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COMMISSION DE STATISTIQUE et COMMISSION ÉCONOMIQUE POUR L'EUROPE
CONFÉRENCE DES STATISTICIENS EUROPÉENS

Quarante-septième réunion plénière
(Neuchâtel, 14-16 juin 1999)

RAPPORT DE LA RÉUNION DE TRAVAIL SUR LES SYSTÈMES D'INFORMATION GÉOGRAPHIQUE (SIG)

Note du secrétariat

1. La réunion de travail s'est tenue du 5 au 7 octobre 1998 à Ottawa (Canada), sur l'invitation de Statistique Canada. Y ont participé les représentants des pays ci-après : Allemagne, Autriche, Belgique, Canada, Danemark, Espagne, Estonie, États-Unis, Finlande, France, Irlande, Italie, Lettonie, Norvège, Pays-Bas, Royaume-Uni, Suède et Suisse. L'Union européenne était représentée par Eurostat.

2. La réunion a été ouverte par M. Gordon Brackstone, statisticien adjoint en chef de Statistique Canada, qui a accueilli les participants en leur souhaitant le plus grand succès dans leurs travaux et un agréable séjour à Ottawa.

3. L'ordre du jour provisoire a été adopté.

4. M. Tim DAVIS (Canada) a été élu Président et M. Dick MEULDIJK (Pays-Bas) Vice-Président.

5. Les participants ont examiné les thèmes ci-après :

a) Enquête sur l'utilisation des SIG dans les services de statistique;

b) Recherche en science de l'information géographique;

c) Intégration des statistiques et de la géographie;

d) Aspects communs des applications des SIG dans différents domaines d'étude;

e) État d'avancement des projets GISCO et SIRE d'Eurostat;

f) Questions de politique en rapport avec la mise en application des SIG;

g) Supports méthodologiques.

6. Les débats ont été animés par les intervenants suivants : M. Dick MEULDIJK (Pays-Bas) pour le thème a); Mme Randy FUSARO (U.S. Bureau of the Census) pour le thème b); M. Tim DAVIS (Canada) pour le thème c); Mme Margaret WAGGET (Royaume-Uni) pour le thème d); M. Gilles DECAND (Eurostat) pour le thème e); et M. Dick MEULDIJK (Pays-Bas) pour les thèmes f) et g).

7. Les différents thèmes ont été examinés sur la base de 24 communications et de 8 exposés présentés par l'Allemagne, l'Autriche, la Belgique, le Canada, l'Estonie, les États-Unis, la Finlande, l'Italie, la Norvège, les Pays-Bas, le Royaume-Uni, la Suède, la Suisse et Eurostat.

8. Les pays et organisations ci-après avaient été sollicités pour établir des communications :

- thème a) : Canada,
- thème b) : États-Unis,
- thème c) : Canada,
- thème d) : Royaume-Uni,
- thème e) : Eurostat,
- thème f) : Eurostat et Pays-Bas,
- thème g) : Estonie, Finlande, Royaume-Uni et Suède.

9. Les participants ont recommandé qu'une nouvelle réunion de travail sur les SIG soit organisée du 28 au 30 avril 2000 afin d'étudier les sujets suivants :

i) Gestion des bases de données spatiales et entreposage des (géo-) données;

ii) Solutions Internet et Intranet;

iii) Questions de politique et d'organisation liées aux SIG et aux statistiques;

iv) Analyse spatiale dans un contexte statistique et procédures de contrôle de la divulgation des données;

v) Démonstrations;

vi) Enquête sur l'utilisation des SIG dans les services de statistique.

10. Les participants ont rendu hommage à Statistique Canada pour son hospitalité et l'excellente organisation de la réunion, et ont chaleureusement remercié les organisateurs.

11. Le rapport de la réunion a été adopté à la séance de clôture.

12. Un résumé des principales conclusions formulées par les participants au cours des débats sur les différents thèmes de l'ordre du jour est présenté en annexe (en anglais seulement).

