GIS-based Facility Information Management Systems : *an evolving success story*

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Abstract :

GIS-based Facility Information Management Systems (FIMS) offer several advantages over traditional CAD-based FIMS systems, particularly in integrating land management (campus or site level) and facility management (building, floor and room level) into one package. This presentation follows the development and success story of a custom enterprise FIMS built on a standard off-the-shelf GIS software platform and it's evolution into a next generation web-based system. The presentation highlights the importance of careful business process and workflow integration into system design and its benefits as extended product lifecycle and increased Return On Investment (ROI). Also discussed are ideas on automated space performance metrics reporting, emergency and work-order management, space allocation and visualization, and practical decision support tools for planning and locating new facilities.

Background:

This paper presents some useful insights on development of GIS based Facilities Management (FM) systems using examples and experience at two government sites – The Public Works Department at the Naval Surface Warfare Center (NSWC) Dahlgren Division, Virginia, and the Naval Air Station Patuxent River, Maryland. A government mandate required these bases to have a Facilities & Assets Inventory Information system that met the following criteria:

- Provide basic facility information management capability and basic metrics to support decision making
- The system needed to work within the existing business processes practiced within the organizations
- The system had to integrate with existing graphic and non-graphic data

At both these sites, an ArcView3.x GIS based customized FM solution was developed - CADModule for NAS Patuxent River and Facilities Data Viewer (FDViewer) for NSWC Dahlgren. Despite significant changes in GIS and CAD technology, these systems have been in active use since the last five years due to careful integration with business processes and needs of the users. As their evolution into the next generation system is underway, the core functionality remains valid and a number of lessons can be learned from the successful life of these systems.

Starting Smart : Building a Business Solution rather than a Technology Solution
Successful investment in a Facility Information Management System (FIMS) requires careful planning and a holistic understanding of the mission and goals of the organization, its structure and key business processes. Both the CADModule and FDViewer systems were developed based on extensive user interviews structured on the ICOM (Inputs, Controls, Outputs and Mechanisms) model identifying specific needs, processes and issues.

