

## **GEO-INFORMATION EDUCATION IN DEVELOPING COUNTRIES:EXAMPLE INDONESIA AND BRAZIL**

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### **ABSTRACT**

The geo-information is considered as a comprised of photogrammetry, remote sensing, GIS and cartography. The education and training in geo-information started around two decades ago, when the first remote sensing satellite was launched. This paper deals with the development of geo-information education as well as training in the developing countries. A special reference is made to the situation in Brazil and Indonesia.

### **1 INTRODUCTION**

In many countries, the geo-information is considered as a comprised of photogrammetry, remote sensing, GIS and cartography. The education and training in geo-information started around two decades ago, when the first remote sensing satellite was launched.

In Brazil started in the beginning of the seventies, when the National Institute for Space Research-INPE has started the master program in remote sensing. In 1985/1986, INPE has developed the first GIS software, in portuguese language. As a consequence it was started a regular educational program through training courses and postgraduation programs in different regions in Brazil. After this, the University of São Paulo started the postgraduation program in GIS. Since that time up to now the geo-information education has improved and many universities have introduced the remote sensing, GIS and GPS disciplines in their regular programs.

In Indonesia the situation is almost the same, the education programs in geo-information just started some 20 years ago.

### **2 GEO-INFORMATION EDUCATION IN BRAZIL**

In Brazil the term geo-information is not very used by the professional involved with these four areas. The cartography course in Brazil started in the fifties. Today there are cartography engineering courses in the Federal University of Pernambuco-UFP, in Recife (NE region); two courses in Rio de Janeiro, at the State University of Rio de Janeiro-UERJ and at the Engineering Militar Institute-IME. There is also a course in the State University of São Paulo-UNESP, in Presidente Prudente Campus and other in the Federal University of Paraná-UFP, in Curitiba. All these institutions are involved with cartography, remote sensing, photogrammetry and GIS, mainly the UFP and IME.

Many graduation courses in natural resources area, such as geography, agronomy, forest engineering, biology, ecology, geology, have introduced the cartography, remote sensing and GIS disciplines in their regular programs

#### **2.1 Postgraduation courses in geo-information area**

Since its foundation the National Institute for Space Research-INPE had an important concern with the Human Resources qualification, having created master's and doctor's degree courses in the Remote Sensing area. In 1969 INPE has created the master course in remote sensing, and in 1998 was created the doctor program. Up to now more than 260 students have graduated in the master course. INPE has currently 64 regular students in the master program and 17 students in the doctor program. These students usually come from both Brazil and Latin America. These courses are considered of an excellent quality (grades A and B) according to the evaluation of the Coordination for

Improvement of Higher Education Personnel-CAPEs, an institution on duty of taking care of the graduation in Brazil (Sausen, 1994). In these two programs, the students are basically qualified in remote sensing and GIS, and they have to develop a research project in one of these two areas in order to get their master or doctor degree.

Since 1985 INPE have been holding the International Course on Remote Sensing, dedicated to the Latin American students as a request from the Office for Outer Space Affairs under the United Nations Program on Space Applications. The objective of this course is to qualify specialist from developing countries in remote sensing and GIS techniques for survey and monitoring natural resources. This is a long-term course (7 month long), and has already trained 120 professionals from different countries in the region. In this course the students have both remote sensing and GIS disciplines, and the GIS softwares developed by INPE are used during the research project development. This course is developing in partnership with the National Council for Scientific and Technological Development-CNPq and United Nations University-UNU (Sausen, 1995).

In 1990, the University of São Paulo-USP began its master and doctor program in GIS. This program is dedicated to the use of GIS applied to engineering area. This program is under the responsibility of the postgraduation program of the Transportation Engineering Department. Up to now around 20 students got their degree.

The Geoprocessing Laboratory, in the Geography Department, in the Geoscience Institute, at Federal University of Rio de Janeiro-UFRJ has been developing a specialization course in geoprocessing and GIS since 1998.

The Federal University of Rio Grande do Sul, southern of Brazil, has created a master course in remote sensing in 1990. In this University there is a Remote Sensing and Meteorology Centre where are developed researches in remote sensing, GIS and meteorology areas, whose facilities are supporting the master program.

The UN Outer Space Affairs Division is promoting the implementation of the Centre for Education in Space Science and Technology in Developing Countries. One of the objectives of these Centres is to promote specialization courses (9 months long) in remote sensing, GIS and GPS. Three Centres were implemented around the world, placed in India, Nigeria and Marrocos. At this moment Brazil and Mexico are implementing the Centre for Latin America and Caribbean region. For the first four years the Centre Headquarter will be in Brazil and INPE will be supporting the Centre activities, through its facilities and academic staff.

## **2.2 GIS software developed by INPE**

In 1986 INPE has developed the first GIS software in Portuguese (SGI). This software was developed in DOS, for PC. In order to disseminate it, INPE has held a large training program (short-term courses) in Brazil. This program was held basically in INPE headquarter, universities and through Remote Sensing Laboratories located in different regions in Brazil. At the same time INPE has held training courses in some countries in Latin America. The GIS software was developed and used in the remote sensing specialization and master course until 1994, when the software SPRING (in linux and windows) was developed.