ANNEX

SUMMARY OF THE MAIN CONCLUSIONS REACHED AT THE MEETING

Note by the secretariat

A. Survey on GIS use in statistical offices

1. The consideration of this agenda item was based on the analysis of *Questionnaires on the implementation of GIS in Statistics* completed by countries in 1998. It is a continuation of a Survey on GIS use in statistical offices conducted in 1993 and 1997.

2. The participants agreed that there is a great similarity in GIS areas of statistical applications, technologies used and trends in integration of data sources. Challenges still remaining include the cost of GIS information and its monopolisation. The opinion was also expressed that providing good training opportunities for staff involved in GIS applications is extremely important. Participants recommended to continue with the survey in future. It was mentioned that it would be desirable in future to create interactive possibilities for the database of GIS survey maintenance for countries.

3. Furthermore, it was recommended to draw more attention in future to the issues associated with standardization, metadata, and new methodological solutions for integration of statistics and geography.

B. Research in geographical information science

4. The overview of research in geographical information science in the United States was presented by David M. Mark, Professor of Geography at the University at Buffalo. Among the priorities in GIS research, the following were mentioned: spatial data acquisition and integration, distributed computing, extension of geographic representation and analysis to three-dimensional and dynamic information, spatial analysis in a GIS environment to identify problem causes and solutions, and developing the National Spatial Data Infrastructure.

5. Research in data acquisition and integration aims at finding ways to reduce acquisition costs, to automatically integrate new data with existing data, and to facilitate analysis of data from diverse sources. The studies associated with distributed computing deal with the possibility of incorporating GIS functions as modules in distributed computing environments. Research is also needed to extend existing GIS applications to larger and more complex datasets and to connect the analytical techniques used in other fields to the GIS environment.

6. GIS offers a great potential benefit to society. Therefore, among the first priorities are exploration of how to guide the development of GIS towards maximum equity, efficiency and effectiveness, and the impact of GIS

technology on society.

7. The participants were encouraged to seek further information on research in geographic information conducted in the USA on the Website of the US University Consortium for Geographic Information Science at the following address: http://www.ucgis.org.

8. Some participants noted that the strong belief in GIS of decision-makers in USA responsible for GIS applications could be a good example for other countries.

C. Integration of statistics and geography

9. The invited paper on this topic focused on the geographic dimension of statistical data and its role in economic and social development. The functionalities that are specific to statistics and geography were discussed, together with the possibilities and limitations of their integration.

10. The integration of statistical data via GIS often calls for the harmonization and integration of both statistical and geographical concepts, definitions and classifications.

11. The discussion showed that the building of a basic geographical infrastructure still represents a major undertaking for many countries. Some countries reported difficulties in integrating GIS into the existing statistical production process and the lack of managerial support. It was also mentioned that GIS is sometimes regarded as too technical. One of the possible reasons could be that GIS has been more frequently demonstrated as a publishing tool than as a tool to facilitate statistical analysis.

12. It was also pointed out that GIS is sometimes more easily accepted and implemented in transition countries than in developed countries. This is because the integration of GIS and a geographic framework with the statistical system from the very beginning is easier than its incorporation into an established statistical system.

13. The discussion showed that pricing of geo-statistical products is still a very important aspect of the integration of GIS and statistics. Examples of pricing approaches reported by Canada and Switzerland demonstrated that it is possible to increase revenues from sales of geographic information while decreasing prices.

14. A frequent problem when integrating statistical data from different sources is the existence of many different geographic boundary sets which do not correspond. This problem is compounded by frequent changes to the boundaries themselves. These different, and changing, boundaries require a continuous re-casting or conversion of statistics into other geographical units to permit comparison and analysis. Countries are attempting to establish smaller "building-block" units to facilitate such geographic conversions.

15. The important issue to be solved when integrating statistical and geographical data is the implementation of the spatial reference base. The two major solutions presented at the Work Session were a point-based approach and a polygon-based approach. The choice often depends on the national administrative structure in the given country. The referencing strategy has to enable the production of accurate, flexible outputs under conditions of an ever-changing geography.

