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The Development of Digital Cartography in Russia and the Usage of Digital Maps in the Russian State Library

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Today Russia is enjoying a computerisation boom. This boom is stimulated by the recent appearance of a new economic situation. The use of domestic computers is diminishing, and at the same time the market for foreign computers, software and technology is rapidly growing.

Today informatization is a process which is closely related to cardinal changes in the structure and character of economic and social development, with the transition to science-intensive production and to new forms of information exchange. Informatization as an objective reality is for Russia an inevitable development. The transformation of socio-economic relations and the democratization of social life calls for great changes to the structure and character of information support in practically all spheres of activity in society. Despite the general slump in the production of computers and related technologies in Russia a stable demand for computers and software is manifest. A certain reserve for goal-oriented intensification of the process of informatization, with the simultaneous creation of legal, economic and organizational conditions, has been developed. With state support, the federal programme *Informatization of Russia* and other federal and regional programmes have been developed to create information facilities and systems. For the first time in our country, within the Federal Service for Geodesy and Cartography, a new aspect - digital cartography - has started on a production basis and continues quickly to develop. Within a short span of time 6 geo-information regional centres have been established. One of the leading institutions is the Moscow Research and Production Centre for Geo-information 'Rosgeoinform'. The development of digital map-making enjoys the support of the Government of Russia, which has approved the programme *Advanced technologies of cartographic-geodetic support for the Russian Federation*.

In keeping with this programme -which is executed by the Federal Service for Geodesy and Cartography of Russia- the following developments are envisaged:

- creation of a uniform State digital database for cartographic information and for the digital information industry during 1994-1995;
- development of GIS for different purposes and new methods, facilities and technology for the production of digital and electronic maps;
- creation and maintenance of databases for digital and electronic maps at scales 1:200,000 to 1:1,000,000 for the territory of Russia.

The preparation of this goal-oriented Programme was preceded by a long period during which digital cartography matured in our country, and in this process a number of stages should be distinguished.

1. Theoretical studies, which did not extend beyond the framework of faculties and laboratories of educational institutions and research institutes, were directed towards the search for possibilities of using computer technology in conventional cartography (from the beginning of the '60s to the mid-'70s).

2. Production of digital maps for use in the military field (from the late '70s onwards).

With these ends in view, first generation technology was developed and production of digital topographic maps was started. The technology depended on domestic computers and peripherals (devices for manual and semi-automatic digitization of metrical measurements of objects and keyboard input of semantics). This technology is described in a series of articles in the journal *Geodezia i Kartografiya* of 1989. During these years some specific problems were solved in principle, relating to the specific nature of cartographical representation and the contents of maps, properties of cartographic information, devices for the digitization of maps, and of the tasks of the operator in an automated cartographic system.

Proceeding from this, requirements for digital terrain models (DTM) and their normative basis in the form of directive documents, logical instructions, classifiers for the coding of the metric and semantic components of cartographic data, and the format of storage of DTM within the aggregate of databases were developed.

This technology, methods of digitisation of cartographic information (CI) and its processing by computer were in effect equal to advanced technologies of that period. Amongst these methods the following deserve special attention:

- parallel input of metrical measurements and semantics, which takes into account such factors as the large volume of digitised data and the necessity to minimise software intended for the processing of digital cartographic information (DCI);

- compacting of metrical measurements of DCI with the fan method;
- taking into account the deformation of cartographic materials;
- cutting and joining of DCI;
- control of DCI of the terrain by profiling;
- attaining topological adequacy of digital maps to maps which were used in creating them;
- presentation of digital data on the terrain both in the matrix and linear contour form and other forms.

These methods are described in detail in *Cifrovye karty*¹.

3. The creation of digital maps in the interests of the national economy (since 1992). The characteristic features of this period are:

- a. the start of the possibility to create digital maps with the help of advanced -mainly foreign- computer technology and software;
- b. the expansion of contacts in the field of computer technology and digital cartography between Russian specialists, representatives of well known State organizations and private firms;
- c. the creation of domestic technology for the production of digital maps of the 2nd (manual digitising with PC's) and 3rd generation (scanning of printed maps and automated identification of CI);
- d. the development of goal-oriented GIS on the basis of already existing databases of digital maps on the scales 1:200,000 and 1:1,000,000, and the development of technologies for the production of digital topographical plans;
- e. the appearance, parallel to the state GIS centres, of some one hundred small businesses -and their number continues to grow- which specialise in the production of digital maps and their use in different GIS.

It should be mentioned here that the third stage resembles a boiling cauldron, which contains organisations acting in the sphere of digital cartography, which greatly differ in their potential and purposes. On the one hand there are federal centres for GIS which are well provided with software, technology and qualified staff. On the other hand there are mostly small private firms which are well equipped with the necessary hard- and software. However these latter produce digital maps which are not compatible with each other and with the digital maps of production centres which are part of the Federal Service for Geodesy and Cartography. Moreover, many of these firms do not possess a licence which would permit them to do this kind of work.

¹ Zdanov, N.D., E.A. Zalkovski and E.I. Halugin: *Cifrovye karty*, Moscow, Nedra Publishing House, 1992.