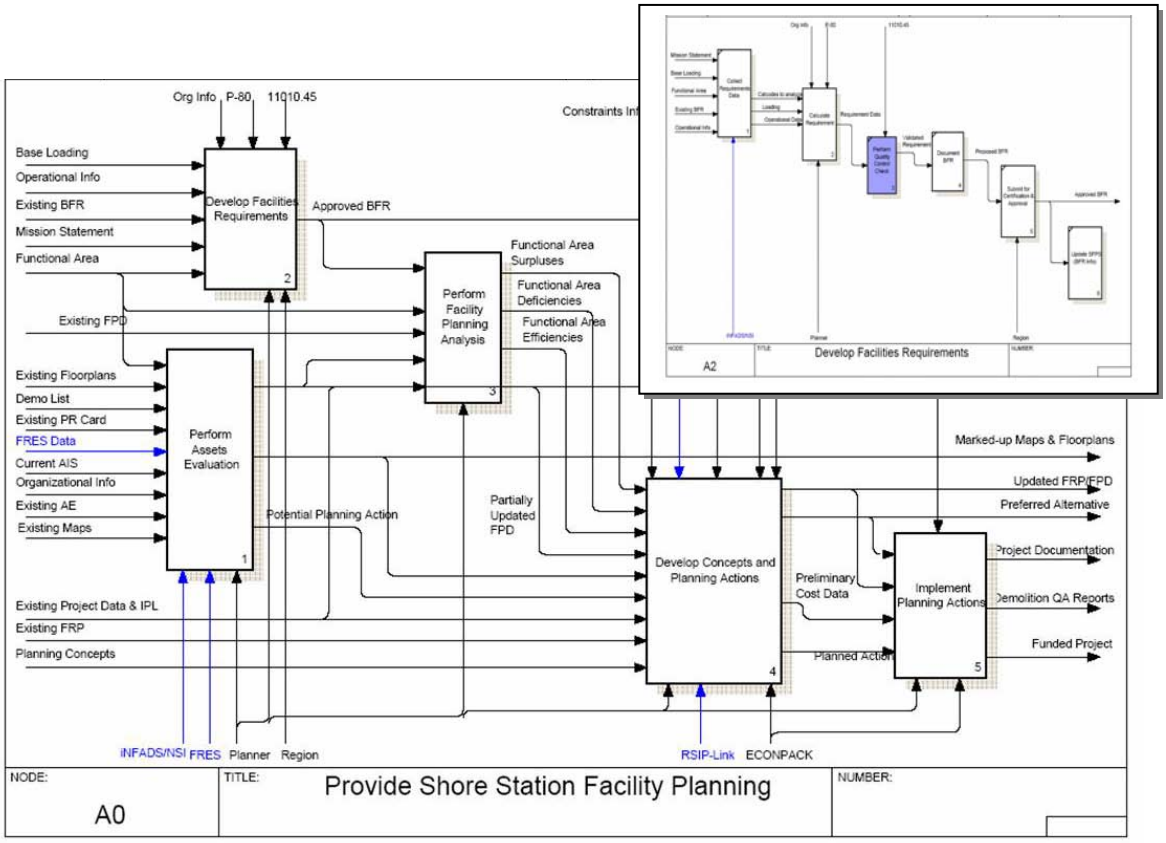


Figure 1: Analysis of Business Processes as the foundation for FM application development

The key common factors influencing the FM system development were :

A Diverse User Group:
Though the Public Works Department (PWD) was the main user group dealing with facility management, the user profile had a wide range from CAD/GIS technicians to planners and policy makers. The user base also extended outside the PWD to include command, environmental, human resources, and security departments. The users also had a broad range of interests – from emergency work orders at the room scale, space management and custodial assets at the facility level to land planning issues at the base campus level. About 20% of the end-user groups were responsible for maintaining/creating maps/floorplans and databases related to FM while 80% of the end users required access to information for supporting their decision making. Clearly, any

FM system deployed had to have almost universal access to these users, be easy to use and incorporate the common language across the user base and be flexible to allow lightweight and advanced functionality. The range of user-types also warranted different types of reporting and analysis capabilities within the system.

Integration with Existing Databases, Applications and Workflows:
It was critical to build a FIMS integrated with existing databases and workflows not only to leverage the investment and resources already committed but also to minimize training and maintenance requirements. For the Navy, the Shore Facilities Planning System (SFPS) process outlines key business process models, data models and information flows and provides crucial guidance to facilities management.

