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THE ROLE OF THE DEFENSE MAPPING AGENCY INTER AMERICAN GEODETIC SURVEY (DMA IAGS) IN NATION-BUILDING

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(Essay)

THE ROLE OF THE DEFENSE MAPPING AGENCY INTER AMERICAN GEODETIC SURVEY (DMA IAGS) IN NATION-BUILDING

by

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AUTHOR: Hector Wood, LTC, CE
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The basic question is whether the operations of the Defense Mapping Agency Inter American Geodetic Survey (DMA IAGS) make a significant contribution to the development of Latin American countries. Data was gathered using literature search, questionnaires, and personal interviews with both DMA IAGS and foreign national collaborating officials. The DMA IAGS has been in Latin America since 1946 collaborating with Latin American countries in mapping operations. During this time DMA IAGS has guided and partially funded the establishment of thousands of miles of geodetic control, photographed large land areas, school trained over 3600 personnel and produced thousands of topographic maps. The geodetic control, cartographic products, and trained personnel are essential, basic tools for the development of Latin American countries. Highway construction, river navigation, hydroelectric dams, and oil exploration are a few of the projects that are dependent on the topographic capability being established on each country by DMA IAGS. Cadastral Programs have the potential to accelerate the National Topographic Mapping Programs. DMA IAGS could improve its position by increasing its effort in Cadastral Programs. It is evident that DMA IAGS, although a defense oriented agency, is one of the major contributors to nation-building in Latin America.

THE ROLE OF THE DEFENSE MAPPING AGENCY INTER AMERICAN GEODETIC SURVEY (DMA IAGS) IN NATION-BUILDING

Many countries in Latin America today face, among other things, the serious problem of an explosive increase in population which is not in balance with their capabilities for socio-economic development. In many cases it is impossible to attain a reasonable exploitation of the natural resources available, to increase the construction of roads, or to establish sound programs for the progressive development of industry and education. As a direct result of this situation, standards of living can only remain stationary or deteriorate further, creating a dangerous political situation. Latin American leaders, conscious of this danger, have initiated a series of development programs that require diversified types of cartographic products. Dependency on products used in land tenure, agrarian reform, and local tax projects is especially high.[1] Latin American leaders have turned to their mapping agencies to provide the cartographic products required for nation-building projects. These agencies, in turn, look to DMA IAGS, which has been collaborating with them during the past 28 years, to resolve their mapping problems.

The DMA IAGS does not program funds for any specific development project, although one of its function is: "Assist collaborating agencies of Latin America in cartographic, geodetic and geophysical activities which respond to and support their countries' programs of national development."[2] This paper will discuss whether DMA IAGS operations make a significant contribution to the development

of Latin American countries. To give the reader a better understanding of DMA IAGS operations, a brief history will be given.

HISTORY

One of the lessons learned in World War II was that existing maps and charts for large areas of the world contained many deficiencies, and that in many areas, especially the less developed areas, there were no suitable maps available. Maps available frequently were based on old information and lacked the precision and reliability required for fast-moving forces and long-range weapons.[3] In 1944, when the Pan American Institute for Geography and History (PAIGH) requested assistance from the United States for geodetic surveys and production of national topographic maps, President Harry S. Truman responded to this request by directing the War Department to assist in this effort. The United States Army Inter American Geodetic Survey (USA IAGS) was created in April 1946 to meet the Army's responsibilities in a collaborating program to map areas of Central and South America and the Antilles. This program, known by the short title MAPPLAN, is a segment of the world-wide tri-service mapping program established by the Joint Chiefs of Staff (JCS) to obtain correlated topographic maps and charts of countries friendly to the United States.[4]

Operations are conducted under diplomatic agreements negotiated by the State Department with countries of Latin America. These agreements are general in nature and make no reference to specific areas to be mapped. In the period between 1946 and 1962

the State Department entered into formal mapping agreements with 18 countries. Argentina and Uruguay have never entered into a formal agreement, but informal arrangements have allowed DMA IAGS to work in those countries from time to time.

