

FEASIBILITY FOR THE ESTABLISHMENT OF
AN EDUCATIONAL SYSTEM OF SURVEYING AND
MAPPING ON A HIGH ACADEMIC LEVEL FOR THE
REGION OF SOUTHEAST ASIA AND ITS POSSIBLE
CURRICULUM

Wang Zhizhuo

This paper is written at the suggestion of Prof. Dr. J. Hothmer, the president of Com. VI ISPRS, in pursuance with a resolution of the South East Asian Regional Conference on Education in Photogrammetry and Remote Sensing, Kuala Lumpur May 1983. The following discussions are all my personal. However, since I am now teaching in the Wuhan Technical University of Surveying and Mapping, China, influences from the present state of this University can not be avoided in drafting the curriculum of the different disciplines concerned.

I. THE SCOPE OF SURVEYING AND MAPPING

Connected with the fundamentals of mathematics and physics on the one hand and related to the various branches of geoscience and space science on the other, the science of surveying and mapping has found wide applications in economical construction, scientific research and military fields. It describes in geometrical terms the earth (continents and oceans), and the natural and artificial features on the surface of the earth; it can also determine the terrestrial and ex-

traterrestrial parameters of the gravity field, while at the same time providing ways and means to interpret physically remote sensing images so as to obtain reliable information about ground objects and their environments.

At the present time, the science of surveying and mapping is to a large extent influenced by automation. Many of the instruments that we use to obtain information have become electronic ones, and data processing can be left to the care of the computer. Therefore, all that geodesists or photogrammetrists have to do is to choose proper programmes and put in necessary data. Map-making is also heading gradually for automation. Map content and land information have a tendency to be digitized and stored in a geographical data base, which can be retrieved automatically according to the needs of the user or put out in the form of thematic maps.

Furthermore, the science of surveying and mapping should be able to measure the changes in some parameters and the state about the earth. By linking the changes with time, we may predict future happenings of some phenomena on the earth so as to take necessary steps to prevent possible disasters. We can nowadays obtain data from a combination of many sources, such as the multi-spectrum, infra-red and radar wave information we get on the earth, from the airplane and from the satellite. This shows that great many disciplines are involved in surveying and mapping, and a very high accuracy is required in some aspects.

But on the other hand, the idea now of regarding surveying and mapping as a totality is still lacking in the realm of science. There is no unified recognition from the communities which it serves. Many people are still doubting whether surveying and mapping can be es-

established as an independent science in its own right. It is true that surveyors and cartographers have not yet been able to find a common term for a science that encompasses geodesy, photogrammetry and remote sensing, engineering surveying and cartography, and are not sure whether these component parts belong to one discipline or to several disciplines. When we talk about the education in these fields, we even lack a basically identical teaching plan and syllabus. In the world today, the land surveyor is the kind of job that is mostly offered to those who study surveying and mapping. The tasks of a land surveyor are cadastral survey, land allocation and regulation, which do not need advanced studies in theory. Some of land surveyors are even graduates from departments of civil engineering or forestry. Their social status is generally lower than that of civil engineers, mechanical engineers and electric engineers.

II. The Existing State of Education in Surveying and Mapping

Higher education in surveying and mapping in the world today has been developing quite unevenly. Generally speaking, departments of education in many countries have been rather negligent in this respect. There are no disciplines of surveying and mapping in universities of many countries in the world. Many of them are satisfied with only some courses relating to surveying and mapping offered in the departments like civil engineering or forestry. Since 1960's, a number of universities have incorporated the discipline of surveying and mapping, which is usually a general, comprehensive one

with no subdivisions. As time goes on, many new technologies have infiltrated into the areas of surveying and mapping. If not adequately trained, the scientific and technical personnel in surveying and mapping will fail to meet the demands that arise out of social needs. This has compelled people to give due attention to the education in surveying and mapping.

