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THE MULTIPURPOSE CADASTRE EVOLUTION IN BRAZIL

A Evolução do Cadastro Técnico Multifinalitário no Brasil

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ABSTRACT

This article presents a historical review of the multipurpose cadastre evolution in Brazil, along with the efforts about the public politics that had supported it and, some aspects of its evolution at the scientific and technical fields. The authors of this paper are professionals who have worked for some decades at this field, meaning to spread the Multipurpose Cadastre for institutions and among public managers, registering the value of some government programs in the area, especially those related to the support of university programs to train professionals. It is also important to show the value of some international anchors that were very important on this Cadastre trajectory in Brazil. In this paper also explores the relationship between Cadastre, cartography and technologies that evolved, that are extremely important to the cadastre development, once that its necessary to collect, process and storage data in a structured cadastral system. In order to achieve that goals in this paper initiates with an overview of the Tordesillas Treaty, the first land law that mentions cadastre, some government programs developed before 10.267/01 law. After this, some technology evolution in cadastral field and related areas is briefly showed and in sequence, the training programs that were created including a master and a doctor degree in Multipurpose Cadastre in Brazil. After discussing those issues is evident the needs that the cadastre area and related areas have: more people prepared to work in this field and more financial investment in a way that it becomes possible to improve the development in Brazilian municipalities.

Keywords: Multipurpose Technical Cadastre; Technological Developments; Cartography; Brazilian Cadastral Laws; Multipurpose Cadastre's Professionals.

RESUMO

Este artigo apresenta um breve histórico da evolução do Cadastro Técnico Multifinalitário (CTM) no Brasil juntamente com os esforços relativos às políticas públicas que o apoiaram e, alguns aspectos da sua evolução nos campos científicos e tecnológicos. Os autores deste artigo são profissionais com décadas de experiência nesta área, difundindo o CTM em instituições e entre gestores públicos, deixando claro o valor dos programas de governo na área, especialmente aqueles relacionados aos programas de fomento universitários e de treinamento de pessoal. Também se faz importante mostrar-se aqui o valor de algumas âncoras internacionais, muito importantes para a trajetória do cadastro no Brasil.

Neste artigo também são exploradas as relações entre cadastro, cartografia e as demais tecnologias, as quais são extremamente importantes para o desenvolvimento do cadastro, uma vez que se faz necessária a coleta, processamento e armazenamento dos dados estruturados em um sistema cadastral. Para que se atinjam os objetivos deste artigo, inicia-se com uma análise histórica passando pelo Tratado de Tordesilhas, a primeira lei que menciona o cadastro, alguns programas de governo desenvolvidos até chegar-se na Lei 10.267/01. Após isto, mostra-se na seqüência uma breve evolução das tecnologias utilizadas no campo do cadastro e áreas correlatas, os programas de treinamento de pessoal incluindo mestrado e doutorado em CTM no Brasil. Após discutirem-se estes assuntos, fica evidente a necessidade existente em cadastro e nas especialidades a ele relacionadas de: maior quantidade de pessoal qualificado no mercado de trabalho e mais investimento financeiro de modo que se possam vencer os obstáculos existentes no desenvolvimento dos municípios brasileiros.

Palavras Chaves: Cadastro Técnico Multifinalitário; Desenvolvimento Tecnológico; Cartografia; Legislação Cadastral Brasileira; Profissionais do CTM.

1. INTRODUCTION

Cadastre, according to the Federation of International Surveyors (FIG, 2007), is an information system, based on the parcel, which contains a record of rights, obligations and land interests.

In Brazil the registration of a land parcel is conceived in the most of time for taxes purposes; however, the proposal of the Multipurpose Cadastre has a much more ample concept. It is based on: collecting, storing and processing information about the parcel with multiple purposes, in order of planning and managing the territory in all aspects required. The final goal is to improve the life quality of a population by seeking improvements in several areas such as education, health, transportation, legal and social stability, among others.

Although the Brazilian Federal Constitution mention that it is the obligation of government to map the territory, many regions of the country still don't have a map in a proper scale for cadastre, and, this process has been delayed for a long time. The mapping and land registration is claim to be very expensive to the government and that's the main reason for the cadastre in Brazil has never been achieved all its potential and fulfillment. .

While the awareness that an efficient planning of the territory involves a detailed study of the area and that it is not possible without mapping and cadastre, a proper land managing is compromised.

To summarize this paper discusses the Brazilian evolution concerning the cadastre legislation the technologies used for data acquisition and training courses in the area and the prospects for the future of the cadastre in Brazilian society.

