

# Professional Continuous Updating in Remote Sensing Applications in Argentina

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**Key words:** scientific and technological evolution, postgraduate development, surveyors' professional updating, horizontal cooperation, remote sensing.

## ABSTRACT

In a world constantly changing due to the economical globalization and the accelerated scientific and technological development, with regional integrations and harder professional rivalries, the surveyors' continuous updating in knowledge and procedures becomes imperative thus allowing the betterment of the profession.

In Argentina, confronted with the reformulation of the curriculum designs for Surveying Engineering which will soon facilitate the graduate professionals to handle the most recent technologies and developments, particularly connected with geomatics, and postgraduate studies just beginning, there is a universe of professionals who are working presently and demand modernisation for all. Such modernisation must define the roles of a process of brushing up each professional's knowledge and procedures that may assure a higher recognition to the profession.

The diversity of thematic areas involved in the surveying profession, in view of the limited economical resources of Argentina, demands the need of defining tactics to answer to the new professional requirements.

The horizontal cooperation programs between universities and academic and scientific institutions and professional associations for the installation of effective professional updating systems foster the surveyors' training in specific areas.

This paper shows the encouraging experience of the agreement promoted by the Argentinean Valuation Institute [*Instituto Argentino de Tasaciones*] with the National University of Santiago del Estero [*Universidad Nacional de Santiago del Estero*] and National University of Catamarca [*Universidad Nacional de Catamarca*]. The agreement's aims are centred on the deepening and updating of the knowledge in land valuation and remote sensing applications. A space is created for reflection about the evolution of the valuation and the advantages that provide the remote sensing techniques for evaluation of natural resources. They favour the incorporation of the digital satellite images processing in the land valuation procedures with the benefits that are provided by this georeferenced information for the development of different applications according to diverse working purposes.

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## 1. INTRODUCTION

New knowledge generating from scientific and technological transformations and the new forms of professional practices that are foreseen from the globalization phenomenon account for the challenges that Surveying is confronted with at the present moment.

The Higher Education National Act 24521/95 determines that the Argentinean universities need to revise and update their curriculum designs in order to give satisfaction to the demands deriving from the self evaluation and accreditation processes for the graduate careers. In the area of surveying engineering such processes have meant the reformulation of the curricula to adapt them to the new guidelines fixed by the National Council of Land Surveyors' Schools [*Consejo Nacional de Escuelas de Agrimensura (CONEA)*] and the Federal Council of Engineering Schools' Deans [*Consejo Federal de Decanos de Ingeniería (CONFEDI)*], in order to improve the planning and the curriculum development thus allowing schools to find a due place in a context following the regulations and quality standards required for the purpose of official accreditation. In this way the universities seek the adaptation of the graduate studies to the demands today. This implies the incorporation of scientific and technological advances according to the principles of pertinence, quality and international setting of the profession of surveyors. Such principles are considered the essential aspects that orient the leading role of higher education in society.

Over the last ten years some proposals for postgraduate studies in the area of Surveying have been developed in Argentina and, in spite of their recent history, they mean to constitute and adequate answer to the need of highly qualified human resources, with a growing participation in research so as to generate new knowledge and new technologies. Mr Roberto Ruiz Torrealba (1992), Academic Vice President of the University of Venezuela, states that when the university gets strong at the postgraduate level, it begins to demand higher credentials for the teaching and research staff thus contributing to the improvement of the academic level and to the reestablishment of the normal academic circuit. The postgraduate level, the natural and necessary basis for the development of a coherent academic career facilitates the development of a university culture that allows for the institutional evaluation, both at the level of the institution per se and at the level of the teaching, research and extension programs, as well as at the level of the individuals involved.

Confronted with the redesigning of the curricula in the area of Surveying Engineering with the aim of introducing the would be engineers in the domain of the most recent technologies and developments – mainly those connected with geomatics – and with the formulation of a still initial postgraduate area, there exists a meaningful number of people who have complete a university degree in Surveying. They are working in their profession and at the same time demand updating. Such updating must define the roles of a process of brushing up each

professional's knowledge and procedures that may assure a higher recognition to the profession.

