

Advancement of an Enterprise Coastal GIS in Martin County, Florida

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ABSTRACT

The growing number of issues governing coastal projects in Martin County, Florida has resulted in the increase in both the number and specificity of all grants and permits. To address these issues and to streamline the management of its coastal programs, the Coastal Division is developing a customized, GIS-based Coastal Information Management System (CIMS). Recent improvements to ESRI's ArcGIS suite of software are enabling Martin County to integrate disparate datasets, often spatial by nature, into the coastal GIS database and the CIMS. Martin County has invested considerable time and money to create a prototype Coastal GIS. The County is focusing its resources on building a sustainable, standardized, and documented Coastal GIS that meets the needs of Martin County and that contributes and conforms to the evolving state of the national coastal geo-spatial initiatives. The Marine Data Model, among other initiatives, provides the point of departure from which Martin County is designing, building, and integrating GIS data into its Coastal GIS.

INTRODUCTION

Martin County is located on the central Atlantic coast of Florida. Martin County's shoreline extends 21 miles. In the northern section of the county, the St. Lucie Inlet provides access from the Atlantic Ocean to two major waterways: the Okeechobee Waterway (OWW) and the Atlantic Intracoastal Waterway (AICWW). The OWW runs east to west through Lake Okeechobee and links Florida's east and west coasts. The AICWW runs north to south, in Martin County, through the Indian River Lagoon estuarine system. The Lagoon provides essential fish habitat to many estuarine and oceanic species, as well as critical habitat for the West Indian Manatee and juvenile sea turtles. The U.S. Environmental Protection Agency designated the Indian River Lagoon in 1990 as an Estuary of National Significance. Furthermore, adult sea turtles, some of them listed in the endangered species list, nest on Martin County Atlantic beaches and add great value to the County's natural resources. To protect these resources, the County has chosen to maintain its "slow growth" community status. With no major industries, the County relies heavily on marine related interests to fuel its economy – a fact made evident by the County seal, which proclaims Martin County "The Sailfish Capital of the World."

PROJECT RATIONALE

The Martin County Engineering Department Coastal Division administers the County's Coastal Programs. The Division takes responsibility for the following:

- Artificial Reef Construction and Management
- Beach Maintenance and Management
- Waterway Maintenance and Management
- Habitat Management

Each of these areas of responsibility involves administering multiple grants, permits, and consultant / contractor agreements. Managing and tracking coastal program information and the increasing number of grant and permit conditions associated with the different projects in each program is becoming increasingly complex. The complexity of the management issues and the

magnitude of the data collected prompted the coastal division to consider the development of a GIS-based coastal information management system to address these issues.

PROJECT OVERVIEW

To address these information management issues and to streamline its coastal program business processes, the Engineering Department is developing a GIS-based Coastal Information Management System (CIMS) (Figure 1). The goal of the CIMS is to facilitate the integration and management of the coastal programs financial, planning, operational, and monitoring information, and to improve data dissemination capabilities to the public, to scientific and engineering communities, and to regulatory agencies.

