MODERNISATION THROUGH PHOTOGRAMMETRY-ECONOMIC AND OTHER ASPECTS

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COMMISSION IV WG IV/2

INTRODUCTION

The use of Aerial Photography can be considered as a revolutionary development in the field of Surveying and Mapping. Most information can be interpreted and plotted to scale without actual visits to the ground. The rapidly increasing sophistication in the instrumentation coupled with computerised systems have added new dimensions. However the situation in respect of modernisation in photogrammetry in less developed countries (LDCs) as compared to that in developed countries (DCs) is different.

In India, aerial photography was introduced in 1920s for land surveying leading to the establishment of the use of aerial photography as a routine for production of standard topographical maps, on scale 1 inch to 1 mile. Till early 1950s, simple graphical methods were used to produce air survey sections in the office, prints of which were taken to the ground for verification and contouring. This type of method involving the use of aerial photographs but not involving the use of photogrammetric machines is being referred to as air-cum-ground method. Photogrammetric control and plotting machines introduced in the country in 1950s were extensively used in India for the production of topographical maps on the standard scale of 1:50,000. With the introduction of digital mapping system in the country on experimental basis, analytical photogrammetry with digits is expected to emerge as a viable system of mapping in the future.

Cadastral Surveys and engineering surveys by State government organisations in India are by and large carried out by ground survey methods. It is an established fact that the use of aerial photographs would bring down the cost and time of survey significantly while improving the accuracy particularly in respect of shapes and details. But several problems are coming in the way of switching over to the system using aerial photographs. Thus within the same country there is a wide technological gap.

In this paper an attempt is made to analyse economic and other aspects of the use of photogrammetry as a modern technique for surveying and mapping in Indian conditions which may be relevant for some other LDC's also.

MODERNISATION

Theories of transformation of traditional societies into"modern" ones are based on serveral assumptions, most important of them being the assumption that 'modern' is synonymous with

western models. In this context, the aspect of organising human-power to generate opportunities and results should also be considered particularly in over populated and labour abundant LDCs. It will not be an exaggeration to say that 'people not science and technology' will determine our future.Modernisation, therefore, should be a judicious blend of capital and labour intensive approaches till take-off stage is achieved in terms of real economic progress.

Several approaches to the modernisation of underdeveloped societies have emerged as a result of sincere search for evolving profound laws governing social reality. Amongst various objectives proclaimed in international forums, the following can be considered as most relevant concerning the use of science and technology in pursuing development of various nations.

- Transfer of technology for the benefit of development.
- Sharing of knowledge and experience by all members of the international countries.
- Enhancing indigenous capabilities in a context of national self-reliance.
- Promoting self reliance through cooperation among developing countries.

Modernisation in LDCs normally implies import of technology from advanced countries. This isa continuous process. Generally in LDCs it so happens that the technology for modernisation is taken, in a more or less unadapted form from the advanced economies. Introduction of photogrammetric machines in India manufactured in DCs can be considered as an example of 'Dependency' theory of economy. The question to consider in this context is whether this type of technological dependence helps development or not. In the past two decades, the rise of influence of certain countries over others in cultural,military,political and economic affairs has been witnessed. Dominance and dependence have become realities of the modern society of the world. DCs amongst themselves have in general mutually beneficial systems. But when it concerns LDCs, they seem to preserve, a basically exploitative system.

Some believe that development and dependence are possible at the same time. Considering that development is a relative term, the above statement can be accepted as correct under certain conditions. The experience of the past few decades shows that dependency is incompatible with development.

Cybernetic models based on the relationship between technology (involving use of machines) and society can bring out several useful facts relevant to modernisation. In simple terms, the cybernetic models are useful in investigating the reasons/ causes which are responsible for creating gaps between 'actual immediate state" and the "goal state". This would ultimately help in minimising the deviations/gaps in the adopted system. It is in this context that economic and other aspects of modernisation through Photogrammetry have been considered.