The diversity of thematic areas included in Surveying, within the context of limited economic resources characteristic of Argentina today poses the need to define strategies that will allow a rapid and creative answer to the new professional requirements in the presence of demands deriving from the occupational market. In this way, the information that can be obtained from satellite images is truly important to aid from our profession the achievement of the role that our country wants to achieve in the region, particularly after the launching of the Argentinean satellite SAC-C in November 2000. This is so mainly because the handling and management of georeferenced data of diverse nature and for different objectives connected with the cadastre, the natural resources and the geodiversities constitute the basic foundations of Surveying.

The smooth and flexible exchange deriving from cooperation programs between universities and professional institutes with the aim of starting effective systems of professional updating becomes the starting and stimulating sign that will allow to launch the updating of the professional groups in Surveying. In this sense some invigorating experiences are in the course of development. Promoted by the Argentinean Institute of Valuation [*Instituto Argentino de Tasaciones*] with the National University of Santiago del Estero and the National University of Catamarca they are aimed at deepening and updating knowledge applied to remote sensing and real estate valuation, thus creating an appropriate reflection on the evolution of the valuation discipline and the advantages provided by the techniques of digital images processing as efficient tools for the evaluation of natural resources.

## **2. MAIN EDUCATIONAL OUTLINES IN ARGENTINA**

The Federal Education Act 24195 passed in 1993 started a process of total renewal of the Argentinean educational system through the organisation of the different school levels. It establishes that it is the national government who determines and controls the educational policies taking care of education as a permanent process and following given principles and criteria, such as the strengthening of the national identity, the consolidation of a representative, republican and federal mode of democracy; the social, cultural, scientific and technological development; the economic growth of the country; the agreement for the formal educational actions and the non formal activity run by the different sections of society; the stimulus, promotion and fostering of educational innovations, and the alternative systems of education, among others.

With the passing of the Federal Education Act on, some authors have shown a clear tendency oriented to the planning of the curriculum designs of a flexible, open, agreed on, and participative type (Palladino, 1998). In this sense the Federal Council of Culture and Education [*Consejo Federal de Cultura y Educación*], presided over by the National Minister of the area and integrated by the ministers of the different jurisdictions plus a representative of the Inter University National Council [*Consejo Interuniversitario Nacional (CIN)*] has the function of fixing the public basic contents, the curriculum designs, the evaluation modalities for each educational cycle, levels and special schools making up the educational system according to the national educational policies.

The Higher Education Act 24521, passed in 1995, regulates the higher educational system comprising university and non university institutions either national, provincial or municipal, both public and private. The law establishes that the State holds the responsibility of providing the public higher educational services, a duty that cannot be delegated. The objectives of higher education are clearly established in the Act 24195 and in the Act 24521. They aim at educating scientists, professionals and technicians who are characterised by a solid process of learning and a strong commitment to society; promoting the development of research and artistic creativity thus contributing to the scientific, technological and cultural development of the nation; granting the increase of the levels of academic quality and excellence; fostering an adequate diversity that can meet the requirements of the population, of the cultural system and of the production structure; and increase and diversify the opportunities of updating, conversion and full qualification for the members and graduates of the system.

The academic and institutional autonomy set by the law, grants among other functions that of creating graduate and postgraduate careers, formulating and developing curricula both for learning and scientific research as well as for extension services to the community; granting academic and professional degrees in accordance with the conditions established in the law itself; and finally developing and participating in educational undertakings that may favour the advancement and application of knowledge.

Article 43 has resulted the most controversial of the law as a consequence of introducing the concept of professions regulated by the State for those whose professional practice may risk the public interest due to its direct connection with health, security, rights, possessions, or the education of the citizens. The list of professions included here is determined with a restrictive criterion by the Ministry of Education and Culture together with the Council of Universities. The professional activities are regulated in the same way.

The curricula of the professions regulated by the State must comply with a minimum number of credits determined by the Ministry of Education and Culture in agreement with the University Council. The same happens with the requirements related to the development of the basic curricular contents and with the criteria applied to the intensity of the practices of the training processes, besides the periodic requirements for the career accreditation by the National Commission of University Evaluation and Accreditation [*Comisión Nacional de Evaluación y Acreditación Universitaria (CONEAU)*] or by reputed private entities that will organise themselves for such aims.

