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Photogrammetric Education
and Course Curricula in Developing Countries

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PHOTOGRAMMETRIC EDUCATION
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ABSTRACT

Photogrammetry is the most efficient method of surveying widely used for its accuracy and speed. All developing countries are introducing photogrammetric method of survey in their survey organisations. Photogrammetric education in developing countries should be given high priority to assist in speeding up surveys for economic development. After two decades of studies a clear picture of photogrammetric educational requirement has emerged which identifies three levels of photogrammetric education viz. technician level, graduate or technologist level and post-graduate or professional level. The suggested course content and the distribution of lectures and practical instruction hours of three levels of courses which may be followed in developing countries have been discussed.

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INTRODUCTION

Photogrammetry as the most modern technique of surveying has been practised all over the world for over sixty years. During this period photogrammetry has been established as the most efficient method of surveying considering the aspects of speed, economy and accuracy. Since surveying and mapping are essential pre-requisites for planning of economic development of a country, all developing countries should introduce photogrammetric method of survey in their national organization for speeding up surveys. Photogrammetric education should therefore, be given increasing attention so that photogrammetry can solve the economic and social problems of the developing countries.

LEVELS OF PHOTOGRAMMETRIC EDUCATION AND NUMBER

Photogrammetric method of surveying using stereo-plotting photogrammetric instruments was introduced in India in 1954. During the years 1954 to 1964, additional photogrammetric instruments were procured but training was conducted on as required basis for photogrammetric machine operators. It was soon realised that the introduction of photogrammetry on a large scale called for more intensive and well-coordinated photogrammetric educational programme.

After two decades of photogrammetric practice in India a clearer picture of photogrammetric educational requirement emerged which identified three levels of photogrammetric instructions - the first at post-graduate or

professional level for executive officers who can plan and execute photogrammetric tasks independently, take up applied research and impart instructions at graduate or post-graduate level; the second at graduate or technologist level for persons of supervisory level who should be able to solve technical problems related to photogrammetric production and guide and supervise technicians; and the third at the technician level for persons who can carry out photogrammetric plotting or photogrammetric extension of control under guidance or supervision. The above three levels have also been identified by Dr. A. J. Brandenberger, Chairman, ISP Working Group VI/1 of Laval University, Quebec City, Canada who has been studying this aspect of photogrammetric education since 1964. In developing countries these three levels of photogrammetrists have to be trained to ensure speedy introduction of photogrammetric method of surveying.

Another important aspect of photogrammetric education is to ascertain the workable ratio of photogrammetric personnel at three different levels i.e. between photogrammetrists with post-graduate education, photogrammetric technologists and photogrammetric technicians. This ratio will vary from one developing country to the other. From the available information it appears that on a world-wide basis there exists an average ratio of 1:3:5 between the three levels. For individual countries the ratio between three levels shows considerable fluctuations from 1:3:4 to 1:3:20. However, a ratio of 1:2:6 or 1:2:8 will be more suitable for most of the developing countries.

On the basis of the above careful analysis of world-wide situation of present photogrammetric personnel and realistic projection of future requirements and assuming an appropriate ratio of personnel at the above three levels it should be possible to arrive at some figures for total photogrammetric manpower requirement at three levels so that it should be possible to do some realistic planning for providing necessary photogrammetric education facilities.

Dr. Brandenberger in his report to the 12th ISP Congress, Ottawa, 1972 came to the following conclusion : "Based on the present progress rate of photogrammetric activity, this would lead to the following preliminary projections of photogrammetric manpower for the next five years for the world: required annual intake for professional photogrammetrists - 750; photogrammetric technicians - 2700; and auxiliaries or plotter operators - 4,500". If we compare the reported world land area and India's land area, Indian's requirement of photogrammetric personnel per year will be 6:20:35 i.e. a total of 61. This gives a fairly realistic figure for planning of photogrammetric education in a developing country.

COURSE SYLLABUS AND DURATION

The next two important questions that the developing countries have to consider are; the first, what to teach in each of the three different levels of photogrammetric education i.e. what will be the course syllabus; the second, how much to teach i.e. what will be the duration of the course.