16. The demonstrated examples of the use of GIS to integrate statistical and geographic data in many countries provide evidence of the value of this approach. The usefulness of the compilation lies in its abilities to link together different data sets on the basis of common location, to highlight the spatial perspective of the statistical data, and to enable visualisation and analysis of relationships amongst data themes. The added value benefits include greater flexibility in producing outputs and responding to change, production of non-standard outputs, enabling ad hoc enquiries, and the construction of spatial and statistical models for visualising, analysing and interpolating data.

17. Furthermore, some countries reported that GIS facilitates improvements in data collection operations both for Censuses and sample surveys. Improvements to address lists and integration of data from administrative registers lead to more accurate coverage lists and better sampling frames.

18. Some participants mentioned that although many barriers to the integration of geographic and statistical data still remain, the power and utility of GIS is rapidly spreading to less technical users. Geographic data are more widely available, both from public and private sources, and users can access simple GIS software via the Internet.

D. Common aspects of GIS applications in different subject-matter areas.

19. The meeting discussed the use of GIS in a wide variety of statistical domains. These include land-use statistics, crime analysis, population census, and ensuring data confidentiality. Several applications deal with public sector policy and programs, such as GIS applications in health, agriculture, communications, economics, emergency preparedness, and socio-economic and municipal planning.

20. It was noted that for numerous tasks in public administrations, geographic data has become an important part of decision processes. Being able to combine geographical, demographical and other non-graphical statistical data increases the quality of statistical analysis and spreads the spectrum of final users. The documentation submitted for the meeting proves the feasibility of combining GIS and statistics for different purposes.

21. The discussion revealed several common aspects in the implementation and use of GIS in different areas. The design of the GIS applications and software, standardization, problems with data availability, quality and cost, the increasing demand for geo-referenced statistics, especially for small

areas, and the associated confidentiality problems were highlighted in the discussion.

22. There is a large pool of geodata already collected and often several geo-data sources can be considered. To avoid overlapping with official mapping bodies, the integration of existing maps is preferable. However, due to their variety, data are often spatially distributed and fall under the responsibility of different data providers. It was noted that this results in difficulties for users to access the data, and there is a lack of a common European "market place" between the producers and users of geographical data.

23. Another important trend is a closer cooperation between public and private sectors in the development of common spatial data infrastructures. This reduces the costs of data set creation and increases the value of data through standardization. Furthermore, it requires the development of standardized data transfer formats and tools.

24. The major obstacles to the broader use of geo-data in statistics are similar in many areas. These include: a) lack of awareness of existing geo-data; b) lack of co-ordination with National Mapping Agencies and other official mapping bodies; c) lack of efficient and user-friendly data interchange and communication procedures; d) redundancy in data acquisition and data storage; e) insufficient data maintenance; f) lack of guidelines for meta-information; g) highly variable prices; h) copyright problems.

25. Another common problem is the quality and availability of digital geo-data. It would be desirable to compile data directories with information on all the available digital and geocoded spatial data, and on its quality. In addition, tools are needed to collect, disseminate and evaluate this information. There is also a need for a comprehensive metainformation system into which GIS functionality would be integrated.

26. A common aspect considered was the availability of software tools permitting the implementation of GIS applications in different areas. It was noted that there is a lack of tools for the interchange of spatial data, enabling the linkage of various GIS, geo-data formats, geo-viewers and application areas. Some participants mentioned that in many cases it might be more efficient to link the existing statistical and GIS packages rather than to develop new software.

27. Several participants identified a growing awareness of the value of spatial analysis within their organizations. Although experience in the use of spatial analysis software is only now developing, there is a clear need for further work and discussion in this area.

28. Concerning the spatial analysis software, the US representative informed the Work Session about two reference sources for spatial data analysis development in the US. Information about SPACESTAT, an extension to ArcView that enables the use of advanced spatial statistics, can be found at the following Internet address: www.rri.wvu.edu/spacestat.htm. The other reference

source is the software for spatial and temporal analysis of crime (STAC) developed by the Illinois Criminal Information Agency: ww.acsp.uic.edu/icjia.htm.

