THE EARLY PERIOD OF THE "DIGITAL REVOLUTION" FROM THE POINT OF VIEW OF INTELLECTUAL HISTORY

Assoc. Prof. Aleksei Miloslavov[1]
Assos. Prof. Olga Kuzmina[1]
[1] Saint-Petersburg State University; IFMO University, Russia

ABSTRACT

At present, in the literature that are devoted on social life, it has become commonplace to claim that we live in the era of the "digital revolution". Our paper deal with computer science in the period from the late 40's to early 60's of the twentieth century, which is considered from the point of view of "intellectual history". We concern with, in the main, two problems. First is self-consciousness of members of computer science community in relation to other spheres of scientific and engineering-practical activity, including the question about the correlation of theoretical and applied components in the structure of the knowledge. Secondly, we tell about interactions of a new sphere of professional activity have been occurred in this period with various social practices - scientific, industrial, political and so on. Based on the texts that reflect the incipience of computer science in the West and in the Soviet Union, we reveal some features of the "philosophy" of the early period of the digital revolution in the context of the existence of two ideological systems.

Keywords: Digital revolution, computer science, Intellectual history

INTRODUCTION

At the present time, in the literature about a social problems became commonplace the statement that we live in the era of the "digital revolution". Indeed, computer technology is ubiquitous included in a variety of areas of human activity, often replacing a man. A significant part of trades on the stock exchange is carried out by autonomous intellectual agents. The processes of automation and use of robots in the sphere of industrial production and in the services sector have reached such level of development that some specialists to use the term "robonomics" for naming the economic relations of the near future [1]. The blockchains technology and the related phenomenon of cryptocurrency throw down the gauntlet to financial institutions and organizations. People in everyday life use social networks, interact with "smart things", dream of living in "smart cities" built up by "smart houses".

The further course of the "digital revolution" is discussed not only in the works of futurologists and authors of fiction novels, but also in the publications of members of such respected areas of knowledge as economics, sociology, computer science. So, for example, some experts already to day suggest to think about the social consequences of the soon creation of "SuperIntelligence", whose activities will radically change the lives of single man and humanity as a whole [2].

In this regard, it seems reasonable to look back and pay attention to those years when "revolutionary activity" was just beginning in order to analyze the intentions and expectations of those scientists and engineers thanks to which most of our contemporaries living in developed countries, have at least one computer at home. This step will not only pay tribute to the founding fathers of computer science, but it can be assumed that it will create an opportunity to assess the correctness and validity of forecasts regarding the future course of the digital revolution and the prospects that await a man in the world of IT.

Below we will tell about the time from the late 40's to the early 60's of the 20th century. These chronological frames are due to the following. First, during this period, computers and phenomena associated with their work become an object of study from the scientific (university) community. But they not yet affected by the tendency of global commercialization. Secondly, at this time the main disciplinary trends of research and engineering activities in the computer sciences were constituted.

Not being able to present in this work all the theoretical and technical innovations that objectified the development of computer science in this period, we will focus on the following problems. First, it is a problem of self-definition of scientists in relation to other spheres of scientific and engineering activity, including the question of the correlation of theoretical and applied components in the structure of knowledge. Secondly, we investigate the way in which have been interpreted the interaction between the emerging sphere of professional and scientific activity with various social practices. Finally, through engage texts that reflecting the emergence of computer science both in the West and in the Soviet Union, we reveal some features of the "philosophy" of the early period of the digital revolution in the context of the existence of two social systems.

Below we will present a fragment of the "intellectual history" of the first stage of the development of computer science and their influence on a variety of public practices. As is known, in the opinion of Robert Darnton, the "intellectual history" embraces the consideration of concepts, the state of public opinion, the history of the expansion of ideas, ets [3]. We will consider these aspects in retrospect of the digital revolution.

THE FIRST STEPS OF THE DIGITAL REVOLUTION

It can be argued that by the end of the 1930s, formed the entire conceptual ground necessary to create digital computers. Detailed reconstruction of the historical path of its formation is not the purpose of this article. For this reason, we point out here only the main, in our opinion, intellectual results that contributed to the creation of digital computers.

First, various methods of encoding information were developed and applied in practice - from telegraphic messages to military cryptography. Secondly, the development of electrical engineering has ensured not only an elemental base sufficient for the creation of digital computers, but also led to the development of a mathematical apparatus for their description and design (K. Shannon, V. Shestakov, etc.). Thirdly, the idea of the mechanical execution of arithmetic

operations, originating from the times of the Ancient World, for example, the "Antikythera Mechanism", was further developed in the machines of B. Pascal and G.-V. Leibniz. In the XX century, it gained wide practical realization in the arithmometers produced by different firms, as well as in more ambitious engineering projects, for example, in the tabulator G. Hollerith.