The educational system in surveying and mapping vary greatly from place to place in the world. This diversity does not only exist between different countries but also between different universities in the same country. In the following, the situation of higher education in surveying and mapping of several countries (about the countries in the region of south-east Asia will be stated in next chapter) is enumerated. It can be seen that the education in surveying and mapping is progressing very slowly, and their durations of schooling differ widely too. With only a few exceptions, most universities have just one comprehensive discipline of surveying and mapping which is not subdivided. If we allow this situation to remain as it is for a long time, the science of surveying and mapping will be unable to develop at a fast speed and fulfil the tasks it ought to.

In France, there are no separate disciplines in surveying in Universities. The high level technical personnel in surveying and mapping, like the senior surveying engineers in the National Institute of Geography (IGN), are those who have graduated from a certain university of science and technology and then come to the school of science affiliated to IGN for their special training in surveying and mapping.

In England, there are a few universities offering bachelor degree in surveying since after the year 70's, like the University of

Glasgow and the London Polytechnic. Before that time, the high level technical personnel in surveying were university graduates in science or engineering and then afterwards took courses in geodesy and photogrammetry in universities like the University College in London.

Oxford University offers courses in geodesy to only very few selected university graduates.

In America, disciplines of photogrammetry and geodesy were set up in 1967 in University of Illinois; discipline of surveying was set up in 1971 in the department of civil engineering in Purdue University. Soon afterwards disciplines in surveying, photogrammetry or land surveying were set up in different universities, like the Ohio-State University, Iowa-State University, Florida University, California-State University. All of these universities offer Bachelor degree in Surveying. Ohio-State University and Cornell University have master and doctor degree programmes and give courses in surveying related subjects for post-graduate study.

In Canada, Laval University in Quebec started to have surveying department in 1908, offering bachelor degree. But in 1918 this surveying department incorporated in the forestry department. It was not until 1950 that surveying and forestry were again separated as two separate disciplines, each having their own specialized courses. New Brunswick University started to have surveying department in 1960 and offers bachelor, master and doctor degrees after fulfilling the respective requirements.

In Germany, Austria and Switzerland, surveying disciplines had been set up in technical universities early in the year 20's. Most of them are affiliated to department of civil engineering, while a few others are set up as separate departments. The length of schoo-

ling is four years for a diplom engineer degree, and another 2-3 years of study is required for a doctor engineer degree. However geodesy, photogrammetry and engineering survey all remain as one surveying discipline in under-graduate studies. After the second world war the technical universities having surveying and mapping disciplines in the Federal Republic of Germany are namely: of Aachen, Brunswick, Berlin, Bonn, Darmstadt, Hannover, Karlsruhe, Munich, Stuttgart. In German Democratic Republic, in the technical university Dresden there is a geodetic discipline and Cartographic discipline, offering diplom engineer degree after 4 to 4½ school years. In Switzerland, in the technical universities in Zurich and Lausanne there is a geodetic discipline, while in several technical universities in Austria, there are surveying and geodetic disciplines of 5 school years, among which the first three years are devoted to fundamental courses and then disciplines are separated into: (1) national and engineering surveying, (2) Photogrammetry and Cartography, (3) Mathematics and physical geodesy and geophysics.

In the Technological University Delft, Holland, there is a geodetic department, offering engineer degree (Ir) after graduation. University Utrecht offers only postgraduate studies in Cartography. In the International Institute for Aerial Survey and Earth Sciences (ITC) there are four departments in the field of surveying and mapping, namely: Photogrammetry, Aerophotography and Remote Sensing, Cartography and Urban Survey. In order to meet the needs of the technical and management personnel in different levels for the developing countries, the training in ITC is divided into the following four levels, namely: technician, technologist, postgraduate and master

degree. In the Soviet Union, there are two universities (called institutes), one in Moscow and another in New Siberia, specially set up for the field of surveying and mapping with subdivided disciplines of Geodesy, photogrammetry, engineering surveying, Cartography and surveying instrumentation.

