

P&RS in the Cartographic Engineering - UNESP/Brazil

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ABSTRACT

UNESP (Universidade Estadual Paulista) is an university which "campi" are distributed for several cities of the State of São Paulo. At Presidente Prudente, western of the state, the IPEA (Institute of Planning and Environmental Studies) offers the undergraduate course of Cartographic Engineering, since 1977, under direct responsibility of the Department of Cartography.

In this course, Photogrammetry and Remote Sensing (P&RS) add 750 hours that are equivalent to 16% pf the grand total (4710 hours in 5 years) and to 27% of the professional part (2820 hours in the 3 last years).

This paper intends to review the activities of the Department of Cartography in P&RS during 10 years of existence of the undergraduate course of Cartographic Engineering. Besides, the paper analyses the perspectives to the future, considering mostly the cartographic necessities of a large country as Brazil.

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1. INTRODUCTION

In 1987 the Cartographic Engineering Course (CECart) of UNESP (Universidade Estadual Paulista), campus of Presidente Prudente-SP, has completed ten years of activities. There was not a significant celebration, but these ten years of work could not go unnoticed. The lived difficulties have caused an experience that if it is reflected properly it will contribute to choose a course to future.

The reading of working group reports of Commission VI reveals the effort made by the international photogrammetric community in order to survey and to know the educational reality of many countries. The sense of this paper is to contribute but modestly to this knowledgement, presenting and discussing the lived experience by Department of Cartography (DCart) at administration of CECart, considering the national and international frame.

2. BRAZILIAN SITUATION

Brazil is a large country with 8,511,965 km² of area, that represents about 47% of South America. It is the fifth country of the world in extension. There are approximately 82% of the territory mapped at 1:250000 scale; it is estimated about 60% to the scales of 1:50000 and 1:100000 covering the South, Southeast and Northeast of Brazil. There are more than 4000 municipalities, the great number without topographic mapping or if it exists needy of revision.

There are about ten great airsurvey companies working mostly to federal, state or municipal government agencies. There are about 1200 cartographic engineers undergraduated in the last 25 years. Obviously not all of them working at P&RS. Beside them there are other types of engineers disputing in this specialized area. At first glance, it seems that P&RS exist in Brazil only at the last 25 years, but that is not true. It is said that one of the first engineering existing in the country was the cartographic one and the first surveys date to 1940. Really the care with surveying and mapping is old (CARVALHO |4|).

In the whole country there are only five courses of Cartographic Engineering which meaning is succesfully explained by FAGUNDES |6|. Every year circa of 150 students enroll themselves at universities in order to course Cartographic Engineering. In general, not more than the half of them get the graduation in five years, the minimum time required in practice to conclude the course. To continue the specialized education is possible at UFPr (Universidade Federal do Paraná) that offers MSc and PhD degrees. The formation of technicians in the country is neglected, not only in P&RS, but also in almost all other areas. In this case, it functions the informal education (ANDRADE |2|).

Nowadays, in Brazil, the quantity of PhD people in

Photogrammetry is not superior to ten. The MSc people maybe not reach fifty. In Remote Sensing the number is higher either PhD or MSc, the majority concentrated at INPE (Space Research Institute). The small number of graduated people in Photogrammetry (mainly of PhD) has probably been the major difficulty for its scientific and technological development in Brazil.

3. THE CARTOGRAPHIC ENGINEERING AT UNESP/PRES. PRUDENTE

IPEA of UNESP at Pres. Prudente-SP has planned the CECart to five years at minimum, as required by specific federal law. The roll of disciplines was split into five distinct groups of formation, namely: basic (years 1 and 2), general (2 and 3), general professional (2 and 3), specific professional (3, 4 and 5) and complementar professional (4 and 5), as showed by table 1. The Department of Mathematics is responsible for applied math; the Department of Planning acts in disciplines of human, planning and administration areas; the Department of Environmental Sciences attends the topics related to environmental and the DCart is responsible for professional disciplines, for management of specific projects, training supervision and for execution of Final Project.

3.1. Short history

The first phase of DCart existence, from 1977 to 1979, was distinguished by assistance to basic formation along with other departments. As the first classes went progressing in the CECart, the DCart has begun the engagement of qualified professionals to the specific disciplines. This period corresponds to the second phase of the course from 1980 to 1983. These professionals were required at the work market, due to their great professional experience, although without a formal graduation title like MSc or PhD. As it is already mentioned, these titles are rare in Brazil. It is convenient to mention that the formal title itself supplies the regimental requirements of UNESP; however, it is desired something greater: that graduated people are able to implement research branches at DCart, in order to produce new knowledgement, to assemble teachers and students around research projects, and to attend the community among other things.