Several suggestions for the model syllabuses for photogrammetric education at different levels were submitted to the 11th International Congress of Photogrammetry, Laussane 1968. The Netherlands in his invited paper "Education and Training in Photogrammetry" in which the details information about several institutions all over the world teaching photogrammetry have been indicated in terms of number of hours devoted on nine specified theory subjects and on nine practical exercises. Dr.H.M.Karara, University of Illinois, USA in his presented paper "Photogrammetric and Geodetic Engineering (PGE): A New Area of Specialization in Civil Engineering at the University of Illinois" had described the new set up of photogrammetric education at the undergraduate and graduate level. Paul E.Norman, National Aeronautics and Space Administration, USA in his presented paper "Photogrammetric Training for Developing Countries" had presented three training programmes viz. the University Programme, the Intermediate Programme and the Technician Programme to meet the Photogrammetric training needs of developing countries.

The International Institute for Aerial Survey and Earth Sciences (ITC), The Netherlands conducts several courses in photogrammetry: P-1 course corresponding to post-graduate level education in photogrammetry, P-5 course corresponding to graduate or technologist level education in photogrammetry, and P-8 course corresponding to diploma or technician level education in photogrammetry in order to offer photogrammetric education in the specialised skills and knowledge required for the three different levels. The photogrammetric education in the ITC is provided in order to assist national cartographic agencies in the production of topographic maps and other photogrammetric products which are urgently required for economic development. The ITC Photogrammetry courses are designed for the practice of the profession i.e. after returning to their countries, the students are expected to put into practice the acquired knowhow in a productive way. This approach is ideally suited for developing countries.

In Survey Training Institute, Hyderabad three basic courses in surveying and mapping of 2 years' duration are conducted for new entrants to Survey of India at three levels

viz. technician (course 150), technologist (course 400) and professional or executive (course 500). The following theoretical and practical instructions in photogrammetry are imparted in these basic courses.

	Class	Laboratory	Field
	<u>Lectures</u>	<u>Exercises</u>	<u>Exercises</u>
Course 150 - Surveying Technician Level	40 hours	20 weeks	10 weeks
Course 400 - Surveying Technologist Level	60 "	15 "	4 "
Course 500 - Survey Engineering (Professional Level)	80 "	12 "	4 "

After completion of basic training, surveyors of all three levels go to productive survey units for acquiring practical experience in surveying and mapping. After about 3 to 5 years' productive experience, surveyors with aptitude for photogrammetry come back to Survey Training Institute for mid-career photogrammetry courses.

The Photogrammetry Courses conducted in Survey Training Institute, Hyderabad are mainly of three levels viz. Courses 445-Photogrammetry Operator and 450-Photogrammetry Control Surveyor which are of technician level; Course 560-Photogrammetry Technologist of graduate level; and Course 710-Advanced Photogrammetry of post-graduate level. The particulars of the photogrammetry courses of India are given below .

Course 445 - Photogrammetry Operator Course is a mid-career course for imparting training at the technician level in the operation of photogrammetric instruments for stereoplotting and its duration is 3 months. The course is meant for persons who have passed the Intermediate Examination with Mathematics, have completed Course 400 or equivalent and have 3 year's experience in a survey organisation or have passed Matriculation (High School) Examination or its equivalent and have 7 years' experience in a survey organisation. The course capacity is 16. Two such courses are conducted every year commencing in March and July.

Course 450 - Photogrammetry Control Surveyor Course is mid-career course for imparting training at the technician level in the operation of photogrammetric instruments for photogrammetric extension of control by aerial triangulation and adjustment of aerial triangulation. The course duration is 3 months. The course is meant for persons who

have passed the Intermediate Examination or its equivalent with Mathematics and have completed Course 445 or equivalent and have 3 years' experience in a photogrammetric organization. The course capacity is 16. One course is conducted every year commencing in March.

Though the duration of these two courses may appear to be short, we have found that in view of the photogrammetric background built up during the basic courses 150 and 400 of two years' duration and practical experience of 3 to 7 years, the candidates have been able to attain the desired proficiency in this period. In these two courses the emphasis is on education and training in practical aspects of photogrammetry for employment as individual photogrammetrists.

Course 560 - Photogrammetry Technologist level course is a mid-career course of higher level, which in addition to providing extensive practical training in supervisory aspects, goes deeper into the theoretical aspects of photogrammetry equivalent to degree level in universities. The course duration is 8 months. The course is meant for persons who have passed B.A. or B.Sc. Examination with Mathematics or its equivalent; or who have completed courses 400, 445 and 450 and have 5 years' experience in a photogrammetric organization. The candidates who complete this course is capable of occupying senior supervisory posts in photogrammetric offices.

