COMPUTERS AND ECONOMIC PLANNING: THE SOVIET EXPERIENCE

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CAMBRIDGE UNIVERSITY PRESS
CAMBRIDGE
LONDON · NEW YORK · NEW ROCHELLE
MELBOURNE · SYDNEY

PREFACE

This book describes the effect which the application of computer technology has had on the system of economic planning and management in the Soviet Union. The potential impact of computers on economic planning is enormous. To appreciate this one only has to recall one of the arguments made in the debate in the 1930s on the feasibility of central planning. It was asserted then that an efficient allocation of resources in a centrally planned economy was inconceivable, because such an allocation would require the solution of 'millions of equations'. At that time, of course, no electronic computers were available. Today the situation is quite different and the computational objection would have much less force.

Interestingly, Oscar Lange, the author of the famous 'competitive solution' of the planning problem in the 1930s, turned in his last article, published in 1967, to the potential impact of computers on economic planning. There he reinterpreted the market as a 'computer *sui generis* which serves to solve a system of simultaneous equations' by the tâtonnement process, noting that the solution mechanism operated not via a physical process, as in an analogue computer, but by a social process. He then went on to compare the merits of the 'two instruments of economic accounting' available to managers in socialist economies, the electronic computer and the market (Lange (1967), p. 159).

In his article Lange was concerned with the potential impact of computers when they had been fully assimilated into planning and when technical difficulties had been overcome. The aim of this book, in contrast, is to establish in detail what changes computers have brought to the actual operation of the Soviet economy, in which neither of these two conditions has been fulfilled. We begin by examining the history of the Soviet efforts to use computers for management purposes. The second chapter gives an account of

alternative basic approaches to adapting the planning system to take advantage of computers. This is followed by four chapters describing the use of computers at four major organisations or levels of industrial management: the State Planning Commission (Gosplan); the State Committee for Supply (Gossnab); ministries; and enterprises and production associations (*ob'edineniya*). A final chapter offers an overall assessment and some conclusions.

The book is organised so that a reader with a general interest in the Soviet economy can get a fairly self-contained account of the background and implications of Soviet work in computer-based planning systems by looking at Chapters 1 and 7. The reader interested in the more abstract aspects of economic planning may find Chapters 2 and 3 of most interest. The remaining chapters describe the impact of computers on particular organisations and the special problems of modelling and implementation encountered there.

The materials for this study are largely Soviet publications supplemented by a visit to the Soviet Union in 1973. Soviet sources have seemed to me to be relatively open and frank in discussing the successes and failures of computer use. However, I recognise that they are no substitute for direct access to practitioners in the field, which was not available to me. I am aware, moreover, that an outsider can capture only imperfectly the atmosphere of an ambitious programme such as the one described here.

A large number of people have helped me to complete this study. I am especially indebted to Francis Seton of Oxford University who supervised the thesis from which the present book is derived. Most of the research was done at the Centre for Russian and East European Studies at Birmingham University, and I owe a great deal to the encouragement and help of many individuals working at or attached to the Centre, in particular R. W. Davies (then Director of the Centre), Philip Hanson, Julian Cooper, and Chris Siemaszko. The help of the Centre's librarian, Jenny Brine, was invaluable. I am also grateful to Paul Hare of Stirling University for reading successive drafts of many chapters. Mrs C. Newnham typed the manuscript with her customary speed and efficiency.

GLOSSARY

Glossary of terms used in connection with automated planning and management systems in the USSR

