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Working Group 5

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[Working Group Report]

GENERAL REPORT ON THE PLANNING, ECONOMY AND PROFESSIONAL ASPECTS OF  
PHOTOGRAMMETRY IN THE WORLD

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Abstract

Aerial photogrammetric mapping remains an essential element for various purposes in all countries. In most countries, the topographical mapping is done by public (governmental) organizations, in which the planning, economy and professional aspects are controlled under the framework of their general economic plans. In several emerging and developing countries the mapping operations continue to be influenced by foreign countries and international organizations; some through technical assistance in terms of material, personnel, equipment, etc. It seems that, barring a few private organizations, cost-effectiveness models of any significant form is used by none. Performance/accuracy seems to be considered as the most important factor of effectiveness. Several organizations consider some form of program evaluation review techniques. Most of them prepare periodic reports (with informative cost and time data on the completed jobs), which are usually not released to external agencies. Production, inventory and quality controls are implemented in some agencies. Problems related to standards and specifications, manpower and job programming, etc. are aspects in which continued studies are strongly recommended.

## Introduction

At the XIII Congress of the International Society for Photogrammetry held at Helsinki, Finland in 1976, it was recommended [vide Resolutions of Commission VI] that the Working Group VI-5 on "Planning, Economy and Professional Aspects" continue its activities.

Technical, economic and time factors interact in a complex fashion for photogrammetry organizations for their normal works, on which depend their plans for future progress. The complexity is intensified when the responsibilities are diffused between the sponsoring and working agencies. This is more so when the socio-economic environments of their operations are quite uncertain.

There are generally many ways to approach a problem. There is often no clear demarkation line between the work of the photogrammetrist and that of the user of photogrammetric data. The user can be from any field such as regional planning, space science, industrial engineering, bio-medical sciences, etc. Because of diversities in the applications, each job may be uniquely different from the other. This means that each project needs to be carefully planned and designed.

Such a project development, however, becomes ineffective if its cost-effectiveness is inadequate. As a result of its success with various industries in the world, the "cost-effectiveness analysis" approach discussed in Seiler (1969) is spreading to numerous fields of application in engineering technology (see Ghosh, 1976). This approach is to consider first a "cost-model" (considering various factors) and then an "effectiveness-model" (also considering several factors). Finally, the cost-effectiveness analyses are made in view of the organization's objectives.

Realizing the complexities of planning and the economic aspects of our profession, the ISP Commission VI observed at Helsinki that "with ever-increasing complexities of methods, materials, machines, etc., there is a great awareness on the cost-effectiveness ideas towards more efficient procedures or working systems". A world consensus in this regard would very much be desirable.

Accordingly, as the first step, a committee (working group) of 22 colleagues from as many nations was formed. This group is significantly representative in terms of the ISP member nations they represented, in terms of their types of organisations and in terms of their areas of expertise. The group worked within the guidelines of the ISP resolutions. While working towards the formation of the group, its chairman solicited ideas and opinions from the group members and other experts as well. The final list of the members is given below after their respective countries listed in alphabetical order:

Algeria	: Capt. Mohamed Boualga
Brazil	: Col. Fernando R. DeCarvalho
Canada	: Dr. Marco Leupin
Colombia	: Mr. Alfonso Diaz Garzon
Czechoslovakia	: Dr. Ondrej Jerabek
Germany (West)	: Mr. G. Winkelmann
Ghana	: Dr. Joseph P. Okang
Greece	: Dr. Demetrius Rokos
Hungary	: Doc. Janos Gebry
India	: Col. Prabhakar Misra
Indonesia	: Mr. Leo Nardi
Iran	: Col. Majid Darbandi

Israel : Dr. Moshe T. Erez  
 Kenya : Mr. David N. Kiromo  
 Libya : Mr. Muftah M. Unis  
 Norway : Mr. Dag Norberg  
 Poland : Dr. Zbigniew Sitek [also President, Commission VI, ISP]  
 Spain : Mr. Luis Sacristan Maria  
 Sri Lanka : Mr. Christopher Nanayakkara  
 Thailand : Maj. General Phayon Phumhiran  
 Trinidad and  
     Tobago : Dr. Aldwyn T. Philip  
 U.S.A. : Dr. Sanjib K. Ghosh [Chairman of the Working Group, now in  
           Canada].