The overall goal of DMA IAGS is to make the countries of Latin America self-sufficient cartographically. Toward that end, DMA IAGS has been involved in the formation of many cartographic agencies throughout Latin America. The specific mission and functions of DMA IAGS are found in Annex A. A secondary mission was assigned in 1963 to provide support for economic development programs of the U.S. Agency for International Development (USAID). This activity, completely finance by USAID, provided a team of scientists and technical specialists to assist directors of USAID missions in various Latin American countries in the development and execution of plans for expanded and more efficient use of natural resources. In 1971 the Director of DMA IAGS made a formal request to the Department of Defense for an augmentation of mission. This was approved and the new mission includes cartographic support of nation-building activities involving programs such as remote sensing and others which will be discussed later in this paper.[5] It is the day to day operations of DMA IAGS as they pertain to nation-building activities that this paper will address. For the interested reader, the DMA organizational chart, the DMA IAGS organization chart, and the DMA IAGS detailed method of operations are found in Annexes B, C, and D respectively.

OPERATIONS

Normally, as soon as the diplomatic agreement is signed, DMA IAGS will establish a small office in-country to plan, in conjunction with the local nationals, a National Mapping Program. Once the plans have been developed, the technicians and equipment are brought in and some local nationals are sent to the Cartographic School for training. The first step is to start a geodetic net that will establish horizontal and vertical control throughout the country. Aerial photography is then taken, normally concurrent with the establishment of a geodetic net. The compilation of the manuscript starts as soon as other field data is collected. As the manuscripts are compiled, they are sent to the photographic laboratory for reduction, to cartography for scribing, and to reproduction for printing into a topographic map. This is a very brief and generalized description of the mapping process, but the intent is to mention the main categories which will now be discussed as they pertain to nation-building.

Geodetic Net

The geodetic net is an array of accurate and properly spaced horizontal (latitude and longitude) and vertical (elevation) permanent bench marks established throughout the country. In the long process of establishing the geodetic net, many local nationals are trained in the art of surveying. The training is initially obtained on-the-job and later by attending the Cartographic School in the Canal Zone.

As these individuals become proficient in the surveying field, they become a permanent asset to their country. Those that attend the Cartographic School in the Canal Zone feel appreciative of the training and will normally go out of their way to praise the United States. There is a certain amount of trained personnel leaving the mapping agencies and integrating in other sections of the economy. This drain of trained personnel is not wasted as it serves to accelerate development in other parts of the economy. Some become college instructors, contributing to further dessimination of geodetic knowledge in their country. These nation-building benefits, obtained from the school-trained personnel, are long lasting and chain reacting.

The geodetic net, made out of concrete monuments, is a permanent asset to the country from which many nation-building projects are derived. For example, the bench marks in Paraguay are being used to benefit the United States and Paraguay. Due to the world energy crisis, EXXON and TEXACO are prospecting for oil in the desert region of Paraguay. These companies are using aerial photography, taken previously for mapping operations, to study the land and plan their work. Once their work plan is completed, they use the geodetic bench marks as take-off points to survey to the drilling site. This saves thousands of dollars and valuable time which is so essential to their operations. If oil is found in this region it will be a tremendous boost for the development of Paraguay and will aid the United States with its energy crisis.

Another good example is the navigation study made in Paraguay

by the United Nations. The United Nations requested the geodetic data of the level line running parallel to the Paraguay River to do a navigation study of the river. The navigation study, when completed, will be of great value for many projects involving country development. In a country like Paraguay where there are few roads and many rivers, an increase in the navigational system will benefit the agricultural community, the city markets, and the exporting industry.

The above two examples show how DMA IAGS operations in geodetic work are instrumental in the development of Latin American countries. There have been other benefits from the geodetic work that include benefits to Latin America, the United States, and other parts of the world. For example, the tide gage system in Latin America was a major basic program of DMA IAGS in establishing the vertical geodetic control. Now the local government mapping agencies have had to take over the responsibility. DMA IAGS still has tide gages on loan in all the countries. The National Ocean Survey (NOS) uses this information for their tide tables. The Bureau of Fisheries and other U.S. agencies also use the data. Twelve of the tide gage stations along the west coast of Latin America are tied into the Tsunami Sea Wave Warning System.

Photography

Aerial photography is one of the most important and expensive steps in the development of topographic maps. All the detail and exact location of the land features are captured by the photographs. Later they are transcribed by several technical processes

into a topographic map. It should be remembered that a topographic map is nothing more than a compilation of many photographs with colors, symbols, and writing added to aid the layman in reading the map. Once an area has been photographed, the photographs become a demand item for users of the area. In a country with few topographic maps, the photographs, although hard to interpret, are a great aid to users that have a need for topographic information. The local mapping agencies have the expertise to join the photographs of a large area and form what is called a mosaic. Land owners, prospectors, construction companies, and universities are a few of the requestors wanting mosaics of areas of special interest to them. The funds realized from the sales serve as income for the mapping agencies which in turn releases valuable tax funds that can be used for possible nation-building projects. There are many more examples relating aerial photographs with development programs. However, the important thing to recognize is that the aerial photography, normally financed with DMA IAGS funds and expertise advise, is an important step in the development of an area.

