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## *Aeronautical Chart and Information Center Technical Training Activities\**

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*ABSTRACT: The technical training concepts, requirements, and procedures of the USAF Aeronautical Chart & Information Center are presented within the framework of a rapidly advancing technology. The paper emphasizes the importance of comprehensive planning for the initial academic training of the Cartographer and for a continuing up-dating of his skills in order to maximize the advantages offered by technological improvements.*

THE events of the past few years point with certainty to the challenge which faces those of us who support the economic and military strength of the Nation with the cartographic materials essential to progress in these areas. It would be difficult to make accurate statements which compare technological progress of any period of the past with that which can be expected in the next half decade; for each period of time provides its own unique contribution to subsequent progress. However, an objective view can be taken of the individual who has provided the cartographic skills of the recent past, and the question asked, "Can this man provide the skills which are needed for the future?"

### PREPAREDNESS FOR THE FUTURE

In answering this question, let us first recognize that the physician, the lawyer, the

engineer, and members of other professions which are based on a formal schedule of academic training, enter active practice with a reasonably current knowledge of the state of their art. It is a fact that, with few exceptions, the individual depended upon to fill the needs for cartographic skills has been developed without the advantages of similarly planned academic training, and that he over a period of time gains experience which, more often than not, channels his activity along specialist lines. The advantages of an individual specializing in a portion of a chosen career field are unquestioned; the disadvantages of specializing without first having qualified as a general practitioner should be equally obvious.

The degree to which these disadvantages are considered organizationally as being im-

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portant depends of course on the diversity of the cartographic work in which an organization participates or expects to perform. But even with this qualification, it can easily happen that the specialist can be lost in the backwash of technological change unless a directed effort is made to keep abreast. It is unfortunate for the individual, and equally so for the organization, when lack of background knowledges become an obstacle to successfully meeting this minimum requirement.

#### ASSURANCE OF ADEQUATE ORGANIZATION

Accepting the current situation of the general non-availability of planned academic preparation for cartographers, what then is the answer to the problem of assuring an organization that adequate skills will be available to meet the challenge of providing new products, more precise data, and to maximize the advantages offered by technological advances?

The primary participants in the solution to this problem are the individual and the organization management. Most individuals desire to progress to positions of increased responsibility. The individual recognizes that in order to advance in the organization, he must achieve an increased potential for accomplishing more difficult and responsible work. The organization recognizes that its success is dependent upon the ability to match work requirements with personnel skills on a flexible and timely basis. Organizational requirements and individual goals can therefore be merged in a common objective which can be achieved through a coordinated training program for upgrading the skills of the individual in areas considered important to organizational success. The USAF Aeronautical Chart and Information Center has developed a training plan for its employees based on this concept.

#### IMPLEMENTATION OF PLAN

Our implementation of this plan begins with the identification of the technical skills represented by our available manpower resources. While this information is currently available to us only in the form of manually controlled records, the application of electronic data processing techniques is planned as a means of providing more complete and timely information from this skill inventory. Knowing our current status of skills, the areas of potential deficiencies can be determined based on program forecasts and research and development activity in areas of concern. An

analysis of this nature indicates increasing and new requirements in major activities such as advanced analytical photogrammetry, stereo-photogrammetric instrument operation, geodetic analysis and adjustment, geophysical and astrophysical studies, electronic computer programming, operation and management, precision photographic processing, cartographic design and compilation, analyses of air navigation and control systems, quality control, statistical testing and evaluation, and advanced scientific management.

#### DESCRIPTION OF TRAINING PLAN

The current ACIC training plan is designed to insure that the skills necessary to support these activities will be available as needed, both in the required volume and at the required level of competence. The training plan includes courses of instruction which are categorized as primary, advanced, and special training programs.

The primary training program is directed toward two specific objectives. The first objective is to provide new employees, primarily college graduates, who have been hired at the entrance level on the basis of education, with practical training in the application of cartographic techniques. The second objective is to provide basic mathematics courses to those personnel who require refresher work, or who have not had prior adequate mathematical training. These two courses, together with normal on-the-job training and job rotation, are expected to provide the "general practitioner" pool of cartographers which can be drawn upon for the advanced and special training programs.