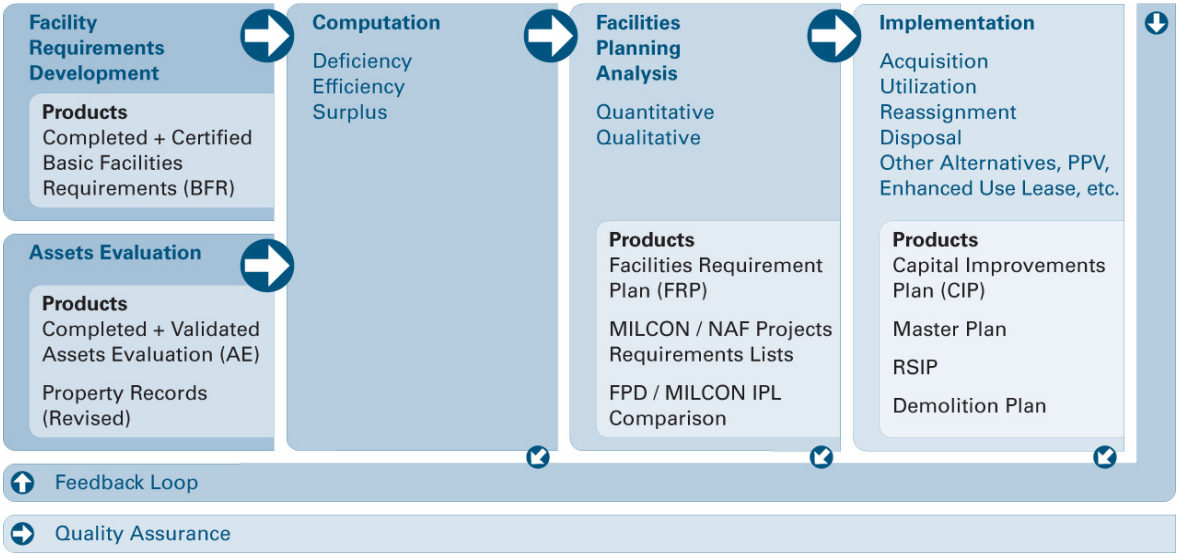


Figure 2: Shore Facilities Planning Process guiding FM workflows

In the case of FDViewer development, the challenge was to integrate databases and workflows from several departments. PWD Dahlgren – the main user group had a number of IT systems implemented centered on the Public Works Management Automation System (PWMA) dealing with work order and emergency services information. They had also implemented FileNet, a document management system, had fully adopted the Tri-Services standards for CAD and GIS data and were part of the base-wide implementation of Citrix Winframe. Existing applications such as AutoCAD, ArcView GIS were already being used to create and update floor plans and base maps. An extensive SQL server database with facilities, personnel and organization related information linked to the Naval Facilities Assets Data Base (NFADB now known as iNFADS) was already in use and updated regularly. A data and information migration plan was developed relatively easily to support the FDViewer application.

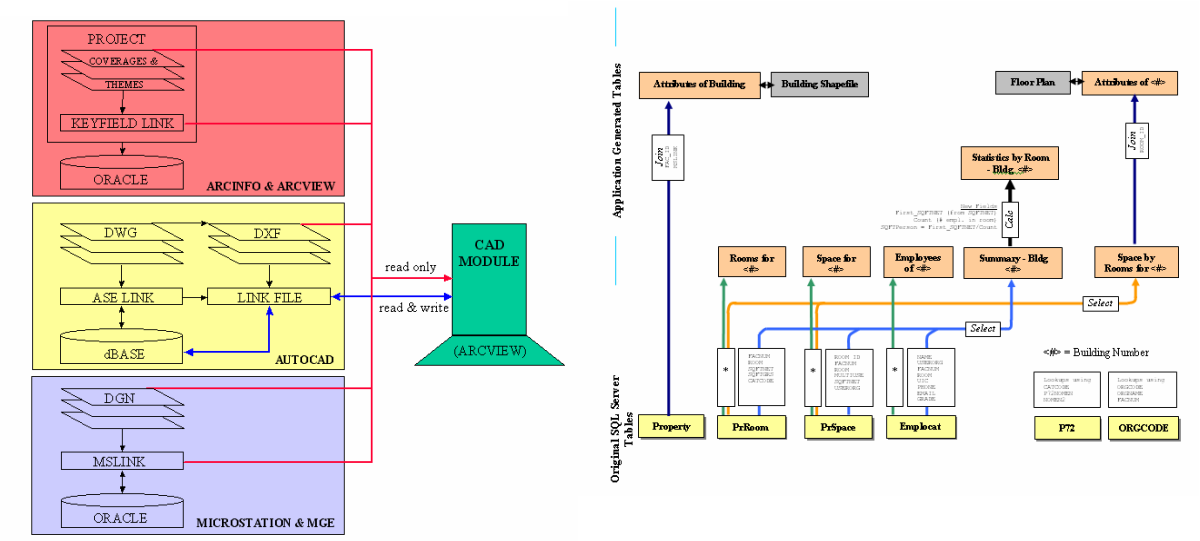
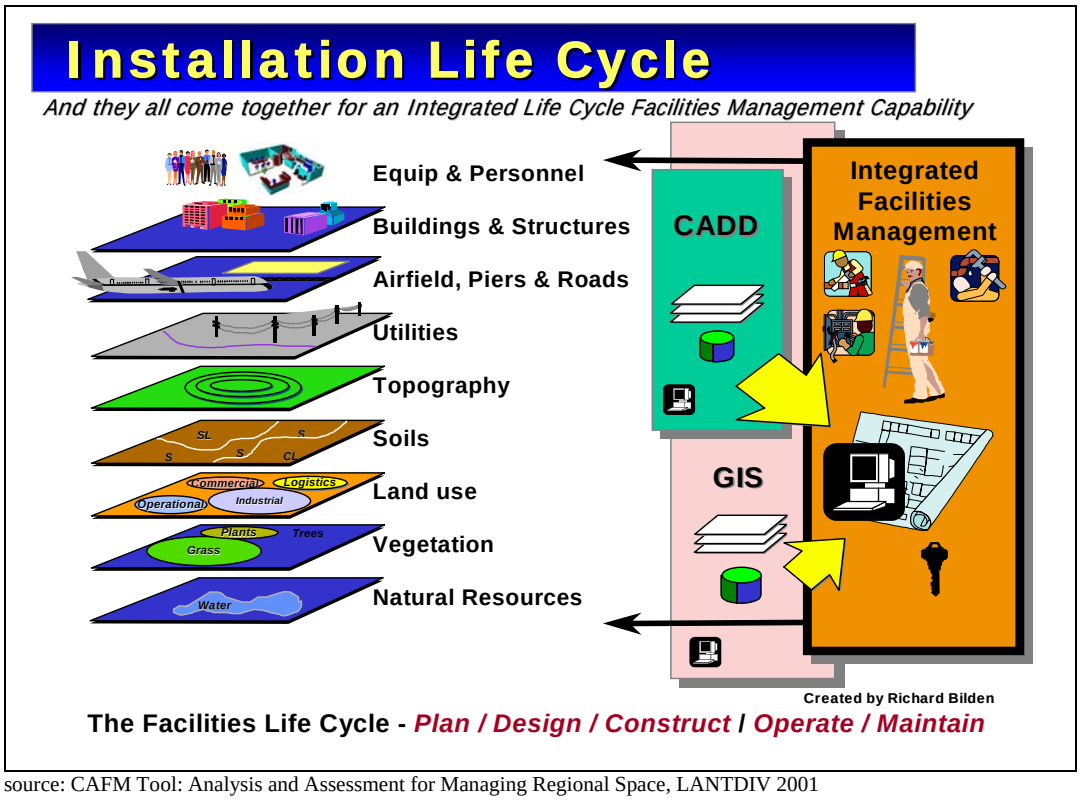