Topographic Maps

Compilation of manuscripts normally starts as soon as the supplemental control and field classification data becomes available. The compilation is done by talented technicians, with good depth perception vision, using optical instruments that project the information of the photograph in three dimensions. The 1/50,000 scale topographic maps are normally compiled at a scale of 1/25,000.

This scale is large enough that it can be used for some development programs. Many organizations prefer a sepia copy of the 1/25,000 manuscript rather than the final topographic map which has a smaller scale. Others will buy both to obtain the printed information of the topographic map which is normally missing from the manuscript.

The personnel in the Photography, Cartography, and Reproduction sections are talented people normally trained at the Cartographic School in the Canal Zone. Most of the cartographers are talented draftmen that are capable of doing other work as required by their organizations. Important organizations such as the Organization of American States (OAS) turn to the local mapping agencies for support of their nation-building projects. Their support consists of special large scale maps of the area to be developed. The cartographic section is the key element in producing these maps. For example, the OAS has just requested from the Instituto Geografico Militar (IGM), the national mapping agency for Paraguay, that a special map be made of a long narrow area, which will be used to study the feasibility of constructing a road from the largest cement factory in Paraguay to the site where the largest hydroelectric dam in the world will be constructed. In this endeavor, the IGM will receive substantial income from the production of the special map; Paraguay will be one road richer; will sell the cement to Brazil for the building of the dam; and will receive its share of the hydroelectric power which is so essential to the development of the country.

Topographic maps normally are produced with a scale of 1/12,500 for city maps and scales of 1/50,000, 1/100,000, and 1/250,000

for other areas of the country. These maps are principal tools in nation-building studies. City maps are used by utility companies for their work, by municipalities for traffic studies and control, by business firms for delivery routes, and by the ordinary citizen to save time in his daily activities. The other maps are fundamental for studies in the development of a specific area. For example, in the Republic of Panama the 1/50,000 scale maps were instrumental in the development of beaches and island resorts to promote tourism which is an important revenue for the nation. The Instituto Geografico Nacional (IGN), the mapping agency for the Republic of Panama, has produced many special maps for nation-building projects such as hydroelectric plants, plans of irrigation, highway construction, construction of international airports, control of cattle and farming, etc.[7] It is important to note that the technicians responsible for production of these special maps were trained at the DMA IAGS Cartographic School.

Training

As a service to the governments of Latin America, the DMA IAGS offers training in the specialized skills required for the various phases of geodesy, cartography, and hydrography. This training is provided in the Spanish language at the DMA IAGS Cartographic School to assist national cartographic agencies to develop talent for the production of topographic maps and other cartographic products that can be used for economic development.[8]

Training is one of the most important missions of DMA IAGS.

Historically the need for training was recognized when the organization was first established. Initially, all training was conducted in-country and on-the-job. By 1952, it was recognized that the training should be formalized and the Cartographic School was established that year.[9] The establishment of the Cartographic School is the most important and influential step for nation-building that DMA IAGS has taken in its 28 year history. Since 1952, the Cartographic School has trained more than 3600 students from all the Latin American countries, including countries with which the United States has no diplomatic mapping agreement.[10] Knowledge acquired by the students is something that no revolution or change of government can take from them. This knowledge is dynamic because as long as the individual remains in the country, he will be active in its propagation and will use it to influence the proper development of his country.

Training is an active force in DMA IAGS. Almost every time a DMA IAGS technician makes a trip to perform some special service, he becomes involved in training personnel of the local mapping agency. As techniques change or new methods are introduced, the information is sent to the projects for dessimination to the collaborating agencies. In this manner, DMA IAGS is continously contributing to the development of Latin American countries.