Finally, the tradition of logical research, initiated by Aristotle's writings, has rooted in the intellectual tradition that there are rules according to which it is necessary to work with information regardless of its content. The use of a logical apparatus for solving the problems of justifying mathematics in the first half of the 20th century, in turn, became a catalyst for intensifying research on the problem of computability. These studies led to the formation of various models for the presentation of computational procedures, including those based on the notion of "machine" (A. Turing, E Post).

Beginning in 1939, the Second World War interrupted the smooth flow of scientific life. At the same time, it stimulated work aimed at the creation of computers. The successful use of computing devices to solve ballistic problems and problems associated with encryption and decryption of messages can be considered as the first step on the road to a digital revolution. The importance of building machines that significantly speed up the information processing was demonstrated to representatives of military departments, state officials and managers of large companies. The idea of computerization went beyond the narrow circle of representatives of the scientific community and innovative engineers and gradually began to master the mass consciousness.

Peter J. Denning, speaking about the history of the development of computer science, draws attention to the fact that in the 40s of the XX century, this area of knowledge was understood as study of automatic computing. [4] But already in the 1950s, as the same author points out, the emphasis in understanding the subject field of research shifts to the concept of "information processing".

Indeed, in the 50s computers began to find application in various fields, requiring the processing of a large amount of information. In this respect, the article “The Computer Age” prepared by the team of authors and published in the journal “Business Week”, and then reprinted in “Computer and Automation” is indicative [5]. The content of the article is an overview of projects for the use of digital computers in firms and in some US government agencies. This is an interesting document in the context of the intellectual history of the "digital revolution", because it reflects the expectations which representatives of various spheres of activity are pinned on computers. The authors emphasized that the use of computers leads to "new management thinking" and helps to improve the work [5]. Thanks to computing machines can test new ideas, which increase production efficiency. For example, to solve the problems associated with oil refining at Texas Co. IBM-705 was used. The time for the calculations was reduced from one week to 15 minutes due to the use of the machine. [5]. So, speed, accuracy and, as a result, cheaper work - these are the competitive advantages that the companies received to improve production process using computers. It was planned to use the machines not only to speed up the calculations. It was supposed eventually expand to the mathematical and logical simulation of complete company setups. [ibid] The project of Texas Co

was not the only one. Computing Laboratory of Wayne University around the same time was busy developing software that would be a step towards full office-factory integration through a computer. [5]

According to the authors of the article, the turning point in the proliferation of computers in business was in 1955, when many companies began to increase the use of computer technology for data processing. General Electric, which was involved in the production of computers, itself, used 144 computers of various types and sizes at the time of writing of the article. In general, we can say that the business community enthusiastically accepted the appearance of computers and quickly assessed the possibilities of their application.

However, it is worth noting that the public reaction to the use of computers in the production sector was not unambiguous. For example, Fletcher Pratt described an episode when the managers of a project to automate an oil refinery in Canada tried not to advertise their participation in it. The benefit from the realization of the conceived is a reduction of 30% of the labor resources necessary for the operation of production. [6] This fact aroused fears due to a possible negative public reaction and, as a result, possible difficulties for the company's work elsewhere. At the same time, the author of the article noted that the oil refinery itself is located in a region where there is no surplus of labor, and severe climatic conditions do not facilitate the attraction of labor migrants. In addition, the article said that many companies for the same reason hide the purchase of computer time on Univac. Obviously, for a significant part of American society, the further expansion of the automation of production and the use of computer technology was associated with the threat of unemployment and the possible deterioration of material welfare.

Computers have been used in the military sphere too. In the context of talking about the digital revolution, it is important that computers were planned in the 1950s not only to perform ballistic calculations, but also to solve more complex problems. For example, in [5] it is reported that, at the request of the US government, model calculations of the consequences that could occur for the country's industry as a result of a nuclear strike were carried out.

In addition, in the historical period under consideration, a cautious attitude in the public consciousness was manifested, not only with respect to developing computer technology, but also in relation to science in general. Thus, Jay W. Forrester, referring to the study, noted that for a large part of American schoolchildren, science is associated with such words as "evil, villain, and atom bombs" [7]. This fact is very interesting, but within the framework of this article we will not consider the reasons for such "anti-scientistic" sentiments that formed in the 50s in the United States. We only note that they were strikingly different from the enthusiasm with which the legitimized cybernetics was perceived in the Soviet Union.