2. TORDESILLAS' TREATY AND THE HEREDITARY PROVINCES

In order to write a historical analysis on Brazilian cadastre is necessary to also analyze the history of the Brazilian land use.

After the end of the moor domain over the Iberian Peninsula the lucrative products of the east, mainly from India, came to Europe via Morocco by Arabs caravans. The solution for Spain and Portugal accessing the original markets with products from Africa and Asia should be through alternative means: by the oceans. The first who proposed this solution was Prince Henry of Portugal, son of D. John. The difficulty for its mission was the lack of geographic information of the seas, suitable marine equipment and experienced sailors. In 1450 Europe knew only 10% of the planet surface and sea navigation was limited to the coast regions.

The European activities were easily expanded because of four innovations: a new type of ship - the Caravela, the compass, navigation by the stars and the Mercator Projection. Three of these four essential innovations are in the cartography field. But the real and the main engine for these expeditions were economics. In a single century sea connections were created between Europe and Africa, Asia, Australia and both Americas. The actors in in the beginning of this scene were just two nations: Portugal kingdom and the recently formed Spain. England, Netherlands and others joined the achievements in this competition a decade later. In the begining, a possible conflict could only appear between the interests of Portugal and Spain. It explains why these two nations have tried to divide the world between themselves throughout a series of agreements and treaties to demarcate areas of

interest and, avoid conflict. Possible interests from other nations, including the native peoples were just ignored.

The first agreement was the "*bula Aetermi regis*" from 1481 which granted all areas from South of Canary Islands untill Portugal and the rest (all north region of this line) to Spain. The "world of Europe" was still small, the Americas was discovered only 11 years later. This discovery in 1492 radically changed the geo-strategic plans of these two nations and the 1481 agreement had to be renegotiated. Spain and Portugal had divergent views as to reach the Asian markets: Spain through the western route and Portugal around Africa.

2.1 Tordesillas' Treaty, 1494

Just one year after the first voyage of Christopher Columbus (1492) the Spanish government called the Pope Alexander VI to arbitrate the demarcation of a separation line between them and Portugal. The Pope officiated in 1493 the "bula *Inter coetera*", a meridian from pole to pole, 100 leagues west of the Cape Verde Islands and granted in terms of donation, the undiscovered lands to the west to Spain and the east to Portugal.

The Portuguese Crown (D. John II) objected the papal decision and requested a renegotiation. A year later, in 1494, the Tordesillas' Treaty , negotiated by an astronomer, a geographer and a Portuguese navigator (Duarte Pacheco Pereira) defined a new meridian: 370 leagues (approximately 1770 km) from the Santo Antao Island (Cape Verde), replacing the 100 leagues line from last year treaty.

With this treaty Portugal could begin a legal occupation in the Brazilian coast. With Pedro Alvares Cabral arrival on April 22 of year 1500, the first Portuguese colony in the new American continent were created.

The Brazilian coast was divided by King John II, between 1534 and 1536, initially in 15 zones, called Hereditary Capitain, each one, granted to a "donee", a court noble or a senior official of the Portuguese state. The economic development initiated through sugar cane cultivation , the sugar production, and the sale of this product in Europe, which was very profitable at that time. The first workers for the plantations were indians who were trapped inside and slaved by the Portuguese donees.

The settlers, who came from Portugal to Brazil, also were not always voluntary immigrants. The penal code in Portugal at the time provided more than 200 violations punishable by deportation to one of Portugal's colony, mainly to Brazil. For other immigrants, from any other countries, there was only one condition: to be Catholic.

Many of the Indian slaves died because of diseases brought by Europeans. Also, the number of people who committed suicide was high. The "incoming" of an Indian as a slave to the farmers was considered unsatisfactory. But human labor was essential to have a productive farm. And, productivity was one of the first requirements for the settler to get a land use. Thus, the candidate of it, intending to prove the productive land condition, had to present a sufficient capital for the basic facilities of the farm (purchase of livestock, improvements, fences, seeds, etc.) and should own an adequate number of slaves.

In 1538 the African slaves first arrive in Brazilian lands and in the following decades the slaves were systematically replaced with them, valued by the owners of the farms as the best "incoming". So within a few years, Brazil became the world's largest producer of some products, and, the most lucrative of the early centuries of the colony was the sugar.

The system of land use known as '*sesmaria*' was maintained throughout the colonial period until Brazil's independence in 1822. It concept was at the same time a land measure and the concept of land use itself (fig. 1).

Conceptually the land use was a concession in the early decades of the captaincy, donated by a settler to a user that, as a grantee of a concession, has the obligation of economic exploration and making it a productive land. The land use would stop automatically in cases of lack of productivity.

