

Progress in the Digital Cadastre of Puerto Rico

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Abstract

CRIM is the organization responsible for the collection of all municipal property taxes in the Commonwealth of Puerto Rico. It was created in 1991 as part of a municipal reform that was intended to position municipalities closer to their primary sources of revenue. CRIM provides fiscal services to 78 municipalities and, as a municipal organization is responsible for the segregation, appraisal, notification, and collection of real and personal property taxes and the distribution of public funds provided by the sources defined by law. In addition, it is responsible to bring up to date and to maintain the cadastre of Puerto Rico, now with more than 1M properties. During the past year, CRIM was able to increase its productivity by approximately 300% using GIS software and in-house application development, adding 65,000 new properties to the parcel map.

1. OVERVIEW

The Division of Digital Cadastre of CRIM (Centro de Recaudación de Ingresos Municipales) is responsible to bring up to date and to maintain the cadastre of Puerto Rico. During the past year, the Division was able to increase its productivity by approximately 300% using GIS software and in-house application development, adding 65,000 new properties to the parcel map. This document states the current status of the Division and provides a description of the projects and tasks performed.

2. BACKGROUND

The Land Information Management System (LIMS) project was the precursor of the Digital Cadastre project. LIMS begun in 1995 and was supposed to provide a multifunctional cadastre as product. Because misleading decisions by the agency administration at that time resulted in irregularities, CRIM paid over 90% of 56 million dollars without receiving the respective products for that amount. This issue ended in convictions to 17 government officials and contractors. In July 2003, a legal agreement between CRIM and sub-contractors was settled for the agency to pay 75% of the debt and the sub-contractors to finish and deliver all tasks defined in the contract and complete the project. The agreement also permitted CRIM to recover all products already done by the sub-contractors, but that were not delivered to the agency.

The Division of Digital Cadastre was created to carry out the requirements of the agreement and to direct the work to create a digital cadastre for tax purposes. The main goal is to facilitate the process of parcel divisions and taxation and also recover the

trustworthiness of the agency by the tax payers. At the moment the Division was created, an estimated 30% of the initial conversion tasks were done during the LIMS project and no data was yet prepared to be use in a geographic information system.

The Division consists of 27 employees, comprised by the following: Director of Digital Cadastre, Supervisor of Cadastral and Cartographic Information Technicians, Geographic Database Administrator, GIS Coordinator, 10 Quality Control Technicians, Cadastral and Cartographic Information Technicians, and 5 office workers. Some municipalities designated employees to our office in order to use the agency's resources and equipment.

3. OBJECTIVES

The main objectives of the Division of Digital Cadastre are:

- a. Maintain and update the cartographic inventory of real estate for tax purposes.
- b. Promote the efficient establishment, collection, and distribution of municipal taxes revenues.
- c. Increase municipal revenues.
- d. Minimize waiting time of service application forms, and provide better service to citizens and government agencies.

4. THE CHALLENGE

Before using GIS, the agency suffered from poor workflow and delayed updates to the map. Citizens received delayed notifications of their service applications, promoting redundancy of service requests and a significant increase in the number of applications to process. There were approximately 36,000 service applications in backlog by 2003. Agency employees also relied on hard copies of property maps, updated using raster conversion software, for appraisal and collection purposes. No appraisal or tax information was related to a spatial representation, thus no easy way to identify and locate a property was in place. Data needed to be more frequently updated and workflow needed to be improved and more efficient.

5. THE SOLUTION

To improve workflow, the agency implemented a GIS solution to streamline the cartographic process. This solution consists of an ArcSDE installation integrated with an Oracle database operating within a Storage Area Network (SAN). ESRI's Job Tracking software was used to implement a new workflow for the technical team and provides managers a way to follow-up job assignments and its historical transactions. Technicians use ArcInfo and ArEditor for cartographic updates along with Novalis' Parcel Editor Extension for easy step-by-step workflow embedded in the desktop user interface.

Maplex for ArcGIS was used in the cartographic production of maps. Also, a second work shift was stated increasing the number of technicians to 29.

An internet/intranet application was developed using ArcIMS to provide an interactive map to many state government agencies, all municipalities, and CRIM's regional offices. This application let users have access to nearly live updated data, reading directly from the database, and also eliminating the use of outdated hardcopy maps. With our GIS solution we were able to relate relevant information from the agency's tax database to the parcel map, giving users a meaningful way to find and interpret existing data.