III. The Situation of higher education in surveying and mapping in South-east Asian Countries

The following brief report about the state of higher education in surveying and mapping in south-east Asian Countries is based upon the relevant literatures, particularly the papers presented at the South East Asian Regional Conference on Photogrammetry and Remote Sensing Education held in Kuala Lumpur, May. 1983. These materials are far from being complete and Countries not mentioned here are plenty. Moreover the geographic range of south east Asia is also not quite definite.

Howadays, there are six universities in Malaysia where surveying and photogrammetric courses are offered. These are namely: the university of Malaya (UM), the MARA Institute of technology (MIT), the National University (UKM), the University of Agriculture (UPM), the University of Technology (UTM) and the University of Science (USM). Some of them give certificates like: Diploma in Land Surveying, Diploma in Photogrammetry, Certificate in photogrammetry and Photo-Interpretation, or Bachelor of Surveying (Land), depending upon their different teaching programmes.

In India, higher education in Geodesy is covered by Courses of post-graduate level, being conducted in the Survey Training Institute, Hyderabad. In some Indian Universities e.g. in the University of Roorkee and in the Perarignar Anna University of Technology, geodesy is taught as an auxiliary subject in the graduate course and also in the post-graduate courses in Advanced Survey and Photogrammetry and in Remote Sensing respectively.

In Indonesia, Department of Geodesy at Institute of Technology Bandung was established in 1950 as a division of technological Faculty of the University of Indonesia. Subjects given are Geodesy, Photogrammetry and Remote Sensing, Cartography and Land Information System. The Faculty of Geography of the Gadjah Mada University has established a Department of Remote Sensing in 1975. In combination with the Department of Cartography, both departments have been integrated into the Department of Geographic Techniques in 1983 and started a master program in remote sensing. In Thailand, there is a Department of Survey Engineering at Chulalongkorn University. It is active in photogrammetric research and offers bachelor and master degrees.

Education and training in remote sensing in Thailand seem to be very active and fast growing, especially when the country has a (LANDSAT) satellite receiving station in 1981 and the Asian Institute of Technology (AIT) has set up its Remote Sensing Centre in 1982. The Asian Institute of Technology has just commenced its training course and would have a master degree program in the near future.

In China, the Wuhan Technical University of Surveying and Mapping (Former name of the University was the "Wuhan College of Geodesy, Photogrammetry and Cartography") was established in 1956. There are

seven disciplines namely: Engineering Surveying; Photogrammetry and Remote Sensing; Geodesy; Cartography; Surveying Instrumentation; Radio technology and Computer technology and computational mathematics. At present, there are in school nearly 2000 regular undergraduate students. After four school years of learning, they are offered with Bachelor degree. It takes another three years for postgraduate study, offering the title of master degree. Hereafter postgraduate students working for doctor degree will also be admitted by examination. Besides there are more than 10 other universities in China like the Tongji University with a discipline of Engineering Surveying, the south-west Jiao-Tung University with a discipline of Aerophotogrammetry, especially set up for railway location purposes. In the Engineering College of the Chéng-Gòng University of Taiwan, China, there is a geodetic discipline for under graduate students and a Research Institute of Aerophotogrammetry for post graduate studies.

In the Japanese Universities or colleges, courses in surveying are included in other disciplines like geography, geology, civil engineering, city planning, agriculture, mining, marine engineering etc. There are few professors in University who teach the surveying course as specialists in Japan. Almost all of the teachers are teaching their technical subjects besides surveying. Education in photogrammetry and remote sensing is generally included in the lecture of surveying but a few universities offer separate courses.

Australia and New Zealand are close neighbourhood of south east Asia. In the Engineering Faculty of the University of New South Wales, Australia, three departments have been established in the field of surveying, namely: the Department of Geodesy, of photogrammetry and of Engineering Surveying. Besides, there are more than ten universities or Institutes, like the Royal Melbourne Institute of Technology,

South Australian Institute of Technology etc, which offer degrees like Bachelor of Surveying, Bachelor of Applied Science or Bachelor of Technology.