3.2. Current situation

From 1983 up to now it has established the third phase of this young department. In this period the investment for human resources to form masters and doctors was enormous. At the present, DCart has 21 teachers being 3 PhD, 6 MSc and 12 Auxiliars. At a first look, in ten years it seems to be a good result. Sometimes, unhappily, the brazilian universities lose teachers of tried experience at a proportion bigger than the other countries because of wage and cultural questions. This is a challenge that society and government have to solve.

Table 1: Topics and its groups at CECart; grand total = 4710 h

Basic formation:	total = 1410 h
Differential and Integral Calculus I	120
Differential and Integral Calculus II	120
General and Experimental Physics I	120
General and Experimental Physics II	120
Probabilities and Statistics	120
Design and Descriptive Geometry	60
Technique Design	90
Vectors and Analytic Geometry	120
Data Processing and Numeric Calculus	120
Ordinary Differential Equations	60
General and Experimental Chemistry	60
Linear Algebra	60
Materials Resistency	60
Mechanics	60
General and Experimental Eletricity	60
Transportation Phenomena	60
General formation:	total = 360 h
Laws	60
Economics	60
Administration	60
Soil and Vegetation	60
Fundaments of Fitogeography	60
Fundaments of Climatology	60
Professional general formation:	total = 690 h
Topography	150
Geology	90
Geophysics	60
Geomorfology	60
Hidrology	60
Transportation	120
Basic Sanitation	60
Cartographic Materials	90
Specific professional formation	total = 1170 h
Geodesy	150
General Astronomy	150
Photogrammetry I - Basic	180
Photogrammetry II - Analog	120
Photogrammetry III - Analytic	60
Image Interpretation	150
Remote Sensing	120
Cartographic Representation	120
Special Topography	120
Complementary professional formation:	total = 960 h
Adjustment of Observations	120
Integrated Planning	60
Final Project	210
Supervisory Training	570
Specific Laws	total = 120 h

3.3. P&RS presence

Specifically, the area of P&RS at Dcart has 10 teachers being 3 PhD, 4 MSc and 3 Auxiliars. The disciplines of the CeCart curriculum in P&RS under these teachers responsibilities are:

Photogrammetry I - Basic	semester 5 and 6	180 h
Photogrammetry II - Analog	" 7 " 8	120
Photogrammetry III - Analytic	" 9	60
Image Interpretation	" 5 and 6	150
Remote Sensing	" 7 " 8	120
Aerophotogrammetry (Geography Course)		
Trailing	years 3, 4 and 5	570
Final Project	semester 10	210

The trainings are rather realized by the students at private companies or state cartographic agencies. In the Final Project other disciplines participate too: Geodesy, Topography, Adjustment of Observations, Cartography and Astronomy.

The time burden of disciplines, training and final project referent to P&RS adds 750 hours, that is equivalent to approximately 16% of the grand total of 4710 hours in five years. Considering the professional part of the course (the last three years) the percentage is approximately 27% of 2820 hours.

Nowadays, IPEA disposes the following equipment to attend P&RS:

- Meteorological station
- Wefax station
- Stereometric cameras SMK 40 and SMK 120
- Phototheodolite Photheo 19/1318
- Stereoplotters: Santoni III, Wild A9 and B9, Topocart C, Stereometrograph G, Technocart D, and Multiplex
- Transmark B Point Transfer
- Stecometer C and Coordimeter G
- Stereotopo
- Precision coordinatograph
- Sketchmasters
- Mirror stereoscopes
- Interpretation stereoscopes equipment
- Microdensitometer
- Microcomputers EGO-PC (compatible with IBM/PC).

Besides this equipment there are theodolites, precision levels, EDM and accessories for Astronomy, Geodesy and Topography and light tables for Cartography.

3.4. Test field of Botucatu (TFB)

The TFB project is active since 1982. Currently it is the greatest project of DCart. Essentially it searches to establish the necessary infra-structure to support the researches of the department, as well as to complete the didactic activities for

students. It is split in two sub-projects: the first refers to realization of the test field for Photogrammetry and Geodesy in the campus of Botucatu, distant 380 km eastern from Presidente Prudente, that places great logistic troubles; the second refers to introduce the computational laboratory in the campus which is not completely implanted yet. There are 10 microcomputers compatible with IBM/PC; it is expected the installation of a minicomputer to support projects with greater computational burden.

The objectives of this project are: to provide ambiency to periodic checking of equipment (calibration) at actual working conditions; to execute practical activities for training the students; to stimulate the production of technical reports to assist the disciplines of P&RS among others.