This concept of land use concession for farming exploration is well rooted in the history of human civilization. Some clauses can be find since the second millennium Before Christ, including in the Hammurabi Code.

The interest of the crown was also to create larges and productive agricultural units to provide the demands of products at lucrative European markets. About the sugar cane, Portugal had for a long time a monopoly on the product throughout Europe. So, ever since the beginning of the occupation, the vast territory of the colony was divided among a few producers. The concentration of the land in few hands was, from the beginning of

Fig. 1: The possessions of Spain and Portugal in South America in 1598. Source:Drawn from Info World Atlas historic Hermann Kinder and Werner Hilgemann, ISBN 84-790-005-6.

the colony, a land policy that priories European markets.

3. LAND LAW

Two years after independence in 1824, Brazil has its first constitution in which the Brazilians, for the first time, received the right to private property. The fact that every single person who took possession of some land could feel legally the owner, combined with the end of the requirement to prove the productivity of the land, resulted in a greater concentration of land in the hands of the already rich farmers.

The first public registry to prove ownership or land tenure was the "vicar book" 1843, a pre-form of a rural cadastre. The idea of the law was so separate in a clearly way what was public and private land. This registry was declaratory and didn't bring the legal property. There was no measurement or any kind of field control to verify the declared land that could be used in the future to create the first cadastre. The truthfulness of those declared properties was just presumed, not controlled.

The history of the Brazilian cadastre begins with the 601 Law. This was the first law intending to create a cadastre to register what was really private land and a vacant land (belonging to the state). More than 150 years after this law there are still many cases with enormous difficulties of identifying and boundary the lands with certainty and precision, what is, by definition of the law: "vacant land".

The first registration Brazilian still had to wait more than 100 years for a register system that presented law security concerning the identification and boundery of the property. In 1964 the "Statute of the Land" was created, this was the first cadastre (rural) in Brazil.

4. THE FIRST LAW THAT MENTIONS THE CADASTRE

According to Brazil (1983), the first land law that mentions cadastre is the Law N. 4504created at November 30, 1964. It provides for the Land Statute, and other measures. The 5.504 law has had several changes. The amends that succed it was: Law No. 5.709/1971, Law No. 6.746/1979, LAW No. 7647 / 1988 DEC.LEI No. 2431 / 1988 and MPV No. 2183-56, 24.08. 2001.

From the law it can be extracted its 46 article mentioning: "The Brazilian Institute of Agrarian Reform will promote surveys, with the use, for the indicated cases foreseen in Chapter II, Title I, to the creation of rural properties cadastre throughout the country, comprehending:

I - data for characterization of rural properties;

II - Nature and conditions of access roads and their distances to the nearest population centers;

III - conditions of exploration and land use;

In the same article can also be extracted what can be expected from the cadastral survey:

1-The cadastre is organized according to rules and pre-approved forms of the Brazilian Institute of Agrarian Reform in the manner prescribed by regulation, and can be centrally run by the regional institution, States or municipalities, in which case the Brazilian Institute for Reform Agrarian should provide them technical and financial assistance in order to accelerate their achievement in areas with priority concerning the agrarian reform.

2 - The entries will aim to ensure the possibility of classification, identification and grouping several rural properties belonging to a single owner, even those in different towns, with a cadastre certificate been given to the owner as mentioned in this regulation Law.

3 - The cadastre data will be continually updated, adding new properties and, from 5 to 5 years it will be made general revisions to update the records already included in the cadastre.

Evaluating these points extracted from the Law itself, it is clear that since that time there was

clear law regarding the need for cadastral survey and its advantages for the land user and also for the government.

In 1972 (Brasil, 1983) was created a cadastre law in order to regulate the precision of the measures, and the error of closuring the polygon could not be more than 5% of the total area of the property.

5. CIATA PROJECT

Some years after the creation of the Land Law the Ciata Project was created. It consist in an agreement for improving the technical and administrative skills of the Municipalities servants, implemented in September 1977, was primarily responsible for initiating the computerization of municipal governments providing them with technical infra-structure and workers. It was a preview of what is now obligation to be follow by the municipalities, nowadays determined by the Fiscal Responsibility Law.

In many Brazilian states this was a project implemented by SERPRO (a Federal Data Processing Institution). It is a public company inside the Ministry of Treasure since 1964, when it was created by the 4.516 Law, which main goal is providing technology information services and communication in many public areas.

After the CIATA project many municipalities received computers, computer systems, processing data stations, and, they could bring to them one of the most important tasks that a municipality should have.