Three more web applications were developed, providing agency officials and other users access to information and status of citizens' requests and application forms, digital cartographic maps updated in ArcGIS, and allowing them to submit new service application forms online. These applications, as well as other across the agency, will eventually be more integrated to the GIS database and provide the agency with spatially enabled tools for analysis and better and faster services.

6. PRODUCTION

By September 2006, the Division of Digital Cadastre updated 90,184 parcels in the cadastral map since its creation in 2003. Summed to 928,692 parcels already converted by the sub-contractors, we obtain a total of 1,018,876 existing parcels in the map. The following graphic presents the significant increase in parcel production and compares fiscal years from 2001.

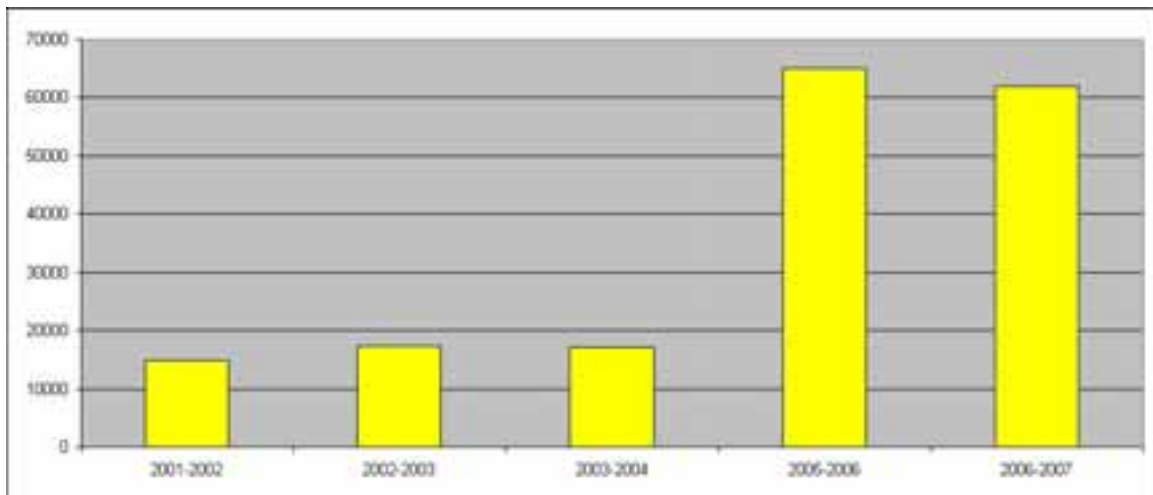


Figure 1. Parcels generated by fiscal year.

During the last fiscal year 65,000 new parcels were created for an approximated 300% increase in comparison to previous years. By April 2007, 61,957 new parcels were already created and included in the map.

Figures 2 and 3 present detailed information of the parcels generated and service requests already worked. Both graphics show data for a period of 13 months, from May 2006 to April 2007. The analysis provides more detailed evaluation of the production achieved.

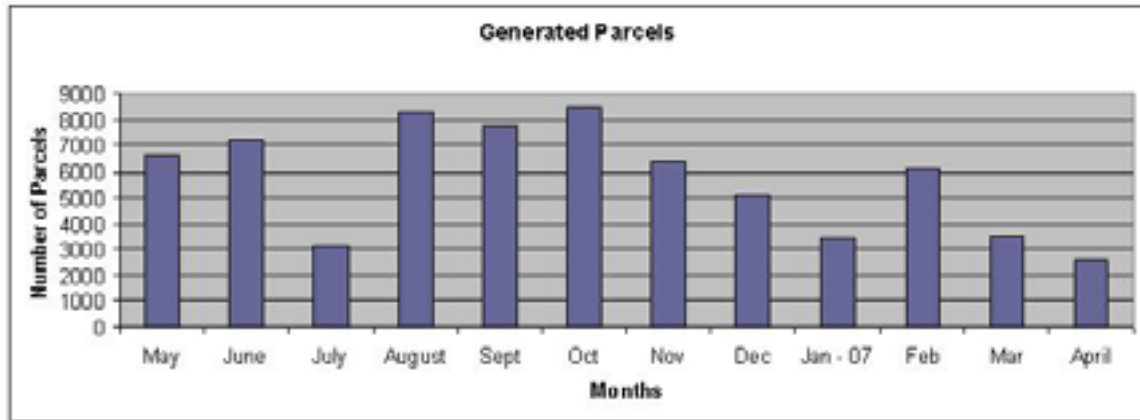


Figure 2. Parcels generated by month from May 2006 to April 2007.

