

# EXPERIMENT IN TRAINING MUNICIPAL CIVIL SERVANTS IN FREE GEOPROCESSING SOFTWARES OF BRAZIL

*Experiência no Treinamento de Servidores Públicos Municipais em Software de Geoprocessamento Gratuito no Brasil*

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## RESUMO

Nos anos de 2008 e 2009 realizaram-se cursos de capacitação de funcionários públicos municipais, de trinta e oito prefeituras do Estado de Santa Catarina no Brasil. Isto aconteceu através do programa PROEXT 2007, desenvolvido pelos Ministérios: das Cidades e da Educação, cujo objetivo foi disponibilizar cursos aos funcionários nos temas: sensoriamento remoto, cartografia, sistema de posicionamento global e sistemas de informação. Este artigo tem como objetivo descrever a capacitação ocorrida através de cursos de curta duração, o perfil dos capacitados, funcionários de prefeituras do Estado de Santa Catarina, usuários dos produtos cartográficos produzidos no Brasil. Apresenta-se neste texto uma breve descrição dos softwares utilizados neste programa de capacitação: GeoSNIC, TerraView e TerraSIG, softwares estes desenvolvidos por instituições brasileiras e gratuitamente disponibilizados na internet. Para nivelar o conhecimento técnico dos participantes ministraram-se aulas teóricas iniciando-se posteriormente a prática com os softwares. A heterogeneidade quanto á formação dos estudantes fez com que o curso fosse planejado e executado buscando-se um nivelamento do conteúdo técnico teórico desafiando a equipe executora do projeto. Ao final, os softwares se mostraram uma importante ferramenta para a gestão pública municipal, eficientes em suas funcionalidades se comparados a softwares proprietários.

**Palavras chaves:** Capacitação, Municípios, SIG.

## ABSTRACT

In the years of 2008 and 2009 it was realized a training program to municipal civil servants of thirty eights city halls in the state of Santa Catarina in Brazil. It happened through the PROEXT 2007 program developed by the Cities and Education Ministry with the objective of providing the servants courses of the following subjects: remote sensing, cartography, global positioning system and information systems. This paper has as goal to describe the training applied trough short-time courses, the profile of the students, professionals from Santa Catarina's city halls, users of the cartography products produces in Brazil. It is presented in this paper a brief description of the software used at the course: GeoSNIC, TerraView and TerraSIG, developed by Brazilian institutions and freely made available on the internet. For leveling the technical knowledge of the participants theoretical classes were given with practical ones in sequence to practice the software. The heterogeneity of the previous academic knowledge of the students made the course to be planned and executed seeking for a leveling of the technical content challenging the executor tem of the project. In the end, the software proved to be an important tool to municipal public management, efficient in their functionalities if compared to proprietary software.

**Keywords:** Training, Municipality, GIS.

## 1. INTRODUCTION

Brazil, a country as big as a continent, has five thousands and sixty-four municipalities that are the smallest political-administrative units (IBGE, 2009). Each municipality has to organize and update, a big volume of territorial information due to their constitutional competences and social responsibilities. The information that is managed is extremely important for several sectors of society, public politics and municipal and regional planning are based on this data. Most of them are georeferenced, or, can be geographically located, what makes geoprocessing techniques vital to provide an optimization in the decision making process. It is usual to have professional workers at the city halls with territorial data at hand without training or a proper understanding in cartography or related areas. In small municipalities it can be even precarious having lack of professionals to supply the demand of current activities in all the sectors of municipal public administration.

For that reason, some administrative institutions of the government are discussing a way of training municipal civil servants, providing them the technical conditions for using geoprocessing systems in a more effective and technically correct way.

Due to the concern of developing alternatives to supply the need of working with reliable and free software, The Brazilian Government through its institutions, has developed a public politics of municipal government support. It is a known fact that in the smallest political-administrative unit in Brazil, the municipality, a significant number of data related to its territory (constructions, infra-structure, and even social activities) are produced. As a result of that, the developing of free software of geoprocessing and GIS – Geographic Information System, provides a great contribution as an economical policy instrument for the sustainable development.