Cadastral Programs

Cadastral programs are projects that identify, define, and map all land holdings, both urban and rural in a specific area or

in the entire country. The purpose of these projects is to provide the local governments with the basic elements for a more equitable property tax assessment and collection mechanism. The projects normally establish a national cadastral office that combine the functions of cadastral mapping, land surveying, and property registration. The programs are funded by USAID as a loan to the national government. DMA IAGS is involved from the start since it is DMA IAGS personnel who develop and staff the programs, and see that they are approved. Once the loan is approved, DMA IAGS personnel move to the country to direct the cadastral project. The involvement of DMA IAGS is deep, since the compilation of the cadastral manuscripts is done at the national mapping agencies by personnel trained and supervised by DMA IAGS advisors. A good example is the Cadastral Survey and Property Tax Improvement Project that has just been initiated in Paraguay. A DMA IAGS cadastral specialist suggested the program to USAID and the government of Paraguay. Once the interest was developed, he worked on a reimbursable temporary duty basis with USAID until the program was approved by both governments. He and two other DMA IAGS cadastral specialists will direct the project and will insure that it is integrated with the national topographic mapping program. The cadastral program, because of its additional funds, will expedite the national topographic mapping programs. Maps are compiled and printed faster, making them available sooner for use in projects of national development.

It is evident that cadastral programs are fundamental for proper growth of a developing nation. These programs combine the

efforts of several government agencies and guide them in their participation in a national development project. It appears that DMA IAGS, a defense oriented organization, does not devote sufficient time and effort to projects of national development. Perhaps it would be beneficial for DMA IAGS to devote a greater portion of its assests to cadastral programs as they bring in additional funds and expedite the national topographic mapping programs. This becomes important since the trend in the United States is to continue to reduce DOD budgets. Cadastral programs could offset corresponding reductions to the DMA IAGS budget. The benefits received both by the participating nation in cadastral work and topographic maps and by DMA IAGS make cadastral programs worth-while projects.

NEW TECHNIQUES

New technology, especially that developed by the space program, is being used by DMA IAGS to conduct topographic experiments and to aid developing Latin American nations in their struggle for economic development. The launching of manned and unmanned satellites dedicated to earth resources observations has provided a powerful tool for enabling quality maps to be prepared faster and cheaper than by the present methods. The South American continent presents optimum conditions to examine the cost benefits derived from such imagery, while at the same time permitting these countries to produce cartographic products over previously unmapped areas.[12]

The Latin American mapping agencies are aware that in order to fulfill the needs of national development, they must turn to other

systems that are cheaper and faster than the present system. When the United States announced the Earth Resources Observation Systems (EROS) and the SKYLAB experiments, a total of 17 Latin American mapping agencies in conjunction with DMA IAGS proposed a number of cartographic experiments utilizing the new imagery.

Earth Resources Observation System (EROS)

To introduce remote sensing technology to the Latin American cartographic communities, DMA IAGS has joined forces with the Department of the Interior. DMA IAGS is now the U.S. Geological Survey's (USGS) agent for Latin American EROS programs. Working with USGS, DMA IAGS is conducting workshops to enable cartographers from all parts of Latin America to conduct cartographic experiments and study the usage of satellite imagery.

DMA IAGS is actively involved in transferring remote sensing technology to Latin America. A total of 17 EROS centers have been established to serve as browse facilities and information centers on remote sensing. Each center is in a different country and accomodates the needs for remote sensing information for that country.[14] The information provided to these centers is not being wasted as the following examples will show.

The Remote Sensing Branch of the Venezuelan National Cartographic Agency has completed 20 projects utilizing remote sensing materials supplied by DMA IAGS. One of its most useful projects entailed a study of the Orinoco River flood stages. The repetitive nature of the ERTS satellite (the satellite returns to the same area

every 18 days) makes it ideal for this type of work.[15]

In Colombia a study is being made to determine the present and potential salinity or alcalinity of the soil in a large irrigation drainage area. This is an important project for the country because future agriculture experiments in this area will be planned based on the resultant thematic map.[16]

In Bolivia, the EROS Distribution Center furnished imagery over the inundated area of the worst flood Bolivia has had in the past 50 years. The imagery is being furnished to the provinces to study and devise methods to control future floods.

The DMA IAGS central distribution center in the Canal Zone continues to supply the 17 national centers with materials and information. They in turn continue to apply remote sensing techniques to the development of the resources of their own country.