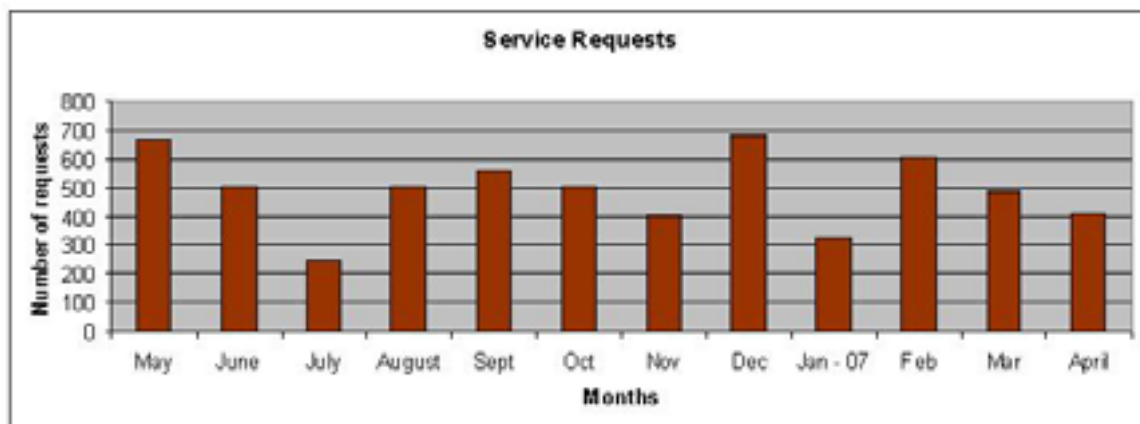


Figure 3. Service requests worked by month from May 2006 to April 2007.

July 2006, January 2007, and April 2007 were the least productive months for parcels generated. This reduction concurred with low seasons due to holidays and vacation recesses. During July 2006 several software upgrades and configuration changes in the data schema were carry out. The composition and complexity of the service requests have a significant effect in production due their very own nature. Since the creation of a second work shift in January 2006, production has increased dramatically. The following sections provide technical information and description of what have been done to promote this increase in productivity.

7. INFRASTRUCTURE

ArcSDE was installed in the UNIX box, where Oracle 9i is also installed. All the data is store in the Storage Area Network (SAN). All vector data was loaded to the same tablespace.

ArcIMS is installed in one HP ProLiant DL360 G3 server. This server works as the webserver for the ArcIMS application, as ArcIMS Application Server and as ArcIMS Spatial Server. Other five (5) DL360 G3 servers work as ArcIMS Spatial Servers. One of the ArcIMS Spatial Servers also has MS SQL Server installed for testing and management of a simple database application with an Access GUI (figure 4).