In order to bring to the society alternative GIS software the Ministry of the Cities and the Ministry of Education developed the PROEXT 2007 program – Programa de Extensão Universitária. This edition of the program aimed to train the servants of Brazilian municipalities in the subjects related to: remote sensing, cartography, global positioning system and geographic information systems.

This paper describes briefly the software used in the training, the method used to provide the short-time course and analyzes of the background graduation of them, all users of cartography information in some level.

## 2. LITERATURE REVIEW

The use of aerial photography and satellite images are the most known remote sensing products used to generate cartography due to territorial

management. In order to provide the reader of this paper a short description of technical terms is written below.

In the past years, new technologies and tools for acquiring, processing and distribution of local and regional scales, have improved their quality due to the introduction of new sensors, to register environmental data and, the fast advance in software and hardware, automating production makes new data available with alternatives to access and distribution easily understandable to system users (LOCH & ERBA, 2007).

The importance of the theme relies in the advance of the computer technologies allows a public administrator of a municipality to know, with accuracy, where and how to identify and intervene in municipal problems. The easy visualization of geographic data and resources of analysis makes it an important tool in municipal territorial management (ANDRADE et al. 2007).

FARWICK (2002) states that municipal territorial management must, first of all, analyze municipality in a regional context, taking in consideration the migratory aspects, their reasons and effects, once that economical and social segregation leads to urban areas with big housing and environmental issues. The inadequate use of data and information taken through satellite harms, for example, implies in poor geometric quality of cartography products when users use them without following the cartographic basic rules (MÖLLER, 2003).

Considering the exposure above is necessary to think in a way of restrain the indiscriminate generation and use of cartography products with low quality. It can be achieved by training the users that are in this paper case, are municipal civil servants. It is mandatory to the public managers should be able to know the importance of the issue and the implications about not hiring a professional with technical knowledge that are necessary to the county, been able, for example, to analyze a cartographic product received. For that happening is necessary a disseminating of knowledge as a more effective way of training.

For that reason, in order to have a better understanding of the technical terms here mentioned, there is below a brief literature review:

### 2.1 Remote Sensing

It refers to the use of techniques based on instruments to the acquiring and measuring data/information organized in space (geographically speaking), with some properties (related to spectrum, space and physic) about a set of targets where the captured scene corresponds to the faces, objects and materials. This happens due to the application of one or more recording equipments that are not in contact with the target object (NASA, 2009).

The sensors can be categorized through their

characteristics. We are going to consider here the fact they can be: non-imageables (when they do not produce an image of the observed object such as radiometers and spectroradiometers) and imageables (that produce the image of the observed object photographic sensors, microwave sensors, etc.) (LIU, 2007).

The use of remote sensing techniques for data acquisition provides a considerable increase in the quality and quantity of material to be used in territorial investigations. Some phenomena that can occur in some places can be unique in time and space. The remote sensing enables the observation of these phenomena and through the used geoprocessing techniques it is possible to analyze past and present situations, and even make prognostics as well as monitoring of urban floods, urban expansions, etc.

## 2.2 Geoprocessing

Is the association of techniques related to the collecting, storing and treating georeferenced information that can be used to some activities about the geographic space (IBGE, 2009). Geoprocessing embodies, according to most of the authors in the area: digital processing of images, digital cartography and geographic information systems (GIS). Many times it is only associated to the application or proposition of techniques but it must be understood in a more extended concept, since it leads to the understanding of reality from a scientific context (MOURA, 2005).

## 2.3 Geographic Information System - GIS

They are usually accepted as a technology with all the necessary tools to make analysis of territorial data offering through them, the understanding of occupation and use of the geographical space (SILVA, 2003).

