



# **NORTH TECHNICAL UNIVERSITY**

**FACULTY OF ENGINEERING IN APPLIED SCIENCES**

**CAREER OF ENGINEERING IN COMPUTER SYSTEMS**

## **ARTICLE**

## **ENGLISH**

### **TOPIC**

**“STUDY AND IMPLEMENTATION OF A SYSTEM GIS WEB FOR THE SYSTEM OF AVALUOS AND CADASTERS OF THE ILLUSTRIOUS MUNICIPALITY OF IBARRA”**

### **APPLICATION**

**“SYSTEM GIS FOR THE REGULATED AREA OF THE CANTON OF IBARRA”**

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Ibarra – Ecuador

## EXECUTIVE SUMMARY

The present document details all the processes that were continued for the development of the System GIS for the regulated area of Ibarra (GIS IMI); for the System of Cadasters and Avaluos of the Illustrious Municipality of Ibarra.

In the elaboration and development of the System GIS IMI, the document presents five chapters. In each one it is detailed the processes, methodologies and concepts that will serve as help in the course of the elaboration of the System.

In the chapter one, a description is made subsequently from the institution to which leaves to apply the system, in the chapter two main concepts they are detailed that they are involved and they are necessary to know in the development of the application.

In the chapter three, are carried out an analysis of the tools for the development of the system and it is selected the most advisable according to the architecture to outline.

The chapter four are developed through the phases of the software methodology XP (Extreme Programming), being this one of those more used by the bosses of projects. Lastly in the chapter five the conclusions are

detailed those that you has ended up when carrying out the System.

# CHAPTER I

## 1. INTRODUCTION

### 1.1. Antecedents

The Illustrious Municipality of Ibarra is a public Institution that has as mission to Plan, to regulate, to execute and to promote the sustainable integral development of the canton of Ibarra, through efficient and transparent services of quality with the active participation of the citizenship socially in order to achieve a good one to live.

The cadastral information, especially the one referred to the value of the surface of the inhabited areas, is a fact more associated to the territorial entities and therefore, it is in susceptible principle of being negotiated by Systems of Geographical Information.

The Systems GIS facilitates the connection of geographical information with descriptive information. Contrary to a traditional map, a GIS can present on the map of a certain region, in way interactive, several layers that you/they overcome and that they contain thematic information; for example, have

more than enough natural resources, human establishments, education, transport, health, agriculture, geology, etc.

## **1.2. Base Legal of the Institution.**

### **1.2.1. Mission of IMI.**

The municipality of Ibarra plans, it regulates, it executes and it promotes the sustainable integral development of the canton, through efficient and transparent services of quality with the active participation of the socially responsible citizenship in order to achieve the good one to live.

### **1.2.2. Vision of IMI.**

We will be a municipality leader in administration with social responsibility that guarantees justness, honesty, work and efficiency why Ibarra is constituted in a prosperous canton, attractiveness and incluyente, capital of the services and the knowledge, relating of the good one to live in the north region of the Ecuador.

## **1.3. Problem.**

At the present time the Municipality of Ibarra has a system GIS, in which the space information is managed through plane files, making these that the consultations of properties and analysis of the geographical information are slow and difficult, the access

of the users is not also concurrent and it is limited alone to the local net of the Municipality.

The System GIS at the moment works in a desk environment through a control called X it Activates MapObject and Visual Basic, that which limits its yield a lot since all the geographical information is managed through shapefiles.

## **1.4. Objectives.**

### **1.4.1. General Objective.**

To implement a System of Geographical Information Web that allows the interaction with the System of Cadasters and Evaluations of the Municipality of Ibarra, of quick access and attendee for the users.

# CHAPTER II

## **2. THEORETICAL MARCO.**

### **2.1. System of Geographical Information.**

A GIS can be defined as a software group, hardware, methodologies, data and people (users), perfectly integrated, so that ago possible the gathering, storage, prosecution and analysis of data georeferenciados, as

well as the production of information of its application, with the purpose of solving administration problems and of planning. [Lib.01]

## 2.2. Exchange of Space data in the Web.

### 2.2.1. The Open Geospatial Consortium OGC.

The OGC (Open Geospatial Consortium) she is born in 1994, it is an international organization without ends of lucre, integrated by companies, public organisms and Universities, in a consent process for the definition of open standards and interoperables inside the Systems of Geographical Information and of the World Wide Web, looking for agreements that facilitate the interoperación of geoprocetamiento systems and to facilitate the exchange of the geographical information.

### 2.2.2. Languages of Marked.

A language of marked is a form of coding a document that together with the text, it incorporates labels or marks that contain additional information about the structure of the text or its presentation. As: XML, HTML, GML, KML, SVG and GeoRSS.

### 2.2.3. Formatos Vectoriales.

They are formats for code of a variety of structures of expressed geographical data in a vectorial way. As: GeoJSON and WKT.

