated ideas and formulated problems. So, generally speaking, he was the brain of the projects".

In the 1950-s the role of this top secret Computer Centre for the development of Soviet computer science was difficult to overestimate. Taking into account the variety and complexity of scientific research, number of qualified specialists it was the largest and the most powerful scientific computer center in the USSR and one of the best in the world.

### 3 Scientific Results and Achievements

The most important role in Kitov's life played the book by Norbert Wiener "Cybernetics or Control and Communication in Animal and Machine" which Anatoly Ivanovich read in 1952 in the secret Soviet library. Communist authorities of the USSR under the guidance of Joseph Stalin at that time named cybernetics "pseudoscience and servant of imperialism". Anatoly Kitov needed great courage not only to read the Wiener's book but to write article "Main Features of Cybernetics" - the first positive article on cybernetics in the USSR. In the Stalin times he risked not only by his freedom but also by his life. During two years, since 1953 till 1955 A. Kitov delivered a lot of lectures about cybernetics, but this article was published only in 1955 after long negotiations with Soviet ideologists after Stalin death. A. Kitov asked mathematicians Sergey Sobolev and Alexey Lyapunov to be co-authors of the article. This article became the starting point of Soviet cybernetics. Academician Guriy Marchuk, former president of the Academy of Sciences of the USSR, wrote: "the article made decisive impact on the academic public, which obtained a firm ground of new science, stimulating the people to change and update their mentality. In the article the authors considered general scientific meaning of the cybernetics as emerging theory of information science, as well as the theory of electronic computing machines and systems of automatic control. That was really the scientific event of great value".

Since 1953 till 1960 A. Kitov published several fundamental scientific works on informatics and cybernetics. In January 1956 Kitov published his book "Electronic Digital machines" - the first Soviet book about computers. The last part of it was about using computers in economics, production processes automation, artificial intelligence, etc. He understood that computers were able to transform all spheres of human life. American scientist John W. Carr who analyzed more than 150 main publications on the topic wrote about Kitov's book in his book "Lectures of Programming" (1958): "Probably the most comprehensive description of the computer programming problems, illustrated with detailed analysed examples of both manual and automatic programming, is available at present in the book by A. Kitov. Some parts of it have been translated into English so they are available at the American Computer Association".

So, in the 1950s, the Kitov's book was really one of the best books dedicated to computers and programming.

"Electronic Digital machines" by Kitov was published in the USA, China, Czechoslovakia, Poland, German Democratic Republic and other countries. Guriy Marchuk wrote: " Electronic Digital machines" by A. Kitov, published in 1956, was the first systematized course for a broad circle of students and specialists who began mastering electronic computers, computing and their practical applications. The book actually caused an overturn in attitudes of many researchers since it had been written simply and easily, clearly presenting comprehensive amount of well systematized material".

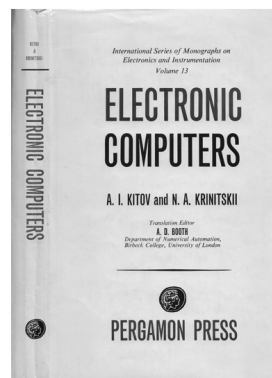
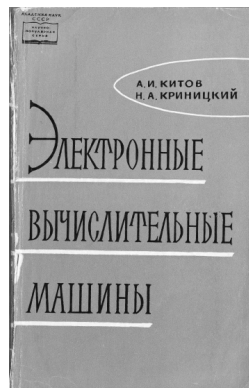
In 1956 one more book "Elements of Programming" by A. Kitov and his two co-authors was published.

In 1956-1957 A. Kitov started in the Ministry of Defense and in the USSR the new scientific research area "Development and Usage of Information Retrieval Systems".

In 1958 A. Kitov published brochure "Digital computing machines" in 42,000 copies in which the perspective of comprehensive automation of administrative work and management in the country was described for the first time. He suggested to connect all computing centers into one national united network.

In 1958 Kitov, in collaboration with colleagues received patent for new operation principle of computer central arithmetic device, so-called "Method of computer command rate quadruple combination". That method was implemented in computer M-100, the most powerful Soviet computer at that period of time. It was used in solving problems of antiaircraft missile aiming at flying target and in other military tasks. A. Kitov was the chief designer of M-100. Its architecture was described in his dissertation thesis "Computer applications for problems of antiaircraft defense", which was successfully submitted in 1963 and was awarded "Doctor of technical sciences" degree. He analyzed basic principles of special computers design and structure, their programming languages, as well as mathematical computer modeling of dynamic systems for antiaircraft defense problems such as ballistics, flying target tracking, etc.