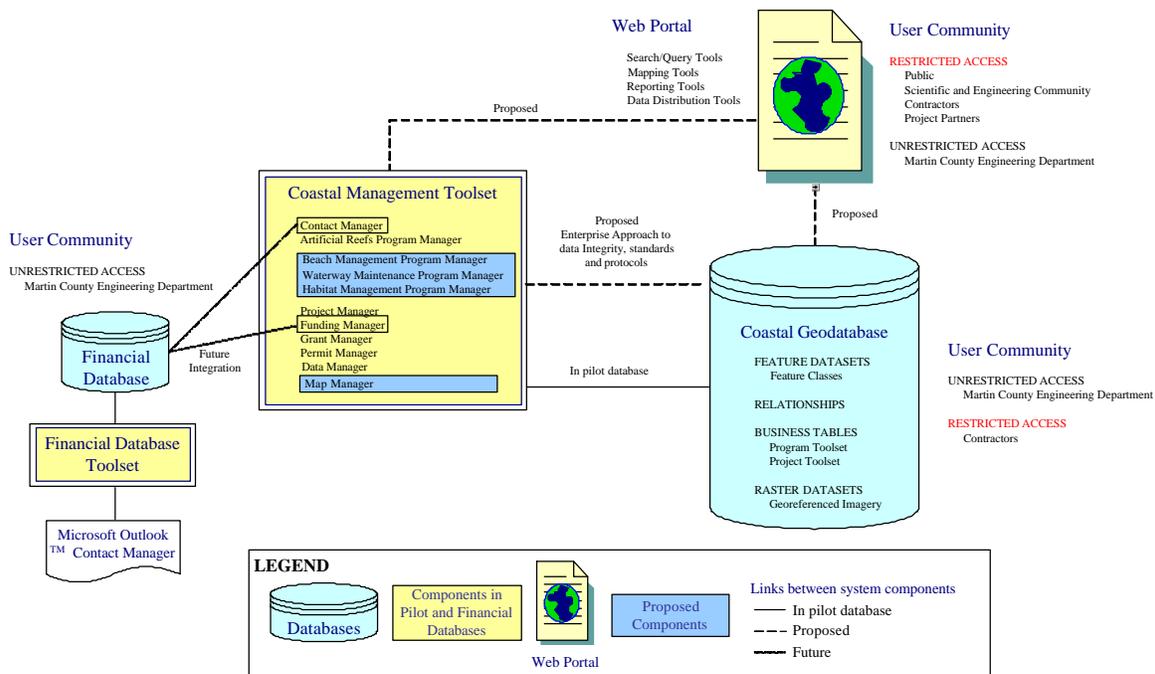


Figure 1 - CIMS Conceptual Diagram (Source: Taylor Engineering, Inc. in Carvalho, 2004)

Scoping Phase

In the fall of 2002, the Engineering Department initiated a scoping phase for the implementation of a Coastal GIS and the CIMS. The scoping phase resulted in the development of a prototype that included:

- A personal geodatabase that stores artificial reef project related data (i.e. project management and permit and grant monitoring data).
- A data entry / data editing graphic user interface that accesses the project data within the geodatabase
- A series of artificial reef planning tools that assists in the artificial reef project planning.

Assessment Phase

The coastal geodatabase is a fundamental component of the CIMS. Geographic in nature, the responsibilities associated with the management of the coastal programs tend to require considerable amounts of spatial information. The assessment phase helped document the

lessons learned in the scoping phase and prepared the team for the implementation of the enterprise geodatabase. The initial design assessments and project refinements resulted in a review of the coastal geodatabase business objectives and in the articulation of the functional and non-functional business requirements for the enterprise coastal geodatabase (Coastal GIS).

Coastal GIS Business Objectives

The geodatabase design will support the business objectives of the Martin County coastal programs. These business objectives include:

1. Efficiently manage Martin County's habitat, beach, waterway, and artificial reef programs.
2. Monitor and analyze the effectiveness of the Coastal Program's.
3. Manage and track permit and grant requirements and automate permit and grant application submittals.
4. Properly distribute, track, and manage the Coastal Program budget and grant funding.
5. Collaborate with, and disseminate information to federal and state agencies, to the scientific and engineering communities and to the public.
6. Analyze project monitoring data and scientific model results and successfully plan the Program's future.

Coastal GIS Functional Business Requirements

Functional business requirements are the requirements to which the Coastal GIS must comply to meet the Martin County Engineering Department's business objectives. Figure 2 summarizes the Martin County coastal GIS functional business requirements in the form of use cases. Use cases describe functional business requirements and the specific ways in which users interact with the GIS. Use cases connect to "actors." Actors represent the multiple users that interact with the systems. In this project, the actors include the Martin County staff, the program partners (i.e., government agencies), the engineering and scientific community, and the public. Use cases describe the business functions available to the actors.