### 2.2.4. OGC Web Services (OWS).

The OWS is specifications of standard international for the OGC for the use of the geographical information through the Web. It is the generic name with which all the standard OGC groups Web Services (WMS, WFS, WCS, CSW, WPS, etc.). [Lib.02]

#### 2.2.4.1. WMS (Web Map Services).

The service Web Map Services interactúa with the clients through petitions HTTP, produces maps indexed spacely in a dynamic way, starting from geographical information. These maps are correspondents to the clients in form of digital image.

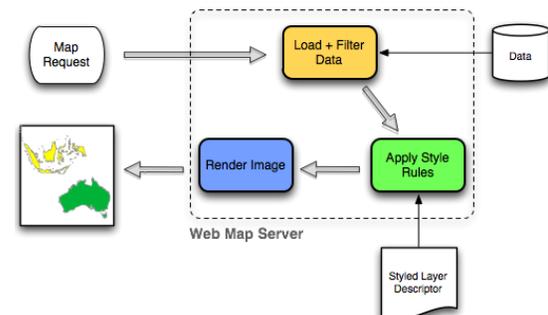


Figure 1 OCG WMS  
Source: [www.01]

#### 2.2.4.2. WFS (Web Features Services).

WFS provides an interface that allows the client to obtain and to upgrade data georeferenciados by means of the format GML of multiple servants WFS using the protocol HTTP. It allows to consent to

vectorial data and to consult all the attributes of a phenomenon (feature) geographical.

Through these interfaces it can combine, to use and to manipulate the information that is behind the maps by means of the invocation of operations WFS on the geographical elements.

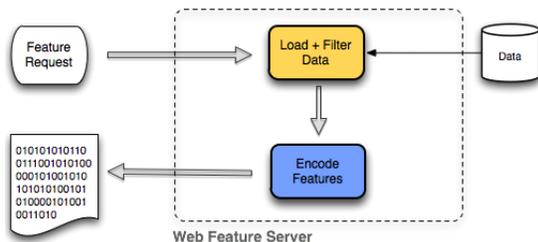


Figure 2 OGC WFS  
Source: [www.01]

### 2.2.4.3. WCS (Web Coverage Service).

It defines the interface and operations that allow the access interoperable to "coverages" geoespaciales, the term refers to content as: images satelitales, air pictures, digital models of elevation (DEM), and any space phenomenon represented by values in each measure point. [Lib.03]

## 2.3. Database.

### 2.3.1. Relational Database.

#### 2.3.1.1. PostgreSQL.

It is a system of database administration object-relational, since it includes characteristic of orientation to objects, as inheritance, types of data, functions, restrictions, triggers, rules and transactional

integrity. PostgreSQL is characterized to be a stable system, of high yield, great flexibility since works in most of the operating systems.

PostgreSQL uses a model client servant and it uses multiprocesos to guarantee the stability of the system, a failure in one of the processes won't affect the rest and the system continued working.

### 2.3.2. Spatial Database.

#### 2.3.2.1. PostGIS.

It is a module that he adds support of geographical objects to the database object-relacional PostgreSQL, transforming it into a space database for their use in GIS.

Their implementation is based on geometries and optimized slight indexes, to reduce the disk use and memory.

## 2.4. Servers of Applications.

### 2.4.1. HTTP Apache.

It is a servant web HTTP of open code, for platforms Unix (BSD, GNU/Linux, etc.), Microsoft Windows, Macintosh and other that implements the protocol HTTP/1.1 and the notion of virtual place. [www.02]

### 2.4.2. Tomcat.

It works as a servlets container developed under the project Jakarta in the Apache

Software Foundation. Tomcat implements the specifications of the servlets and of JavaServer Pages (JSP) of Sun Microsystems. It works in any operating system that has the virtual machine Java. [www.03]

## **2.5. Languages of Programming.**

### **2.5.1. CSS.**

It is a language used to control the aspect or presentation of the defined electronic documents with HTML and XHTML. CSS is the best form of separating the contents and its presentation and it is indispensable to create pages complex web. [www.04]

### **2.5.2. PHP.**

It is an interpreted programming language (Language of high yield), designed originally for the creation of pages dynamic web. It is used mainly for the interpretation on the side of the servant (server-side scripting). [www.05]

### **2.5.3. JAVASCRIPT.**

It is an interpreted programming language, dialect of the standard ECMAScript. He is defined as guided to prototypes, imperative, weakly tipado and dynamic, developed to increase the functionalities of the language HTML. [www.06]

### **2.5.4. PHP MAPSCRIPT.**

It is a module to enlarge functionalities to PHP so that he works with MapServer. This module will allow him to use the language of scripting of great reach of PHP to create and to modify in a dynamic way the images of map of MapServer. [www.07]

### **2.5.5. MAPFILE.**

It is the main file of configuration of MapServer. It is a text file, with extension ".map", in that a series of parameters is included which define the available layers in the service, the style with which they will be represented, its simbología in that format will be generated the image, the reference system, etc. [www.08]