ABD	(*Avtomatizirovannyi bank dannykh*) A bank of data stored in a computer. TsSU is developing such a bank as part of ASGS (q.v.).
AIUS	(*Avtomatizirovannaya informatsionno-upravlayushchaya sistema standartizartsii i metrologii Gosstandarta SSSR*) The automated system for the State Committee on Standards.
ASFR	(*Avtomatizirovannaya sistema finansovykh resursov*) The automated system covering the activity of the Ministry of Finance.
ASGS	(*Avtomatizirovannaya sistema gosudarstvennoi statistiki*) The automated system dealing with the functions of TsSU.
ASN	(*Avtomatizirovannaya sistema normativov*) The automated system with the function of collecting and preparing data on normatives (input coefficients) of various kinds for use in planning. Though it is sometimes referred to as a subsystem of ASPR (q.v.), ASN also has connections with enterprises and ministries.
ASOI tsen	(*Avtomatizirovannaya sistema obrabotki informatsii po tsenam*) The automated system which processes information used by the State Committee on Prices of the USSR Council of Ministers.
ASPR	(*Avtomatizirovannaya sistema planovykh raschetov*) The automated system designed to assist Gosplan USSR and Union Republic Gosplans in the performance of planning functions.
ASU MTS	(*Avtomatizirovannaya sistema upravleniya material'no-tekhnicheskym snabzheniem*) The automated system which covers the activity of Gossnab.
ASUNT	(*Avtomatizirovannaya sistema upravleniya nauchno-tekhnicheskym progressom*) The automated system dealing with the planning and control of research and development at the State Committee for Science and Technology.
ASUO	(*Avtomatizirovannaya sistema upravleniya ob'edineniem*) These systems will be responsible for the management of (production) *ob'edineniya*.
ASUP	(*Avtomatizirovannaya sistema upravleniya predpriyatiem*) These systems are responsible for the management functions of individual enterprises.

ASU-pribor	(*Avtomatizirovannaya sistema upravleniya Ministerstvom proborostroeniya*) The management system for the instrument-building industry. An example of an OASU (q.v.).
ASUS	(*Avtomatizirovannaya sistema upravleniya stroitel'stvom*) The automated system concerned with the activity of Gosstroi, the State Committee for Construction.
ASUTP	(*Avtomatizirovannaya sistema upravleniya tekhnologicheskim protsessom*) These systems are concerned with controlling complex physical processes in, for example, the chemical industry, rather than with planning and management.
ASVT	(*Agregat sredstv vychislitel'noi tekhniki*) A family of second and third generation computers used both in process control and in management.
EASS	(*Edinaya avtomatizirovannaya sistema svyazei*) The overall automated communications network for the USSR.
EMM	(*Ekonomiko-matematicheskii model'*) Mathematical economic model.
ES EVM	(*Edinaya sistema elektronno-vychislitel'nykh mashin*) A family of third generation computers, produced under a Comecon co-operation agreement; also known as the Ryad series.
EUSPD	(*Edinaya unifitsirovannaya sistema planovoi dokumentatsii*) A unified system of planning documentation specially designed for ASPR (q.v.).
EVM	(*Elektronno-vychislitel'naya mashina*) An electronic computer.
GSVTs	(*Gosudarstvennaya sistema vychislitel'nykh tsentrov*) A grid of computer centres serving enterprises, ministries and higher-level organs (Gosplan, Gossnab, TsSU). Transfer of information between them is handled by the EASS (q.v.) which together with GSVTs forms the technical base of OGAS (q.v.). Initially, the management automation programme in general was referred to as the building of GSVTs.
IPU	(*Institut problem upravleniya*). The institute of control problems, a research institute subordinate to the Ministry of Instrument Building and the Academy of Sciences, and formerly known as *Institut avtomatiki i telemekhaniki*, the institute for automation and remote control.
ISKhOD	(*Integrirovannaya sistema khraneniya i obrabotki dannykh*) An expression similar to ISOD (q.v.), but used in connection with the design of ASPR (q.v.).
ISOD	(*Integrirovannaya sistema obrabotki dannykh*) The outcome of a reorganisation of information processing in a branch, enterprise or smaller unit, so that information collection and processing are co-ordinated and data needs are met without redundancy of information.
KIP	(*Kustovyi informatsionnyi punkt*) An information collection and processing centre serving several users, usually enterprises.
KIVTs	(*Kustovyi informatsionno-vychislitel'nyi tsentr*) An information centre equipped with a computer and serving several users, usually enterprises.

MSS (*Mashino-schetnaya stantsiya*) A centre organised by TsSU and equipped with calculating machines (sometimes computers), which carries out data processing for enterprises on a contract basis as well as TsSU work.

NIIMS (*Nauchno-issledovatel'skii institut ekonomiki i organizatsiya material'no-tekhnicheskogo snabzheniya*). The scientific research institute for the economics and organisation of supply, a part of Gossnab USSR.