Coastal GIS Non-Functional Business Requirements

Non-functional business requirements include both the services and system characteristics associated with its implementation. Non-functional business requirements do not support specific business functions (i.e., track grant and permit conditions); rather, they describe the requirements that help meet the functional requirements (i.e., hardware and software). The project non-functional business requirements include:

- Minimum number of users:
 - ArcSDE geodatabase
 - Four concurrent Engineering Department staff members
 - Web portal
 - Five contractors
 - Fifteen government agency staff (FDEP, USACE, FWC)
 - Undetermined number of citizens

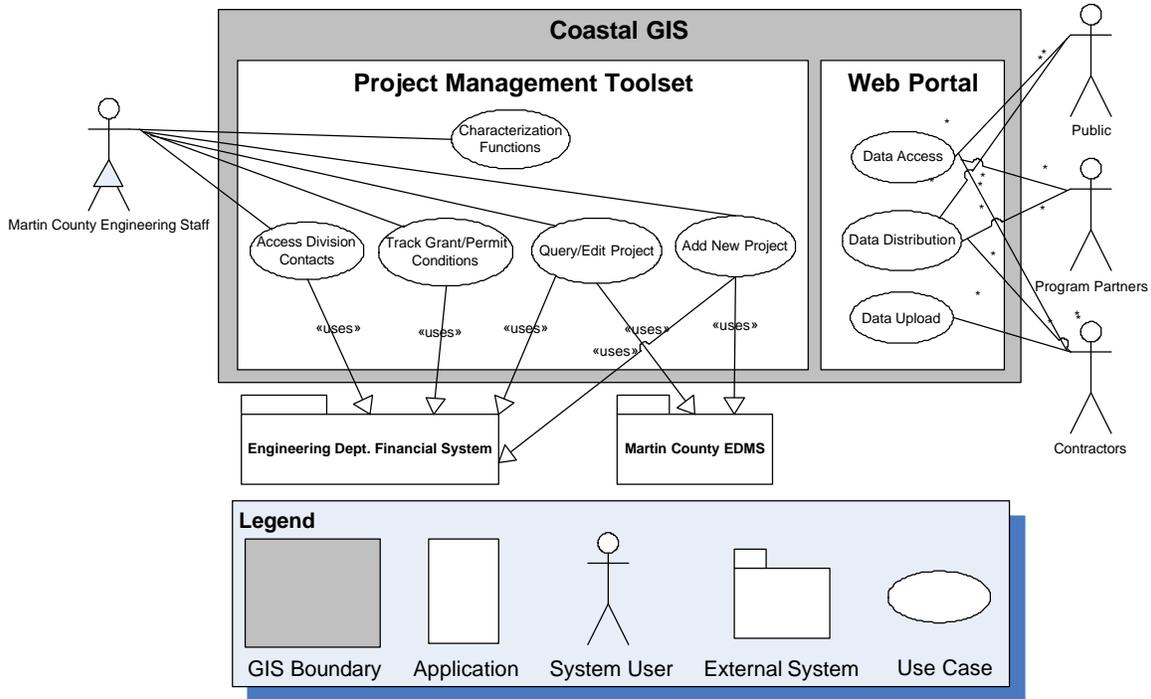


Figure 2 - Martin County coastal GIS functional business requirements (Source: GIS Solutions, Inc. in GIS Solutions, Inc. et al., 2004)

- User access levels:
 - Project management toolset (Martin County network)
 - Engineering Department staff will have read / write privileges to the geodatabase through commercially off-the-shelf (COTS) and customized desktop tools.
 - Web portal
 - Government agencies and contractors will have data downloading and viewing privileges.
 - Contractors will have file transfer protocol (FTP) privileges through the Web Portal to upload contract deliverables.
 - The public will have querying and viewing privileges through the Web Portal. Data distribution to the public will use an online request mechanism.