## **2.6. FRAMEWORKS**

It is a conceptual and technological structure of defined support, usually with devices or concrete software modules, with base to which another software project can be more easily organized and developed. [www.09]

### **2.6.1. Symfony 1.16.**

It is a framework PHP that facilitates and it optimizes the development of the applications web. Symfony takes charge of all the common and boring aspects of the applications web, letting the programmer to be devoted to contribute value developing the unique characteristics of each project. Symfony separates the business logic, the servant logic and the presentation of the application web. [www.10]

### **2.6.2. Doctrine.**

Doctrine is a mapeador of object-relacional (ORM) written in PHP that provides a layer of persistence for objects PHP. It is a layer of abstraction that is located exactly above a SGBD. [www.11]

### **2.6.3. Ext JS.**

It is a library of JavaScript for the development of applications interactive web

using technologies like AJAX, DHTML and DOM. It was developed by Sencha. [www.12]

## **2.7. Methodology of Extreme Programming XP.**

### **2.7.1. Definition.**

It is an agile methodology based on four principles: simplicity, communication, feedback and value. Also guided by tests and refactorización; the tests are designed before programs the functionality, the programmer believes their own unit test. Xp looks for the client's satisfaction trying to maintain during the whole time its trust in the product.

### **2.7.2. Activities.**

#### **2.7.2.1. To Code.**

It is necessary to code and to capture our ideas through the code.

#### **2.7.2.2. To Make Tests.**

The tests give the opportunity to know if that implemented is it that in fact one had in mind. The tests indicate us that our work works, when we cannot think of any test that can originate a failure in our system, then we will have ended up completely.

#### **2.7.2.3. To Listen.**

We have to listen our clients which the problems of their business are, we should have one he listens active explaining what is

easy and difficult of obtaining, and the feedback between both helps us to all to understand the problems.

### **2.7.2.4. To Design.**

The design believes a structure that organizes the logic of the system, a good design it allows that the system grows with changes in a single place. The designs should be simple, if in some part of the system it is of complex development, that adapted is to divide it in several. If there are shortcomings in the design or bad designs, these they should be corrected as soon as possible.

### **2.7.3. Cycle of Life.**

The cycle of life of XP is emphasized in the character iterativo and incremental of the development, a development iteration is a period of time in which is carried out a group of certain functionalities that you/they correspond to a group of user's histories in the case of XP.

The iterations are relatively short since it is thought that among quicker he is given developments to the client, more feedback he will obtain and this will represent a better quality of the long term product. A phase of initial analysis guided to program the development iterations exists and each iteration includes design, code and tests. [www.13]

### **2.7.4. Phases.**

#### **2.7.4.1. Phase of Exploration.**

In this phase she is defined the reach of the project. The client details what needs by

means of the writing of simple Histories of User. The programmers estimate the times of development based on this information.

It should be clear that the estimates carried out in this phase are primary, and they could vary when it is analyzed more in detail in each iteración.

This hard phase typically a couple of weeks, and the result is a general vision of the system. [www.13]

#### **2.7.4.2. Phase of Planning.**

The phase of planning is a short phase, in which the client, the managers and the group of developers agree the order in that user's histories should be implemented, and, associated to these, the deliveries. The result of this phase is the plan of Deliveries. [www.14]

#### **2.7.4.3. Phase of Iteration.**

This is the main phase in the cycle of development of XP. The functionalities are developed in this phase, generating at the end of each an a deliverable one functional that implements user's histories assigned to the iteration. The iterations are also used to measure the progress of the project. An iteration finishes without errors it is a clear measure of advance. [www.13]

#### **2.7.4.4. Phase of Production.**

It requires tests and extra confirmation of the operation of the system before this you can liberate the client. In this phase, the new changes can still be opposing and he should take the decision of if it is included or not in the one rereads you current. [www.13]

### **2.7.5. Devices.**

#### **2.7.5.1. Histories of User.**

It represents a brief description of the behavior of the system, it uses the client's terminology without technical language, one is carried out for each main characteristic of the system, they are used to make estimates of time and for the plan of deliveries, they replace a great document of requirements and they preside over the creation of the tests of acceptance. [www.14]

#### **2.7.5.2. Tasks of Engineering.**

The engineering tasks are used to describe the tasks that are carried out on the project. The tasks can be: I develop, correction, improves, etc.

These tasks have relationship with user's history; it is specified the beginning date and end of the task, it is named the responsible programmer of completing it and we describe that it is to make in the task. [www.15]

#### **2.7.5.3. Cases of Test of Acceptance.**

It allows to confirm that the history has been implemented correctly. [www.15]

#### **2.7.5.4. Card CRC.**

These cards are divided in three sections that the information of the name of the class, their responsibilities and their collaborators contain. In them the design of the system is expressed. [www.15]

## 2.8. Some Definitions.

### 2.8.1. Server of Maps.

A servant of maps, good known for their initials IMS (Internet Map Server) it provides maps or cartography through the Internet, facilitating the process of publication of up-to-date Geographical Information, in real time and cheaper form to any part of the world. [www.16].