PHOTOGRAMMETRIC METHODS

Results of surveys by ground survey method, air-cum-ground survey method and Photogrammetry carried out in different parts of India during the past few years have been taken as guide in working out figures for comparison. Details in respect of some selected scales of survey have been worked out for a general comparison. While working out the cost figures in respect of photogrammetry the following expression has been used to cover for the cost of equipment

$$\text{Equipment cost per year} = c\left(\frac{1}{l} + \frac{1}{2} \cdot r \cdot t\right)$$

Where c = Initial cost of the equipment

l = Expected life of the equipment in years

r = rate of interest per annum

t = equipment in use in years.

The following data has been adopted :

1 US§ = Indian Rupees 13.25

Cost of Photogrammetric plotting. (including machine overhead cost)	§ 1200
Cost of photogrammetric control (Including machine overhead cost)	§4,300
Expected life	15 years
Interest Rate on capital investment	16% per annum
Ground verification cost	§ 830 per month
Ground control cost	§1,435 per month
Levelling cost	§ 900 per month
Fair Mapping cost	§ 225 per month
Survey Party Overheads	60%
General Overheads	30%

There are other indirect costs connected with the items mentioned below which have not been included in the above costs.

- Training of staff inside and outside the country to enable them to work on the modern imported machines.

- Installation and maintenance of the modern equipment. Very often the expensive equipment remains idle due to non-availability of proper repair/maintenance facilities.

- Special infrastructural facilities like air conditioning, special flooring, dust proof arrangement, power supply, water supply, etc.

- Switching over from conventional system to modern system involving replacing/condemnation of conventional equipment.

- Changing working culture.

- Depreciation /obsolescence of equipment.

The cost and man power figures for three different scales of survey and by different methods are shown in tables 1 and 2.

TABLE 1.

Cost of survey per Sq.Km. by different methods (in US dollars)

Method of Survey	Scale of Survey		
	1:25,000	1:10,000	1:5,000
Ground Survey	190	505	2065
Air-cum-ground Survey	85	255	770
Photogrammetry with ground contouring	90	335	900
Photogrammetry with machine contouring	110	340	785

TABLE 2:

Man-power employment by different methods for an area of 100 Sq.Km.

	1:25,000 scale		1:10,000 scale		1:5,000 scale	
	Man months		Man months		Man months	
	Surveyor	Labour	Surveyor	Labour	Surveyor	Labour
Ground Survey	15	43	37	119	135	242
Air-cum-ground survey	11	13	23	46	54	160
Photogrammetry with contouring on ground	10	11	21	36	56	117
Photogrammetry with contouring on machine	9	7	20	27	47	78

The comparisons made above in respect of cost and map power are only for providing a general idea. These figures are subject to variation depending on the actual environmental and other conditions of work.

The cost difference in the methods employing rectification and air survey combination is not much. While rectification involves use of importedinstruments with less man power, air survey combination requires more man power but involves inexpensive office work.

ECONOMIC AND OTHER ASPECTS.

From Table 1 it can be sen that ground surveys are not only time consuming but are expensive as compared to other methods involving the use of aerial photographs. Due to the heavy capital investment involving foreign exchange, the cost of photogrammetric survey is higher than air-cum-ground survey, though not significantly.

Cost Benefit Analysis (CBA) may differ from country to country in respect of procedures and also with regard to what CBA includes or omits as benefits and costs. The evaluation of CBA should also include social gains and losses particularly in public funded projects. From the information about the man powerrequirement for different methods of survey given in Table 2, it can be seen that in the case of photogrammetric and air-cum-ground survey methods the difference in surveyor man months is small while that in labour man months is considerable. Thatis, the method of air-cum-ground survey takes almost the same time as the photogrammetric method but employs larger man power. Further, in air-cum-ground survey method, imported/ sophisticated machinery and special infrastructure arrangements are not necessary. Both these advantages of air-cum-ground survey method are worthy of consideration, particularly in LDCs.

