

**Photogrammetry & Remote Sensing: Manpower, Education & Research
Facilities, International Documentation Center**

(General Summary Report of ISPRS Working Group (WG) VI-1)

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Abstract

The tasks of ISPRS WG VI-1 are to up-date the WG VI-1 inventory on a world-wide basis on the photogrammetry and remote sensing manpower, education and research facilities as well as on the International Documentation Center (IDC) maintained by WG VI-1 as part of a broader based Surveying & Mapping (S & M) Data Bank established at Laval University on the basis of United Nations (UN) surveys and other sources. Pertinent information is obtained world-wide by the 19 regional sub-working groups of WG VI-1. The paper deals with the compilation and analysis of the data available and received. Emphasis is given on the trends in manpower development, with respect of education and research facilities, and on the usefulness of an International Documentation Center under consideration of recent developments of Geographical Information Systems (GIS). In addition, conclusions are drawn and presented in the paper and certain recommendations are formulated on future efforts to be made in manpower, education and research facilities developments as well as future work for the International Documentation Center.

Résumé

Les tâches du Groupe de Travail (GT) VI-1 de la SIPT sont: la mise à jour de l'inventaire à l'échelle mondiale du GT VI-1 sur la main-d'oeuvre en photogrammétrie et en télédétection, sur les facilités en éducation et en recherche ainsi que sur le Centre International de Documentation (CID) maintenu par le GT VI-1 faisant partie d'une Banque de Données plus vaste établie à l'Université Laval sur la géodésie et la cartographie à partir de la compilation d'enquêtes des Nations Unies (NU) et d'autres sources. On a obtenu des informations pertinentes grâce aux 19 sous-groupes de travail régionaux faisant partie du GT VI-1. De plus, on traite dans cette communication de la compilation et de l'analyse des données disponibles et récemment reçues. On met beaucoup d'emphase sur les tendances du développement de la main-d'oeuvre, des facilités d'enseignement et de recherche et de l'utilité d'un Centre International de Documentation tout en considérant les développements récents des Systèmes d'Information Géographique (STG).

Enfin, on a tiré quelques conclusions qui sont présentées dans cette communication et des recommandations y sont formulées quant aux efforts à faire dans un proche avenir concernant les développements en main-d'oeuvre, en facilités pour l'enseignement et la recherche et quant au travail à compléter pour le Centre International de Documentation.

Organizational and Administrative Aspects Related to ISPRS WG VI-1

In line with the task of ISPRS WG VI-1, this working group has been organized into regional sub-working groups each headed by a regional chairman. Up to now, the following persons are regular members of the working group (regional sub-working group chairmen):

1. Mr. Samuel K. Allen, Chief, Academic & Operations Branch, DMA IAGS Cartographic School, Drawer 934, APO Miami 34004, U.S.A. - Responsible for Sub-Working Group: Mexico and Central American Countries.
2. Prof. Abdul Bazak Abu Bakar, Head, Dept. of Photogrammetry, Faculty of Surveying, University of Technology - Malaysia, New Branch Campus, Skudai, Johor, Malaysia. - Responsible for Sub-Working Group: Malaysia (including Sabah and Sarawak), Thailand, Burma, Vietnam, Laos, Cambodia and Singapore.
3. Prof. Dr. Gerhard Brandstätter, Abteilung für Photogrammetrie & Fernerkundung, Technische Universität Graz, Rechbauerstrasse 12, 8010 Graz, Austria. - Responsible for Sub-Working Group: German Speaking European Countries.
4. Prof. Jorgen Risager Christensen, Dept. of Surveying & Photogrammetry, Royal Technical University of Denmark, DK-2800 Lyngby, Denmark. - Responsible for Sub-Working Group: Scandinavian Countries.
5. Mr. Ian R. Hall, Lecturer, Dept. of Surveying, Royal Melbourne Institute of Technology, GPO Box 2476 V, 124 La Trobe Street, Melbourne, Vic. 3001, Australia. - Responsible for Sub-Working Group: Australia, New Zealand and Oceania.
6. Prof. José Eduardo Julia, Jefe, Catedra de Fotogrametria, Instituto de Geodesia, Universidad Nacional de Tucuman, Avda. Independencia 1800, 4000 S.M. de Tucuman, Argentina. - Responsible for Sub-Working Group: South American Countries with the exception of Brazil, Guyana, Suriname and French Guyana.
7. Prof. Yan Kai, Head, Dept. of Photogrammetry & Remote Sensing, Wuhan Technical University of Surveying & Mapping, 23 Lo-Yu Road, Wuhan, People's Republic of China. - Responsible for Sub-Working: China and North Korea.