The Argentinean university community has widely debated this issue pointing to the philosophic and sociological dilemma implied in the law by the restrictive legal criterion given to the ministry which can in the end start a division between first class and second class categories for the careers. It is evident that the economic support of the state in an environment of really scant resources is primarily oriented to finance the curriculum development of the professions regulated by the state. Besides there exists a generalised feeling of fear related to the determination of professional practices; the feeling is that different careers can overlap their tasks and activities thus attempting against the survival of many professions.

The Argentinean Federation of Surveyors [*Federación Argentina de Agrimensores (FADA)*] and the National Commission of Surveying Schools have submitted petitions to the Ministry of Education and Culture requesting that Surveying be included in the list of professions contemplated by the Article 43; the objective reason for this being that this profession really affects the public interest.

Due to its direct connection with the real estates and personal and property rights, from its origins in Argentina, Surveying has been a profession regulated by the State. Thus during the presidency of Bernardino Rivadavia, in the year 1824, the first regulations related to the profession of Surveying appeared. According to these, the public department of topography, apart from giving approval and registering the land surveying maps, granted the degree of surveyor to those who passed a number of demanding exams; this education and degree granting was later on passed over to the university environments.

In order to sustain the convenience of including Surveying in the list of professions regulated by the State in accordance with Article 43 of the Higher Education Act, the National Commission of Surveyors' Schools has pointed that:

*“... the strong legal economic and social content of Surveying is in direct and immediate relation with its objectives among which is that of achieving Territorial Ordering and satisfying in this way the need of the nations ... holding the territorial ordering of the States as the basic unit element connected with the borders which also serve both for the separation of the territories with the neighbouring states as well as for separating public and private properties, ... there will be Territorial Ordering when the borders be determined, materialised, mapped and registered in the territorial cadastre with the aid of Surveying ...”* (CONAE, 1998).

In spite of the doctrine and legal reasons submitted to the consideration of the Ministry of Education and Culture, and while other professions have been already determined as regulated by the State, the profession of Surveying has not yet been included.

### **3. CURRICULAR UPDATING AND POSTGRADUATE EDUCATION IN SURVEYING**

It is possible to acknowledge that the curricular updating processes in Surveying derive in part from the need to incorporate recent knowledge generated from the scientific and technological transformations operated particularly in the field of geomatics. Thus updating the Surveying careers in order to go along with the global evolution experimented by the profession, has meant approaching the curricular redesign from an integral perspective.

Apart from the guidelines established by the National Ministry of Education and Culture in accordance with the Higher Education Act 24521/95 the integral revision of the curricular designs and development of Surveying has also been mandated in order to adjust the career to the new standards of efficiency and accreditation keeping in mind its possible incorporation in the list of professions regulated by the State. For this reason, the National Commission of Surveyors' Schools (CONEA) has elaborated lines for the curricular homogenisation on the basis of the minimum contents to be included in the careers of Surveying in the Argentinean universities. The Federal Council of Deans of Engineering (CONFEDI), has in turn

elaborated recommendations for the curricular updating and has fixed descriptors oriented to homogenising the curricula in the area of Surveying that are carried out in the different Schools of Engineering in the country, with special emphasis in the number of school hours established for each of the subjects in particular and for the career in general -with the minimum of 3,750 contact hours of schooling-.

As regards the graduate education in Argentina at the present time, as it is true for the rest of Latin America, it consists not only of doctoral studies but also, and in a decreasing order of complexity, of Master's degrees and diplomas, reflecting the incorporation from the 80's of the American model in the region. These three levels of graduate education are contemplated by the Act 24521, and in every case they must be accredited by the National Commission of Evaluation and University Accreditation.

In the last decade, Doctoral Programs oriented to graduates of Engineering were developed. They basically consist of a number of courses with a certain level of credits, the elaboration of a thesis project –scientific research project to be developed in the postgraduate education areas– and a public defence of such thesis. It is necessary to have into account that the Doctoral Programs do not constitute themselves the way of professional improvement, that is to say, they do not have as goals to update or improve the professional performance of the candidates, but to train scientists and academics to nurture the research centres and university staffs, with the capacity to generate new knowledge and new technologies, and to feedback in turn the graduate education process.