This project during the years of it works has proposed the data acquisition by the use of some forms: The Street Form or The Block Form and the Cadastral Information Form. The first one relates the street data to the urban property. Each street receives a unique code. Each street data base contents all the public services placed in it and the value of the square meter of the land property, extracted from a Property Value Map. The second one has information related to the build on the land property such as: it specific constructive characteristics and its location (Beppler, 2007).

6. THE PNAFM PROJECT

The National Program of Fiscal management of the municipalities - the PNAFM, is about the modernization of managing and control, for example, the implementation of technical and management training programs headed for financial control, citizen service, data bases interaction, human resources, consulting, information technology acquisitions, infra-structure and geoprocessing.

The PNAFM financial resources come from BID (Inter-American Development Bank). The destination of this money is the strengthening of the municipalities management by financial support of its projects that consider actions behold to the modernizations of the Brazilian municipalities. This project, is a key point for a feasible projects in Cartography areas, Cadastre, Property Value Maps and Municipal Master Plan.

One of the positives points of the program is the possibility of improving the human resources of the municipality. Moreover the program has proven to be a differential when comparing with other existing programs in Brazil. A Federal Public Banck known as "*Caixa Econômica Federal*" has invested a lot of money in training programs for the municipalities staff in Multipurpose Cadastre, Value Property Maps, GIS software and improving the computer systems and databases, allowing the acquisition of proprietary software or free software as well.

7. 10.267 LAW OF 2001

The Federal Government in the late 1990's in joints with some institutes of State Lands proposed changes in legislation related to rural areas, resulting in the creation of a new Law: 10.267 in 28/08/2001, which is the newest law about cadastre in Brazil. The government with this new law, determine that INCRA and the Internal Revenue Service (IRS) are responsible for organizing and coordinating all the rural information, understandig that these two institutions have structures with technical expertise in cadastral area.

According to Costa (2004) the 10.267 Law, of 28/08/2001, in its paragraph 2, Article 2, creates the National Registry of Rural Property - CNIR, which have a common information base, managed jointly by INCRA and the IRS, produced and shared by several federal and state public institutions that produce and use information about the rural areas.

In its paragraph 3, Article 1 of the Act, it is determined that the common basis CNIR adopt an unique code, to be established in a joint act of INCRA and IRS, for rural properties registered in

order to allow their identification and sharing the information between the participating institutions. In paragraph 4, it determine also, that, will integrate CNIR data bases created and managed by participating institutions, consisting of data specific to your interests, which may be shared by them, subject to the regulatory standards of each entity.

This law also creates a new relationship between INCRA and the Registry Property Services, and determines the requirement for georeferencing the edges of rural properties using the Brazilian Geodetic System. The Enactment 4.449 of 30/10/2002, regulates 10.267 Law, and establishes among others, that INCRA is the institution responsible for georeferencing certification of rural properties. This Enactment stipulates in its Articles 7 that it should establish the rules for access password and access levels to the information existing in the CNIR in a way not to restrict the access of the entities that belongs to the cadastre network without, however, allowing the unrestricted access of secret data that could violate the right to privacy. In its article 8 says that the costs to the identification of the property according with the law not applies to the rural property area does not exceed four rural module.

Through a historical analysis it is possible to realize that the 10267/2001 law was a great advance for the technical register of rural properties in Brazil. Before this law the parcels was defined by measurements of its sides with no concern for the unity of the parcel. After, there was the publication of rules and forms to guide the procedures for obtaining the coordinates of the points that are geographically locate a property.

The georeferencing rules intend to guide professionals who work in the surveyor field, measuring and georeferencing rural property in order to attend the new Law, that was written based on the Technical Manual of Land Mapping from INCRA, approved by Ministerial Decree No. 547 of 26/04/1988.

Several sections of the Georeferencing Rules were fully extracted from Chapter 3 - Technical standards for Topographic Surveys, contained in that manual cited and approved by INCRA on September 14, 2001, through the OS / INCRA / SD / No. 014/01 of 28 September 2001.

Some topics were included intending to modernize it as result of the technological development and the use of Geographic Information System - GIS, that should be brought to the modern management of land resources dealing with new georeferencing tools used to known the boundaries and natural features and cultural ones, with its their attributes and having the ability to integrate these GIS's.

About the global positioning systems using satellites, a huge step was given with the introduction of the NAVSTAR-GPS into the rules.

8. GUIDELINES FOR URBAN CADASTRE AND 511 ENACMENT FROM DECEMBER 2009

After the advances that happened for rural cadastre brought by 10.267 Law in 2001 the urban area needed a clear definition its municipal cadastre. Even though in almost all municipalities some cadastral systems were already created, they were usually limited in order to calculate property taxes (Fig. 2). They were developed to assist the municipality concerning the national tax code and related laws. There was not an office or an institution to guide the goals and purposes of a cadastre.