8. Prof. Ir. Hardi Koesalamardi, Geodetic Dept., Bandung Institute of Technology, Jalan Ganesya 10, Bandung, Indonesia. - Responsible for Sub-Working Group: Indonesia, Philippines and Brunei.

9. Prof. Dr. Taichi Oshima, Institute of Surveying, Photogrammetry & Remote Sensing, Dept. of Civil Engineering, Hosei University, 3-T-2 Kajino-Cho, Koganei, Tokyo 184, Japan. - Responsible for Sub-Working Group: Japan, South Korea, Taiwan, Hong Kong and Macau.

10. Prof. Bruno Pasquier, Ecole nationale des sciences géographiques, 2, avenue Pasteur, 94160 Saint-Mandé, France. - Responsible for Sub-Working Group: France, Belgique, Andorra, Monaco et Pays non-anglophones de l'Afrique.

11. Prof. Dr. R.S. Rokos, Dept. of Cadastre, Photogrammetry & Cartography, University of Thessaloniki, University Box 1439, Thessaloniki, Greece. - Responsible for Sub-Working Group: Greece, Cyprus, Albania and Yugoslavia.

12. Prof. Dr. R.S. Rostom, Dept. of Surveying & Photogrammetry, University of Nairobi, Box 30197, Nairobi, Kenya. - Responsible for Sub-Working Group: "Anglophone" African Countries.

13. Prof. Dr. Paul R. Wolf, Dept. of Civil & Environmental Engineering, University of Wisconsin, Engineering Bldg., Madison, Wisconsin 53706, U.S.A. - Responsible for the Sub-Working Group: U.S.A. and Canada.

In addition, the following sub-working groups have been created and the following colleagues have been asked, or have accepted, to serve as sub-working group chairmen:

14. Brazil, Guyana, Suriname, French Guyana: Dr. Placidino Machado Fagundes, Director, Departamento de Cartografia, Universidad do Estado do Rio de Janeiro, Rua São Francisco Xavier, No. 524; 20.550, Rio de Janeiro, Brazil.

15. Eastern European Countries: Dr. Habil Josef Jachimski, Institute of Mining & Industrial Geodesy, Stanislaw Staszic University of Mining & Metallurgy, UI, Carcynskiego, 31-059 Cracow, Poland.

16. Indian Sub-Continent: Dr. Rama Shankar Tiwari, Professor & Head, Surveying & Photogrammetry Section, Dept. of Civil Engineering, University of Roorkee, Sahrapur, Roorkee, U.P. 247672, India.

17. USSR & Mongolia: Prof. Dr. Ivan Antipov, Director, Research Institute of Applied Geodesy, Krassnyi Prospect 35, Novosibirsk, USSR.

18. Western Asian Countries: Prof. Nasser A. Al-Homaid, Photogrammetry Division, Dept. of Civil Engineering, University of Petroleum & Minerals, Nr. 314, Dhahran 31261, Saudi Arabia.

19. Western European Countries: Prof. Dr. A.J. Brandenberger, c/o Photogrammetry, Faculty of Forestry & Geodesy, 1356 Pav. Casault, Laval University, Quebec (Quebec) G1K 7P4, Canada.