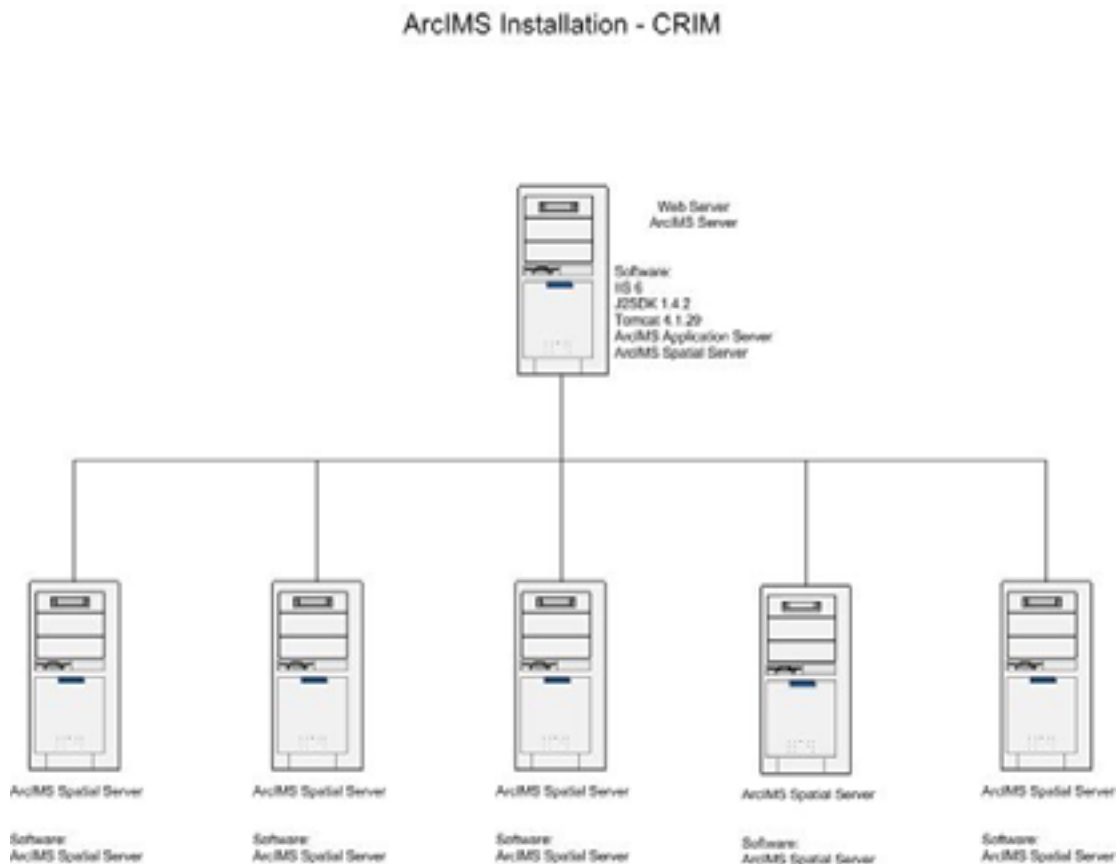


Figure 4. ArcIMS hardware configuration.

Parcel Editor License Manager is installed in one of the HP ProLiant DL380 G3, designed also as the development server. To be able to serve as a license manager for Parcel Editor, the application is required to be installed in the machine. Also, ArcGIS Desktop is installed in this server. Another HP ProLiant DL380 G3 works as the ArcGIS License Manager and Domain Controller. The following illustration presents the overall configuration based on software in CRIM.

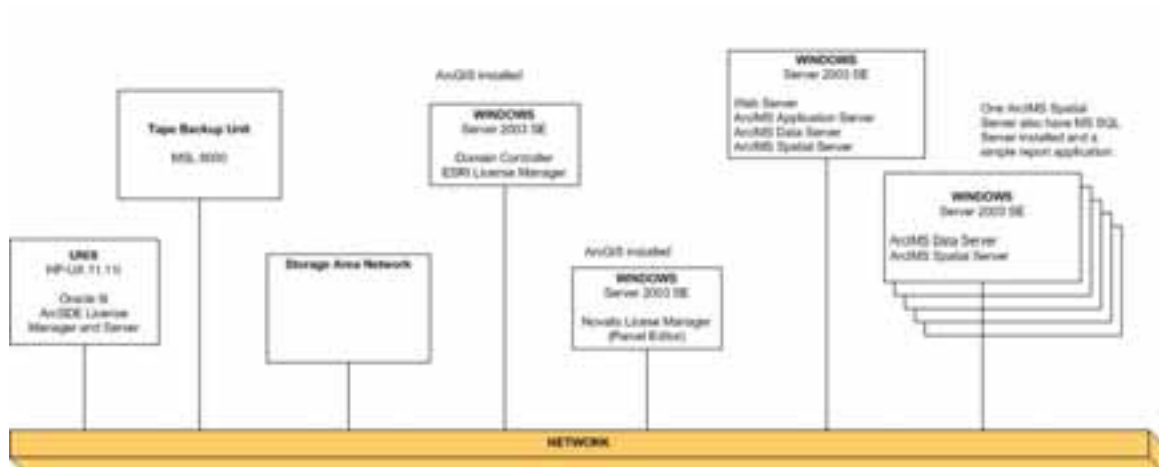


Figure 5. CRIM infrastructure for Digital Cadastre.