On the basis of generalised estimated figures of surveys on three broad scales of survey, the overall employment generated every year by adopting air-cum-ground method of survey in place of photogrammetric method for surveys on scales 1:25,000 and larger for the entire country is given below:

Man power employment generation through Air-Cum-Ground survey method

Scale of Survey	Estimated area for survey in Sq.Km.	Employment generation per year	
		Surveyors	Labour
1:25,000	87,000	1740	4220
1:10,000	18,000	540	3420
1: 5,000	5,000	450	4100
	TOTAL	2730	8050

From the above table it can be seen that employment opportunity for more than 2700 survey personnel and over 800 labour force is generated every year.

In the air-cum-ground survey method, rectified photographs can be used if the terrain is more or less flat (slope within the permissible limit). Otherwise, simple air survey combination can be done to produce air survey sections. This method is a bit tidious and requires close supervision. Further, along the margins of the photographs and the strips there can be some adjustment problems. Even in photogrammetry similar problems of adjustments crop up particularly while using control points of different series and seasons. These are not likely to cause any problem as far as relative accuracy and objectives of the survey are concerned. There is often a tendency for perfectionism to maintain or safeguard the reputation/prestige of the organisation with regard to accuracy and professional standards. A practical approach needs to be adopted in laying down accuracy standards and also in the adoption of the methods in achieving the objectives keeping in view economy and efficiency.

APPROACH AND CONCLUDING REMARKS

Major problems in the LDCs can said to be mainly rooted in the operational tactics of the present exploitative type of international system. Greater capital investments, instead of providing thrusts to the development process are strengthening the monopolisation of certain institutions. In this process with clear urban-industrial leaning, the main victims are the rural poor. Therefore, developing human resources should be one of the most important objectives of the development process in LDCs. Imparting of knowledge and skill should be used as effective transforming forces for reducing inequalities.

In the light of discussions made above, air-cum-ground method of survey can be considered as an appropriate one for Indian conditions. The import of Photogrammetric machines does not seem essential to meet the mapping needs of the country considering speed/time, accuracy, economy, manpower deployment foreign exchange reserves, etc. This illustration of modernising through Photogrammetry is brought out as an example to highlight the fact that modernisation has to be adopted based on actual needs.

It is an established fact that ground surveys are not only slow and expensive but burdened with several other disadvantages Therefore, efforts should be made to replace the ground survey methods with air-cum-ground survey methods in the first instance.

The existing photogrammetric instruments should be used mainly for surveys on scales 1:25,000 or smaller. For larger scales of surveys, air-cum-ground method of survey is more appropriate. If, however, there is still machine potential available, planimetry can be done on the machines and contouring on the ground. This approach will work out to be more economical while creating man power employment opportunity.

A review of the existing situation regarding instrumentation in photogrammetry shows that India's contribution in the evolution of optical-mechanical type of machines has been practically nil and India has thus lagged behind the DCs. Only a handful of countries have the technology for manufacturing the modern photogrammetric instruments. Therefore, there is no possibility in the near future that India would be able to catch up with the latest technology by following the same path of evolution as adopted by the West. In this back-ground, it will be appropriate to skip the intermediate steps and attempt to enter into the latest i.e., All Digital Photogrammetric System. Satellite data is available in digital form. It is possible to generate aerial photogrammetric data also in digital form. Digital mapping systems which are under development can be employed for processing digital aero-space data. Such systems of mapping would reduce the present time-lag between date of survey and date of publishing the map from 3-5years to less than a year.

India has embarked upon an ambitious plan in the field of computerisation. Therefore, development of digital systems for processing Aero-space data is within its scope. It is also possible to develp digital systems which can be connected to the existing Analogue Plotting systems. In this attempt, several countries should join together because the task is so complex with many constraints that it cannot be handled satisfactorily by any one country individually.

Introduction of modern methods through import in most of the developing countries would need huge resources in respect of capital investment, training of man power, infrastructural changes, etc., which these countries can hardly afford. In the case of over populated countries, the present approach of adoption of photogrammetry as part of modernisation requires a review based on considerations like direct and indirect costs, employment opportunities and other socio-economic conditions. If the DCs are really keen in helping LDCs to modernisse and develop, theyshould promote self-reliance amongst LDCsthrough transfer and sharing of Technology instead of strengthening the present system of exports and imports of equipment on commercial lines.

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