The Argentinean experience referred to postgraduate education in Surveying is very recent; it was started only in the last decade. The need to give impulse to the fourth level accreditation and research in the sciences connected with Surveying was also kept in mind when the CONEA was organised in the year 1997 and as such it was included among its objectives. The Surveying Doctorate offered at the National University of Catamarca, the first doctorate in its type in America, was started in 1990 and is traced back to the German university model of studies in Surveying. The duration of the studies is variable with a minimum of two years and a maximum of five, for the process of accrediting the specialised education courses and the complementary education as well. These courses are taken according to the credits and speciality offers in different universities in the country or abroad. Candidates must pass examinations of two foreign languages and write a thesis whose project must be approved of by the doctorate commission, and must go through a public defence with the presence of a board of examiners with expertise.

So far three professionals have obtained the degree of Doctor in Surveying and only two of them live in Argentina. The difficulties observed evidence diverse aspects to be overcome, such as the lack of articulation between the graduate and the postgraduate education, and the scant aid at the institutional level. There is no doubt that success of a national program aimed at academic excellence and scientific and technological development, duly planned and coordinated depends on a harmonic convergence of three essential factors: human resources, infrastructure and financing, the first two depending to a high degree on the last one. The fact is that in Argentina today, financing doctorates' programs is almost utopian.

Tradition in our country did not contemplate an educational system between the degree of Surveying Engineering and the corresponding doctorate. This led to the rethinking of the

design of postgraduate careers in terms of diplomas and masters degrees. Examples of this are the diploma in valuations and the diploma in georeferencing which were started in 1996 at the National University of San Juan. However, and it is fair to state there is a postgraduate educational offer in the country which is not exclusively oriented to the surveyors. Yet it comprises areas of interest within the ample thematic interests of the profession, such as the Doctorate of Geophysics –two surveyors held this degree- developed by the National University of Rosario. There is also a small group of surveyors who have done or are doing postgraduate courses in other countries. It can be expected then, to widen in the short term the spectrum of highly qualified human resources for the impelling of the research in Surveying and to feedback the postgraduate education.

#### **4. THE NEED TO START PROFESSIONAL UPDATING NETWORKS**

In Argentina there are approximately 4,500 professionals in Surveying who took their graduate studies before the process of homogenisation and curricular updating started in 1997. Though there are no registers in the country containing information related to the number of postgraduates in each profession, it is estimated that about 0.5% of the total of surveyors have completed postgraduate education. Then confronted with the reformulation of the curriculum designs for Surveying Engineering which will soon facilitate the graduate professionals to handle the most recent technologies and developments, particularly connected with geomatics, and postgraduate studies just beginning, there is a universe of professionals who are working presently and demand modernisation for all. Their claims must be considered in order to give the profession a higher level on the basis of the strengthening of the individual capacities by means of the updating of the applied knowledge and the professional practices. In order to achieve this every asset and opportunity must be taken advantage of.

The updating and training programs for the academic and research staff have a long tradition in the universities. For instance, the Funds for the Bettering of the University Quality [*Fondo para el Mejoramiento de la Calidad Universitaria (FOMECA)*] can be considered a political effort in this sense, financing in the last years different projects for the improvement of the teaching quality in Engineering at national universities. However, it must be noticed that Surveying Engineering has had very little participation in this and other programs.

The cooperation networks in the academic field, and particularly at the universities, do not constitute a new subject. But it is possible to redesign, rationalise and develop them qualitatively seeking a continuous professional updating in connection with Surveying. To do this it is not necessary to resort to a “vertical cooperation” (institutions with a high scientific and technological development assisting others with lower possibilities) -usually of an international character-; but it is preferable that a “horizontal cooperation” should prevail (Brovetto, 1996) among the universities in the country, with compatible development, identical problems and similar objectives. The universities should articulate with other academic and scientific institutions and with professional associations in order to take advantage of the achievements and assets of each of them with solidarity, that is for the benefit of all, facing the main thematic updating with certain perspectives of achievement as the point of departure.