In 1958 A. Kitov and N. Krinitskiy published the book "Electronic Computers". In 1962 Pergamon Press published English translation of this book; in the preface professor A.D. Booth wrote: "This book gives, for the first time in the West, the Russian approach to an elementary description of the principles, construction and programming of automatic digital computers. It will be noted that special reference is made to the solution of mathematical and logical problems and to the automatic control of processes. It is particularly interesting for the worker in this field to see how closely this treatment follows that which has developed in the West, and to observe the modifications which have resulted from the computing machines which are available in Russia. Electrical and Electronic engineers, mathematicians, physicians and all concerned with the design and use of computers will welcome this Russian work".



**Fig. 2.** The book "Electronic Computers" by A. Kitov and N. Krinitskiy in Russian (1958) and English (1962).

In 1959 A. Kitov and N. Krinitskiy published large textbook "Electronic Digital Computers and Programming" which became the most popular one among engineering universities. Several generations of students in the half of the world (in the USSR, Eastern Europe and China) studied with that book which was one of the best in the field of programming and computers at that time.

It is necessary to mark out two pioneer initiatives of A.Kitov which had national importance. In January 1959 A. Kitov sent a letter to the USSR leader Nikita Khrushchev "About creating automated management system for national economy" where he proposed to create national computer network to be used for multiple purposes, first of all to manage Soviet economy. Anatoly Ivanovich added his brochure "Digital computing machines" (1958) to this letter.

The top leaders of the country partly supported Kitov's initiatives, and special government resolution was approved with the decision to produce modern computers and use them in production automation. But main ideas of Kitov's letter regarding managing economy with the help of national computer network were not approved.

In November 1959 A. Kitov made the first in the USSR report on management information systems (MIS) for enterprises and industries. In autumn 1959 A. Kitov sent the second letter to Nikita Khrushchev in which he suggested the way to minimize expenses of creating national computer network. He added to this letter project in 200 pages (called Red Book) of creation unified automated administrative control system to be used simultaneously for army and civil economy. It should be based on common network of computer centers established and maintained by the Ministry of Defense. Concentration of computers in powerful centers with reliable maintenance, run by military personnel, would sufficiently raise quality of their usage.

The second Kitov's initiative had worse consequences than his previous letter. He criticized the situation with using computers in the USSR, especially in the Soviet Army, and it caused discontent and rage of high authorities. The project was rejected, and A. Kitov was expelled from the Communist Party of the USSR, moved off his administrative position and left the Soviet Army.

It was a severe blow. That could be certain end of any political and scientific career for most of those who would, by a misplay of luck, find himself in similar situation but not for A. Kitov. He was a man of ideas and real patriot of his country. Although being forced to start again with another work, in the beginning of the 1960-s, he did not quit the idea of global automatic control system. In 1961 he published one of his main works in the field of management information systems - "Cybernetics and management of national economy". Kitov considered Soviet economy as a complex cybernetical system which had to be optimized. To manage it efficiently it was necessary to build distributed national network of computing centers which would work with economic information. He suggested to join main computers into United centralized management information system for national economy. This article by was highly appreciated by Soviet and foreign specialists, including specialists from the USA. The big positive review on this article appeared in 1963 in the *Operations Research* journal (Vol. 11, № 6, November-December).

In 1962 Kitov made a report called "Associative programming" in which stated the main ideas of his theory of working with large information units. He authored and introduced notion "associative programming", defining it as following. "Associative programming is a totality of solution methods, intended for information logic problems, which are based on programming of associative relations between the data stored in computer memory ... In other countries this range of problems is also called: list-processing, node-processing, chain-addressing, control words method, etc."

In the middle of 1960<sup>th</sup> A. Kitov was appointed the Chief designer of the Industrial management information system (MIS) of the Ministry for Radio Engineering Industry. His team worked out main algorithms for MIS, created modeling methods and produced sufficient amount of software. That system was highly evaluated by the governmental experts and recommended as standard for other ministries connected with defense production. Academician Viktor Glushkov, director of Institute for Cybernetics and vice-president of the Academy of Sciences of Ukraine, was scientific leader of the MIS project in the USSR. Kitov kept close partnership with him.