NIISU (*Nauchno-issledovatel'skii institut sistem upravleniya*). The scientific-research institute for management systems of Gossnab USSR.

OASU (*Otraslevaya avtomatizirovannaya sistema upravleniya*) An automated system for performing the functions of planning and management at ministry or branch level.

OGAS (*Obshche-gosudarstvennaya sistema sbora i obrabotki informatsii (dannykh) dlya ucheta, planirovaniya i upravleniya narodnym khozyaistvom*) A comprehensive expression for the link-up of all the automated systems operating at different levels in economic planning and management. The hardware, or technical base of OGAS is the GSVTs (q.v.).

OGSPD (*Obshche-gosudarstvennaya sistema peredachi dannykh*) The automated system which organises data exchanges between computer centres; a component part of EASS (q.v.).

OKP (*Obshchesoyuznyi klassifikator produktsii*). The union-wide product classifier; a commodity classification system being developed in the USSR.

SGK (*Soyuzglavkomplekt*). A chief administration for supplying enterprises under construction with equipment of a certain kind; part of Gossnab's product distribution system.

SGSS (*Soyuzglavsnabsbyt*). A chief administration for the supply of a group of products; part of Gossnab's distribution system.

SKP (*Sistema kompleksnogo planirovaniya*) The system of integrated planning; a system of plans linking long-term, five-year and annual plans and incorporating the construction of programmes for regions and sectors of the economy.

SOFE (*Sistema optimal'nogo funktsionirovaniya ekonomiki*) A general conception of the operation of the economy originating in TsEMI in the 1960s and developed in the 1970s. SOFE envisages the construction of a plan by a computer-based iterative procedure and its implementation at least in part by a market system.

TsEMI (*Tsentral'nyi ekonomiko-matkematicheskii institut*). The central mathematical economics institute; a research institute of the USSR Academy of Sciences.

TsSU (*Tsentral'noe statisticheskoe upravlenie*). The central statistical agency.

VTs (*Vychislitel'nyi tsentr*) A computer centre.

VTsKP (*Vychislitel'nyi tsentr kollektivnogo pol'zovanina*) A computer centre set up to serve several users.

CONTENTS

1

THE HISTORICAL BACKGROUND

1 INTRODUCTION

Proposals to use computers on a large scale for economic planning and management first gained currency in the USSR in the late 1950s and early 1960s. For such proposals to be acceptable and for their implementation to be feasible it was necessary that a set of preconditions be fulfilled; by the early 1960s these conditions were largely met.

The first of them was the acceptance of cybernetics in the USSR as a science not at odds with dialectical and historical materialism.[1] The ideas of Norbert Wiener and his fellow cyberneticists originally received a hostile reception in the USSR, expressed in the famous article 'Whom Cybernetics Serves' published in *Voprosy Filosofii* in 1953 above the name of 'Materialist' (Materialist (1953)). This article and the entry on cybernetics in the 1954 edition of the *Short Philosophical Dictionary* denounced cybernetics as a tool of the reactionary bourgeoisie and as inimical to Marxism. But subsequently a body of opinion grew up in favour of cybernetics, and it was even argued that the earlier denunciations of the science had unwittingly accepted a false view deliberately propagated by reactionary interests to conceal the true potential of cybernetics from Soviet scientists.

This more favourable assessment of the new subject gained ground. In 1956 a seminar on cybernetics at Moscow University heard papers on a wide range of subjects, including a paper by Kantorovich on 'Mathematical Methods in Economic Planning'. In 1958 the importance of cybernetics was recognised by the establishment of a Scientific Council of the USSR Academy of Science on Cybernetics, under the direction of A. I. Berg, an admiral with interests in all aspects of cybernetics, including military and economic applications. Cybernetics became officially accepted as a science of rationality which was not at variance with Marxism, but which

operated on a different plane. Indeed Graham observes that during the 1960s cybernetics enjoyed more prestige in the USSR than in any other country in the world (Graham (1973), p. 324).