The lack of a national guideline has become more evident since the Cities Statute (10.257 Law of 2001) requires certain municipalities to prepare a "Master Plan". Most of the municipalities are unable to honor the deadlines for submitting the master plans, sometimes because of the lack of information, (real and legal) about their territory.

In this scenario, the Federal Government through the Ministry of Cities, created in 2007 a working group to prepare a proposal for a guideline

Fig. 2: The implementation of Multipurpose Cadastre.

for a registry, that fulfill the current needs in reliable cadastral information, according with the current reality of Brazilian municipalities. The group has already submitted during the same year the first draft guideline for an audience compound with potential users and managers of municipal cadastres. The proposal was also submitted to a technical analysis by French experts with international experience, through an invitation of the French Embassy in Brasilia.

In December 2009 the Minister signed the enactment of the cities with 511 Guidelines for the Creation, Establishment and Updating of Multipurpose Cadastre (MC) in Brazilian municipalities and presented a didactic first publication to be distributed among municipalities all over the country. The same publication has been translated into Spanish by the Lincoln Institute in Boston (USA) that uses this material to educate professionals about land registration and cadastre in other countries of Latin America. Versions in English and French are also in preparation.

The main goal of the guidelines is to express an idea first to the country, about how to define, organize and implement a registration system in the cities to serve the current and future needs of the city governments and other State organisms.

In the first chapter of the Ministerial Ordinance, is presented the basic structure of the land registration with the main definitions, hierarchically, since the cadastral parcel until the Territorial Information System. The MC (Multipurpose Cadastre) is defined in the guideline as a "territorial official and systematic inventory of the municipality and shall be based upon the survey of the boundaries of each parcel " (art. 1), where "The cadastral parcel is the smallest unit of the register defined as a contiguous piece of land surface with single legal regime. "(art. 2) (fig. 2).

The entire territory of the municipality is composed with parcels. The land registration is considered complete when the surface area of the city itself and the registered city are identical. Other units such as the properties, streets, glebes, parks, lakes, rivers, and so one. should be abut by one or more registered parcels.

To get a complete picture about the real and the legal situation of a property is not enough just to consult the cadastre. Important information is found in other records, for example, in the Real Estate System Registry, which reports on rights relating to property registered as the owner's name and the historic origin of property. Cadastre and Real State Registry are natural complements, their interconnection, correlating the information to the MC "listed in the Real Estate Registry (IR) is known as the System of Cadastre and Land Registration - Sicart" (fig. 3).

The MC is modeled as a "basic registration", limited to little information as the identification and demarcation of the parcel and a unique and stable identification. Other information (tax, environmental issues, parks, buildings, infrastructure, socioeconomic, and so one), will be recorded in specific registers, theme by theme and linked to the MC. The guideline defines in the Art.5, § 1, that "The register includes a number of thematic information on a topic related to the parcels identified in the MC."

A complete cadastral system, then, has all the basic information for each parcel, interwoven with the Real State Registry, and "n" themed found necessary (fig. 4). This set of data and files are the "Territorial Information System (SIT), which is considered the same as the" Land Information System, which is the English term, used internationally.

The second chapter defines the cadastre as "multipurpose" also including the current functions, like the tributary ones. Then, in the chapter about "Cadastral Mapping" the register is linked to the recommendations to the basic laws of National Mapping, the Brazilian Geodetic System - SGB and the Brazilian Institute of Geography and Statistics -

Fig. 3: Modeling of real property legal and cadastral parcels using.

Fig. 4: Interconnection of information between the MC and thematic data.

IBGE, including established standards for the NSDI (National Infrastructure of Spatial Data).

In Chapter IV, the guidelines define the municipality as responsible for registering and recommending the creation of technical teams qualified for the maintenance and continuous updating of the register. Small towns are recommended to form inter-municipal partnerships for this purpose.

The multipurpose of the register is presented in Chapter V as an evolutionary process and open, gradual integration of various issues and actors, which should occur continuously. Its effectiveness depends on the initial modeling data and especially the concept of detachment of the parcels register in the basic cadastre and thematic ones, which should serve the needs of different users, based on a cartographic representation and a single unique identifier stable for each one of the parcels.

For property evaluation, which information is associated with a specific thematic cadastre, recommendations are made in Chapter VI on the strategies and methods for data collection according to the recommendations of the Brazilian Association of Technical Regulation. That's why in the guidelines it is recommended to upgrade the value map in cycles of four or eight years, depending on the size and dynamic of city's buildings, which will propitiate the knowledge of the actual situation and the future perspectives of the values of properties on the market.