In 1967 A. Kitov published his next fundamental book "Programming for information-logical problems" about information retrieval and management information systems. This Kitov's book was translated into German. Serious Kitov's achievement was creating a new programming language ALGEM in the middle of 1960-s to program economic problems. ALGEM was implemented and used in hundreds of enterprises in the USSR and East European countries. In 1971 Kitov published fundamental book "Programming for Economic and Management Problems" (400 pages).

In the 1970-s Kitov turned to implementation of information systems and computer engineering in medicine and health care. That was the period when automatic systems for control and management became very popular. Those years Kitov performed design of management information system "Health care". He formed information model of medical branch, developed standard structure of the system, software packages for information arrays control, developed logic, structure and functional algorithms for information retrieval systems, etc. His principal monograph (1976) written about that project was named "Automation of Information Processing and Control in Health Care". In 1977 publishing house "Medicine" produced his new book, "Introduction to Medical Cybernetics", and in 1983 one more on the subject, called "Medical Cybernetics".

Generally speaking his activity with medical information systems was much nearer to contemporary issues than one could judge from the titles. For example he managed to install in a Moscow hospital one of the first PDP-11/70 - a highly efficient mini-computer of the middle-1970-s. Its programming system MUMPS - Massachusetts General Hospital Multiprogramming System (later it was standard ISO11756:1991) was popular in the USSR as programming system DIAMS for minicomputers SM-4 (similar to PDP). It was predecessor of modern M-technologies for medical applications, supported by post-relational database control system Cache of Inter-Systems.

Kitov is famous as one of the leading scientists in the field of information retrieval systems (IRS), algorithmic languages and methods of associative programming. Results of his researches were presented in his monographs, "Programming for information-logical problems" (1967) and "Programming for Economic and

Management problems" (1971). Kitov led the group of specialists who created new general programming language NORMIN to work with normalized text information. It was implemented in many Soviet health care organizations. Kitov used methods of cybernetics, system analysis, etc. to solve medical and health care problems in the situation of risk and lack of information. Three fundamental books, articles and scientific reports describing computer systems implemented in medical and health care organizations created the foundation of medical cybernetics and informatics in the USSR.



**Fig. 3.** Participants of the International conference of Medical Informatics at Japan (1978). A. Kitov is the fifth in the second row.

Anatoly Kitov made notable contribution as academic teacher. He supervised and consulted Candidate and Doctoral dissertations of more than 40 scientists from Russia, Ukraine, Uzbekistan, Latvia, Moldova, Germany, Hungary, Bulgaria, Poland, China, Viet-Nam and other countries. He also has been a member of the Russian "Programmirovaniye" journal editorial board from the very day of its establishing. Since 1980 till 1997 A. Kitov was professor of Plekhanov Russian Academy of Economics, head of the Computer science chair. He is the author of 12 monographs in computer science which are translated into 9 foreign languages: English, German, Japanese, Chinese, Polish, Hungarian, Romanian, Bulgarian, Czech. His work opened for several generations of specialists the wonderful world of cybernetics and information technologies, founded in the USSR and Russia military, economic and medical informatics.



## 5 Anatoly Kitov and IFIP

During more than 12 years A. Kitov was involved to the IFIP activity. In MedINFO A. Kitov had status "The national representative from the USSR". He was the member of Technical Committee № 4 (TC-4) IFIP. A. Kitov had regular contacts with chairman of TC-4 IFIP professor Jan Roukens (Netherlands) and vice-chairman professor B. Schneider (Germany). A. Kitov took part in three International MEDINFO Congresses:

- MEDINFO-1974, Stokholm (Sweedon).

- MEDINFO-1977, which was held in August 1977 in Toronto (Canada). On this international forum A. Kitov was the chairman of Session T2 - "Biomedical Research General".

- MEDINFO-1980, which was held in September 1980 in Tokio (Japan). Here A. Kitov was the Member of the Programming Committee. Also A. Kitov was IMEA officer from the USSR.

A. Kitov took active part in the work of international committee TC-4 IFIP and in other events abroad, e.g. TC-4 IFIP session in Dijon (France), TC-4 IFIP session in Florence (Italy), TC-4 IFIP session in Amsterdam (Netherlands), in 1978 he took part in the MEDIS'78 in Japan, which was held in Tokio and Osaka, etc.

Anatoly Ivanovich Kitov died on the 14<sup>th</sup> of October, 2005 in Moscow.

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