Even the early opponents of cybernetics had recognised the potential of computer technology, and the 1950s saw the laying of the technical and engineering basis for the later development of the Soviet computer industry. A brief survey of Soviet computer technology, especially in recent years, is given in Appendix 2. After an initial period of rapid development, which kept pace roughly with that in the USA, Soviet computers lagged behind in the late 1950s. However, at the beginning of the 1960s the Soviet computer industry made the important breakthrough into second generation computer technology using transistors instead of valves, which not only made possible higher speeds of operation but also created the technical conditions for greater reliability.

The automation of production itself took precedence in the USSR over the use of computers for management and planning. It was natural for the Soviet government, as it began to pay more and more attention to technical progress in the period beginning in the middle 1950s, to devote resources to the automation of technological processes. A series of decrees dealing with the introduction of technical advances into the economy mentioned the scope for automation, and in the early 1960s a number of process control computers were developed (Ware (1965)). At the same time the possibilities for mechanisation of economic data processing received attention. The Central Statistical Administration (TsSU), its powers enhanced by the 1957 management reform which provided for a reorganisation of control on regional instead of ministerial lines, installed mechanical data-processing equipment in a number of machine accounting stations (*mashino-schetnaya stantsiya* – MSS). From a base of 70 MSS in 1957, equipped with about 4,000 machines (presumably fairly primitive punch-card and adding machines) the network grew by 1968 to about 1,000 stations with 35,000 machines (Treml (1972), pp. 24–7). Initially these MSS worked largely on a contract basis for enterprises in their neighbourhood. Later, as we shall see, they played a role as a basis for TsSU's campaign to control the state network of computer centres.

Finally, in the period beginning in 1960, mathematical economics, and more specifically the mathematical formulation of planning problems, enjoyed a revival in the USSR. The history of this revival has been told by a number of authors (Zauberman (1975). Ellman

(1973)). For our purpose its importance was that it made it possible and necessary to use computers for economic decision making at exactly the opposite pole from TsSU's attempts at low-level mechanical data processing, at the level of Gosplan USSR and the Sovnarkhozes or regional economic councils. The Central Economic Mathematical Institute (TsEMI) was formed in 1963 out of a number of previously existing organisations in the field. Its programme of research, outlined by N. P. Fedorenko in 1964, included the design of a state network of computer centres which would serve as the 'technical base' of the system of optimal planning and management which was the main focus of the Institute's research.

Thus at the beginning of the 1960s, conditions had been created in which proposals to use computers for planning and management of the economy would be seriously entertained. But at this stage not much importance was attached to this aspect of economic management. The 1961 Programme of the CPSU devoted a single paragraph to automation, in which management applications were the last to be mentioned (XXII S'ezd (1962), p. 220).

2 EARLY PROPOSALS

The first developed proposal for the automation of economic management was made by Berg, Kitov and Lyapunov[2] at the Cybernetics section of an all-Union Conference on Computer Mathematics and Technology held in 1959. The authors considered five primary areas for the application of computers in economic management:

1 the system of national-economic accounting and statistics
2 the system of state planning
3 the system of material-technical supply
4 the financial and banking system
5 the system of transport management.

We can see how ambitious the scheme was from the list of applications under heading (2). These include the preparation and use of input–output tables, a system of price formation, investment efficiency calculations and a set of lower-level optimising calculations (Berg (1961), pp. 87, 89–90).

The authors recommend a gradual implementation of their programme, starting with the installation of computers in large enterprises and government departments and progressing through

regional link-ups to the establishment of a unified state network of information and computing centres which would ultimately supply the needs of all organisations in information and data processing. An experimental system to operate in a single region was recommended, with the advantage that 'concentration of Gosplan, Gosbank, TsSU and corresponding *Sovnarkhoz* organs in a single information and computer centre of a given region would ensure more operational contact in work'. The network was intended to amalgamate the separate data-collection systems then functioning.

In 1963 considerable impetus to work in this field was given by a decree of the Central Committee and the Council of Ministers 'On improving the guidance of work on introducing computer technology and automated management systems in the economy'. The text of this decree is not available to me, but one of its important consequences was the foundation of a Chief Administration for the introduction of computers and management systems, within the State Committee of the Council of Ministers for the co-ordination of scientific research work.[3] According to one source the Chief Administration was assigned the following tasks (Makhrov (1974), pp. 12–13):

1 building and installing automated information processing and management systems at all levels of management, from the Statewide level down through ministry and enterprise level systems to the level of controlling technological processes
2 designing high capacity computing systems, suitable for processing economic information
3 building a state network of computer centres servicing local organisations
4 developing coding and classification systems and software
5 preparing recommendations for the education of specialists.