What do the above mentioned authors suggest for overcoming the emerging problems? It is worth paying attention to the fact that their initiatives remain relevant in the light of today's events of the "digital revolution". So, Fletcher Pratt denoted the need for extended education as a tool to solve the employment problem arising in connection with the use of computers and robots in the

workplace. Jay W. Forrester emphasized the need for the scientific and business communities to make efforts to popularize computer technique. Representatives of science should participate in the publication of literature for schoolchildren. And companies engaged in the production of computers could develop mechanism, which enable students in schools to collect prototypes of simple computing devices. In general, judging from the publications in the magazine "Computer and Automation", the problem of adapting school education to the coming "age of computers" was a great concern to specialists of the 50's. This problem was considered both in separate articles and special issues of the magazine. The problem was that schools were not able to prepare the younger generation that meets new requirements [7]. From here followed the questions about continued education, self-education and motivation mechanisms for the implementation of this process. As we see, much of what the authors of the times of the beginning of the "digital revolution" wrote about is still relevant today.

Although Peter J. Denning, as it have been written above, denotes the difference in the development of computer science in the 40s and 50s respectively, we can note at least two common features of these decades of the "computer revolution". First, it was common that in the perception of scientists and engineers, the creation, debugging and control of the machines themselves were of particular importance. So, for example, Ed. Dijkstra, recalling the years of his professional career, have noted: "…the programmer himself have a very modest view of his own work: his work derived all its significance from the existence of that wondefull machine" [8]. This situation is easily explained. The cause was the uniqueness of electronic computing devices, as well as the fact that they were not very reliable. Most often, the first computers were created in a single exemplar. And, as Ed. Dijkstra pointed out: "… in retrospect one can only wonder that those first machines worked at all, at least sometimes"[8]. In connection with this circumstance "…they were all to be found in an environment with the exciting flavor experimental laboratory" [8].

The experimental nature of the work of specialists in the field of computer technology is the second common feature in the development of "computer science" in the 40s and 50s of the last century. Scientists and engineers experimented with hardware, up to the chemical composition of elements, mechanisms of memory organization, ways of recording programs. Some have tried to find an alternative to electronic machines in solving information processing. The value of the "experimental" component in the development of computer science in this period was also emphasized by Wilks M.V. In particular, he noted: "A source of strength in the early days was that groups in various parts of the world were prepared to construct experimental computers without necessarily intending them to be the prototype for serial production. As a result, there became available a body of knowledge about what would work and what would not work, about what it was profitable to do and what it was not profitable to do" [9]. Not all of the planned projects have been successfully implemented. But it can be argued that the principle of "proliferation" introduced by P. Feyerabend in the philosophy of science to designate the process of multiplying competing theories is quite suitable for explaining the successes of computer sciences at the early stage of their development.

THE BEGINNING OF THE DIGITAL REVOLUTION IN THE SOVIET UNION

The period under discussion the "digital revolution" was marked in the Soviet Union by the struggle for cybernetics. The ideological and philosophical foundations of the discussion that has developed around the "management science" are presented in detail and qualitatively in the well-known work of L. Graham [10]. It also outlines the milestones in the development of cybernetic studies conducted by Soviet scientists [11]. It is important to note that the "struggle for cybernetics" and the peculiarities of organization of scientific research in the USSR led to series of consequences interesting for the intellectual history of the "digital revolution". The pioneers of computer science in the Soviet Union in the 50s of the last century, in addition to solving the actual research problems had to be solved yet, at least two major problems. First, it was necessary to justify the existence of the emerging scientific direction in the context of the Marxist-Leninist ideology. Secondly, it was required to build constructive relations with the Soviet bureaucracy, responsible for the organization of scientific works. Some representatives of the bureaucracy then, apparently, sincerely did not understand the importance of creating computers and the importance of the development of digital technologies. To solve these problems, Soviet scientists had to carefully consider the question of the correlation of cybernetics and its parts with the system, both natural and social sciences. In addition, it was necessary to consider thoroughly philosophical and methodological foundation of research. This foundation was not to cause allergies in representatives of the authorities responsible for the ideological correctness of Soviet science. Thus, as one of the most important episodes on the road to the rehabilitation of cybernetics in "socialist science", participants in the events of those years note the publication in the journal “Problems of Philosophy” (the main philosophical periodical of the USSR) of the article by S.L. Sobolev, A.I. Kitov, A.A. Lyapunov "Essential aspects of cybernetics" (1955). The publication of this article was preceded by a thorough discussion of its contents in the editorial board. The content of the article draws attention to the fact that cybernetics is called by authors not a science, but a scientific direction [12]. Also, the authors note that, at the time of writing, it does not yet represent a coherent and integral scientific discipline [ibid.]. The machine and its behavior are included as an element in the sphere of the scientific interests of cybernetics. In addition, it should be noted that the authors of the article quite definitely indicate those disciplines that contribute to the conduct of cybernetic studies. In other words, the problem indicated by Ed. Dijkstra, concerning that set of knowledge which should be mastered by the expert in the field of computer science, in this case finds a solution. Written by well-known Soviet scientists and published in the main ideological journal of the USSR, the article in question not only served to justify cybernetics, but also to a significant extent marked the specific nature of the course of the "digital revolution" in the Soviet Union. Thus, one of the features that distinguish Soviet research in the field of computer science from the works carried out in the West in the 1950s was recognition of the fundamental mathematical component related to information processing as a necessary basic element of the emerging knowledge field. The reason behind this vector of development was that at the head of the "cybernetic