To reach these objectives the test field was chosen in order to attend some requirements, namely: urban area vicinity, security, relief variation, perpetuity, vegetation diversity and insertion into UNESP system.

Given its didactic complementation characteristic the development of the TFB is not very fast. Each class of the last year (5th) of CECart performs a part of the project. So, until now the situation, is the following:

- 82 class - flight planning; geodetic triangulation and traverse; global recognition; monumentation; signalizing; photogrammetric flight (realized by FAB - Brazilian Air Force).
- 83 class - planning and recognition for coordinate transportation from fundamental network; monumentation of high precision marks; high precision coordinate transportation; target perpetuity; precision geodetic traversing.
- 84 class - survey of supplementary control points; signalizing; new photogrammetric flight (FAB again).
- 85 class - survey of supplementary control points in a small area for stereoscopic plotting.
- 86 class - high precision geometric levelling; continuity of supplementary control; precision geodetic traversing with IBGE (brazilian Institute of Geography and Statistics Foundation); Laplace's point (performed by IBGE).
- 87 class - monumentation and survey of control points on a small area for camera calibration (72 points in 3km x 3km).

3.5. Other projects

- Survey of historical monuments of Pres. Prudente with Municipal Historical Museum Foundation of Pres. Prudente.
- Test Field of Luziânia (Goiás) with INPE.
- Technical Cadastre of Humaitá (Amazonas) in Rondon Project.
- Survey of infesting of Santo Anastácio Reservoir with SABESP (Basic Sanitation of São Paulo State).

These projects were developed by teachers of DCart and students of CECart.

3.6. Work Market

The table 2 shows the total number of professionals undergraduated by CECart and their situation in front of the work market. Consider that 30 is the number of new students each year. In July 1977, thirty began and thirteen finished in July 1982; in March 1978 other thirty new students enrolled and nineteen get finished and so on. Therefore, from 180 enrolled students until 1982, 113 had concluded the course that means 63%. Nowadays, 82 (circa of 73% of engineers) work in Cartographic Engineering.

It does not exist a survey of Cartographic Engineering work market by distinct areas. It is estimated that twenty to thirty undergraduated students are working in P&RS, some of them enrolled with graduate programs (MSc and PhD). It is also estimated that perhaps more of the half those work in Cartographic Engineering have contact with P&RS end-products.

Table 2: work market for engineers undergraduated at Pres. Prudente

classification	classes						total	%
	july 82	dec 82	83	84	85	86		
graduation	6	3	2	0	1	1	13	11.50
independent	2	1	0	0	3	1	7	6.20
general	3	10	11	8	20	10	62	54.87
subtotal	11	14	13	8	24	12	82	72.57
other areas	2	3	8	7	3	3	26	23.01
unemployed	0	1	1	1	1	0	4	3.54
not consulted	0	1	0	0	0	0	1	0,88
total	13	19	22	16	28	15	113	100.00

Original: Brazilian Association of Cartographic Engineers - Regional São Paulo - ABEC/SP.

4. PERSPECTIVES TO THE FUTURE

Recently, UNESP has created the career of "researcher". A professional may be enrolled since he or she has an equivalent title of PhD. In this career research has preference but the researcher may also lecture and advise. This will certainly develop the general level of research at UNESP. Although, in the specific area of P&RS of DCart, unhappily, this cannot change the situation because of lack of PhD people in P&RS. A possible solution is to appeal for foreign researches.

It is expected a new era for DCart from current year because of greater research projects. Possibly, they will be developed with other important education and research institutions. It believes that the educational aspect will be benefited with the creation of new conditions for participation of CECart students.

Nowadays, Department of Cartography plans to implant the "Program of Human Resources Formation in Cartographic Sciences" that will act at technician level (Cartography and Photogrammetry), undergraduation level (continuity of CECart and its strengthening) and graduation level ("late sensu" and "stricto sensu"). The viability of this program passes by the wage question and so by the government sensibility to implement an efficient educational policy that really conserves the experts in the university. Perhaps, in Brazil, more important than the wage question is the cultural one when considering the researcher's permanence at inland cities because of lack of "cultural life".

5. CONCLUSION

P&RS represents a very important contribution to Brazilian Cartography and other areas. The number of companies and engineers acting in airsurvey and P&RS attend to national requirements at least for the time being. However, the scientific and technological development imposes continuity of investments in human resources at under and graduation levels. It urges to begin to prepare technicians in P&RS in Brazil.

At the new phase that is in the beginning by now at DCart these questions should be discussed with the Brazilian cartographic community with the eyes and the ears alert to international community.

New projects should emerge in order to the conduct philosophy of DCart can be continued that means to put the students in direct contact with real work conditions.

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