In order to obtain the necessary information a special questionnaire was mailed by the Chairman of ISPRS WG-1 to each regional sub-working group chairman. In addition, the sub-working group chairmen were asked to nominate for each country in their sub-working group regions at least one national delegate being a member of the respective sub-working group. Furthermore, the sub-working group chairmen were asked to forward to their national delegates copies of the special questionnaire for completion. Finally, each sub-working group chairman was asked to undertake (in collaboration with the national delegates) an inventory of the available photogrammetry and remote sensing manpower in his respective sub-working group region.

Furthermore, the sub-working group chairmen were encouraged to personally attend the Commission VI Symposium in Badagry, Nigeria and they were asked to present at the Symposium a short progress report on the activities of their sub-working group and also to forward such a report to the working group chairman before the Symposium.

Finally, the sub-working group chairmen were asked to prepare a report on their findings (surveys) for their sub-working group regions with an analysis of the data collected, conclusions and recommendations; a report (paper) which could be eventually submitted to the 1988 ISPRS Kyoto Congress (Presented Papers).

INVENTORY ON THE WORLD'S PHOTOGRAMMETRY AND REMOTE SENSING MANPOWER

According to Ref. 1 there was in 1984 a photogrammetry and remote sensing manpower in the world of 150,000 persons. It was the task of the ISPRS WG VI-1 to up-date this figure up to the 1988 ISPRS Congress in Kyoto. Also it is of importance for education planning for the future to determine the ratio U:T:A where:

- U Personnel with a completed university level education of the equivalent.
- T Personnel with a completed technician level education, and
- A Auxiliary personnel (auxiliary plotter operators, photo lab personnel, etc.).

In photogrammetry and remote sensing this ratio is still not yet exactly known. However, such a ratio has been determined in 1976 for the world's total Surveying & Mapping (S & M) manpower. According to Ref. 2, this ratio amounted to:

U:T:A = 1:5:4; where U+T+A = \approx 1.2 million people.

An important task of ISPRS WG VI-1 is to determine whether the ratio 1:5:4 also applies to photogrammetry and remote sensing or whether in these disciplines there exists a more or less different ratio. It is hoped that more concrete information on the existing ratio U:T:A for photogrammetry and remote sensing can be determined later on using the data provided by the regional sub-working groups.

A further task of ISPRS WG VI-1 is the determination of the actual proportions of the world's photogrammetry and remote sensing manpowers in government services and in the private sector. As to the world's total S & M manpower, it is estimated that 60% of this manpower work in government agencies and 40% in the private sector. It is necessary to determine whether this ratio also applies to photogrammetry and remote sensing; with other words the specific ratio for photogrammetry and remote sensing still has to be determined. There is another important task of ISPRS WG VI-1 namely to determine the number of new personnel which is or is supposed to be graduated or trained each year as a percentage of the world's total active photogrammetry and remote sensing manpower. According to Ref. 2 and for the world's total S & M manpower this percentage is or is supposed to be 5% of the active manpower (taking into consideration the varying retirement ages in various countries). Regarding the world's photogrammetry and remote sensing manpower, it has to be determined whether such a percentage is also applicable to these professions and if not to find the most appropriate annual education and training percentage (of the active manpower) for the world's photogrammetry and remote sensing manpower. For this purpose both the actual proportion of the photogrammetry and of the remote sensing manpowers have to be known and this because of the rather different educational backgrounds and study programs for these two manpower sub-disciplines. If one only considers the application of photogrammetry for national geodesy and base mapping and if one only considers the application of remote sensing for thematic mapping, it is known that these operations on an official basis are mainly the responsibility of the national cartographic agencies (e.g., the U.S.G.S. Division of National Mapping or the Main Administration of Geodesy & Cartography of the USSR). In this particular case the above mentioned proportions have been determined and have been published for the year 1980 in Ref. 3. According to this reference and in the year 1980 the manpowers of the world's national cartographic agencies included 9% in photogrammetry and 1% in remote sensing, i.e. a ratio of 9:1. However, considering the whole professions and on a global basis it can be assumed that at present the ratio is somewhat different due to the more rapid increase of the world's remote sensing manpower. It will be the task of ISPRS WG VI-1 to determine the present ratio between the world's photogrammetry and remote sensing people which ratio will be of importance for the planning of future education and training requirements of the two manpowers (photogrammetry and remote sensing).