The final chapter (VII) of the guidance in "The Legal Framework and Final Provisions" defines the MC as a system that is under full responsibility of the municipality and is its property. Therefore, is subordinate to the tenet of public administration.

In November 2010 the Guidelines for the Creation, Establishment and Updating of Land Multipurpose Cadastre in Brazilian Municipalities - Manual for Support was published, to give a more detailed interpretation for each of the articles of the guidelines. Its update and reissue is planned to happen whenever necessary.

The Minister of Cities at that time, Marcio Fortes de Almeida, said in the preface of this guide:

"*The registration executed according with these national guidelines is essential for the development of several municipal actions, making feasible the integration of social, economic, legal, physical and environmental data, forming from these data systematized and standardized information for a complete management of the cities, and its sustainable development, encouraging the application of the instruments foreseen in the Statute of the City (Special Zones of Social Interest - ZEIS, created land, surface rights, special adverse urban, urban land use, among others). "... "The publication of this manual is a crucial step to support its dissemination and implementation in the municipalities of Brazil. "* (Fig. 5and 6).

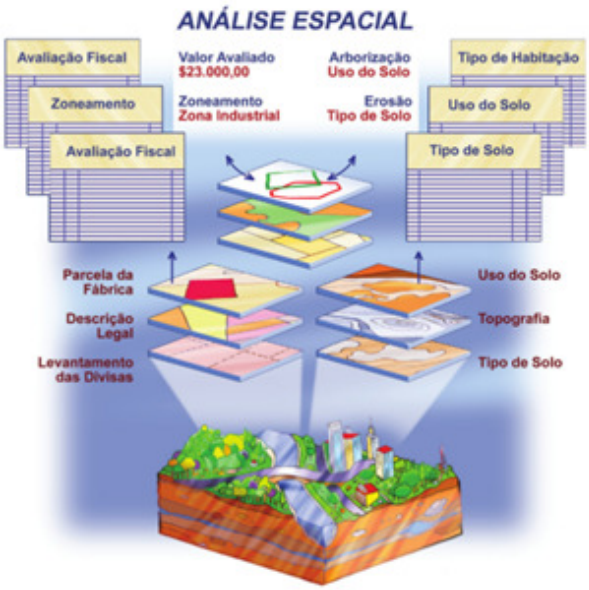

Fig.5: The multipurpose of the Cadastre.

Fig. 6: The 'flag' of the MC.

9. TECHNOLOGY EVOLUTION FOR CADASTRAL DATA AQUISITION

The evolution of the technologies intending to obtain information about the parcels is attached to the evolution of mathematical theories developed over the centuries.

In the field of technology involving topography, the theodolites and precision levers have been widely used for the purpose of obtaining information about the position of points that defines the parcel borders. Over time these equipments were modernized incorporating devices that allowed the determination of points in a more automatically way, as in the case of the electronic levers and laser. Theodolites and levers were replaced by equipment that are "instruments for measuring angles and distances, integrating into one device, an electronic theodolite and an electronic meter away." (Barros, 2001)

In the 70's of the twentieth-century the NAVSTAR / GPS (Satellite Navigation with Time And Ranging) or just GPS was implemented and became one of the most modern positioning systems in use around the world due to it benefits, specially the speed, precision and economy for data acquisition. The survey methods have evolved and vary depending on the model of GPS equipment used and the desired accuracy needed for the data. (Botelho, 2003).

The cartographic production has always been tied to Geodesy and techniques of data collection, whether alphanumeric or graphic. As for Geodesy there have been great advances in recent decades: the improvements in defining the reference ellipsoid, and a new reference ellipsoid for the whole of Latin America: SIRGAS. In the field of remote sensing science, specially the photogrammetric technique is used for cartographic purposes generating maps at different scales, attending to Brazilian legislation about the systematic mapping. Many advances happened in this area in recent decades, changing from the manufacturing equipment and software, to Analytic Photogrammetry, what happened in the early 1980s. In the 1990's the digital Photogrammetry became part of public competition and so the Brazilian companies have begun its investments in this field.

For Loch and Erba (2007), the systematic generation of maps with compatible scale representation to the needs of the cadastre is necessary, on a high-scale representations, which are perfectly obtained by aerial Photogrammetry.