SKYLAB Experiments

The manned missions of SKYLAB have also been instrumental in contributing to cartographic experiments. SKYLAB photography has been used successfully in two topographic projects for national development. In Santa Cruz, Bolivia, the 1/50,000 scale map of the area was revised within a 24 man-hour period by using SKYLAB photography.[17] Comparing this to the conventional revision method, considerable time and money were saved. In Concepcion, Paraguay, a 1/100,000 scale planimetric map was made using SKYLAB photography.[18] This provided fast, accurate mapping over an area previously unmapped. It is evident that satellite photography is a valuable aid to carto-

graphers, particularly in developing countries. It provides an economical and rapid means of accomplishing both initial mapping and map revision.

CONCLUSIONS

One of the functions of DMA IAGS is: "Assist the collaborating agencies of Latin America in cartographic, geodetic and geophysical activities which respond to and support their countries' programs of national development."[19] Although DMA IAGS does not program funds to assist programs of national development, the funds programmed for assistance of the national mapping program indirectly make a significant contribution to the national development of the country. This is evident by the use of geodetic data and cartographic products in projects of national development such as: planning for construction of major highways and railroads; studies of flood control and areas of inundation in the planning of hydroelectric dams; oil exploration and mining of other minerals, etc.

The most important contribution made by DMA IAGS towards nation-building is the input of trained personnel to the scientific community which is an essential element to the continued growth of a country. More than 3600 students have been school trained since 1952. Many others received instruction on-the-job and were encouraged to develop programs of self-study. These students have formed a basic foundation in geodetic and cartographic science in their country.

Cadastral programs, when executed at an early stage of mapping development, can be integrated with the national mapping

program and serve to expedite it. They are a good source of new funds that can be generated for the benefit of the participating country in the cadastral and topographic fields.

It is still too early to determine the cost effectiveness of the new space technology for use in topography. Due to its sophistication, it can be used more readily in a country like Brazil, which is undergoing tremendous development, than in a country like Paraguay or Bolivia where a fast development pace has not yet begun.

DMA IAGS, although a defense oriented organization, is one of the major contributors for nation-building in Latin America.

RECOMMENDATION

It is recommended that DMA IAGS investigate the possibility of increasing its efforts in the Cadastral field.

HECTOR WOOD
Lieutenant Colonel
Corps of Engineers

FOOTNOTES

1. Interview with Jack E. Staples, NM-14, Chief, Plans and Operations Division, DMA IAGS, Canal Zone, 26 August 1974.

2. Defense Mapping Agency Inter American Geodetic Survey, Joint Manpower Program for 1975-1979, p. I-01 (hereafter referred to as DMA IAGS Joint Manpower Program).

3. United States Southern Command (USSOUTHCOM), Mapping and Charting Program, Operation Plan FY 70 (FOUO), pp. 1-2.

4. U.S. Army Inter American Geodetic Survey, Mission Organization Activities for 1966, p.1.

5. Interview with Mark Z. Brandon III, GS-14, Chief Liaison Officer, DMA IAGS, Washington, D. C., 2 July 1974.

6. Ibid.

7. Interview with Jose Tejeda, Sub-Director, Instituto Geografico Nacional, Republic of Panama, 28 August 1974.

8. Defense Mapping Agency Inter American Geodetic Survey, Cartographic School, Prospectus of Training, p. 1.

9. Ibid.

10. Interview with Chester A. Trim, NM-14, Chief, Cartographic School, DMA IAGS, Canal Zone, 29 August 1974.

11. Interview with Jack D. Rosholt, GS-14, Cadaster Program Specialist, DMA IAGS Paraguay, 13 September 1974.

12. Jack E. Staples, NM-14, SKYLAB S190A and S190B Cartographic Experiments in Latin America, p. 3.

13. Interview Brandon.

14. Susan Baer Robinson, NM-5, DMA IAGS EROS Latin American Programs, pp. 1-2.

15. Ibid., pp. 3-4.

16. Ibid., p. 4.

17. Staples, p.5.

18. Ibid., p. 7.

19. DMA IAGS Joint Manpower Program, p. I-01.

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2. Brown, Merrill R., Fassett, Norman E., and Kozlosky, Joseph A. Mapping and Geodesy Goals in Latin America. Washington, D.C : Convention Proceedings of the American Congress of Surveying and Mapping, 1967.

   (A comprehensive overview of history, achievements, and future direction of DMA IAGS.)

3. Defense Mapping Agency Inter American Geodetic Survey Cartographic School. Prospectus of Training. Canal Zone: 1974.

   (A brief history of the school and a description of courses offered at the school.)

4. Defense Mapping Agency Inter American Geodetic Survey. Joint Manpower Program for 1975-1979. Canal Zone: 20 February 1974.