## Questionnaire

The group developed a questionnaire and in order to form a preliminary opinion survey all the members were requested to respond to the questions, which are as follows:

### I. COST related questions (relating to your organization/country):

1. In your organization/country, do you use any cost-model? If so, what? Does it consider the economic fluctuations of the country/world?
2. The following cost factors are somewhat well-known. If you use them say "yes". In that case, state the relative importance assigned to them.
  - a) Level of use; b) Inheritance; c) Research and development;
  - d) Inputs: Labor, Material and equipment, Capital, Other;
  - e) Outputs: Charts, maps, etc.; Photographs, mosaics, orthophotographs, etc.; Digital information; Publication/literature; Other;
  - f) Time; g) Performance; h) Geographical location; and
  - i) Others (please state).

### II. EFFECTIVENESS related questions (relating to your organization/country):

1. Do you use any effectiveness-model? If so, what? Do you update in keeping with the socio-politico-economic situation of your country/world?
2. The following effectiveness factors are somewhat well-known. If you use them, say "yes". If yes, state the relative importance assigned to them.
  - a) Performance/accuracy; what criteria are used to check the performance?
  - b) Availability; c) Reliability; d) Survivability; and
  - e) Others (please state).

### III. Do you use any COST-EFFECTIVENESS model? If so, what?

### IV. In your JOB PLANNING efforts:

1. Do you use any Program Evaluation Review Technique? If so, what major items are considered relevant?
2. Do you use any form of Critical Path Method? If so, what major items are considered relevant?

- V. What other DECISION THEORY, if any, is used ?
- VI. Are you aware of and do you implement any of the following CONTROLS, before, during or after production runs ?
1. Production control, involving: Routing (sequence), Loading (assigning of work), Scheduling, Estimating, Expediting.
  2. Inventory control, dealing with: Raw materials, work in progress, and finished product/information data.
  3. Quality control: What specific tests are used and at what stages ?
- VII. Your suggestions and comments relevant to the photogrammetric operations (conventional, nonconventional) will be appreciated.

## Responses

Only eleven responses were received. However, these are somewhat representative, being from eleven different countries with diverse politico-economic backgrounds. Separately, other sources of information were explored and the following general ideas are presented. The numbers correspond to those of the questionnaire.

- I. In all organizations, they use some form of 'cost-model', at least in calculating total costs of specific projects as well as annual costs. The economic fluctuations (inflation in particular) are generally considered. This, however, is done in some organizations rather indirectly, for example, in terms of cost of labor fluctuations, depreciation of equipment, administrative overhead, etc.

Amongst the cost factors, the *level of use* is considered only in terms of generalizing or rounding of cost figures for future budgeting purposes. Otherwise, actual cost is considered. *Inheritance* is of significance everywhere. The techniques appear to be greatly biased on available equipment and the technical backgrounds of available personnel. *Research and development* (R&D) are considered primarily to adopt accepted methods to the current needs. In this regard, costs involving R&D are generally considered as separate contingencies.

Amongst the input items, *materials and equipment* are considered with high emphasis. *Labor*, although not a contingent item with mapping organizations, is considered with low emphasis. *Capital* is considered, if at all, with very low emphasis. On the output items, however, digital information is considered only for aerial triangulation or cadastral work. Descriptive publications are generally confined to short reports submitted for public information. As such, their costs are seldom itemized. In most countries, the budgetary provisions do not adequately include inflationary considerations. In this respect, material and equipment related cost data suffer most.

*Time* as a factor is considered in some aspects although no actual cost function is generally evaluated. *Depreciation* of instruments is a factor of general concern but their *obsolescence* is not.

*Performance* as a cost factor is considered significant by most agencies. *Geographical location* is considered with emphasis in agencies or countries which are dependent on equipment, material, labor or job sponsorship coming from foreign sources. These are, nonetheless, job related. Cost-benefit analyses of some kinds are performed by some for development projects.