The advanced training program is directed toward upgrading the technical backgrounds of personnel in order that advanced technologies can be exploited as the need arises. This program covers subject areas such as advanced mathematics, advanced scientific electronic computer programming and data processing, astronomy, celestial mechanics, geodesy, and computational photogrammetry.

The special training program covers a broad spectrum of activity and is designed to maintain currentness in all the technical and management phases of our work and to provide initial training not included in the primary training program. Training is furnished in such diverse technical fields as the operation of stereo-photogrammetric equipment, photometry, statistical quality control, error

theory, orientation in electronic computer programming and management, air traffic control, radar prediction, shaded relief drawing, and orientation in USAF Weapon Systems and operational concepts. Administrative and management courses are given high priority consideration, and include production control, management practices for first line supervisors, management courses for middle management, and, most recently, a course in advanced scientific management for all the key civilian and military personnel of the Center.

#### TRAINING ENVIRONMENT

Having identified our training requirements, the selection of an appropriate training environment is next considered. The various environments either in effect or planned for the future by ACIC are:

- a. Training on the job by ACIC supervisors as part of normal production work.
- b. Training conducted by ACIC personnel during normal duty hours apart from normal production work.
- c. Training conducted by ACIC personnel after normal duty hours with all students in a volunteer status.
- d. Attendance at schools conducted by the USAF Air Training Command, the Air University, and other joint service schools.
- e. Manufacturers' courses for training in the use and maintenance of new equipments.
- f. Correspondence school courses.
- g. Special contract courses with Universities with students in a duty status.
- h. Established courses at Universities.
- i. Voluntary enrollment in undergraduate or graduate University night school courses. The Federal Executive Board of the Greater St. Louis area is currently preparing a proposal for a government sponsored graduate night school course leading to a Masters Degree in Public Administration for career management employees of the Federal Agencies located in St. Louis. Similar programs in technical areas are also being considered.
- j. A cooperative work-study program, which provides an integration of academic study with practical work experience and training.

The selection of a training environment which will best meet a specific training re-

quirement is affected by several factors which are important to the degree of success which will be reached. These factors are: organizational urgency for the training, availability of the required training course, the degree of employee motivation for self-improvement, and the relative costs when alternatives exist.

In applying these factors to the categories of primary, advanced and special training, the following course environments have been established as being most suited to our current situation.

#### PRIMARY TRAINING PROGRAM

- a. The first objective of the primary training program, that of providing practical training in the application of cartographic techniques for new employees, is conducted as formal training, off-the-job, during normal duty hours by ACIC instructors for a period of six months. The over-riding factors in this situation are relative costs and urgency of the training requirement. While the input to this course over the past several years has varied from twelve students per month to a high of sixty-two per month, with the current total enrollment being approximately two hundred, it is possible to adjust to varying student loads since instructor personnel are provided as needed from the production work force. It has been determined that for the type of training required, an operationally effective cartographer can be developed more economically and in a shorter period of time by the formal class-room environment than by any other technique. As a supplementary longer range program, ACIC is undertaking plans for a cooperative arrangement with Southern Illinois University whereby students enrolled in the Geography Program, and who undertake electives in mathematics and cartography, may alternate each academic semester with employment at ACIC. It is believed that if this plan can be successfully carried out, further progress will have been made toward encouraging the establishment of Cartography as a major undergraduate course of study in Universities of the U. S.

The second objective of the primary training program centers primarily on the degree of employee motivation for

self-improvement—the recognition by employees that in order to advance in the organization, their technical competence must reach a level which will encourage their selection by management for advanced and special training. It is under this situation that some courses have been arranged whereby employees voluntarily undertake training after duty hours in mathematics. Also, employees are encouraged to enroll in recommended courses at Universities, and undertake appropriate correspondence school courses.

#### ADVANCED TRAINING

- b. The environment for the advanced training program is influenced primarily by availability of the required courses, and organizational urgency of the requirement from a timeliness standpoint. Where the advanced training is tailored to a specific organizational requirement, and is not available to the employee as an established course of instruction at educational institutions, contract courses have been established with Universities such as Yale and Cincinnati for courses in astronomy, and with Ohio State for courses in advanced computational photogrammetry and geodesy. The selected students attend these courses in a full duty status with all tuition paid by ACIC.