The following list numbered the general specifications of hardware acquired by CRIM.

- m Unix environment
 - o HP 9000 rp3440
 - 2 PA-8800 processors – 800 MHz and 1 GHz with 1.5 MB L1 cache/32 MB L2 cache
 - 13 GB of RAM
 - HP-UX 11iv1 (all required patches by ESRI)
- m Windows environment
 - o HP ProLiant DL380 G3 (2 servers)
 - Intel Xeon Processor 3.20 GHz
 - ServerWorks GC –LE Chipset
 - 1 GB of RAM
 - Two NC7781 PCI-X Gigabit NICs
 - 30 GB of internal HD
 - Integrated ATI Rage XL Video Controller with 8-MB SDRAM Memory
 - MS Windows Server 2003 SE
 - o HP ProLiant DL360 G3 (6 servers)
 - Intel Xeon Processor 3.20 GHz
 - 2 GB of RAM
 - Two NC7781 PCI-X Gigabit NICs
 - 30 GB of internal HD
 - Integrated ATI Rage XL Video Controller with 8-MB SDRAM Memory
 - MS Windows Server 2003 SE
- m HP StorageWorks Enterprise Virtual Array 3000
 - Total storage space: 4TB

- MS Windows 2000 (SP4)
 - 2 GB RAM
- m HP StorageWorks MSL6000 Tape Library
 - 2 drives Ultrium 460

8. SOFTWARE

In our facilities we have server and desktop products part of the ArcGIS system. Also, we use third party software that work integrated with ArcGIS Desktop. The GIS related software installed in site is:

- m ArcSDE 9.1 (SP 2)
 - o Oracle 9i (9.2.0.3.0)
 - All required patches installed
- m ArcIMS 9.1 (SP 2)
 - o IIS 6.0
 - o J2SDK 1.4.2
 - o Tomcat 4.1.29
- m ArcGIS Desktop 9.1 (SP 2)
 - o ArcInfo
 - o ArcEditor
 - o ArcView
- m ArcGIS Desktop Extensions
 - o Maplex
 - o Spatial Analyst
 - o ArcScan
 - o Publisher
 - o 3D Analyst
- m Cartographic Production Tools
 - o Job Tracking 3.0 (SP)
- m Third-party
 - o Novalis Parcel Editor

9. WORKFLOW

Before a service request is assign to a technician, an employee checks for proper format and completeness; all required documents must be included with the request form. Paper

maps are scanned and stored in disk for easy access by the technicians. Using JTX we can attach any digital document to a job. In the desktop environment, CRIM uses workflows created with JTX and Parcel Editor. The JTX workflow has the following defined steps:

- a. Buscar AOI (start ArcMap to search parcels and defined AOI)
- b. Crear AOI del Job (create AOI)
- c. Revisa si hay version (if true, delete the mxd, otherwise create the version)
- d. Crear Version (create version) o Borrar MXD (delete mxd)
- e. Comenzar Edicion (start ArcMap and start the editing process)
- f. Añadir Documentos y Comentarios (add comments of editing step)
- g. Borrar MXD (delete mxd)
- h. Hacer QC (start ArcMap and the QC process)
- i. Aprobo (decisional step – if approve, add comments and assigned to post)
- j. Añadir Notas y Comentarios (add comments of editing step)
- k. Asignar el Caso a Post (assign job to Post group)
- l. Hacer el Post (start ArcMap and Post)
- m. Añadir Notas y Comentarios (add comments of editing step)
- n. Cerrar el Caso (close job)

The workflows developed with Parcel Editor just provide a straight forward process to select parcels, edit, and check topology. In CRIM, the default version of the sde database is protected; we created a new version owned by the jtx user and set it to use this version for management. QC/QA group checks for proper editing of the parcel map and verify values assigned to attributes. After approval of QC/QA technician, the job is assign to a manager to post the version. Once the job is closed in the software by a manager, all the paperwork is send back to a regional office and the owner of the property is notified.

10. WEB APPLICATIONS

This section describes the web applications developed by the Division of Digital Cadastre. CRIM provides government agencies and municipalities access to cadastre information. An interactive map application was created using ArcIMS, allowing users to search the map by owner or parcel number. The buffer functionality also provides a great way to look for adjacent owners of a specific property for notification purposes. This application provides direct access to updated information in the database. Figure 6 shows a snapshot of the interactive map application.