### 2.8.2. Clients Light GIS.

A slight client for GIS is an application in Internet with which we can visualize and to treat the Geographical Information through some basic tools of manipulation, sailing and analysis. [www.17]

### 2.8.3. Client Heavy GIS.

It is denominated heavy client to the program "client" of an architecture client-servant when the biggest computation load is displaced toward the computer that executes this program. The program client is qualified as heavy when it assumes most of the functionalities. [www.18]

### 2.8.4. Norma ISO 19110: Methodology for the creation of catalog of phenomena.

The ISO 19110 provide a normative mark to organize and to disclose the classification of phenomena of the real world, associated to a relative location to the earth.

It specifies as the classification of phenomena he is organized in a catalog that is presented to the users, in the form of a group of geographical data, and it defines

the methodology to classify diverse types of phenomena.

# CHAPTER III

## 3. STUDY OF TOOLS GIS - OPEN SOURCE.

### 3.1. Open Source.

It is the term with which one knows to the distributed software and developed freely. The open code has a point of view more guided to the practical benefits of sharing the code that to the ethical and moral questions which highlight in the call Free software. [www.19].

### 3.2. Free software.

The free software, it is the denomination of the software that respects the freedom of the users on their acquired product and, therefore, once obtained it can be used, copied, studied, modified, and redistributed freely.

### 3.3. Servers of Maps.

#### 3.3.1. Square of Compatibility.

Server	Server OWS
Deegree	WMS, WFS, WCS, WFS -T
GeoServer	WMS, WFS, WFS-T, WCS

MapGuide	WMS, WFS
MapServer	WMS, WFS, WCS
QGIS Server	WMS

Square 2 Comparative of Server of Maps, Square of Compatibility

Source: Thesis (Summary)

### 3.3.2. Square of Technical Characteristics.

Server	Platform
Deegree	Windows, Linux.
GeoServer	Windows, Linux, Mac
MapGuide	Windows, Linux
MapServer	Windows, Linux, Mac, Solaris
QGIS Server	Windows, Linux, MacOSX

Square 2 Comparative of Server of Maps, Square of Technical Characteristics.

Source: Thesis (Summary)

### 3.3.3. Square of Functionalities and Characteristic Main.

Server	Thematic maps	Symbol
Deegree	SI	SI
GeoServer	SI	SI
MapGuide	SI	SI
MapServer	SI	SI
QGIS Server	SI	SI

Square 3 Comparative of Server of Maps, Square of Functionalities and Characteristic Main.

Source: Thesis (Resumen)

### 3.3.4. Selection of Tool.

It has been selected MapServer like servant of services WMS, WCS and WFS, for the following reasons:

- It is developed in C, reason why it is quicker to the renderizar moment a map.
- He has a module in PHP (MapScript), for the biggest control and generation of dynamic configurations (MapFiles).
- It has simbología through regular expressions and SLD.
- It is compatible with most of databases geoespaciales and formats of vectorial information and raster.

Also, it was used GeoServer like servant of services WFS-T, to be slighter than Deegree, since it is both the only servants that offer this service. It is also compatible with GeoExt and OpenLayers.

## 3.4. Clients Light GIS.

### 3.4.1. Square of Compatibility.

Client	Client OWS
Geomajas	WMS, WFS, WFS – T
Mapbender	WMS, WFS-T
GeoExt	WMS, WFS, WFS-T, WCS
MapFish	WMS, WFS
OpenLayers	WMS, WFS, WCS, WFS-T
GeoMoose	WMS, WFS

Square 4 Comparative of Clients Light GIS, Square of Compatibility.

Source: Thesis (Summary)

### 3.4.2. Square of Technical Characteristics.

Client	Language Programming
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Geomajas	Language: Java, Api: GWT (Google Web Toolkit)
Mapbender	Language: PHP, JavaScript. Api: JQuery y JQuery UI.
GeoExt	Language: Javascript
MapFish	Language: Java, Javascript, PHP, Python. Framework: Ext JS, Openlayers y GeoExt.
OpenLayers	Language: Javascript.
GeoMoose	Language: JavaScript, PHP.

Square 5 Comparative of Clients Light GIS, Square of Technical Characteristics  
Source: Thesis (Summary)

### 3.4.3. Square of Functionalities and Characteristic Main.

Client	Other clients' dependences
Geomajas	NO
Mapbender	-
GeoExt	OpenLayers
MapFish	Openlayers y GeoExt.
OpenLayers	NO
GeoMoose	Openlayers

Square 6 Comparative of Clients Light GIS, Square of Functionalities and Characteristic Main.  
Source: Thesis (Summary)

### 3.4.4. Selection of Tool.

It has been selected as slight client to OpenLayers, for the following reasons:

- It is compatible with most of formats of marked and vectorial guided to the web.
- The standard necessary OGC supports WMS, WFS, WCS, WFS-T, SLD, GML, KML.