#### SPECIAL TRAINING PROGRAM

The special training program courses, of which there are a great number, are considered individually in determining the appropriate course environment. Factors of relative costs, availability of training courses, and urgency, dictate that stereo photogrammetric training be conducted locally during duty hours but apart from normal production work. The same considerations apply to initial training in shaded relief drawing. Availability of service established courses in photometry, quality and production control, and air traffic control, lead to the selection of individuals for attendance at these schools in a duty status. Short duration courses such as basic management and supervisory training are conducted during normal duty hours by trained ACIC personnel on a continuing basis as the most economical approach to this requirement. Acquisition of new and complex equipment invariably requires that arrangements be made with the manufacturer to provide

training in its operation for selected personnel, who then conduct on-the-job training for the remaining required work force. The Advanced Scientific Management Course for key management personnel of ACIC is accomplished by contract with the Graduate School of Business Administration of Washington University. The course consists of 100 hours of instruction, 50% of which is undertaken during non-duty hours.

The ACIC Training Plan will eventually permit a degree of correlation between organizational training assignments and the progressive career development of the individual employee. Using the designations of Cartographer, Senior, Supervisory, and Managing Cartographer as generally descriptive of the scope of activity and responsibility of individuals, the Primary, Advanced, and Special Training Programs can be systematically applied to achieve a progressive build-up of the knowledges and skills required at each level.

Under optimum conditions, the Cartographer will enter the field well prepared scholastically, and under the primary training program will receive instruction in the cartographic applications used within the organization, and familiarization with the overall instrumentation and materials available for these applications. Senior Cartographers will participate in the Advanced and Special Training Programs which emphasize a broadened technical base in mathematics and the physical sciences, and specialist training in specific fields such as Stereophotogrammetric Plotting, Geodesy, Computer Programming, etc. Senior Cartographers who are selected for supervisory positions will participate in the Special Training Program with emphasis placed on both technical and production management courses. The Managing Cartographer is generally in a position which permits little time for participation in formal training programs, yet adequate training for this level is critical, and must be accomplished in order to permit informed and timely decision making. The Special Training Program for this level emphasizes courses in the managerial field and orientation and up-dating in new equipments, techniques, and USAF Weapon Systems.

#### CURRENT AND FUTURE NEEDS

While a close correlation of training with progressive career development for each

individual is an objective of the ACIC Training Plan, the pressing demand for increased technical proficiency in specific skills frequently requires that a more direct approach be taken to immediate problems. It is fully recognized that while expedients capable of execution in a relatively short period of time

may solve today's emergencies, the needs of the future require a systematic and planned approach which will result in the development of a truly professional Cartographer capable of making the most effective and timely use of the new materials and techniques which will result from technological advances.

## *Upper Atmospheric Wind Determinations from Stereo-Photography of Rocket Vapor Trails\**

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*ABSTRACT: A continuous altitude profile of the velocity vectors of air currents in the upper atmosphere can be obtained by the application of non-topographic photogrammetry. The method presented in this paper consists of taking time sequenced stereo-photographs of vapor trails exhausted by high-altitude rockets with photo-theodolites. By knowing the position and orientation of each terrestrial camera, the displacement vectors of various points on the vapor trail appearing on consecutive sets of stereo-photographs can be determined. An error analysis of the parameters indicates that an accuracy in wind velocity of  $\pm 5$  miles per hour is attainable. The major advantage of this method is the ability to obtain a wealth of fairly accurate velocity information with considerably less cost and complexity than is necessary with present methods.*

### INTRODUCTION

INCREASED information concerning the upper atmosphere is both desired and required by various branches of science. One of the properties of the earth's atmosphere about which more information is wanted is wind velocity. A number of methods already exist for obtaining information about the amount and direction of air currents for various altitudes. However, these methods do not give a continuous profile of velocity; either with respect to altitude or position on the earth. A method is presented in this paper which utilizes an application of photogrammetry to

obtain a continuous profile of wind velocities. It is believed that this method can be used to produce more complete and more accurate information about the upper atmosphere.

Aside from the continuous search for more complete knowledge of the earth and its surrounding environment, there are a number of specific reasons for determining more complete information about air currents in the upper atmosphere. For the purpose of discussions in this paper, the upper atmosphere is defined as ranging from about 20 miles above the earth to the point where the atmosphere ceases to exist. Although there is

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