5. Robinson, Susan Baer. DMA IAGS EROS Latin America Program. Canal Zone: 10 March 1974.

   (An excellent general review describing the Earth Resources Observation Systems Program (EROS) in Latin America.)

6. Rosholt, Jack D., GS-14, Cadaster Program Specialist, Defense Mapping Agency Inter American Geodetic Survey. Personal Interview. Paraguay: 13 September 1974.

7. Staples, Jack E., NM-14, Chief Plans and Operations Division, Defense Mapping Agency Inter American Geodetic Survey. Personal Interview. Canal Zone: 26 August 1974.

8. Staples, Jack E., SKYLAB S190A and S190B Cartographic Experiments in Latin America. Canal Zone: 10 September 1974.

   (An excellent description of four cartographic experiments using SKYLAB photography.)

9. Tejeda, Jose, Sub-Director, Instituto Geografico Nacional, Republic of Panama. Personal Interview. Panama City: 28 August 1974.

10. Trim, Chester A., NM-14, Chief Cartographic School, Defense Mapping Agency Inter America Geodetic Survey. Personal

Interview. Canal Zone: 29 August 1974.

11. U.S. Army Inter American Geodetic Survey. Latin American Proposals to Apply Remote Sensing Techniques to Study Solutions for Urgent Environmental Problems. Canal Zone: January 1972.

(A comprehensive description of four proposals of environmental problems to be executed by using remote sensing imagery.)

12. U.S. Army Inter American Geodetic Survey. Organization and Functions Manual. Canal Zone: 1970.

13. United States Southern Command. Mapping and Charting Program Progress Report FY 70 and Operation Plan FY 71. Canal Zone: 1970. (FOUO).

ANNEX A

DEFENSE MAPPING AGENCY
INTER AMERICAN GEODETIC SURVEY

MISSION AND FUNCTIONS

MISSION:

Provide essential support to cooperating Latin American countries in the production of cartographic, geodetic and geophysical data. Assist Latin American cartographic institutes to become self-sufficient in the production of geodetic and cartographic products required for national planning and development of their respective territories.

FUNCTIONS:

1. Encourage and support the appropriate Latin American government agencies in cartographic, geodetic and geophysical programs which will directly or indirectly satisfy DOD objectives.

2. Assist collaborating agencies of Latin America in cartographic, geodetic and geophysical activities which respond to and support their countries' programs of national development.

3. Maintain a multinational training school providing training in cartography, geodesy and geophysics in consonance with requirements generated by the national development programs.

4. In coordination with the Pan American Institute of Geography and History, foster standardization of cartographic, geodetic and

geophysical equipment, procedures and specifications.

5. Serve as the point of contact for all cartographic programs being executed by the US Government in Latin America.

6. In coordination with Geographic and Defense Attaches, collect existing maps, charts, aerial photography and geodetic, bathymetric and geophysical data to support DOD worldwide requirements.

7. Serve as representative of the Director, DMA, throughout Latin America with responsibility for the execution of cooperative mapping agreements.