movement" in the Soviet Union there were outstanding mathematicians A.N. Kolmogorov, A.A. Lyapunov, A.P. Ershov, A.A. Markov, L.V. Kantorovich et al. The development of the "mathematical direction" of cybernetic research had important consequences. Firstly, the creation of a strong research tradition of theoretical informatics, in the framework of which new, innovative ideas were proposed, largely ahead of their time. So, for example, one of the lectures of A.A. Lyapunov, read in 1952/53 academic year, was called "Synthesis programs." The term "synthesis of programs" entered the literature 25 years after the learning course. Secondly, this trend had in the future, in our opinion, a significant influence on the perception of the science of computers in the eyes of the public. Let us note that the "mathematical impulse" for the development of computer science, set by Soviet scientists in the 1950s, largely anticipated and outstripped the further direction of this field of research. For example, in the "Turing lecture" R. Hamming for 1968 we can read as follows: “In the past I have argued that to require a strong mathematical content for computer science would exclude many of the best people in the field. However, with the coming importance of scheduling and the allocating of the resources of the computer, t have had to reconsider my opinion” [13]. However, the "mathematization" of the educational strategy in the field of informatics, adopted by Soviet scientists, at a certain stage in the development of computer technology in the country, entered into a kind of contradiction with the socially significant popularization of knowledge. The standard program of school education in the Soviet Union did not include those areas of mathematics that use in the operation of computers. In addition, the highest level of theoretical research given by Soviet mathematicians working in the field of computer science has led to the concept of "no-machine" learning being has translated into school educational practices. The consequence of this concept was that the mastery of computer science seemed for a significant part of Soviet schoolchildren a matter, if not senseless, then devoid of concrete practical significance [14].

The specifics of the development of computer science in the Soviet Union was determined, except as noted above, also administrative science management system in general. This circumstance entailed at least two important but contradictory consequences. On the one hand, Soviet scientists often had to overcome the stagnation and conservatism of the bureaucratic system with great efforts. On the other hand, in case of successful presentation of their ideas and plans to representatives of the state authorities, researchers and engineers received strong material and administrative support from the state. The centralized creation of scientific centers connected with the development of computer technology began in the USSR in the second half of the 1950s. Well organized and carried out under the guidance of experts, research in the field of computer science, to the beginning of the 60s is largely neutralized the backlog of the Soviet Union from the Western countries, which took place in the late 40's - early 50’s of the XX century. But we can conclude that the advances in the field of computer science in the USSR affected only the theoretical level of research and manifested itself in some experimental development. They can hardly be called a catalyst for the "digital revolution" to the same extent that the availability of the use of computers for civilian purposes had an impact on various spheres of life in the countries of the West. Unfortunately, decisions about the support of certain projects often were made in the Soviet Union on the basis of various preferences of officials of various departments. In Soviet

society, there was a powerful impetus to the development of cybernetic research and the use of computer technology, asked by representatives of the scientific community, and it has become a kind of "cultural background". But it was often suppressed by incompetent middle-level managers. This social conditions prevailing in the Soviet Union did not contribute to the digital revolution.

CONCLUSION

In this article, we have discussed some features of the development of computer science in the 40-50th of the XX century. From the point of view of intellectual history, the following complex of catalysts, which determined the success of the first period of the "digital revolution», have been identified. First, it is a deep rootedness of the idea of creating computational in the Western intellectual tradition. Secondly, it was the readiness of the business community to perceive new scientific ideas in order to successfully solve the problems of management and production. Finally, there was not one global trend in the commercialization of theoretical and technical developments in those times. This circumstance allowed universities and firms to develop alternative approaches to solving the problems which computer science was dealing with. The complex of these factors made it possible, at an early stage of the digital revolution, to identify the main vectors for the use of computers. Most of the indicated areas remain relevant at the present time.

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