Undoubtedly the main generators of high quality digital cartographical production are the state centres for GIS. Thus the Research Centre 'Rosgeoinform', regardless of its 'youth', is coping successfully with the solution of the following problems:

- the production of digital maps at the scales 1:200,000 and 1:1,000,000;
- working out methods and technologies for the creation of digital and electronic maps of different scales and for different purposes;
- the development of standards for storage of digital maps and exchange with users;
- the development of conversion programmes to make distribution of domestic digital maps possible through more widely accepted international exchange standards;
- the development of GIS to be used on regional (ecology) and municipal (land registration) level.

The centre is equipped with modern computers, domestic and foreign software, and produces digital maps of the 2nd and 3rd generation. It employs more than 200 specialists, including cartographers, mathematicians, programmers and electronic engineers. Currently 'Rosgeoinform' is participating with Canada and Finland in two international projects connected with the creation of GIS.

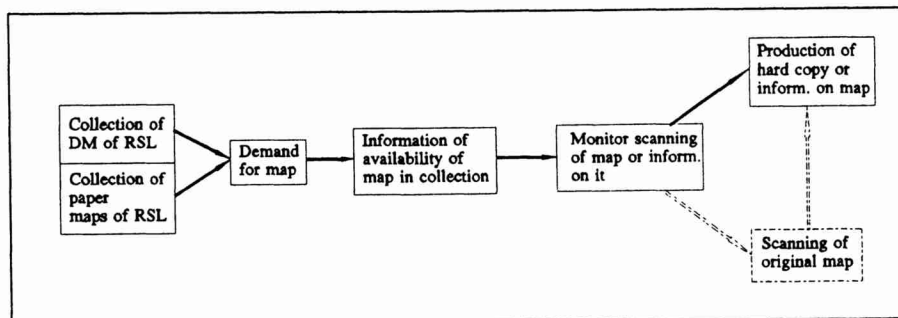
About half of the leading producers of GIS have a presence in Russia. Among them are the two main world competitors: ESRI -which has some 100 users- with ARC/INFO and Intergraph with its line of MGE products. Amongst domestic products for GIS, 'MAG system', developed with the Geographical Faculty of the University of Moscow, 'Geo Draw' and 'Geographist' of the Centre for Geo-Information Research of the Geographical Institute of the Russian Academy of Sciences should be mentioned. These products, as subsystems of GIS, evoke the interest of specialists since they help solve some separate and specific problems.

Scientific conferences, exhibitions and specialized periodicals influence the development of the GIS field in Russia. Thus, in the past 2 years, over 10 conferences on various aspects were held. Most important were the conference and exhibition marking the 75th anniversary of the Principal Geodetic Department of the RSFSR (which now has been merged with the Federal Service for Geodesy and Cartography of Russia), the annual international exhibitions of information sciences, *InterKarta - GIS for Research and Map Production for the Environment* (organized by the Chair of Cartography and Geoinformation of the University of Moscow, 23-25 May 1994), and the all-Russian forum *Geo-Information technologies- Management, Nature Management, Business* (Moscow, 6-11 June 1994). New journals, like the Russian-American weekly *Computerworld*, the newspapers *Open Systems Today* and *Soft Market* have started to appear. The number of articles dealing with geo-information, published in the journal *Geodesy and Cartography*, is growing constantly.

Through a decree by the government of Russia the 'Interdepartmental Committee on Geo-Information Systems' was created in spring 1994. In this way adequate prerequisites for the introduction of possibilities for automation and information technology in different spheres of economy and culture, including librarianship, are available in Russia. Libraries represent the channel through which digital maps, which are usually available only to a narrow circle of users, can find a much wider audience. At present our department is not yet ready, in terms of technology, to introduce digital maps into the readers' service. The available hardware -PC 286- does not permit the adequate demonstration of digital maps; it can display only advertisement reels. However, we are now looking into new possibilities, which will allow us to improve the service to users and promote interaction of the library with other cartographical collections, both domestic and foreign. The fact that the number of digital maps, produced by different organisations, is quickly growing is taken into account.

The digital map of Russia (1:4,000,000) by the Research Centre 'Rosgeoinform' has been published, and the digital map of Moscow (1:20,000) by the joint-stock company 'Resident' has appeared on the market. Thematical digital maps, produced by the State Centre 'Priroda', the Main Research Centre 'Roskomnedra', and the commercial firm 'Geocentre', etc. have been published.

The Russian State Library in Moscow is now actively working on the conception of introducing automated means into the Cartographical Department and its collection. First we will create an electronic catalogue, which will provide access to 250,000 maps and atlases. In the next stage we propose to create a database of map sheets (or their fragments) and develop methods to make them available to users for monitor scanning and for the production of hard copies. In this way the following scheme can be realized:



We intend to cooperate with state and other organisations, which have digitising technology and the necessary staff, and which are ready to make digital maps in keeping with the appropriate requirements, and thus create a digital database of the map collection of the Russian State Library (RSL). When the requested map is lacking in the collections of the RSL, the user is given information on other collections in which the given map may be present. Undoubtedly in future, the databases and the workstations for users will be united into a local area network, and later, maybe, into a distributional co-operative network. Finally, the conception of automation of the cartographic collection of the RSL envisages the creation of the *Map Collection of the Russian State Library GIS*.