29. A possible development that would render GIS technology more accessible to a wider group of users is the implementation of GIS servers on Internet. Such servers could be developed in cooperation with different agencies. In this connection, there would be a need for a centralized infrastructure and maintenance of geographical data ensuring data harmonization across large volumes of distributed data sets.

30. The increased data availability and software has resulted in an increased demand for statistical data for small areas. These data can play an important role in many subject areas, e.g. land-use, environment, regional planning. There are often statistics on rural areas as a whole, but not many detailed statistics on regional levels that could be applied in the planning, developing, auditing or evaluation of agricultural and rural programmes.

31. In order to meet this demand for local and updated statistics, some countries are moving towards a more effective use of administrative archives for statistical purposes. GIS offers a great potential for linking several administrative registers via spatial reference. When local statistics are obtained, confidentiality is a further obstacle, and data cannot be released without some protection strategy. Again, there is a need to develop effective disclosure control procedures to be used in parallel with small area analysis via GIS.

E. Progress in GISCO and SIRE projects conducted by Eurostat

32. Eurostat reported on the progress made in the two projects: Geographic Information System of the Commission (GISCO) and European Infra-Regional Information System (SIRE). The major goals of GISCO are to set up a reference database for the Commission, to promote georeferencing of statistics and to encourage the integration of GIS in national statistical offices. The GISCO project structure and the related policy issues were presented. Progress in the major GISCO activities, i.e. GISCO reference database, data acquisition, map production, spatial analysis, desktop GIS and data dissemination was reported.

33. The aim of SIRE is to meet the growing demand for local (municipal or equivalent) data inside the European Union. The objectives of the project are to improve the availability, comparability and accessibility of local data at the European level; to set up a centralized local database, and to expand the Nomenclature of Territorial Units for Statistics (NUTS) by creating and managing two supplementary levels: NUTS 4 and NUTS 5.

34. GISCO and SIRE are linked via NUTS codes. The aim of the NUTS nomenclature is to provide a uniform breakdown of territorial units for the production of regional statistics in the European Union. Different criteria can be used to subdivide national territory into regions. The NUTS

nomenclature is based primarily on institutional divisions.

35. Very important and at the same time often difficult in the context of NUTS is to keep track of the changes over time and to be able to recreate the nomenclature in effect at any specific date. The first 3 levels of NUTS are relatively stable and do not require any automated procedure. The development of the system has necessitated the assessment of the frequency and volume of changes to boundaries, and to develop a system of managing the NUTS nomenclature over time. The system must permit the definition, collection and storage of variables that can be used for implementing and evaluating EU regional policies, and must also delimitate functional areas (e.g., employment areas, urban areas).

F. Policy issues dealing with the implementation of GIS

36. The invited paper concentrated on the policy issues related to the design and implementation of GIS in statistical offices. The organizational obstacles to the more efficient use of GIS in statistics were discussed, e.g. lack of coordination between different agencies. The discussion considered organizational approaches on two different levels: on the supra-national level (Eurostat) and on the national level.

37. Eurostat informed the Work Session about the INFO 2000 program developed under the 4th Research Framework Programme of the European Union. The Draft Communication from the Commission to the Council of Ministers and Parliament (GI2000) was also presented. It analyses the structure of the market, identifies the main players and suggests a series of activities to be undertaken at the European level to create a specific European structure for geographical information.

38. From an organizational point-of-view, the implementation of GIS at a national level in a statistical institution is a complex issue. It poses high demands for the hardware infrastructure, and it is often necessary to incorporate the basic datasets from external sources and to integrate isolated GIS-related activities. It was pointed out that awareness at the highest managerial level is needed.

39. There is a growing need for increased coordination of activities between national government, statistical and other agencies (including private ones) in GIS-related programs, and to ensure that the outcome of these activities is appropriate to address social needs. GIS will play an important integration role in this respect. The ownership of digital geographic data, protection of privacy, access rights to the geographic data compiled and held by governments, and information liability require clarity in the new, automated context. Data warehousing will become extremely important.