It uses for data integration and analysis a range of different remote sensing data such as: satellite images, digital maps of use and soil type, topographic and vegetation maps, social-economical research, etc. In order to achieve the desired goal to some application, it is important the building of a customized database in compatible scales, or in order to offer and make it easy to users the use, restore and manipulation of several data layers. Summarizing, it is possible to say that the structure of a GIS includes: data processing, static and dynamic model built based on space and time dynamic data integration through modeling of physical and mathematical processes (LIU, 2007).

The types of data generated in a database of GIS software are (LIU, 2007):

I) Thematic maps – matricial and vectorial representation;

II) Registration information – georeferenced points with vectorial coordinates and their attributes in database;

III) Nets – form of georeferenced vectorial lines with the topology in bow-tie and its attributes in a database;

IV) Images of remote sensing – georeferenced digital images;

V) Numerical models of the land – DEM in rectangular tables with matricial and vectorial representation and bow-tie topology or isograms or representation without topology.

What distinguishes one GIS of the other in general are the goals which they are designed for, the data inserted in them and the information that is supposed to be extracted from there.

The topic below describes briefly the software used for training the civil municipal servants.

## 3. INTRODUCING THE SOFTWARES USED IN CLASS

The software used in the training courses is freely available on the internet. A brief description of the softwares and their functionalities are described in the topics below. Is not the intention to make a detailed comparison between the functionalities of the free software developed in Brazil and the proprietary ones.

### 3.1 GeoSNIC

The GeoSNIC is a research tool with information of all the municipality and Brazilian states physically represented in a digital atlas with satellite images in high definition and almost eight hundred indicators for all the 5.564 Brazilian municipality. It is available on the internet through one module that allows the alphanumeric and geographic data search by using web standard tools (Figure 2). It's use is possible without the need of installing additional plugins. It is part of the Cities Information National System described as "Development and Implementation of Geographic Information Systems for Analysis and Dissemination of necessary information due to the Implementation of National Politics of Urban Development in the ambit of Cities Information System (SNIC)", developed by Funcate – Foundation of Science, Applications and Territorial Technology. Known as Geosnic, it is a free tool and it stays open for any citizen use. It receives updates and statistics of public managers that, through trainings, are stimulated to contribute to the database update.

Geosnic has in one single management platform several indicators for the use in public and sectorized politics such as urban planning and application of emergence funds. Built with free software and technical support of the United Nations, Geosnic has the characteristics of the Human Development Atlas, Wikipedia and Google Maps – those last ones are collaborative tools already available on the internet that allow content visualization, maps and satellite images for free.

It database includes all Brazilian municipalities and expect them to include updated data. The work space is the Geosnic main page itself available in Ministry of the Cities website. There is possible to make

search to obtain Brazilian municipality information about their territorial and social-economical aspects.

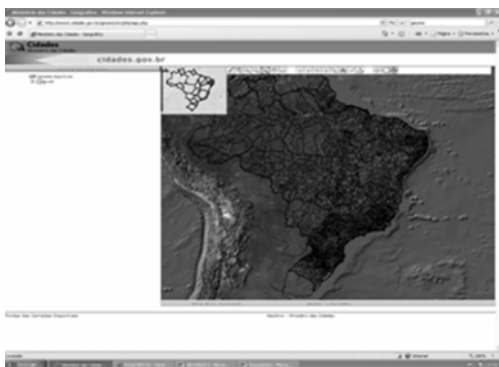


Figure 2 – GeoSNIC Interface. Source: <http://www2.cidades.gov.br/geosnic/src/php/app.php>, 2009

The page is divided in the main areas that are: panel (left side) toolbar (above the map) and visualization area (center, where the map appear). In the panel the presentation control information of the map is shown allowing the user to make configurations.

It is available in the URL: <http://www2.cidades.gov.br/geosnic/src/php/app.php>

### 3.2 TerraView

It is an applicative built by INPE – National Institute of Space Research with the geoprocessing library TerraLib having the following objectives (INPE, 2009):

a) Introduce to the community an easy geographic data visualize with research resources and analysis of them;

b) Give an example of the TerraLib library use.