- It allows renderización SVG.
- He is not only a slight client, but rather it is also an API that helps to the development of applications more complex GIS.
- Compatible with GeoExt and ExtJS.

GeoExt was also used like:

- Store of geographical data, for indexar a graph with their information.
- Control Rich in GIS.

## 3.5. Clients Heavy GIS.

### 3.5.1. Square of Compatibility.

Client	Source of Data and Formats
GvSIG	<ul style="list-style-type: none"> <li>• Ráster: ecw, ENVI hdr, ERDAS img, (Geo)TIFF.</li> <li>• Vectorial &amp; CAD: shapefile, GML, KML, DGN, DXF, DWG.</li> <li>• Spatial Database: PostGIS, MySQL, Oracle, ArcSDE.</li> <li>• Remote Data: ECWP, ArcIMS, estándares OGC.</li> </ul>
GRASS	<ul style="list-style-type: none"> <li>• Ráster: PNG, TIFF.</li> <li>• Vectorial: SVG, DXF.</li> <li>• Spatial Database: SQLite, PostgreSQL.</li> </ul>
Kosmo Desktop	<ul style="list-style-type: none"> <li>• Ráster: ECW, MrSID, Tiff, JPG, GIF, PNG, BMP.</li> <li>• Vectorial: Shapefiles,</li> </ul>

	<p>GML, DXF, DWG, DGN, CSV (por extensión).</p> <ul style="list-style-type: none"> <li>• Spatial Database: PostGIS, Oracle, MySQL.</li> </ul>
OpenJump	<ul style="list-style-type: none"> <li>• Ráster: ECW, MrSID, JPG, TIFF, MIF.</li> <li>• Vectorial: Shapefiles, GML, DXF.</li> <li>• Spatial Database: Postgis, ArcSDE, Oracle y MySQL.</li> </ul>
Quamtum GIS	<ul style="list-style-type: none"> <li>• Ráster: Tif, png</li> <li>• Vectorial: shapefiles, MapInfo, SDTS y GML.</li> <li>• Spatial Database: Postgis.</li> </ul>
Udig	<ul style="list-style-type: none"> <li>• Ráster: ECW, MrSID, JPEG, PNG, TIFF.</li> <li>• Vectorial: Shapefiles.</li> <li>• Spatial Database: ArcSDE, Oracle, DB2, Postgis.</li> </ul>

Square 7 Comparative of Clients Heavy GIS, Square of Compatibility.  
Source: Thesis (Summary)

### 3.5.2. Square of Technical Characteristics.

Client	Platforms
GvSIG	Windows, Linux, MacOS X
GRASS	Windows, Linux, MacOS X
Kosmo Desktop	Windows, Linux
OpenJump	Windows, Linux, Mac, Unix
Quamtum GIS	Windows, Linux, Mac, Unix

Udig	Windows, Linux, Mac
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Square 8 Comparative of Clients Heavy GIS, Square of Technical Characteristics.  
Source: Thesis (Summary)

### 3.5.3. Square of Functionalities and Characteristic Main.

Client	Export of vectorial information to Postgis.
GvSIG	SI
GRASS	SI
Kosmo Desktop	SI
OpenJump	NO
Quamtum GIS	SI (Plugin Spit)
Udig	NO

Square 9 Comparative of Clients Heavy GIS, Square of Functionalities and Characteristic Main.  
Source: Thesis (Resumen)

### 3.5.4. Selection of Tools.

According to the benefits of these tools it has been chosen to the tools to be used in the following way:

GvSIG: For migration of data from the Shape to the database PostGIS, since this tool immigration authorities the data just as it is in the file shape without altering the attributes, it also follows the standard: the primary keys or id's name them with gid and the geometric column with the name the\_geom.

Quamtum GIS: For test of services WMS, WFS and WFS-T, since are a quick client in consultation of services OWS.

uDig: For test of services WMS-C, this it is the only tool that allows to consume a service WMS in Cache.

Kosmo: For edition of geographical information in PostGIS, since bill with more edition tools.

## CHAPTER IV

### 4. DESIGN AND DEVELOPMENT OF THE APPLICATION.

The present chapter is developed through the phases of the methodology of development Extreme Programming XP. Firstly in the Phase of Exploration she is carried out the gathering of user's histories detailing in them the user's necessities, he intends the architecture of the System and of their operation; ending up this way describing the necessary tereas for the realization of the system and their priorities. In the Phase of planning he is carried out the Plan of Deliveries, which has estimates of time, to carry out the deliverable ones in each iteration; subsequently he is carried out the Phase of Iteration where the work is detailed carried out in each task of the necessary iterations for the development of the System, the same ones that he has as exit a prototype from the system to which is

applied the defined tests of acceptance by the user; for I finish when the System fulfills all the requirements and after having approved with all the tests of acceptance you proceeds to the Phase of Production, where it is detailed the procedures to continue and requirements so that system can work in an environment of Production.