The key issue for a map production for multipurpose cadastre relies in its planning thinking carefully in the features to be represented. The map scales requested, according with Beppler (2007) are the 1:2000 or higher. And according to the cartographic accuracy standards in Brazil, satellite images, even those with high-resolution, do not have the required standard planimetric and altimetric precision. To achieve this standard, the method to be used must be the aerial photography from which the data can be supplemented using data obtained simultaneously for distinct equipments and systems such as aerophotogrametric cameras and laser scanning systems, for example.

In recent visits to aerial survey companies is noticeable that in almost all of them, the digital photogrammetric cameras has become the major technological revolution. It is needed to mention the lack of technical literature with a practical approach to showing users what are the differences between the cameras with shutter that can provide instant scenes, and the new photogrammetric digital cameras available in Brazil with a continuous imaging system, through transverse scans through the flight line. Digital cameras available in Brazil adopt imaging systems with similar principles used in the satellite image, using references of the attitude of the sensors for imaging (EMBRAPA, 2008).

Evaluating the latest aerial digital camera available in the market, there are resolutions on the order of 9 microns, which means that on flights with

altitudes around 1.000 meters, one can arrive at a centimeter ground resolution, with values significantly higher to 60 cm that one can have high-resolution satellites. Allied to development questions related with information technology there is a concern about the professional training to work in the cadastral area. This theme is described in item bellow.

10. PROFESSIONAL TRAINING IN THE CADASTRE FIELD

To begin with is necessary to affirm that, despite some attempt from the government, personal formation in cadastre didn't receive the attention required for centuries in Brazil. At first because Multipurpose Cadastre and Land Registry were considered synonyms, and this area of expertise already have a proper graduation field developed to work at the area: engineers, surveys and cartographers. An amplified vision for cadastre only began in the early 1990s with the creation of a Master's degree in Multipurpose Cadastre at a federal university.

However, a master's degree in itself does not solve the deficit of a long time with no proper training in a particular field, especially in a country with continental dimensions such as Brazil with so many needs in the knowledge area. To illustrate the fact, in its 20 years of existence, that post-graduation area in cadastre formed approximately 150 masters and 25 doctors in this field, which is absolutely meaningless to supply the market needs. Both master and doctor professionals, when living the academy, are absorbed by universities, research institutions, public institutions in general that develops works in this field of knowledge. However federal institutions, state and municipal governments are in need of professionals to fulfill the demands of work in this area.

The area of Multipurpose Cadastre and Territorial Management is a multidisciplinary field. So, the training process involve candidates with diverse graduation such as engineers from many areas (civil, cartographers,...), architects, geographers, geologists, administrators, systems analysts, law professionals, among others. This is a big challenge for students and professors. Observing these range of professionals is possible to understand that not everyone has the same abilities and, despite the training and all the study in the area, they are not able to actually proceed very well in all expertise fields involved in such a wide technical area. But, each one, is prepared to act on its own graduation area with special knowledge in cadastre, which is consistent with the purpose of Multipurpose Cadastre itself that involves the measurement, the legislation and the economic aspects of the land and its parcels.

Once the Brazilian reality is exposed concerning the training of professionals, is necessary to make clear the need in investments is imminent, including graduation and technical courses so that we can effectively provide to this country qualified professionals.

11. MASTER AND DOCTORAL DEGREE IN MULTIPURPOSE CADASTRE- MC

Even in the training process after a while, trying to give support to the social demands for training people in cadastre, a proposal for academic training in a post-graduate level were required, intending to involve professional as students in the academic area to study, discuss and investigate the development of the area in Brazil and worldwide.

11.1 Creating the Master Degree in 1990

In the late 80's, when professors in the Department of Engineering at the Federal University of Santa Catarina were returning from their doctoral programs, the first proposal of a master degree in Multipurpose Cadastre was planed from scratch and became the first one in the area in Brazil and Latin America (Loch, 2007a).

In the beginning it was faced a certain resistance even into the University concerning about the area of knowledge itself. It was an unknown area in scientific circles, especially in the Civil Engineering Department were the curse was placed at the Federal University of Santa Catarina's State (UFSC). Until then the labor market only knew the territorial cadastre with the specific mission of the properties delimitation for territorial taxes purposes.

UFSC's Technology Center was a great partner in this battle. This center already had many graduate courses and related master's and doctoral degrees in several fields of knowledge in engineering and co-related areas, immediately helped the development of the area allowing researches in all interdisciplinary fields related with the Multipurpose Cadastre.