8. Operate USARSO Map Depot.

ANNEX B

DEFENSE MAPPING AGENCY

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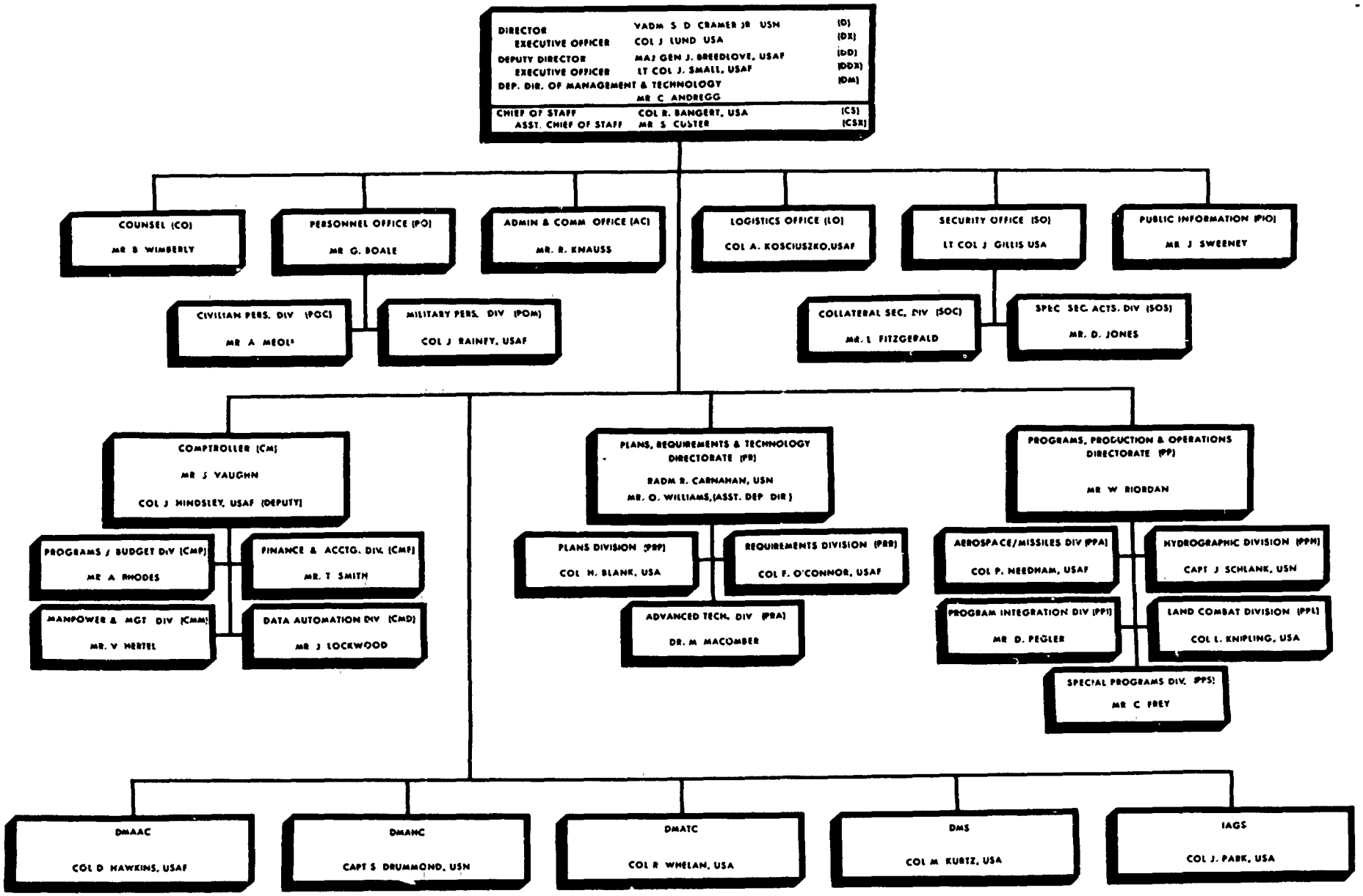
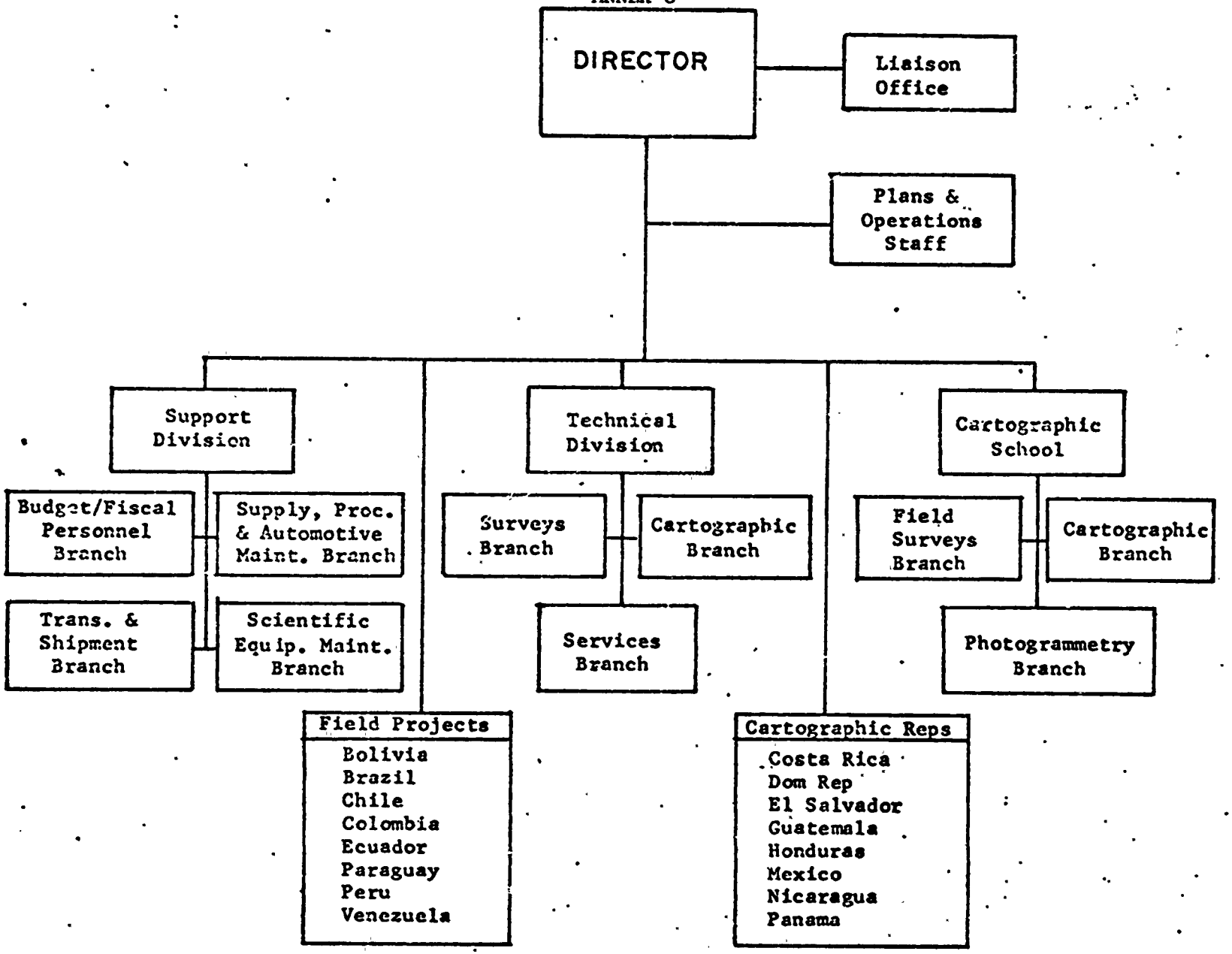