Course 710 - Advanced Photogrammetry course is a post-graduate level mid-career course which imparts advanced education and training in photogrammetry at higher academic level than course 560 with more theoretical studies in order to develop conceptual abilities in photogrammetric practice of senior executive or managerial level personnel who can develop the subject further in both teaching institutions and productive services. The course duration is 12 months. The course is meant for officers who have a university degree in surveying or engineering, have completed Course 500 or its equivalent and 3 years' service in a survey organization or who have completed Course 560 and 10 years' service in a survey organization. The course capacity is 8. In this course emphasis is given on planning, production control, cost estimating and other managerial tasks.

The broad course content and the lecture and practical instructions hours of three levels of photogrammetric courses discussed above are appended as Appendix A and B so that these may be of help to other developing countries.

CONCLUSION

Based on our experience for about two decades, we

are of the opinion that the training in photogrammetry in a vast country like India, should be given in a training institute within the mapping organization but away from the productive units so that the trainees can acquire necessary theoretical background and practical skill within the specified course duration. Some senior officers of the organization should be sent abroad on long courses say two officers per year, in order to keep abreast of the technological advances and in order to keep the academic level of photogrammetric instruction high.

The problems of photogrammetric education and design of course curricula for different levels in a developing country like India and the experiences gained in 25 years have been discussed. The course content and the lecture and practical instruction hours of three levels of photogrammetric courses in India compare favourably with available information on world practice. The model of photogrammetric education in Survey Training Institute, India adequately meets the requirements of the developing countries and can be followed by others.

REFERENCES

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APPENDIX A - Theory Lectures in Photogrammetric Course

Subjects	Lecture periods			
	Course 710	Course 560	Course 445	Course 450
1. Basic principles of photogrammetry: Mathematical, optical, photographic, binocular vision.	30	40	10	10
2. Aerial photography and navigation: Aircrafts, navigation instruments, cameras, auxiliary aids for aerial photography.	70	30	10	10
3. Rectification and orthophotography: Geometry of aerial photographs, rectification, mosaics, orthophotography, photomaps.	100	30	10	10
4. Photogrammetric instruments: Types of instruments, testing and adjustment of photogrammetric instruments, camera calibration, automated systems.	100	60	20	20
5. Applied Mathematics and Computer Applications: Matrix calculus, numerical analysis, computer hardware, computer programming.	200	140	-	-
6. Theory of Observations and Adjustments: Statistics, theory of observations, least squares method, standard problems of adjustment.	70	70	-	-
7. Theory of Orientation: Fundamental formulae, relative orientation, absolute orientation, theory of orientation.	100	50	20	10
8. Aerial triangulation: Triangulation with analogue instruments, analytical triangulation (comparators),				

radial triangulation, adjustment of aerial triangulation.	100	180	10	30
9. Application of aerial photogrammetry and remote sensing: Topographic mapping, large scale mapping, mapping and photo interpretation for geology, forestry, soils, roads and engineering problems. Planning of photogrammetric projects. Digital terrain models.	100	40	20	10
10. Terrestrial and non-topo- graphic photogrammetry: Terrestrial and close range photogrammetry instruments, methods and applications.	30	-	-	-
11. Other subjects: Topogra- phical survey, cartography, etc.	100	20	-	-
TOTAL	1000	660	100	100

APPENDIX B - Practical Exercises in Photogrammetric Courses

Subjects	Practical exercise periods			
	Course 710	Course 560	Course 445	Course 450
1. Exercises for binocular vision, parallax bar measurements, stereoscopic transfer of points	100	20	50	30
2. Exercises in relative orientation, numerical orientation.	100	60	50	30
3. Absolute orientation and plotting exercises in different types of instruments and scales.	100	80	320	40
4. Exercises in computations and programming.	40	40	-	-
5. Rectification and orthophotography.	60	-	30	30
6. Exercises in photographic laboratory, preparation of mosaics and orthophotos.	30	30	30	50
7. Testing of photogrammetric instruments, grid measurements and camera calibration.	90	50	20	20
8. Aerial triangulation including adjustment:				
(a) with analogue instruments	200	380	-	300
(b) with comparators	180	-	-	-
(c) other types - radial	-	-	-	-
9. Exercises in terrestrial and non-topographic photogrammetry.	-	-	-	-
10. Photo interpretation and remote sensing exercises.	-	-	-	-
11. Other exercises.	100	-	-	-
TOTAL	1000	660	500	500