It is not clear which items in this extensive agenda were imposed upon the Chief Administration by the 1963 decree, and which were assigned subsequently. From contemporary discussions it appears that there was little clarity in the proposals, and little agreement about how they were to be realised. In 1964 a joint article by Doroditsyn, Fedorenko and Glushkov[4] considered some organisational problems of establishing a computer grid (Doroditsyn (1964)). The article proposed a three-tier system of computer centres, ranging from a few centres at the highest level, equipped with very powerful computers, to the lowest tier, numbered in thousands and equipped with more modest machines. To build the system a

cybernetics industry would be created, and the authors proposed that responsibility for it should be divided among TsEMI, a newly-created Institute of Systems Techniques and the computer industry. The authors specifically ruled out TsSU's Scientific Research Institute (NII TsSU SSSR) as a candidate for the role of reorganising the existing system of primary information on the ground that it was too busy and in no condition to understand the problem in all its complexity. Finally the authors proposed that the Chief Administration for the introduction of computers be given enlarged powers and made responsible for the development and application of computers.

Inevitably the question of the role of a network of computer centres became inextricably mixed up with discussion of the proposed economic reform. The final period of debate over the reform was inaugurated by an important article in *Pravda* by V. A. Trapeznikov[5] (Trapeznikov (1964)). After arguing for certain changes in the Soviet management system, some of which – the capital charge, increased use of profit as an indicator – were subsequently adopted in the reform, Trapeznikov noted: 'In the recent period, a series of articles has been published about the need to establish a network of computer centres for planning the economy. We must in every way support the large-scale use of computers for economic calculations, in which we have considerably fallen behind the leading capitalist countries. However it would be self-deception to think that it is possible with the help of computers alone to solve the problem of optimal planning and management. It must be based on *correct economic criteria which will stimulate the purposeful development of the economy*' (emphasis in original). The influential mathematical economist Nemchinov, in a well-known article supporting reform proposals, attached a similar role to computer centres, as something complementary to the extension of *khozraschet*, or independent accounting at enterprise level. 'Automated electronic systems of management,' he wrote, 'are intended to give priority to directives and the control figures of the national economic plan and simultaneously to promote the broad use of *khozraschet* and economic levers in the form of a system of social funds, prices, profits and credits' (Nemchinov (1964), pp. 84–5). After the announcement of the reform Starovskii, the head of TsSU, argued that it went against the spirit of the new system of management to represent scientific planning as merely carrying out a set of highly centralised calculations, the results of which were dispatch-

ed by computer centres to subordinate units (Starovskii (1965)).

In the midst of the uncertainty which characterised the pre-reform period, work continued on a modest scale on the design and use of automated planning and management systems. In 1963 Glushkov's Institute of Cybernetics began the task of developing an automated management system for the L'vov television factory. Nemchinov's Laboratory for the application of mathematical methods in economic research and planning designed an integrated series of matrix models of the input–output type (Pirogov (1963), p. 50; Modin (1963)). The Moscow Sovnarkhoz had a dispatching centre which operated on such a system (Chernyak (1963)). A model was developed by TsEMI showing how, using thousands of computers, the economic planning process could be represented as and solved as a gigantic extremal problem (Pugachev (1964)). But all this scarcely amounted to a design for a state network of computer centres or a unified information system. In the event the delay was advantageous. In 1965 the economy's organisational framework was changed, being restored from a regional to a ministerial basis. A Soviet economist later caustically observed that had lines of communication for a state network of computer centres been laid before the change, they would have had to be pulled up after it, and that before the reform there was no integrated economic framework within which the network would operate (see pp. 45–6 below).