#### 4.1. PHASE OF EXPLORATION.

##### Metaphor

The proposed system is an application GIS that allows the unfolding of the cadastral information through thematic maps, generating a vision and wider analysis when uniting the geographical object with the cadastral information of Ibarra. The system also allows to carry out searches and location for geographical aspects and alphanumeric information. Finally the system allows the obtaining of the information that affects or it describes the reality of a property, one could say that a property is the unit of more essential information when studying the I castrate of a city.

## Architecture of the System

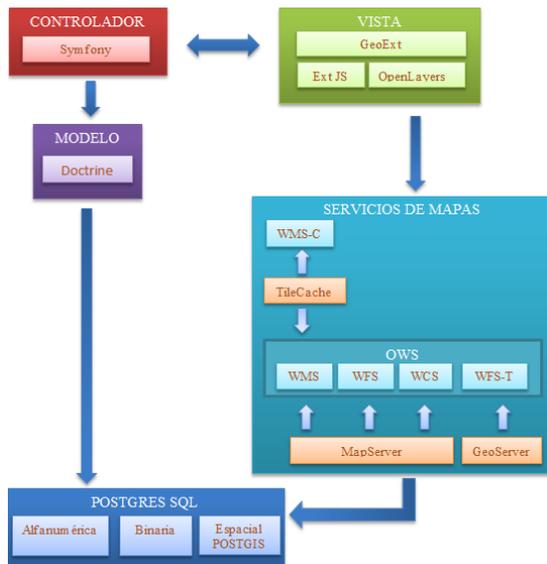


Figure 3 Architecture of the System  
Source: Owner

## Functional Architecture of the System

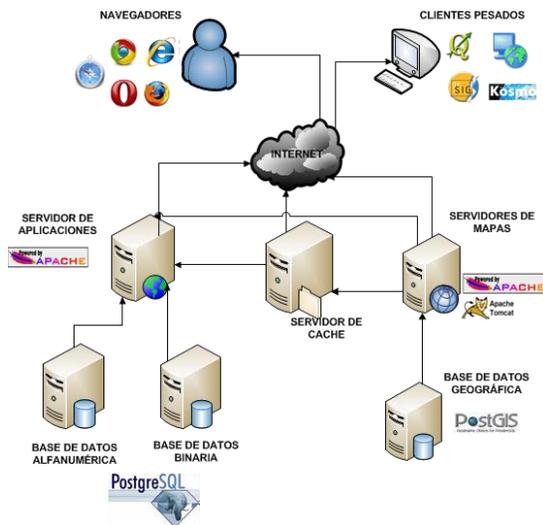


Figure 4 Functional Architecture of the System  
Source: Owner

## Modules of the System

Starting from the description of the functions and processes obtained in user's histories, the System GIS IMI has been designed having as main modules the following ones:



Figure 5 Modules of the System  
Source: Owner

### Module of Security and Access to the System:

In this module it is where the user is identified and to the moment to have access to the system, the different permits like menus, submenús and articles are assigned.

**Module View of Maps:** This module is the main of the application the same one that allows the unfolding and sailing of the cadastral information, through the consumption of the services OWS.

### Module of Consultations and Searches:

This module allows to obtain the information that the geographical object generates, that is to say descriptive information, through searches for different concepts is already geographical or alphanumeric information.

### Detail of Histories of User

- **Module of Security and Access to the System.**

- **History of User 1:** Security and Control of Access.
  - **Task 1:** To design the structure of data for the control of Access to the System.
  - **Task 2:** To create the interface for the into to the System.
- **Module View of Maps.**
  - **History of User 2:** Repository of geographical data.
    - **Task 1:** Installation and configuration of the module Postgis.
    - **Task 2:** Creation of the database and user's lists.
    - **Task 3:** Summary of the cadastral information.
    - **Task 4:** Migration of the geographical information.
  - **History of User 3:** Publication of maps in the web.
    - **Task 1:** Installation of Apache.
    - **Task 2:** Installation and configuration of MapServer.
    - **Task 3:** Publication of the Service WMS.
    - **Task 4:** Installation of Tomcat.
    - **Task 5:** Instalación y configuración de Geoserver.
    - **Task 6:** Installation and configuration of Geoserver.
  - **Task 7:** Installation and configuration of Tile Cache.
  - **Task 8:** Publication of the service WMSC.
  - **History of User 4:** Unfolding of geographical information and collection of layers.
    - **Task 1:** Design of the structure of data for the control of layers.
    - **Task 2:** Design of the main interface of the application.
    - **Task 3:** Programming of he sent of data of configuration of layers.
    - **Task 4:** Programming of the atmosphere of consumption of services WMS and WMSC.
    - **Task 5:** Programming of the tree of collection of layers.
  - **History of User 5:** Sailing functions and describer of legends.
    - **Task 1:** Programming of sailing functions.
    - **Task 2:** Programming of the panel describer of legends.
  - **History of User 6:** Addition and elimination of layers.
    - **Task 1:** Design of the window to add layers and groups of layers.
    - **Task 2:** Programming of the addition and elimination of layers and groups of layers.

