

**United Nations Expert Group Meeting on  
Contemporary Practices in Census Mapping and  
Use of Geographical Information Systems  
29 May-1 June 2007  
United Nations, New York**

**Digital Mapping for the 2001 Population Census in Ukraine: Lessons learned\***

Prepared by

Anatoliy Lyashchenko  
Research Institute of Geodesy and Cartography,  
Lyubov Stelmakh  
State Statistics Committee of Ukraine  
Ukraine

---

\* This document is being reproduced without formal editing.

## Digital Mapping for the 2001 Population Census in Ukraine: Lessons learned

### Introduction

2001 Population Census was specific in the history of Ukraine. It is the first national census of the population in Ukraine since the previous one was carried out in 1989, before the proclamation of independence of Ukraine.

The objective of the first All-Ukrainian population census was to obtain real information about the fundamental changes that had taken place in the socio-economic system of the independent Ukraine, to create the information base of demographic and socio-economic data about the number of the population, its nationality, language and family composition, its distribution by age, gender, citizenship, education, sources of livelihood, occupation, social status, migratory activity, etc. both for the country as the whole and its administrative and territorial divisions.

For Ukrainian statistics it was a complicated assignment to achieve the mentioned above goals, taking into account that:

- it was the first national census of the population in the independent Ukraine and the national methodological, juridical, institutional and technological basis had to be created in a short period of time to run such a large-scale project;
- the census object was the country with the area of more than 603 000 sq km, 30 000 cities and the population of about 50 million
- for Ukraine, it was a transition period of independence formation and socio-economic reforms (such as land reform, administrative-territorial reform, legal reform etc).

The State Statistics Committee of Ukraine (SSCU) accomplished the preparation work and 2001 Ukrainian population census conducting, together with specialists of National Academy of Science, numerous scientific institutions and social unions, executive authorities and self-government, international organizations and statistical offices of other countries. The State Statistics Committee of Ukraine had continual support from numerous international organizations such as United Nations Statistics Division (UNSD), United Nations Population Fund (UNFPA), Statistical Division of United Nations Economic Commission for Europe (UNECE), United Nations Office in Ukraine and also statistical offices of other countries. Cooperation with statistical offices of Sweden, Great Britain, Germany, Canada, USA enabled us to use the best experience of world statistical practice in the development of laws and other regulatory documents, questionnaire methods and computer-aided system for information processing, methods and ways to distribute the obtained results.

Owing to the high level of organizational work, continuous support of state authorities and self-government bodies, international partnership and the application of the modern informational technologies, the first All-Ukrainian population census was successfully conducted.

The ukrainian and international experts, in the sphere of population, positively evaluated the results of 2001 All-Ukrainian population census. The state and international experts in the sphere of population positively evaluated the results of 2001 All-Ukrainian population census. These results are fully described in a monograph (*SSCU, 2004*), its electronic version is available in English at a special web site dedicated to the results and materials of 2001 census <http://www.ukrcensus.gov.ua/>.

This paper briefly describes such main aspects as:

- mapping in 2001 census;
- using the information technologies and GIS in processing and distribution of the results of 2001 census;
- development and realization of the strategy for wide implementation of digital maps and GIS in practical work of State Statistics Committee of Ukraine, including the preparation for 2011 census;
- integration of the data of State Statistics into the Ukraine National Spatial Data Infrastructure (UkrNSDI).

### **1. Mapping and using the GIS in 2001 census**

According to the classification of levels of digital maps and GIS usage in census, given in *Manual (United Nations, 2000)*, All-Ukrainian population census could be considered as transitional level, which is characterized by the following technologies at certain stages:

- 1) Using traditional methods, papers maps and plans to create schematic address plans and to delineate enumeration areas at preparation stages of the census.
- 2) Using the computer-aided system “Census-2001” for initial census data processing, control, encoding, generalization and storing of the census data.
- 3) Using GIS for mapping of the results of census, for creation of statistical interactive electronic maps, and for distribution of the results of work on CD and via Internet.
- 4) Using the created mapping materials to form geospatial database and to prepare large-scale implementation of GIS in the next census.

This approach was determined by the following reasons:

- absence of necessary digital maps for the most of urban area;
- the maps and plans of most settlements out of date since they were created in the late 1980s;
- in the early 1990s, after the declaration the Ukrainian independence, a lot of settlements and streets were renamed;
- administrative and land reforms led to changes in borders of settlements and administrative units;
- economical problems are of the transition period and socio-economic reforms interfered with the process.