Then it amounts to setting up networks of horizontal co-operation for the smooth and flexible exchange of all their members, thus creating a common academic space throughout the country made up of the set of capacities and potentialities of the Surveyors in order to face as a massive effort the process of continuous updating demanded by the profession.

## 5. CONTINUOUS PROFESSIONAL UPDATING IN REMOTE SENSING

The diversity of thematic areas included in the profession of Surveying, in an environment of limited economic resources prevailing in Argentina today, demands the need to define strategies capable of answering the new professional requirements quickly and with creativity. The strategies for professional updating must be designed in accordance with prioritised areas that can be feasible of achievement within a scheme of harmonic convergence of the three essential factors already pointed to: human resources, infrastructure and sufficient financing.

In this way the different applications of data obtainable from satellite images results in a priority to share from the profession the role that our country means to achieve in the area, particularly from the moment of the launching of the Argentinean satellite SAC-C in November 2000. This is so because the handling and administration of georeferenced data of different nature and for different objectives, related to the cadastre, the natural resources and the geodiversities constitute the basic foundations of Surveying. It must be pointed that the remote sensing, approached from an ever increasing number of sciences and with multiple applications in different professions, needs to be incorporated as an everyday practice in the professional activities of surveyors. There are surveyors, in Argentina, specialised in remote sensing, especially as applied to the evaluation of natural resources. Besides, the significant evolution of computing has allowed access to computers more and more powerful and of a lower cost and there are really accessible softwares for the digital image processing. Finally, the infrastructure, equipment and the appointment of permanent teaching staffs available at the universities and other academic and scientific institutions ready to face the professional updating tasks minimise the operating cost. And the professional associations must assume the leading role of changing into the necessary liaison between surveyors and the updating proposals in their own jurisdictions. Thus everyone will be able to get the benefits of the knowledge updating process and of working procedures that will give a higher level to the profession.

As precursors the Argentinean Institute of Valuations together with the National University of Santiago del Estero and the National University of Catamarca have started the development of some stimulating and encouraging experiences for the purpose of deepening and updating knowledge related to teledetection and real estate valuations. The Secretary of Science and Technology of the National University of Catamarca (FOMECA) and the Professional Council of Engineering and Architecture of the Province of Santiago del Estero [*Consejo Profesional de la Ingeniería y Arquitectura de Santiago del Estero*] have readily joined in. In reference to the activities planned for the year 2002, the courses to be taught in Catamarca and Santiago del Estero have already been allotted the corresponding academic credits.

## 5.1 Main Characteristivs and Results of an Updating Experience

Different professional updating and postgraduate courses were developed in the second semester of the year 2001 in Buenos Aires, Catamarca and Santiago del Estero covering different thematic contents and varying contact hours between a minimum of 20 periods and a maximum of 40, plus, as it is the case with Catamarca, 30 periods for independent work in the area of digital satellite image processing. All of these were conducted by the authors of the present paper and with the organisation by different institutions.

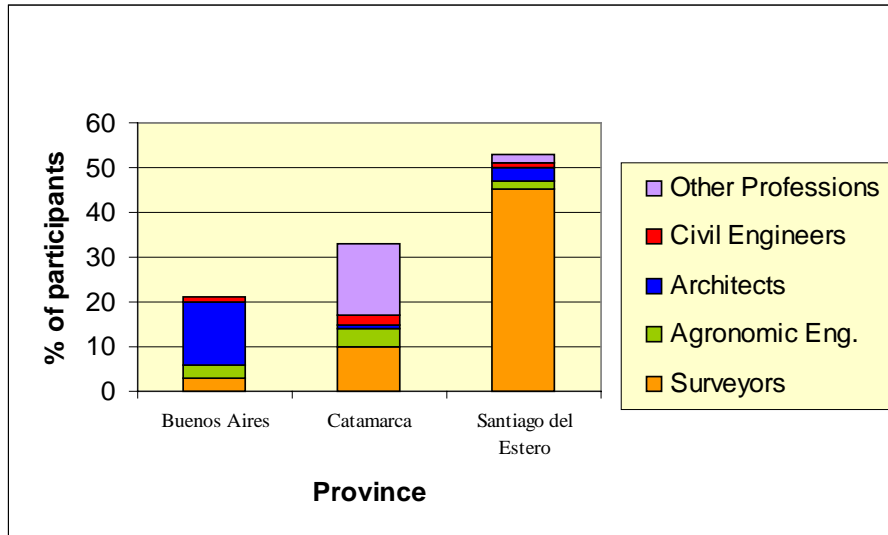
The objectives in general were oriented to: (a) create a reflection space about the comparative advantages rendered by the remote sensing techniques as efficient tools for the evaluation of natural resources, (b) facilitate the incorporation of digital satellite image processing techniques for the analysis and interpretation of different environments of the land surface, (c) show the benefits of availability of georeferenced information obtained from satellite images in order to carry out applications with different working purposes, and (d) foster the exchange of experiences in the area of scientific research among professionals of different fields. The organising institution, the level of participation and the main thematic orientation developed are shown in the following table:

Table 1: Level of participation per course

<i>Organising Institution</i>	<i>Province</i>	<i>Contents Orientation</i>	<i>Number of Participants</i>
Argentinean Institute of Valuation	Buenos Aires	Satellite image application in real estate valuation processes	21
Secretary of Science and Technology (National University of Catamarca) – Plan FOMECA	Catamarca	Digital images processing for the evaluation of natural resources	33
Professional Council of Engineering and Architecture	Santiago del Estero	Valuation methodologies for urban and rural estates	53
<b>Total of Participant Professionals</b>			<b>107</b>

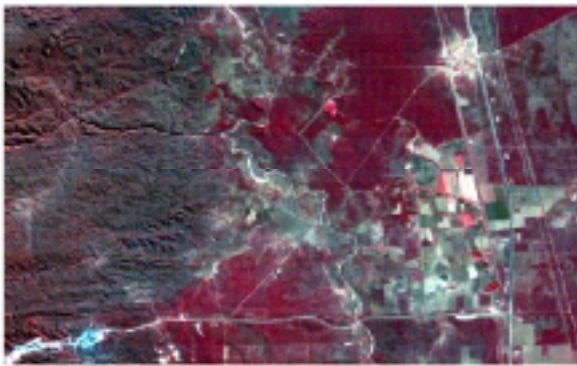
As it has been pointed out above, the application of satellite images provided by the remote sensing for the evaluation of natural resources is not a subject of exclusive competence of Surveying, as it is not the speciality in real estate valuations. As a consequence, the activities resulted in real professional updating services, not only for surveyors; above all, they resulted in enriching experiences from the point of view of the multidisciplinary work. Graph 1 shows the levels of participation in the different proposals distinguishing the participating professionals.

Graph 1: Level of participation per professions



The proposal developed in Catamarca, oriented to the evaluation of natural resources through satellite images, was particularly attractive for professionals in natural resources, biologists, chemists, geologists and geographers. They were not present in the other courses, this being the reason for including in “other professions” in the graph. In this case the effort to make the different interests in such a heterogeneous group compatible demanded working with differentiated pilot areas with the purpose of the digital processing of Landsat TM images; this can be seen as follows.

Composition 2-3-4 (Landsat TM)



Composition 1-2-3 (Landsat TM)



It deserves pointing out that the outstanding participation of surveyors in the course taught in Santiago del Estero, organised by the local professional association of surveyors, emphasises the important role they have relative to a continuous professional updating.

## 6. FINAL REMARKS

The principal aim of the present paper has been to show a professional updating experience, though incipient, in some areas and technology of a significant impact in Surveying. The higher education changes, the demands of postgraduate education and the changes that the professional practices undergo as the results of an accelerated scientific and technological evolution, in a context of economic limitations in Argentina should provoke our reflection on our own strengths and opportunities to set up effective systems of professional updating.

The horizontal co-operation constitutes a significant effort for the modernisation of Land Surveying from the inside, with our own local strengths. The existence of a network of universities and other academic and scientific institutions articulated with the professional associations will mean the positive strategy to respond quickly and with creativity to the new professional requirements confronted with the demands determined today by the labour market.

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