DMA INTER AMERICAN GEODETIC SURVEY

ANNEX C



ANNEX D

METHOD OF OPERATION

DMA IAGS is currently represented in 16 Latin American countries by a Project Director or Cartographic Representative. Its operations are scattered over an area of some 6,700,000 square miles utilizing vehicles, aircraft, precision instruments, mapping equipment, and radio communication equipment necessary to accomplish the mission.

From its Canal Zone Headquarters located on the Pacific Side of the Canal Zone, the DMA IAGS directs and supports projects in the collaborating countries.

In the participating countries, accomodations for the project office, vehicle maintenance, and storage of supplies and equipment are usually shared with the designated collaborating agency which often provides this space without charge.

U. S. Project force normally consists of a Project Director, a supply NCO, a civilian Project Engineer, and civilian cartographers varying with the magnitude and diversity of the work in progress. Vehicles, instruments, other equipment, and funds are provided commensurate with the scope of work involved. The Project Director is responsible for the administration of the project, including personnel, funds, supply, maintenance, and technical operations. Non-U.S. personnel are employed as clerks, mechanics, guides, packers, light keepers and common laborers.

DMA IAGS project personnel work in close collaboration with

the national mapping agencies to further the adoption of standard mapping methods and procedures, and to insure that the work meets established accuracy requirements. DMA IAGS personnel also assure that the U.S. contribution is utilized efficiently for maximum achievement of the common objectives. The scope of this contribution includes the following:

1. The provision of technical advice and assistance encompassing all phases of geodesy and cartography.

2. The provision of technical training for personnel of the collaborating governments.

3. The loan of required technical and supporting equipment to the mapping agencies of the cooperating countries.

4. The accomplishment, with U.S. resources of key mapping operations which are beyond the capabilities of the collaborating government.

The mapping program is truly a collaborative effort in that the monetary value of resources and services contributed by the participating countries is higher than the support furnished by the United States. In some instances, the collaborating agencies provide additional indigenous employees and furnish, without charge, petroleum products.

Although no DMA IAGS personnel are assigned to the British, French, and Netherlands possessions in Latin America, DMA IAGS personnel have worked in these areas to accomplish international geodetic ties and to collect cartographic and related data.