Therefore, creation of the full list of settlements, delimitation of the borders of administrative units and putting in order the names of streets, the numeration of the blocks, houses, flats, updating of mapping materials and census enumeration areas of the whole country was the primary goal of 2001 census preparation. At this stage, about 2 460 census maps and schemes were updated, including 1 971 schematic plans of towns and villages, 489 maps of districts. Schematic plans were created on the base of topographical foundation with scale 1:5 000 or 1:2 000 and were approved by Inspection of the State service of geodesy, cartography and cadastre. A total cost of this work was \$1,4 million. Beside this, house lists in each block in and large villages were created. A total cost of this work was \$1 million and it took 20 workdays. 9 500 workers in cities and 1 300 workers in large villages were involved in this work. Average working load on each registrar was 23 houses per day in cities and 29 houses in large villages. It is significant, that while creating the blocks’ lists registrars simultaneously specified schematic address plans. The total number of persons involved in 2001

census was 248 666, including: deputy chiefs of district statistical offices – 676; heads of census departments and their assistants – 10 972; instructor-inspectors – 51 032; enumerators – 185 986 persons. These numbers show the range of All-Ukrainian 2001 population census, highlighting the complication and importance of preparation, organization and methodical work, as well as recruiting and training of the personnel for successful census realization.

The computer-aided system “Census-2001” ensured the high-level computer data processing of the filled census forms: scanning, making electronic copies of the forms, automatic recognition, verification, encoding and 2001 Census database formation with generalization of the data for census areas, towns, villages, village communities, districts, regions and whole country. An important factor of high quality Census-2001 database was development and implementation of the unique system classification and encoding of basic attributes in census datasets which includes: Classifier for Administrative-Territorial Units of Ukraine (C ? ? ? UU), Classifier of economic activity types, Profession classifier which were harmonized with international standards; Classifier of nationalities and languages, reference books for education level determination and others.

Using the unique C ? ? ? UU code in 2001 census datasets and digital maps of administrative units of Ukraine was essential for spatial reference of census results. It enabled us to effectively use the digital maps, produced by State service of geodesy, cartography and cadastre enterprises, to design thematic maps using GIS according to different census indicators. It also conditioned integrated usage of GIS, electronic census datasets and digital maps by end-users for spatial modeling in scientific and applied decision-making.

A good example of census data and digital maps integration usage is geospatial modeling of different variants of administrative division in the process of administrative and territorial reform in Ukraine. At this modeling, the geospatial demographical indicators were used in combinations with other socio-economical indicators (manufacturing allocation and resources usage, housing provision, access to services of transportation, education, health care and others).

According to the program of distribution of All-Ukrainian 2001 population census results about 20 printed and electronic collections on CD were prepared and published, special website of All-Ukrainian 2001 population census was created (<http://www.ukrcensus.gov.ua/>). There we can find electronic tables with census results, methodical census documentation and information about census results publication. Statistical datasets, graphical diagrams and interactive electronic maps are used for census results presentation on CD. This ensures graphical representation of the data and makes electronic data collections a tool for geographic analysis.

## **2. Learned lessons and realization the strategy of large-scale GIS implementation**

Census datasets integration with digital maps enables the statistical offices to increase the services capacity, to provide actual geospatial statistical data and represent them as interactive electronic maps on CD and via Internet. Cooperation of State Statistics Committee of Ukraine and State Service of Geodesy, Cartography and Cadastre in this area, was useful for these both institutions as well as for users of their product. It is determined by the following main factors:

- geospatial statistical data turn into to one of the major informational resources for e-government systems, where GIS is a prime component;
- digital maps, integrated with statistical data, become geospatial database for spatial analysis and modeling within GIS rather than a simple background map;
- users obtain informationally compatible geospatial datasets which could be used directly in their applications.

At the same time, with the growth of the number the users of geospatial statistical datasets, there arises a problem of maintenance of different software (different database systems and GIS tools).

To solve the problem there should be developed standards for digital representation and formats of geospatial data exchange.

One of the most important conditions for successful application of GIS by statistical institutions in preparing and carrying out census is availability of updated digital address plans of the residential areas. For Ukraine it means about 1 342 cities and 28 562 villages. The development and maintenance of such a number of digital plans in the modern information technology society should be considered a national goal. Digital plans have numerous applications and enable us to apply GIS widely in such important spheres of city-life as land cadastre, planning of social, medical, educational and utility services, dealing with emergencies and others. To create and update the digital plans of the areas it is necessary to establish the corresponding institutional, normative and technologic base.

The solution to this task, as well as the mentioned above task to develop standards for data representation and data exchange, relate to the general problem of NSDI formation. Statistical institutions are the key participants in the process of establishing of NSDI and its stable functioning as they:

- are interested in availability of digital plans and maps of good quality, which can be used in GIS, for preparation and census conducting and other demo-social investigations;
- are the main suppliers of the official information concerning different aspects of the life of the society, the condition of the economy and the environment.