- **History of User 7:** Estimate of longitude and area.
  - **Task 1:** Programming of the function of mensuration of longitude.
  - **Task 2:** Programming of the area mensuration.
- **Module of Consultations and Searches.**
  - **History of User 8:** Quick location of cadastral information.
    - **Task 1:** Design and programming of location of areas.
    - **Task 2:** Design and programming of location of streets.
    - **Task 3:** Design and programming of location of main places.
  - **History of User 9:** Consultation of predial Information.
    - **Task 1:** Configuration of the predial layer that allows applications GetFeaturesInfo.
    - **Task 2:** Design of the window of consultation of the predial information.
    - **Task 3:** Programming of the consultation function and load of data.
  - **History of User 10:** Search of a property.
    - **Task 1:** Design of the window for the search of a property.
  - **History of User 7:** Estimate of longitude and area.
    - **Task 2:** Programming of the function of drawing of a property.
  - **History of User 11:** It consults of the zonificación of a property.
    - **Task 1:** Design of the window for consultation of the zonificación of a property.
  - **History of User 12:** It consults of the uses of floor of a property.
    - **Task 1:** Design of the window for consultation of the use of floor of a property.
  - **History of User 13:** It consults of the description of a land.
    - **Task 1:** Design of the window for consultation of the description of the land.
  - **History of User 14:** It consults of the infrastructure and services.
    - **Task 1:** Design of the window for consultation of the infrastructure and services of a property.
  - **History of User 15:** Report of the properties of a citizen.
    - **Task 1:** Report of the properties of a citizen.
  - **History of User 16:** It consults of the predial tax.
    - **Task 1:** Design and programming of the window of consultation of the predial tax.

- **History of User 17:** Consultation of adjacent properties.
  - **Task 1:** Design and Development of the window of consultation of the adjacent ones.
- **History of User 18:** Impression of the Outline of a property.
  - **Task 1:** Interface for the generation of the outline of a property.
  - **Task 2:** Programming of the report of impression of the outline.
- **History of User 19:** It consults of the payment of the predial tax for parishes.
  - **Task 1:** Generation of a dynamic layer for the consultation of the predial tax for parish.
  - **Task 2:** Design of the interface for the consultation of predial taxes for parish.

## 4.2. PHASE OF PLANNING.

### Planning for Histories.

Iterations	H. N°	Begin	End
Firts	1	14/03/2011	23/03/2011
	2	24/03/2011	08/04/2011
Second	3	11/04/2011	29/04/2011
	4	02/05/2011	17/05/2011
Third	5	18/05/2011	23/05/2011
	6	24/05/2011	27/05/2011
	7	30/05/2011	02/06/2011

	8	03/06/2011	14/06/2011
	9	15/06/2011	20/06/2011
Fourth	10	21/06/2011	22/06/2011
	11	23/06/2011	24/06/2011
	12	27/06/2011	28/06/2011
	13	29/06/2011	30/06/2011
	14	01/07/2011	04/07/2011
	15	05/07/2011	06/07/2011
Five	16	07/07/2011	08/07/2011
	17	11/07/2011	12/07/2011
	18	13/07/2011	14/07/2011
	19	15/07/2011	20/07/2011

Square 10 Planning for Histories.  
Source: Owner.

## 4.3. PHASE OF ITERATION .

Once you has concluded with the planning of the iterations that will conform the first delivery of the system, the development team he has in clear which the dear times are to implement user's histories, the corresponding Tasks, and the dependences that exist he enters each one of them.

Now then, in this section, it is sought to explain the process that adopted the development team to implement each History of User corresponding to the delivery of the system like such. That is to say the execution of the necessary Tasks will be explained to supplement each functionality of the proposed system.

You can summarize that the activities executed inside an iteration in XP are:

- To design the tests of acceptance.

- To program user's histories.
- Code Refactorización and the design (when it is necessary).
- To execute the tests of acceptance.

#### 4.4. PHASE OF PRODUCTION.

Next he is carried out a verification of the elements of the system, so that this he has a good operation in a production atmosphere.

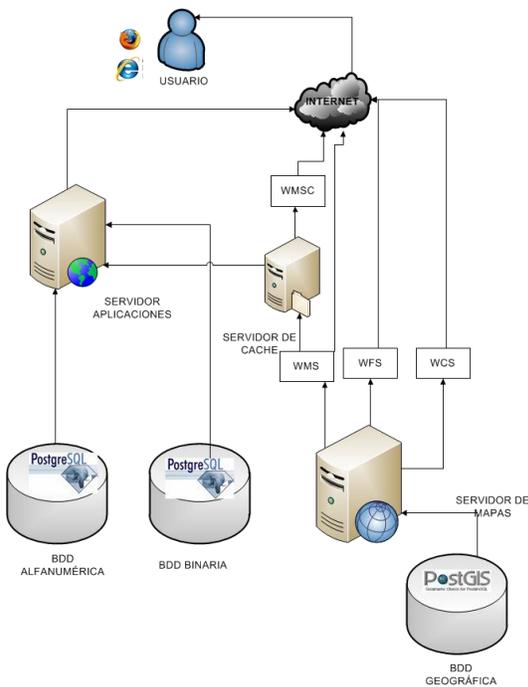


Figure 6 Production environment.  
Source: Owner

## 5. CONCLUSION AND RECOMMENDATIONS.

### 5.1. Impacts.

- The Access and knowledge of the cadastral information on the part of the employees of the Municipality have

increased notably as it indicates in the following graph.