The SPRING software, developed by INPE Image Processing Division, is dedicated to image processing and GIS. It is free software and it is available in INPE Homepage (<http://www.dpi.inpe.br>). Today is possible to find it in Portuguese and Spanish languages, version 3.1. At this moment INPE is seeking for financial support in order to develop an English version. This software is used in the INPE's remote sensing master and doctor programs and in the specialization course as well.

## **2.3 Training activities developed in geo-information**

Since 1994 INPE has been developing several training courses in the SPRING software for Brazilian and Latin American professionals.

In partnership with the Inter-American Institute of Global Changes Research-IAI, INPE has developed a large SPRING training program in all Latin American countries. The program took five years long (from 1994 to 1999) where the software SPRING was used, and it was donated to all participant countries. The main objective of this program was to qualify professionals from natural resources area and the encouragement of the use of geoprocessing technologies applied to global change research. After the training program developed by INPE and IAI, the number of professionals qualified in geo-information has improved in Latin America. 228 students from 15 countries and 105 institutions took part in the program.

The active role performed by Brazil through the participation of scientists from the National Institute of Space Research, as well as the support and software given to the other research centers, was one of the key factors to achieve successful results (Project RLA/92/G3 June, 1999).

In 1999 INPE has started a regular training program about the SPRING software and GIS techniques in partnership with the Latin American Society of Remote Sensing and Spatial Systems-SELPER/ Brazilian Chapter. The courses subject are about Introduction to SPRING software, Geoprocessing Fundamentals, Numeric Terrain Model, Digital Image Processing, Geographic Database, Geographic Data Space Analyses. These training courses are open to all professional interested in geo-information techniques.

Today it is possible to find training opportunities or disciplines about geo-information in several graduation courses in public and private universities around the country. Some universities have laboratories where are developed researches and projects in photogrammetry, remote sensing and GIS areas. The State University of São Paulo-UNESP-Presidente Prudente Campus has a cartography course that is very involved with photogrammetry, remote sensing and GIS. There is a laboratory dedicated to GIS and remote sensing where three professors were graduated in INPE remote sensing master program and a professor got her GIS doctor degree in England.

The Geoprocessing Laboratories Association was created in Brazil for ten years ago whose main concern is the development of projects in remote sensing and GIS areas, applied to natural resources. There are more than 50 laboratory members in this association and very frequently they hold training courses (short-terms) in these two areas.

The InfoGEO Magazine, which is dedicated to geo-information whose technical director is a cartographic engineer, usually offers regularly training courses (short-term) in remote sensing, GIS and GPS areas for professionals involved with natural resources, urban and regional planning, cartography, traffic monitoring, cadaster etc. The main objective of these training courses is to disseminate the geo-information technologies around the country. This magazine it is developing a very important dissemination activities in geo-information in Brazil

### **3 GEO-INFORMATION IN INDONESIA**

The program of human resource development in Indonesia has started around 1969 when the first five years development was launched. Since then Indonesia reaffirm their commitment for education. This includes the education in photogrammetry, and remote sensing as well as cartography technician level (Aziz, 1993).

Nowadays these three subjects are considered as the component of the so-called geo-information. At present the term of geo-information is not well adopted in Indonesia. It is therefore at the surveying course; the subject of geo-information is considered as and comprised of photogrammetry, remote sensing, GIS and cartography. In many cases these subjects are thought as a separate subject. But due to the quickly changing environment of the technologies as well as the tools, the review of surveying course toward geo-information education is a must. This for example has been done and the result is showed in the new curriculum of the Institute of Technology, Bandung (ITB) 1998-2003. The new element such as information science was proposed (see Aziz, 1997).

#### **3.1. Some milestone on the development**

Since 1980's most of the topographic mapping projects in Indonesia was engaged under the mapping component of the Transmigration-V Project, which finance by the World Bank. In this regard the responsible institution for such a huge mapping project is the Indonesian Coordinating Agency for Surveys and Mapping (Bakosurtanal). Because of the magnitude of the project the program has to be supervised and International Advisory Team is then hired. The team supervises and has introduced modern mapping technique such as analytical photogrammetry, automated cartography and GIS. The task is include the implementation of a formal and informal training program. Most of the ITB lecturers engaged with surveying course are involved in the training. To some extent the introduction of modern technology in mapping have changed the nature of surveying courses. This is due to the fact that besides the theoretical part the staff involved directly in practical works. As a consequence some stimulus of the new knowledge is emerged. This means that in the near future the geo-information education will be introduced as a specific domain to complement the existing (conventional) approach.

Another milestone for geo-information education in Indonesia is the application of GIS for the Land Resource Evaluation Project (LREP) and the Remote Sensing for Agriculture Project in mid 80's. Since then a number of universities and institutions has offered the geo-information education as well as training in order to fulfil the demand for mapping activities. The prediction is made that in the next century Indonesia will require a great number of geo-information specialists. This is because the decentralized governmental system is put in effects (Sumarto et al., 1999).