Since the United Nations are presently in the process of conducting another survey of the status of world cartography up to the end of 1987 (including available manpower) it is expected to obtain more concrete information on the world's existing photogrammetry and remote sensing manpowers.

Another question of concern to ISPRS WG VI-1 will be the actual or required manpower densities in photogrammetry and remote sensing. According to Ref. 1, there was in the world and in 1980 a photogrammetry and remote sensing manpower of 150,000 people (excluding the sporadic manpower for strictly military purposes and operations), meaning that 1 person out of about 17,500 inhabitants was active or was supposed to be active in photogrammetry and remote sensing. This would give a first guideline particularly for developing countries to how many photogrammetry and remote sensing people should be available and consequently how many people in these fields should be educated and trained in the future and this as soon as possible. Again it is expected that the reports of the sub-working groups of WG-1 as well as the above mentioned UN survey of the latest status of world cartography will provide more accurate figures on these requirements. In any event it is strongly recommended that the world's countries undertake as soon as possible an analysis on the existing photogrammetry and remote sensing manpower on a national level, on future manpower requirements and consequently on future photogrammetry and remote sensing manpower education and training requirements.

World-wide Inventory of Education Facilities in Photogrammetry & Remote Sensing

In order to obtain the required information on the status of available education and research facilities a special questionnaire was prepared by ISPRS WG VI-1. Copies of this questionnaire were forwarded to all regular members of ISPRS WG VI-1. Compilation and an analysis of information received from the sub-working group regions (completed questionnaires) as well as from other sources is in progress. Because this information is too voluminous it cannot be presented in extenso in this paper. However, the respective data have been stored and are available in/from Laval University's Surveying & Mapping Data Bank. All what can be emphasized here is that there is a marked trend to complete the photogrammetric equipment at respective educational institutions by the acquisition of analytical plotters. Of particular interest is an evaluation of presently available and required teaching staff in educational institutions offering photogrammetry and/or remote sensing programs or courses. Again, the available and received information on this teaching staff is too extensive to be presented in details in this paper and reference is made to Laval University's Surveying & Mapping Data Bank. Nevertheless, it is considered in order to indicate here present trends

in photogrammetry and remote sensing teaching staff developments which clearly indicate that the present day's photogrammetry teaching staff in pertinent education institutions is in a period of stagnation (or in some cases is even subject of reduction) while an upward trend in the remote sensing teaching staff (quantity-wise) can be noticed.

As to presently spent annual funds for photogrammetry and remote sensing teaching and training preliminary figures can be determined based on information contained in Ref. 2. The figure on a global basis is or is supposed to be in the order of US \$80 million per year (excluding education and training for strictly military purposes). This estimation is based on the world's civilian annual expenditures for photogrammetry and remote sensing operations of about US \$2 billion and is derived from the fact that the world spends about 5% of its gross product for all education. Considering that the US \$2 billion represents about 0.02% of the world's gross product this would result in a portion for the education and training of photogrammetry and remote sensing manpower of 0.02% of the above 5% or 0.001% of the world's gross product or at least US \$80 million per year (including general education). As already mentioned these are preliminary figures and ISPRS WG VI-1 is in the process to determine more accurate figures on the costing of education and training in photogrammetry and remote sensing. This is of particular importance for developing countries with a notorious lack of funds and which consequently are depending on multilateral and bilateral economic assistance programs which should include appropriate allocations for education and training programs in photogrammetry and remote sensing. At the same time it is strongly recommended that each country undertake a thorough analysis on its available photogrammetry and remote sensing teaching/training facilities and on the future requirements based on thorough studies on the impact of the photogrammetry and remote sensing operations on the national economy and even the world economy.