The software allows the use of vectorial data (points, lines and polygons) and matricial (tables and images), both stored in a RDBMS – Relational Database Management System, including ACCESS, PostgreSQL, MySQL and Oracle. It is freely distributed in <http://www.dpi.inpe.br/terraview/index.php> where the user can access its manual as well as its documentation.

It works with information layers in its main structure, gathering geographic data that are located in the same region by sharing the same set of attributes. Some examples of Information Plans that can be mentioned are: thematic maps (land maps), registration maps of geographic objects (Distrito Federal municipality map) or even matricial data such as satellite images.

It uses geographic data in usual formats such as: Shapefile format, which is used by Environmental Systems Research Institute, Inc. (ESRI) products, MapInfo Interchange File (MID/MIF), MapInfo products, GeoTIFF or JPEG (general format of matricial data).

TerraView has a good interface is very intuitive to be used by an experience user of the Remote Sensing tools. On the other hand, it falls in the edition

and layout creation tools compared with others similar software. It is more indicated for simple analysis and previously edited data. Although constant updates have been made in the program and new versions have been made available in INPE website. Apart from the limitations and initial failures of the system, it is necessary to say that it is free software that works well in many of the functions of the similar proprietary ones whose licenses are, most of the times, ten times more expensive to the government.

### 3.3 TerraSIG

The geographic information system called TerraSIG was developed by Funcate in a partnership with INPE based on (like the TerraView) TerraLib library. TerraSIG functionalities includes visualization, researching, edition and printing tools. It has similar functions to TerraView.

It has a friendly graphic interface with eight components:

a) Menu Bar: allows the access to several functions of the applicative through the menu;

b) Toolbar: shortcut to navigation, zoom, configuration of main window functions among others;

c) Edition Bar: access to edition of vectorial geographic data functions available when it is in edition mode;

d) Layout Bar: access to printing layout creation available when in printing layout mode;

e) Database tree: area where the database is shown when they are connected and its respective information plans. Only one database can be active a time.

f) View tree: it shows the active database and its respective themes.

g) Visualization area: presentation area of the selected themes for visualization;

h) Active theme table: it shows the alphanumeric attributes of the object active theme.

The software is available for downloading at <http://www.cidades.gov.br/capacitacao-1/proext/insic-material-de-apoio-as-universidades/cd/software>.

## 4. THE TRAINING PROCESS

The development of a training course is made of several activities. The theory to be taught was already defined by the Ministry of the Cities: Fundamentals of Cartography, Remote Sensing, Geographic Information Systems and Global Positioning System. The work started programming the way the subjects would be presented in order to organize the necessary time for expositive classes and planning the practice with the softwares: GeoSNIC, TerraView and TerraSIG. It was also necessary to make evaluations about the presented and acquired content of the course and all of it in 36 hours. Each one of the subjects was presented by an instructor/teacher and the software presented through the use of a computer with multimedia projector. The

next phase was the enrolment process for the course. In the PROEXT 2007 edictal the selected city hall are from the South Region of the Santa Catarina's State and Florianópolis nearby, what represents a total of sixty five political-administrative units. In an attempt to obtain the employees attention, and make them aware of the importance of this training course printed invitations were sent, also via email and phone calls to get contact with the potential students. This phase of the process also had the support of the Ministry of the Cities that send documents reinforcing the importance of having everybody's participation in the event.

The municipalities invited to the training process were: Águas Mornas, Angelina, Armazém, Balneário Arroio do Silva, Balneário Gaivota, Braço do Norte, Canelinha, Cocal do Sul, Ermo, Florianópolis, Garopaba, Grão Para, Gravatal, Imarui, Jacinto Machado, Major Gercino, Morro da Fumaça, Morro Grande, Nova Trento, Nova Veneza, Palhoça, Praia Grande, Rancho Queimado, Rio Fortuna, Santa Rosa de Lima, Santo Amaro da Imperatriz, São João Batista, São João do Sul, São Ludgero, Siderópolis, Sombrio, Tijucas, Timbé do Sul, Treze de Maio, Turvo.