40. Common opinion was expressed that the future development of GIS in statistical offices should also focus on its use for statistical data input and analysis. It was noted, however, that GIS will continue to play an important role in data dissemination. The implementation studies indicate that

the problems to be solved are more organizational than technical in context. Introducing new types of tools and data often requires a major reorganization of activities which can be dealt with in the main by using organizational and management skills.

41. It was pointed out that the role of GIS specialists will change from technical assistance towards client-oriented services and consultancies.

42. The increasing amount of data which can be used in GIS analyses has created more interest in geographically located data and poses a challenge to explore the confidentiality restrictions in its release to general public. Specific policy guidelines are also required for the processing of remotely sensed data.

43. Another important policy issue is the use of standards in the implementation of GIS. In this respect, an overview of the activities of the ISO Technical Committee 211 (TC 211) was given. The TC-211 deals with standardization in the field of digital geographic information. The work aims to link appropriate standards for information technology and data where possible, and to provide a framework for the development of other sector-specific applications using geographic data.

G. Methodological materials

44. The Work Session discussed progress with the two methodological materials prepared on recommendations by the previous Work Session on GIS. These are: *Study on register-based statistics in relation to GIS and geography* (Estonia and Sweden) and *Guidelines for statistical thematic mapping* (Finland and United Kingdom).

45. The *Study on register based statistics* provided an overview of integrating data from administrative registers via a point-based geographic reference. Examples of using the method in Sweden and Estonia were given. Among the advantages of a register-based system can be mentioned the richness of data available in different registers (e.g. population register, business register), and the provision of the most up-to-date data. The differences between point-based and area-based statistics were also considered.

46. The meeting was given information about the progress of work in developing the Website on statistical thematic mapping, prepared jointly by the Office for National Statistics (ONS), United Kingdom, and Statistics Finland. The Website corresponds to the methodological material *Guidelines for statistical thematic mapping*. Making use of the interactive possibilities of the Internet, it will be the main source for the guidelines on how to use thematic mapping. By browsing through the site it will be possible to work through a whole series of text files and examples explaining the principles of statistical map design. It will also be possible to print out the main principles as a methodological paper.

47. United Kingdom informed the Work Session that the Web-site will be available on Internet within a few months after the meeting. Copies of the Website will be distributed to all participants shortly after the Work Session. All participants are encouraged to provide input and feedback to this project.

H. Future work

48. The participants recommended to hold a further Work Session on GIS on 28-30 April 2000 to consider:

(i) Spatial database management and (geo-) data warehousing;
(ii) Internet and Intranet solutions;
(iii) Policy and organizational aspects of GIS and statistics;
(iv) Spatial analysis in a statistical context and disclosure control procedures;
(v) Demonstrations;
(vi) Survey on GIS use in statistical offices.

49. The issues of geo-coding by registers and address lists, the confidentiality of small area statistics, and links to national accounting were also mentioned as important for future work. Many participants expressed the opinion that future Work Sessions should cover the latest new developments as much as possible. Participants were encouraged to exchange information and experiences between the meetings using Internet facilities.

50. The Work Session thoroughly discussed ways to present methodological materials using Internet. It was agreed that it would be of value to extend the work carried out on the thematic mapping Web-site to cover other methodological issues of common interest. In particular, the issues of spatial analysis, data capture and data warehousing were identified as being worthy of further work.

51. It was proposed to construct a number of separate Web-sites within a single framework of a *Web-site on GIS in statistics*. Those participants who would like to be involved in such a development are asked to contact Dick Meuldijk (Statistics Netherlands). It will be agreed within the next 2 months how this work will be taken forward.

I. Other business

52. The Work Session expressed its appreciation to Canada, Finland, Germany, the Netherlands, Norway, Switzerland and USA for the preparation of interesting and informative demonstrations. It also expressed its appreciation to discussants and to all authors of papers.