RESEARCH AND DEVELOPMENT (R & D) IN PHOTOGRAMMETRY AND REMOTE SENSING

To obtain pertinent information on the status of research (including development) facilities in photogrammetry and remote sensing the before mentioned special questionnaire includes sub-questionnaires requesting information on the available R & D manpower, equipment and annual expenditures in photogrammetry and remote sensing. As to these items only preliminary information and figures are available at this time. Based partially on information contained in Ref. 2, one can conclude that a percentage of at least 1.67% of the world's present photogrammetry and remote sensing operation should be devoted to R & D, in terms of manpower and annual expenditures. This requirement is based on the present general R & D efforts of the industrialized countries amounting in the average of 1.67% of the GNP (Gross National Product). This would make up a world R & D manpower in photogrammetry and remote sensing of

about 2,500 people (1.67% of the total manpower in photogrammetry and remote sensing of 150,000 people) with total annual R & D expenditures of at least US \$35 million (excluding classified, strictly military R & D efforts). It is obvious that the evaluation of the present efforts and future requirements as to R & D in photogrammetry and remote sensing, world-wide, must be one of the important tasks of ISPRS WG VI-1. This particularly applies to developing countries with largely insufficient photogrammetry and remote sensing R & D manpowers and expenditures.

There is a large amount of information contained in Laval University's Surveying & Mapping Data Bank on the present day's R & D efforts in photogrammetry and remote sensing and it is hoped that in the near future more specific figures can be communicated on the world's present photogrammetry and remote sensing R & D manpower, available equipment and annual expenditures.

AN INTERNATIONAL DOCUMENTATION CENTER ON SURVEYING & MAPPING (S & M), INCLUDING PHOTOGRAMMETRY AND REMOTE SENSING

As already reported in Ref.'s 4 and 5, there exists a voluminous S & M Data Bank at Laval University (Unit: Photogrammetry) which data bank includes much information also on the world's photogrammetry and remote sensing operation. Such information is of considerable usefulness for the performance of work pertinent to ISPRS WG VI-1, especially as far as professional statistics are concerned. Among other items, the Data Bank contains about 100,000 addresses of organizations and key persons involved in S & M (including photogrammetry and remote sensing). This data bank is as far as possible up-dated and includes also information on available manpower, as well as education and research facilities in photogrammetry and remote sensing. This information is being used to complete the information obtained from the regional sub-working groups of ISPRS WG-1.

Here, it should be added that a portion of the information contained in the data bank was and is provided by official and completed United Nations and FAO questionnaires to pertinent organizations. Access to this particular information to ISPRS WG-1 is assured due to the fact that the author of this paper is the consultant in charge of the United Nations for the analysis of the status of world cartography as well as an FAO consultant for the establishment of a world aerial photographic index.

It is evident that the large amount of information contained in Laval University's S & M Data Bank should be made available to all persons and organizations interested in such information (including persons and organizations particularly interested in photogrammetry and remote sensing).

Along this line it was proposed to create an International Documentation Center on S & M which could be located at Laval University. Regarding such a project other related International Associations have been contacted, in particular FIG, and pertinent positive recommendations have been formulated and adopted. However, the creation of an International Documentation Center on S & M is still a proposal and its realization still remains to be effected. It is hoped that during and after the Kyoto Congress this project can be the subject of further discussions which ultimately would lead to concrete actions, i.e. the creation of such a center, in the very near future.

Acknowledgement

As the chairman of ISPRS WG-1, I am pleased to acknowledge the collaboration of the sub-working group chairmen of WG-1, in particular Professors G. Brandstätter, J.R. Christensen, P.A. Gagnon (Laval University, Photogrammetry; Responsible for Canada), and P. Wolf, who have provided particularly detailed information.

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