System	Access and knowledge of the Information
Previous GIS	13%
GIS IMI	35%

Square 11 Access and knowledge of the Information.  
Source: Owner.

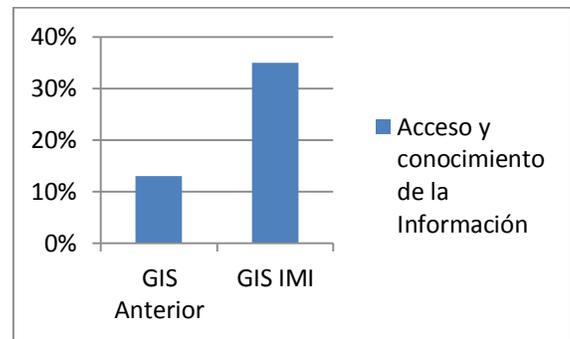


Figure 7 Access and knowledge of the Information.  
Source: Owner

The 13% conforms alone the personnel of the addresses of Cadasters and Evaluations, and Planning, since these addresses were those that generated and they registered this information. Thanks to the new systems GIS IMI has been reached to 35% of employees, since he has left integrating information of other addresses like it is Civic Participation, public Works, and I Traffic and Transporte, with the purpose of being able to publish from the web information that is of its interest.

Also the fact of being a system web, this makes possible that is accessible from the internet, and not alone he concentrates on the local net of the Municipality.

Another contribution has been carried out to the Plan of Territorial Classification in 2011, which generated a lot of information with respect to use and floor occupations, state of roads and sidewalks, etc. The same information that thanks to the System GIS IMI was accessible for other people and external institutions to the Municipality.

It has also been contributed to the integration of information with EMAPA, through an access to the System. This way EMAPA has been able to upgrade its predial information he stops then to have a communication through the cadastral code.

The Firemen also use the system to consult locations of places of interest.

- Con el módulo PostGIS, es mucho más fácil realizar consultas de relaciones espaciales (Cruces, Unión, Intersección, Distancias, etc.), a través de SQL, sin la necesidad de utilizar un cliente pesado.

Example:

It consults geographical of the adjacent of Properties per second.

Consulting	GIS	IMI
1 Property	7 s	3 s
2 Property	13 s	5 s
5 Property	49 s	13 s
8 Property	74 s	17 s

Figure 10 It consults of the adjacent of a property.  
Source: Owner.

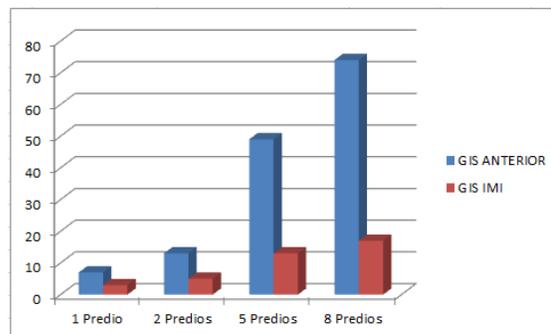


Figure 8 It consults of the adjacent of a Property.  
Source: Owner.

The data and the previous graph indicate us the time in lapsed seconds, in a consultation of intersection of geographical objects, when consulting that properties are adjacent to another. This consultation was carried out on the whole predial layer taking that this it contains 74107 properties.

- Now one can have several concepts of consultation of information on a property, since the geographical and alphanumeric information is separate, while previously in a file shape he should stay the two types of information in this format.

When	PREVIOUS	GIS
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## 5.2. Conclusions.

- The standards of the OGC allow to share geographical information in the internet without caring the platforms or development technologies, it is the base for the interoperability among Systems of Geographical Information.
- The use of the module Postgis, makes that the geographical information is more governable and of easy analysis, through the language SQL.
- The use of free software is beneficial for the institution, since it is a saving in the cost of licenses.
- A software developed with XP, allows to obtain documented the most outstanding information and of interest for a programmer without being left to other topics that they already lengthen the understanding and the quick analysis of a system developed.

## 5.3. Recommendations.

- To the moment to develop a System GIS, it is a good point to think since of the hardware infrastructure on which goes to work, they are systems that require of many prosecution resources and memory.
- It is necessary to guide the development together with the clients or users of the system, since they have the experience

in the handling of the information and other processes.

- To make use of good programming practices and design patterns, they allow to implement applications of easy maintenance and mainly scalable.
- To use standard of consumption and publication of geographical information will allow that to future that information can be shared with other institutions that have interest on the same one.

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