3 THE 1966 DECREE AND ITS CONSEQUENCES

The details of the reform of September 1965 and the simultaneous reorganisation of management are too well-known to need description here (see Zaleski (1967)). What concerns us more closely is the decree of the Central Committee and the Council of Ministers of March 1966, which established the responsibilities of different organisations for developing automated management systems and using computers for planning (Resheniya (1968), pp. 21–7). The allocation of responsibility was as follows:

1 Ministries were charged with establishing automated systems at branch and enterprise level, according to plans approved by Gosplan in conjunction with TsSU and the Ministry of Instrument Building (Minpribor).

2 Minpribor was to be responsible for maintaining technical standards, for the compatibility of the various branch automated

management systems, and for the production of certain computers and peripherals.

3 The Ministry of the Radio Industry (Minradprom) was to be responsible for constructing the state network of computer centres according to TsSU specifications, for the production of computers and peripherals for the system and for software design.

4 TsSU was to be responsible for directing the construction and operation of the network, for laying down the specifications for it jointly with Gosplan, the Academy of Sciences, Minradprom, Minpribor, Gossnab and Gosstroi (the State Committee for Construction), for organising the information system, and for certain other functions.

5 The Academy of Sciences was to be responsible for developing a system of optimal planning, with the assistance of appropriate organisations.

6 Gosplan was assigned responsibility for overall (*svodnyi*) planning of work on the state network and on automated management systems; for overall planning and allocation of computers; for the use of mathematical planning models at Gosplan level and for supervising implementation of the plan for constructing the network.

7 The State Committee on Science and Technology and the State Committee on Standards were assigned certain responsibilities. A division, later a Chief Administration, for computer technology and management systems was created in the former (Makhrov (1974), p. 21.

Plans for the state network were to be prepared by the third quarter of 1966.

The decree had the unfortunate consequence of dividing responsibility for the network so widely and combining so many organisations in work on identical or closely related aspects that it opened the door for dispute over which organisation could claim the major responsibility. As far as production and distribution of hardware is concerned, the decree confirmed a division of responsibility between two producing ministries and three distributing organisations which was later to hamper both the development of computers and the equipment of computer centres. A more important failing was that the phrasing of the decree permitted two organisations, TsSU and Gosplan, to dispute the role of principal organiser of the network. This problem was never really

solved until the end of the eighth five-year plan in 1970.

Immediately after the announcement of the reform in September 1965, Starovskii, the head of TsSU, was arguing for an extended role for his organisation in the new conditions (Starovskii (1965)).

> The reconstruction of the management of industry does not mean a return to the old pre-Sovnarkhoz order of carrying on statistical work ... Ministries have the opportunity to get statistical data through the unified network of TsSU organs, without having recourse to their own economists and engineers to work out statistical data. In the new conditions state statistics will build a system of accounting in such a way as to provide the central planning organs and ministries with all necessary data on industrial branches while maintaining at the same time regional calculations for local party and government economic organisations.

However TsSU had powerful opponents who doubted its abilities to operate a centralised data processing system. Glushkov and Fedorenko emphasised the failure of TsSU to handle primary data properly and to use the information collected to the full (O rabote (1964), pp. 6, 10). The alternative possibility was for Gosplan to stand at the head of a system of information transfer along the lines established by the 1965 reorganisation of management (i.e. Gosplan, branch, enterprise), relying on TsSU-collected data as a starting point for planning and as a check on plan fulfilment. The argument along these lines was continued for several years in the middle 1960s and was overlaid with the question of whether information should be collected on a ministerial or on a regional basis. TsSU favoured the latter method and use of its re-equipped machine-accounting stations for the purpose; Gosplan preferred a ministerial system.

The dispute was made possible by the ambiguity or contradiction in the 1966 decree. It assigned to TsSU the responsibility for 'accounting for [*uchet*] and planning the work of the computer centres, which will carry out the calculations necessary for the national economy, *irrespective of their department subordination*' (Resheniya (1968), p. 24). What then would be the role of the 'branch systems for planning, accounting, management and data-processing' mentioned in paragraph one of the decree as the responsibility of the ministries? It is possible to conceive a system in which computer centres both relayed information from enterprises to Ministries and carried out the necessary calculations for the latter on a *khozraschet* basis, in the way that MSS worked for enterprises. In such a system the relaying agent would be free from any self-