In the early years of the Master's course some problems were happening even in the researchers tem at UFSC. The small number of professors and

laboratory infra-structure resources was also a challenge. Through the approval of research projects was possible to obtain initial funding for integrated projects sponsored by CNPq. After that, was possible to bring international partnerships and, with the arrival of internationally renowned researchers a new perspective began do indicate and the course started its development in research. At that time some German researchers began their participation in a bilateral research project sponsored by CNPq, CAPES, GTZ, and DFG, intending to begin the training of professors and students from both countries. This partnership happens until nowadays and has been extremely productive for the research area of cadastre in Brazil.

The concentration area of "Multipurpose Cadastre" in the Civil Engineering Department at UFSC promoted a revolution among professionals. Until the 1980s the public services concessionaries, public agencies and institutions showed no concern about the fact that each one in purchasing their cadastral products independently. They didn't realize that many of that products could be ordered together and, that they were using, in many situations, the same product to do their tasks. After spreading the idea of a multipurpose cadastre the idea was to make these institutions think about the possibility of purchasing cartographic products that could be used for more than one organism. It made to them look for partners to optimize the individual costs and, in some cases, it was the only way to acquire better quality products that serve to all simultaneously.

11.2 Creating the Doctoral Degree in 2000

According to Loch (2007a) the need for a post-graduation course at the doctoral level was a request that, for many years, professionals from public institutions and professors from Brazilian universities and even from MERCOSUL demanded. It is justified when the problems faced in many countries in Latin America are related with the cadastral area. Most of them have social demands for infra-structure analysis and projects, planning and managing of the cities and, all of it, need cartography and cadastral analysis.

From this demand was created in 2000, the first doctoral course in Multipurpose Cadastre and Territorial Management in Latin America at UFSC. And a group of researchers including professors and students were created to increase the research in cadastre and develop ideas and solutions.

11.3 International Projects in Multipurpose Cadastre

According to Loch (2007b) until the moment had a series of international projects gave support and sustenance to Rural Cadastre in Brazil. In 1984 there was a international congress in the city of Salvador (Bahia State) resulted in internationals partnerships to INCRA (National Institute of Colonization and Territorial Ordering) where it was discussed the needs the rural cadastre in Brazil, giving primary emphasis to the integration of the technical and the legal parts of cadastre.

As an example of partnership it is relevant to expose the state of Parana partnership with the State of Baden-Württemberg in Germany implanting the rural cadastre in a large number of rural municipalities in the south region of that state. The Germans showed the importance in integrating the resources of Geodesy, Topography and Photogrammetry for the generation of the technical part of the cadastral system, which must be integrated into the legal part of it.

It is also valid to register the partnership between several Brazilian Universities: UFSC, UFPE and UFPR, with other German institutions as such as Karlsruhe, Hannover, Aachen, Freiburg and Stuttgart universities, which allowed the development of major advancement in science and technology and especially in the creation of a cadastral mentality in Brazil.

12. FINAL CONSIDERATIONS

In the 1980 decade Brazil has invested large amount of money in cadastral mapping mainly in the Northeast Region of the country. At the same time the CIAT system was created with the intention of generating a series of technical, economic and legal manuals in cadastre for specific purposes, however, at that time it was not possible to accomplish an effective cadastral policy to supply all the social demands, and, that technical manual collection didn't have much participation of the universities. It emphasizes that after the military regime in Brazil, had a small group of professionals who already was working with the value of a multipurpose cadastre, and was aware of its impacts in economic and social development

In order to concentrate the efforts in the cadastral area, after the creation of the pos-graduation curse at UFSC, the concern about

training professionals in the area of knowledge increased and the result was the creation a specific congress for the cadastral area and its related areas that exists until nowadays: The COBRAC.It's a biannual event that had already published about 2.000 articles. It afforded professors from graduation and post-graduation courses to became specialists in the expertise area throughout Brazil, Latin America and Europe. It also allowed Brazil to become known in this field internationally.

The Ministries of Cities and Agrarian Reform are those that most invested in Cadastre in Brazil. In the pasts years the Ministry of Cities in partnership with Caixa Economica Federal (a Brazilian Federal bank) and Lincoln Institute (from USA) has organized a series of events and programs related with training professionals in this field.

It should be clear that the Multipurpose Cadastre is a field of knowledge that can never be separated from the Geodesy and Cartography. It is not possible to imagine projects that requires public investments and management, such as urban and regional planning, environmental management, among others, without cartography and cadastre.

The process training of professionals in MC added with emerging technologies and the expected implementation of public policies intending to implement MC, whether rural or urban, give new perspective for a long time waited, to the formulation of social policies that will improve the quality of life of the population.

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It is also very important to emphasize that, the effort to create and develop the cadastral area, including the post-graduation degree, involves many institutions that also believed in it and could see the importance of the area for Brazil's society evolution.

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