Thus, State statistics committee of Ukraine and State service of geodesy, cartography and cadastre (one of the main program coordinator of UkrNSDI creation) have established a close partnership to develop GIS in statistics and to integrate statistical data and basic geospatial datasets of UkrNSDI. In compliance with the developed strategy of GIS introduction in statistical institutions the following projects were realized in 2005-2006:

- the guide for creation of the geospatial data for census GIS, including digital address plans, was developed;
- the digital maps of administrative units over the whole of the territory of the country to a scale of 1 : 200 000 were created, including the borders of all the town, villages, districts, and regions;
- an alpha-version of GIS for census delineation with usage of the administrative system digital map and address plans was developed;
- digital address plans for 40 biggest cities in the country were created;
- within the preparation work for 2011 census there were carried out a pilot project of GIS implementation in census delineation as a micro-census;
- within the project “Assistance to State Statistics Committee of Ukraine” of the Department for International Development (DFID) of Great Britain the Ukrainian specialists developed a software complex SIMAP for preparing and publishing the statistical electronic interactive maps in Scalable Vector Graphics (SVG) standard format (W3C, 2004);
- electronic maps in SVG format for each region of the country with city and district borders were created for presentation of statistic interactive electronic maps on CDs and on the Internet.

The results of these projects enable us to apply GIS more widely while preparing for 2011 Census in Ukraine.

Among the listed results, it is important to mention that the SIMAP complex is oriented to applying the open specifications of SVG standard and the freely available software Adobe SVG Viewer (Adobe, 2004), which allows publishing quality statistical interactive maps on the Internet. The main JavaScript-functions of SIMAP complex maintain the following functionally connected components of a cartographic web-page:

- electronic SVG-map with the administrative units of the country available for interactive selection;
- list of the administrative units, shown on the current map;
- range diagram, whose columns correspond to selected statistical indicators for the administrative units, which are ordered in accordance with the increase of the value of the selected indicator;
- linear graphs which represent the change of the value of a selected indicator over a period of time for the administrative units;
- colour legend of a thematic map for the values of the current indicator depending on the selected classification method, number of classification levels and colour scheme.

In the SIMAP complex there are three types of the statistical dataset: SIMPLE dataset – one or a few indicators at a certain time; SIMPLE/TIME dataset - one indicator changing over some periods of time; GROUP/TIME dataset- a group of indicators over some periods of time. For the representation of statistical datasets at a cartographical server two types of files in XML format are used:

- metafiles for typical themes of statistical datasets (one file for each theme);
- statistical dataset files (one data file for a certain theme for each cartographical object with indicators for regions).

A metafile contains: name of theme, theme type's code, the number of indicators at the set and the list of the names of indicators. A dataset file contains rows for each administrative unit with the code of the region or subregion, and values of indicators.

Even this brief description shows that the SIMAP complex has a simple structure of informational content, maintains types of object classification (equal intervals, geometric progression, equal frequency, standard deviation and clusters.), maintains interactive electronic maps, graph diagrams and data tables. Such an approach, in our opinion, could supplement the well-known geographical information system PopMap (United Nations, 1997) as an effective tool for representation and distribution of the statistical data in the form of interactive electronic maps on the Internet.

## **Conclusion**

In Ukraine 2001 census, digital maps and GIS were used at the final stage of the census data processing for thematic maps creation and also their presentation and distribution in the form of interactive electronic maps.

The settlements' address plans updated during 2001 census became a good source for digital plans in preparation for 2011 census.

We gained good experience in the state statistics and mapping offices cooperation in applying GIS into statistical practices and integrating the statistical data into NSDI.

The software complex proved to be an effective means in formation and distribution of the statistical data in the form of interactive electronic maps in SVG format.

## References

- (2004) *Adobe SVG Viewer* Download Area. – <http://www.adobe.com/svg/viewer/install/>.
- (2004) *First All-Ukrainian population census 2001: historical, methodological, social, economic and ethnic aspects* / Authors Vlasenko N. S., Libanova E.M., Osaylenko O.G. and others; State Statistics Committee of Ukraine; Institute of demography and social research of National Academy of Science in Ukraine. – Derzhkomstat Ukraine. – 558 p. .
- (2000) *Handbook on Geographic Information Systems and Digital Mapping* (ST/ESA/STAT/SER.F/79), Department of Economic and Social Affairs Statistics Division. United Nations, New York. – 197 p.
- (1997) *PopMap – Users' Guide and Reference Manual*.  
([www.un.org/Depts/unsd/softproj/index.html](http://www.un.org/Depts/unsd/softproj/index.html))
- (2004) *W3C, Scalable Vector Graphics (SVG) Full 1.2 Specification*: <http://www.w3.org/TR/SVG12>.

*Paper prepared by*

*Prof. Dr. Anatoliy Lyashchenko (Research Institute of Geodesy and Cartography/ Deputy Director),*

*69, Chervonoarmiyska Str., Kyiv, 03150, Ukraine*

*Fax: (+380 44) 2493453*

*Email: [lan@ndiasb.kiev.ua](mailto:lan@ndiasb.kiev.ua)*

*Lyubov Stelmakh (State Statistics Committee of Ukraine/Administration of Statistics of Population/chief)*

*3, Shota Rustaveli Str., Kyiv, 01023, Ukraine*

*Fax: (+380 44) 234-05-53*

*Email: [l.stelmakh@ukrstat.gov.ua](mailto:l.stelmakh@ukrstat.gov.ua)*