II. It seems that no *effectiveness model* is considered by any. However, all indicated that some sort of empirically obtained considerations do influence their decision-making processes. *Performance* along with *accuracy* is generally evaluated; the criteria are varied, though. Some follow well known specifications (for example, of NATO, SEATO, USGS, etc.) while others have their own patterns and derive tables of performance giving lists of areas mapped according to time taken, terrain type, scale of mapping, etc.

*Availability, reliability and survivality* factors are not considered generally. These depend very much on the financial constraints for those that consider them.

III. It seems that *cost-effectiveness model* of any sort is not used by the public sector respondents. Most of them are, however, aware of the underlying principles. Some agencies working in the private sector do consider some sort of cost-effectiveness concept.

IV. Some form of *Program Evaluation Review Technique* (PERT) is used by almost everyone. For some, this is done in terms of the total production of the organization. For others, this is done with regard to specific items (e.g., plotting instruments, cartographic work, etc.). The *Critical Path Technique* (CPT), although well known to most, is used by only few, if at all.

V. No formal *decision theory* is in use, it seems. The decisions are generally based on the experience and expertise of the management personnel.

VI. Some form of *production control* is implemented by all respondents. This includes routing, loading, scheduling estimating and expediting. *Inventory control* is implemented by all respondents. Some specified in particular that controls on materials, work in progress, and finished products are performed before, during and after the production runs, respectively. Some form of *quality control* is maintained by each. Field checks are usually performed during and after the photogrammetric operations. Checks for thorough completion of specific items in a project are emphasized generally. The errors or misclosures known at discrete points are usually expressed and assessed in terms of standard deviations in bivariate data forms (e.g., planimetry and height or X and Y coordinates in planimetry).

## General Considerations

The following general comments are based on the extra remarks given by the respondents and on other sources explored by the author.

The "mood" of the Working Group represents a belated recognition that the problems of the World (of hunger and poverty, advancement and deterioration-control, both in view of our professional goals) merit international attention. It is time that the science-technology be encouraged to move out of the class rooms and the research laboratories to address the agonizing problems of the real world.

The information concerning cost, accuracy, time, etc. which any organization/country has accumulated through years is of importance in planning for the future. The considerable differences in costs on labor, materials and equipment would make it almost impossible to use one general "model" for every organization/country. Research in this direction should be encouraged.

In some cases, the photogrammetrist is excluded at the initial stages of decision making. This invariably forces the technical priorities to be altered. Often the stated specifications are unrealistic in terms of accuracy requirements or on the times for execution of jobs or in the form of the finished product. The profession finally suffers in these regards. There is a general cry for research, which could enhance the effectiveness by providing proper statistical data for such factors as accuracy and performance criteria.

Some countries, for their topographic and other mappings, depend (willingly or unwillingly) on extra-territorial and/or foreign countries/agencies. In most such cases, unfortunately, cost-effectiveness considerations are grossly moot, while economic and professional aspects are filled with frustrations. National and technical aspirations are choked with deceptive arguments. Apparently, the profession has often to yield to political influences.

Recent developments of aerial, terrestrial and space inventory capabilities (including multispectral scanners, multifrequency radars and computer systems) are providing powerful tools for timely and appropriate information for economic developments and environmental protection. Newer interpretation equipment designed to maximize the capabilities of the human interpreter have appeared on the market. Photogrammetric instruments are becoming more sophisticated and capable of obtaining smaller bits of information with more accuracy than were possible erstwhile.

Application of photogrammetry in engineering and scientific fields have increased. They use close-range and micro-range conventional and non-conventional techniques. All the same, the conventional applications in the field of aerial mapping are steadily growing in all countries. Several modern techniques (orthophoto and automated cartography in particular) are of interest to practically all the respondents. A universal growth of activities with photogrammetry and remote sensing is thus apparent. However, such growing activities make us realize the importance of careful planning with due considerations for the professional and economic aspects.