In New Zealand, a school of Surveying was established at the University of Otago. It was established primarily for the purpose of training cadastral surveyors. A four year Bachelor of Surveying degree and further a two year Master of Surveying degree have evolved. In order to train Candidates who are seeking careers in the field of measurement science, geodesy or photogrammetry and who have little or no interest in cadastral surveying is to provide a three-year Bachelor of science degree in the field of measurement science. Graduates may specialize in geodesy, photogrammetry or Cartography by proceeding to a one-year Postgraduate Diploma in science, followed by a Master of science degree which normally extends over one year.

IV. THE ESTABLISHMENT OF A HIGHER EDUCATIONAL SYSTEM OF SURVEYING AND MAPPING FOR THE SOUTHEAST ASIA REGION AND ITS POSSIBLE CURRICULUM

From what has been said before, we know that the present situation of education in surveying and mapping falls short of the tasks confronting surveyors and cartographers and the demands arising in the course of research work. Different communities in society also require more complicated and more extensive services from surveyors and cartographers. Consequently, it is necessary to establish a high-level, complete educational system of surveying and mapping in higher

educational institutions. This is not only true of the region of South-east Asia, but also the whole world. At present, there are already some high level educational institutions of surveying and mapping in Southeast Asia. Therefore, it is not only necessary but also possible to establish such institutions in this region to train advanced surveyors and cartographers that are needed here, rather than send people overseas to North America or to Europe.

The educational institutions in surveying and mapping established within the framework of a higher educational system should aim at training personnel who are able to make full use of the new emerging theory and technology. To this end, the teaching plan and the syllabus should keep abreast of the current development and the scope should be very wide. Take mathematics for instance. We should include in its syllabus the courses of numeric computation methods and computer science. The contents of electronics should be so wide that future graduates will be able to operate the most up-to-date instruments and even participate in the design of a new instrument to some extent if need arises. Moreover, we must be fully aware of the fact that the development in surveying and mapping necessitates a sound theoretical grounding on the part of students. So we must ensure that students have a good training in this connection so that they can engage in further studies on their own and enrich their knowledge so as to meet future needs.

A. Disciplines Offered

Since the scope of surveying and mapping is ever increasing, it is very difficult to train advanced personnel within one big framework with no subdivisions. Therefore, we should divide it into four discip-

lines, namely: geodesy, photogrammetry and remote sensing, engineering surveying and cartography. In making these divisions, the present international associations in surveying and mapping may serve as a kind of guidance. Now we have the following international associations related to surveying and mapping; IAG (International Association of Geodesy), ISPRS (International Society of Photogrammetry and remote Sensing), ICA (International Cartographic Association) and FIG (Federation Internationale des Geometres). It would be very difficult for anyone to understand the diversified topics discussed in all these associations if he is a graduate from the discipline of general surveying and mapping without subdivisions.

The discipline of " photogrammetry and remote sensing" is a discipline in its own right. The alliance of photogrammetry and remote sensing is a very appropriate arrangement for both of them. This is because the new emerging technology of remote sensing really came into being as a result of the development in space technology and computation technology in photogrammetry. Remote sensing is such a multidisciplinary science that it has found its way into the syllabuses of many different disciplines in the universities. It seems that the discipline of remote sensing can be established from many points of view. If we see it from the point of view of technology, for example, we can set up a discipline of remote sensing with emphasis on optics, electronics or automation respectively; if we look at it from the point of view of application, then we can speak of it in terms of geography, geology, forestry and agriculture. But it should be noted that it is photogrammetry that has the closest ties with remote sensing. Photogrammetry has two sides of its own: technology and application. So is also with remote sensing. We think it

is most reasonable and advantageous to establish the discipline of "photogrammetry and remote sensing" as a basis, on top of which to promote the development of remote sensing.