#### 4.1 Training Preparation

The training activities were developed in order to build knowledge in the following subjects:

- 1) Cartography and Remote Sensing;
- 2) TerraView software;
- 3) TerraSIG software;
- 4) GeoSNIC software;
- 5) GPS technique.

To reach the knowledge seek it was necessary to achieve this goals:

- 1) Learn how to use TerraView, Terra SIG, GeoSNIC and GPS;
- 2) Prepare and train city hall servants;
- 3) Incentivate the use of the software by the students;
- 4) Extend the relation between University and community.

The preparation activities of the course were:

- I) Study of the support manuals and bibliography, development of the technique text content;
- II) Preparation of the training classes taught by the project team;
- III) Preparation of the enrolments: it refers to the development of the enrolment form, mailing invitation letters to the city halls, colleting and confirmation of the participants;
- IV) Teaching classes: the classes occurred in two phases: one theoretical and another practical. Each phase consisted in three classes' days;

V) Course evaluation: it happened through filling the forms given by the students in the last day of class and also via email for those who couldn't fill them in immediately.

VI) Reports production: it refers to the filling of the forms sent by PROEXT 2007.

In order to organize the material for the course and the form of content presentation it was necessary to know the participants profile. For that reason an enrolment form was developed where the participant should write some personal information and answer 4 (four) questions about his previous knowledge about the content of the course. The questions were related with cartography, remote sensing, GIS – Geographic Information System and cadastre. Analyzing these forms it was realized that about seventy three percent of the participants did not have previous knowledge in remote sensing, sixty seven percent had knowledge in cadastre and fifty seven percent had knowledge in cartography (figure 1).

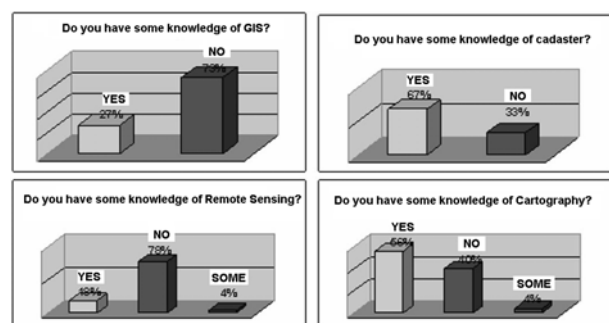


Figure 1 – Graphics indicating the previous knowledge of the students in the areas below. Source: own data taken from enrolment forms.

The educational background of the students is very diverse: civil engineers, edification technician, geographers, agronomy engineers, accountants, topographers among others.

Having all this information it was possible to develop educational material aiming to level the participants knowledge, it means that the theoretical classes should use a simple vocabulary and basically explain the technical fundaments.

The theoretical explanation of the content and the use of the software that occurred among the days 28 to 30/07/2008 and 04 to 06/08/2009, with 36 hours of instruction. It was developed as planned, even though the edictal goal of the project was training at least forty of sixty-five city halls that were invited in the edictal. At first thirty of the sixty-five city halls enrolled and sent fifty nine participants. To complete the minimum number of forty trained municipality, it was necessary to plan a second phase that happened between 07 and 10/07/2009, with 38 instruction hours. The training process was repeated, having some aspects improved according to the experience of the group. It was necessary to bring new participants that couldn't make it in the first phase of the course having twenty new students to participate.

In the first module the theoretical content was presented by the instructors through slides and in the second module, after the students had received the necessary theory they started the practice with GPS

equipment outdoors. To make the practical classes was necessary to use a standard database given by Ministry of the Cities, but during the course, the county of Maracajá/SC brought its data along and allowed the use the cartography base digitally and satellite images. That contribution to the course made a closer connection between the content and the reality of the cities represented there.