In most countries, the mapping operations are in the hands of government departments. Since governmental organizations normally do not strive for generating profits, certain factors like economy, time, materials, etc. are assigned certain weights which are quite different from those accorded in profit making organizations. Sometimes, however, "pilot projects" are carried out to evaluate the economic (cost-effective) and technical potentials of expected projects involving large volumes of work. On the other hand, some projects are "political" and economics in these are of minor importance. Furthermore, governmental agencies being non-competitive, improvements in them are rather slow, if at all.

Organizations in the so called "developing" countries are generally experiencing slow progress because of economic woes and uncertainties due to inflationary trends. They invite suggestions and supports so that their production quality and quantity can be improved.

Some of the "developing" countries have other professional problems. Most of their photogrammetrists are trained for routine type topographical mapping without any specialization in specific branches and applications of photogrammetry. Thus, photogrammetric projects other than topo mapping are either not accepted by them or are diverted to other (sometimes non-professional or foreign) agencies. Furthermore, there are generally in-service training but post-graduate level education and serious research are in essence non-existent in these countries. Thus, improvement in performance and

assimilation of new technology are not realized. This makes them dependent on others for ever, it seems.

## Conclusions

On the basis of this group effort, we notice several high priority problems that would require a team effort to address the following: (1) A need to develop international standards for mapping and map related photogrammetric data acquisition and data processing systems; (2) A need for an international assessment of manpower in the mapping and other fields related to photogrammetry and remote sensing; and (3) A need for researches to develop program planning and evaluation systems in various countries. These are elaborated below:

### INTERNATIONAL PHOTOGRAMMETRIC STANDARDS

A clear understanding is desirable for two terms used in this regard, (a) *Standards*, against which measurements can be made and results can be assessed in order to serve as references, models or rules in measuring the quantities or the qualities, establishing practices and procedures; and (b) *Specifications*, i.e., the rules and comprehensive sets of considerations established for data acquisition, data processing or data analysis systems.

All instruments and procedures yield precision. However, precision can be high, yielding the resultant accuracy to be low sometimes. But the accuracy can not be high if the precision is low. Accuracy being the real objective, more meaningful utilization of standards under appropriate specifications needs to be studied. Actually, it is not possible to arrive at realistic standards of comparison that will satisfy all equipment manufacturers and users. Accordingly, the criteria are subject to debate and criticism. Nonetheless, a start in international dialogue in this regard is necessary. This, however, remains primarily in the domains of other commissions of the ISP.

### INTERNATIONAL MANPOWER ASSESSMENT

A census of world manpower in photogrammetry and remote sensing would be a formidable task and yet it is a badly needed one. However, authoritative data on number of persons employed, number of graduating students, types of jobs and skills required, and distribution of these jobs in each country are essential for rational planning. Some studies have been made and are being made by Brandenberger (1976) on general mapping problems in the world. This, however, needs more elaborate, fully cooperative and continued efforts. Such data could be used for career opportunities for the technical people as well as for plannings in the academic and production fields.

### RESEARCH TO SUPPORT AND DEVELOP PROGRAMS

Considerable research is needed to look into various planning goals and program models. A variety of conceptual models (cost-effective, PERT, Critical path, etc. are examples) need to be tested and/or new ones formulated. Technological developments need to be monitored continuously to assess their impacts upon the profession.

All these require team efforts. It is the belief of this author that a carefully selected international team in a pattern similar to the one we had in this Working Group should continue these efforts and hopefully will obtain support from well meaning international organizations like the UNO or the World Bank and proceed to undertake the studies with the blessings of ISP. This author has been blessed with excellent cooperation from all the members of this Working Group. There seems to be no lack of interest.

We must understand that as man has evolved from his primitive life, he developed an appetite for large quantities of data, recording observations on his individual and collective activities with ever increasing precision and detail. This aspect of man has been laced with chaos, contention and suffering. It is equally saturated with the search for order, peace and enjoyment. One aspect of this search in the modern world is planning. This is within the scope of socio-cultural human agreement, which must be marked by harmony, conformity and accord -- the inspiring forces to bring us together. The "search" will stop when the inspirations are not felt any more.

## References

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