Figure 6. ArcIMS application.

The Digital Cadastre website also provides users access to three more applications: service request management, cadastral map search, and online service requests. A service request management application was developed to allow CRIM employees and municipal officials to see and follow up the progress of specific service requests. It also provides access to real time progress reports, data entry, and productivity measurement tools for managers (figure 7).

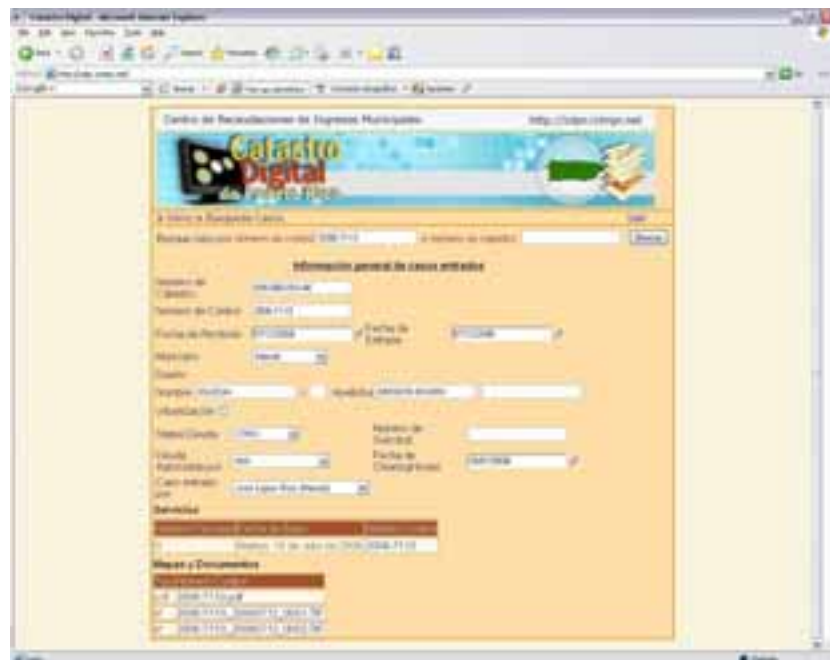


Figure 7. Service request management by web.

Cadastre maps are distributed by CRIM thru the interactive map application and by static digital format file, specifically in pdf format. The latter is also used in the production of hardcopy format. To facilitate this process, a web application was developed to allow users to search for a map and see or download the required digital file. This application provides users access to maps at the same time no human interaction is needed, allowing the Division to assign these free resources to undertake more critical tasks.

Another web application was developed for users to fill service requests online. The application allows users to submit all required documents in digital format. The application helps the agency provide a better and faster service to tax payers.

11. SUMMARY

Since the implementation, the Digital Cadastre Division increased its productivity in more than 330% by the end of last fiscal year, adding 65,000 new properties to the parcel map, more than the previous three years added together. By February 2007, almost 50,000 new properties have been already added in the current year. The repercussion of this work is best represented in the significant increase of revenues collected by CRIM. More than \$871 millions were reported for last year, compared to \$788 millions the year before, an increased in 83 million dollars. This money is to be distributed between the municipalities and help them achieve fiscal independence.

Still having approximately 30,000 service applications in backlog, consisting of an estimated 180,000 properties, the improvement in the workflow and the use of ArcGIS has proven to be a success. State agencies and municipalities having access to the parcel map through the ArcIMS application are now using the information and integrating the data to their daily activities, allowing them for better decision making and citizens' services. With on-going and new agreements between the agency and other government dependencies, we are looking forward to continue promoting data sharing and develop new applications. With the progress done by the agency, the project promotes a recovery of the municipal fiscal health and even more important, it will help to reform the property tax system in coming years. All players involve in land taxation issues like mayors, government agencies, appraisers, surveyors, and citizens, are receiving the benefits of the GIS implementation of the Digital Cadastre project. The perception of these players is now very positive and they are committed to be partners with CRIM in order to effectively handle land taxation issues in the ever changing and fast growing real state market of the Island.

12. AUTHOR INFORMATION

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