- Hardware and software minimum requirements:

System Components	
Hardware	"Geodatabase" server
	Web server
	Work station
Software	Oracle 9i
	ArcSDE 8.3 (2 CPU)
	ArcIMS 4.0.1 (2CPU)
	ArcInfo 8.3 (1 license)

- Minimum required disk space:
 - ArcSDE geodatabase
 - 500 megabytes of vector spatial data (includes basemap and project data feature classes and business tables)
 - 12 gigabytes of georeferenced imagery (i.e. aerial photography, LIDAR)
 - Data located on the file system
 - 2 gigabytes of digital photos
 - 250 megabytes of drawings
 - 250 megabytes of documents
 - 2 gigabytes of video
- Geodatabase design — Marine Data Model (MDM) Implementation
 - The Martin County's geodatabase design team will implement MDM components when applicable and develop new components in areas where the MDM meet the needs of the County.
- The geodatabase extent will include the entire state of Florida with a buffer to the United States Territorial Sea (12 nautical miles).
- Vector spatial data will conform to the Florida East State Plane Coordinate System; use the NAD83, HPGN horizontal datum and the NGVD88 vertical datum; and feet for the data units.
- Location data collected for the Coastal GIS will conform to the Florida Department of Environmental Protection location data standards where possible.
- Where applicable, monitoring data collected for the Coastal GIS will conform to the Florida Department of Environmental Protection beach erosion control monitoring standards.

FUTURE INITIATIVES

Based on the lessons learned during the development of the scoping phase (Phase I) prototype and the feedback from the assessment phase (Phase II), the project team is modifying the design of the personal coastal geodatabase to conform to the Marine Data Model. Figure 3 shows the completed and future project phases and the project timeline.

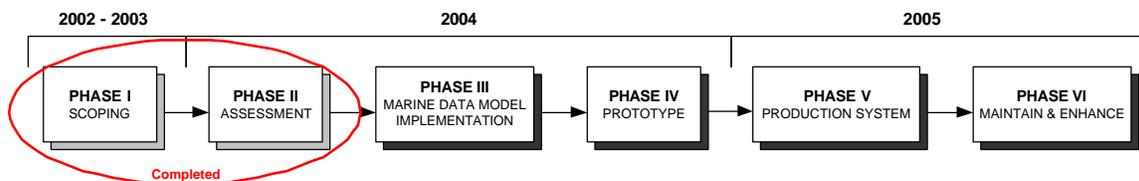


Figure 3 - Completed and future project phases and predicted timelines

Because the scoping phase focused on a single coastal the Artificial Reefs program the project team will continue the design and MDM implementation of geodatabase to encompass the beach, waterway maintenance, and habitat management programs. Once finished with the design of the enterprise coastal geodatabase, the project team plans to start building, populating and testing the enterprise geodatabase prototype (Phases III and IV).

The production phase (Phase V) will include the design and development of the desktop applications and data analysis tools as well as the Web portal. Final product delivery will occur once the project team has fully tested and removed all the bugs from the complete system. Further enhancements (Phase VI) will depend on system performance and user feedback.

The Martin County Information Technology (IT) Department will host the CIMS. The Engineering Department will maintain the (Phase VI) system through an independent contractor working together with the IT Department.

FINAL CONSIDERATIONS

New improvements to the system may result from changes in the regulatory and coastal policy fields. Furthermore, as new GIS technologies evolve and become available, the project team will continue to improve or add new components to the Martin County Coastal Information System, as necessary.

REFERENCES

Carvalho, A. 2004. *Martin County Coastal Geodatabase Scoping Phase Summary Report*. Taylor Engineering, Inc., Jacksonville, FL.

GIS Solutions, Inc., Northstar Geomatics, Inc. and Taylor Engineering, Inc. 2004. *Martin County Coastal Information Management System Implementation Framework*. GIS Solutions, Inc. St. Petersburg, FL.

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