### 3.2. The Status and the Problem

As we all know the term geo-information is not referring to mono-disciplinary way, but more in the integrated approach. With respect to this approach it is clear that geo-information subject will not be limited to surveying course only. All disciplines dealing with the geoscience will require the geo-information subject. If we look to the situation in Indonesia, at present there are at least 12 universities offering geo-information subjects in their curriculum (Sumarto et al., 1999). They provide either a full domain of geo-information or just remote sensing or GIS. The level of training is ranging from technicians to post-graduate. Some of them are:

- The University of Gajah Mada-Yogyakarta (Faculty of Geography, Faculty of Forestry, Faculty of Engineering),
- The University of Indonesia-Jakarta (Faculty of Geography),
- The Institute of Technology, Bandung (ITB) (Department of Geodetic Engineering).

Based on the report of the university mentioned above, the total number of the first degree in geo-information is around 1500 people. It is to believe that this number will be increased by four times when the decentralized governmental system is commencing next year. Of course this challenging task is not easy to solve because there are many things to be considered. One of them is the budget allocation. In this regard some of the state universities like ITB is now try to change their status toward autonomous. Under this status the university may rise and arrange as well as allocate their budget a specific purpose. Even they may deals directly with the province, the regency, and the local government for the human resources development.

Approach taken by the Institute of Agriculture, Bogor - Indonesia is another good example to mention. With the support of the SEAMEO/ESCAP they are now offering a two-year international course in geo-information technology. This course is dedicated to the natural resource management subject. So far this course is the first on its kind (English as the teaching language). The level of this course is post-graduate and the core (major) subjects comprise of (a) Simulation Modelling and Expert System, (b) GIS, (c) Remote Sensing/Image Processing and (d) Decision Support System.

The responsibility for the human resources program is not limited to the formal education only. This may be come from other source like government institution dealing with survey and mapping such as the Training Division of the Survey and Mapping Agency. They offered a regular geo-information course for the government officials, which come from the various institutions (Martha, 1999). This includes course in Digital Image Processing, Remote Sensing and GIS as well as Desktop Cartography. The training division is now trying to improve the training system since the need is enormous. The improvement will be on training staffs, budget and facilities.

With respect to the technology, it is clear that the Internet will become an important part of geo-information system. The function is not only for data access but also for tutorial purposes. This means that a new era of long distance education "broadband" will come soon. Anticipation of course should be made due to the fact that Indonesia is a large country. This is considered as a promising model in order to improve the student knowledge from outer islands.

Equally important are the hardware and the software for geo-information applications. It largely depends on the available software and the computer packages for different applications. Realizing the need for such a wide area of applications the geo-information education should set its priority. In this case the Department of Geodetic Engineering ITB for example is emphasizing the GIS education in data base aspects used for land resource applications.

The geo-information education in Indonesia also cope with problems of the free-market era, which begins in year 2003 for AFTA and in year 2010 for APEC. This includes the problems to apply the international standard of competency for geo-information specialist. The discussion between the profession institutions and the university still on the way to set up the model of competency. Example of the standard applies in neighbouring countries such as Australia and Malaysia was used for comparison. To this end the quality of education and training in Indonesia should be improved to compete the foreign expert. The curriculum for example must be standardized internationally.

### 3.3. Concluding remarks

One of the consequences of these education and training programs is the improvement of the geo-information activities in Brazil in the last ten years. Probably this will continue for the next years cause many professionals graduated in the postgraduation programs in INPE, UFRG and USP are working as professor and researcher in public and private universities. Besides this, the Universities are creating laboratories dedicated to the GIS, cartography and remote sensing. This is motivating the introduction of the geo-information area in the graduation courses to qualify the new professionals for the next decade.

There are many software about GIS, photogrammetry and image processing such as SPRING, ERDAS, ARCInfo, ILWIS, IDRISI, ENVI, Geoinfo, DataGeosis, ER Mapper, available in Brazil. Their representatives use to offer training courses about the software itself and its applications to survey and monitoring of natural resources, urban and regional planning and cartography. The consequence of these actions is the improvement of the geo-information techniques as tool for professionals qualification and to the sustainable development of the country.

To set up a good geo-information education requires a lot of efforts. For developing country like Indonesia these tasks will take a bit longer time compared to the neighbouring countries in South East Asia. However, if we stick only to photogrammetry, remote sensing and GIS no doubt that these subjects will be well thought at various education's levels. The challenge if any is more in the non-technical aspects, especially the financial support for the new equipment and facility. For example, the considerable financial investment is required in setting a GIS facility.

Next year the decentralized system will be implemented in Indonesia. This system may give some consequences for the geo-information education institutions due to the increase number of specialist needed. The reason is that the capacity of output is still limited while the need is enormous. Crash program could be a solution but this type of system is not a proper way to achieve a good quality of specialist. The problem hampered is the standard curriculum to adopt since the resource capability of each region is so differ. Foreign help and advice may be required.

Another consideration must be taken is to anticipate the free-market era, which will come soon. To certify the competency levels of the geo-information specialist is not an easy job. So far Indonesia has no experience in such a certification. To this end the education institutions like ITB as well as professional body has to sit together for a coordination works. Plan for such coordination has been made but trial and error process is always hampering the progress.

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