The cartography base of Maracajá is in dxf format was imported and converted into shapefiles, manipulated in TerraView intending to show all the functionalities of these software. The quickbird image of the county was also imported for the database, exploring the potential of the linking of the vectorial files with the raster files. In TerraSIG possibilities of layout generation were seen and data representation were treated being prepared for printing.

## 5. CHALLENGES AND ACHIEVEMENTS

During the project, from December 2007 to August 2009, seventy nine professionals from Santa Catarina city halls were trained. The goal of sharing the theoretical and practical knowledge was achieved, even though the course public was very heterogeneous but, in a way, it was already expected to have students with different knowledge backgrounds due to the multipurpose applicability of the software presented during the course.

Inside a municipality city hall there are many areas that can benefit from a geoprocessing structure and GIS: urban planning, taxation, construction, inspection, among others, it explanation raised the interest of participants. At the end many students said that would recommend the training process their co-workers.

It was observed that students with higher educational level in areas related to the ones in the course, contributed positively to the classes by sharing their professional experiences during the training with other professionals with similar interests and no previous knowledge at cadastre, cartography, remote sensing or GIS that had some difficulties in following the course. The lack of technical knowledge made the initial development of the course slow and heavy to those with experience in related areas. When the introduction in GIS software started, some students were exhausted, and had low productivity.

To reach the end of the project with the confidence of achieving the planned objectives it took a long way. Some obstacles needed to be overcome. It was necessary to insist on sending invitations to the municipalities that not send participants through conventional mail as well as electronic mail, and to make phone calls to each one of the municipality in an attempt to explain and motivate the employees to take part of the training. Also the Ministry of the Cities throughout the university, contacted the municipalities by mailing the documents describing all the details of the course such as: place, date and time of the training.

In the beginning all the municipalities showed interest and committed to send their employees but when the time has come not all of them did it. Apparently the city halls showed some lack of interest in sending their employees to the training in Florianópolis, the capital city of Santa Catarina's State.

The project team insisted in keeping this contact by calling the city halls that hadn't sent the participants to the course, but the answers were negative. They affirmed that didn't have any professional available to take their classes or that they would return with answers closer to the date, but nothing was really done about it. The phone calls were the most effective way to make the contact. It was necessary that a person of the training team committed to the calls, with the intention to convince the employees of the importance of the training stopped the training preparation to make their professional activities. After having them in class, the challenge was keep everybody's attention in an extremely technical subject (Figure 3).

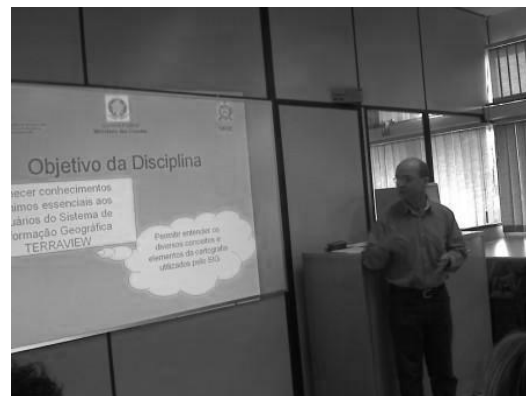


Figure 3 – Class with theoretical content. Source: personal files, 2009

One of the challenges in the first edition of the course in 2008, was the lack of computers to provide the software classes making the instructors unsatisfied with the performance of their activities. At that time the solution was asking those students who had laptop computers, to bring them to class handing them cds containing the softwares to be installed in their personal computers. About thirty percent of the students brought their computers and the other classmates were able to follow as a group step by step the development of the works. It was the biggest complain of the students in the evaluation form of the course the absence of enough computers. In the second edition of the course in 2009, with a smaller number of students, it was possible the available computers for the practical classes with the softwares. There were two students per computer a better condition to the instructors as well as to the students (Figure 4).