B. Curriculum Arrangement

The scheme for curriculum arrangement is seen in Table 1, the length of study being four years. The courses for receiving practical experiences have not been included. At the final stage, 10-15 weeks are needed for graduation thesis.

Courses in Different Disciplines of
Surveying and Mapping

Table I

Disciplines of

Geodesy	Photogrammetry and Remote Sensing	Engineering Surveying	Cartography
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Courses common to all these disciplines are (courses with the same name may have different class hours for different disciplines):

Politics, Physical Training, Foreign Language, Economics, Management, Mathematics,*
Physics, Surveying, Electricity and Electronics, Principle and Application of
Electronic Computer, Surveying Adjustment, Photogrammetry

Geodesy Geodetic Astronomy Gravimetry Satellite Geodesy Figure of the Earth Generalized Surveying Adjustment	Topographic Drawing Geodesy (including Practical Astronomy) Photography and Aerial Photography Photo-Interpretation Cartography Remote Sensing	Topographic Drawing Engineering Drawing Control Surveying Geodesy (including Practical Astronomy) Surveying Instrumentation Outline of Civil Engineering Engineering Surveying	Chemistry Map Drawing Map Layout General Map Compilation Thematic Cartography Map Reproduction Geomorphology Map Projection
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Optional Courses

Electromagnetic Distance Measurement Inertial Geodesy Geophysics Geodynamics	Image Processing(I) Geometric Processing of Satellite Imagery Chemistry in Photography Generalized Surveying Adjustment	Application of Lasers in Engineering Survey Data Processing Non-topographic Photogrammetry Generalized Surveying Adjustment	Remote Sensing and its Applications Automation in Cartography Chemistry in Map Reproduction New Techniques in Map Reproduction Printing and Colours
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* Including Calculus, Linear Algebra(I), Theory of Probability(I) and Statistics(I)

C. Teaching Programme for Post-graduate Study

The objective of post-graduate study for master's degree is to train the candidates to have a solid theoretical basis, a comparatively wide range of knowledge and a systematic technical know-how in their own specialization. They must have the ability to do practical works, to carry out research works as well as to teach in his own discipline. The duration of schooling for the post graduate study for master's degree is three years, among which one and half to two years time is to be devoted to course study and also to the reading of speciality oriented literatures. The rest of the time is for carrying out the research works including theoretical derivations, experiments as well as the writing of the degree thesis. The course offered in post graduate study are listed in Tab. 2. At this stage, photogrammetry and remote sensing are seperated as two specialities.

Courses for Post-Graduate Study
(including both compulsory and optional)

Table 2

Disciplines of

Geodesy	Photogrammetry	Remote Sensing	Engineering Surveying	Cartography
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Courses common to all these disciplines are (courses with the same name may have different class hours for different disciplines):

Foreign Language(II), Second Foreign Language, Linear Algebra(II) Statistics(II);
Computation Methods, Computer Software.

Theory of Earth Rotation Random Data Analysis Math-Physical Equations Functional Analysis Sensor Celestial Mechanics	Digital Image Processing(II) Random Data Analysis Tensor Principle of Data Base	Digital Image Processing(II) Random Data Analysis Digital Signal Processing Pattern Recognition Principle of Data Base	Precise Engineering Surveying Linear Programming Engineering Survey- ing Instrumentation Electromagnetic Distance Measurement	Cartographic Generaliza- tion Principle of Data Base Computer Assisted Cartography Digital Image Processing (I) Discrete Mathematics
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D. Doctor Degree

The candidates for doctor degree must be those who have already acquired master's degree or an equivalent academic qualification. The length of schooling is 2-3 years, mainly devoted to research works for writing a thesis of high quality. According to the need of each individual, some supplementary courses may also be arranged within this period.

References

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