Figure 4 – Practical class with computers in phase II of the project. Source: personal files, 2009

In two editions the training team had trained employees of these municipalities: Alfredo Wagner, Anitápolis, Antonio Carlos, Araranguá, Armazém, Balneário Gaivota, Biguaçu, Capivari de Baixo, Criciúma, Florianópolis, Forquilha, Içara, Laguna, Governador Celso Ramos, Içara, Imbituba, Jaguaruna, Lauro Muller, Leoberto Leal, Meleiro, Maracajá, Orleans, Palhoça, Passo de Torres, Paulo Lopes, Pedras Grandes, Sangão, Santa Rosa do Sul, São Bonifácio, São João Batista, São José, São Ludgero, São Martinho, São Pedro de Alcântara, Sombrio, Treviso, Tubarão, Urussanga (Figure 5).



Figure 5 – Location of the trained municipality. Source: own use of the territorial data taken from the website [www.ibge.gov.br](http://www.ibge.gov.br)

## 6. RESULTS AND DISCUSSION

Preparing training courses to municipalities in Brazil involves a range of activities that all together will take the trained professionals to a new level of understanding in cartography, geoprocessing, GIS and related area.

In this experienced project the training was focused at the use of GeoSNIC, TerraSIG and TerraView softwares showing the free softwares have been developed to help managing the information concerning to the territory.

The training process is not simple. When it comes to Brazilian city halls, some conditions should be taken in account when planning activities of a course like that. First of all, not all the city halls have professionals that work at the technical area covered in this course. In most cases the professionals sent to the training don't have compatible knowledge background with geoprocessing and cartography area and have even

heard any of the technique terms used making necessary to start the training with basic theoretical classes with the objective of leveling the students.

The difficult in talking the city hall managers through the importance of sending the employees to the training, is also an obstacle to be overcome. It was only possible to obtain positive answers through frequent phone calls in an attempt to touch them, about the importance and opportunity offered by that course. Apparently the difficulties on sending their employees remains in the lack of financial means to transport and maintain them in another city or the lack of a person to replace the missing employee at work.

The students that were present there showed great interest in taking part of new courses. Many of them demonstrated the need of constant training and continuous recycling, with the objective of improving their professional career and the provided training was a way to reach that a little bit more but a lot still needs to be done.

The softwares proved to be very efficient in the basic functionalities if compared to proprietary software, which need paid licenses. This give to the city halls a great opportunity specially the small ones that do not have financial resources to buy and keep an information system based on proprietary software.

The text and visual aid used in the course proved to be adequate and complete to its objective after having small changes made by the project team to adapt to the information level desired to be shared with the students.

It was proved to be necessary that the professionals indicated to the course by the city halls, should be the ones working in departments related to geoprocessing and cartography in order to obtain the expected results. In case it is not possible to send employees from those department, it is suggested to divide candidates in classes by knowledge background areas to achieve the expected results.

The course was a big opportunity to get close and integrate the training coach team to the municipality of Florianópolis nearby and Santa Catarina's south regions, opening an important interaction channel. As an example it is possible to mention the presentation and discussion of a real case, the county of Maracajá, located in the south of Santa Catarina's State. That municipality received, as well as others from the region, cartographic products as a compensatory act of the companies involved in the duplication of the federal highway BR101 that fact raised even more the interest of the participants.

To conclude it was observed the importance of a more effective divulgation along with the municipalities by the Ministry of the Cities that are part of GeoSNIC, TerraSIG and TerraView programs in a way to increase their interest and more important, to incentivate the use. The lack of knowledge by municipal executive power was probably, the main reason for the lack of interest detected in the beginning of the training.

Despite all the training it was discussed in class that the implementation and maintenance of the system in the respective municipality will only be possible if there is an internal policy of implementation of it.

It is suggested a more incisive institutional campaign made by federal government focused on bringing to the attention of the public managers, the need of professional training of their employees as well as the need about contracting specialized professionals in cartography or related area. Investing on that is the only way to be able to provide to the society good quality public services by giving the population the expected feedback of the tax payments and showing transparency in the use of govern finances.

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