Figure 3: CADModule and FDViewer integrated existing enterprise databases

Broad Facility Management Application:

One of the key requirements was to incorporate the integrated life cycle facilities management capability which meant integration of land and facilities data and seamless access to a variety of base maps, building floor plans and room level detailed information.



source: CAFM Tool: Analysis and Assessment for Managing Regional Space, LANTDIV 2001

Figure 4 : Integrated Life Cycle Facilities Management

The scope of FM applications was also broad incorporating into one integrated system:

- Space Management – Current and Proposed
- Asset Management and Custodial Services
- Work Order Management and Emergency Service Management
- Area Development / Master Planning
- Data Maintenance & Verification

This broad range was atypical for Commercial Off-The-Shelf (COTS) Computer Aided Facility Management (CAFM) systems available and strengthened the case for developing a custom FIMS based on business requirements.

Choosing a GIS based rather than CAD based platform

GIS technology has had limited use in the field of facility management though this is likely to change in the future as the GIS industry expands. The display, analysis and query of spatial information capabilities of GIS technology integrates quite well with FM requirements, especially when CAD data is easily accessed in a GIS environment. On the other hand, environmental management and land planning activities at the base or military installation level has had extensive use of GIS. Both NSWC Dahlgren and NAS Patuxent River have comprehensive datasets in ArcInfo compatible formats, although the use of GIS had traditionally been in the hands of a few specially trained GIS technicians.

The need to integrate land and facility information into a seamless application along with the availability of a user-friendly, off-the-shelf ArcView GIS software helped make the decision to use ArcView as the end-user platform in developing the CADModule and FDViewer. The main advantages in this approach were:

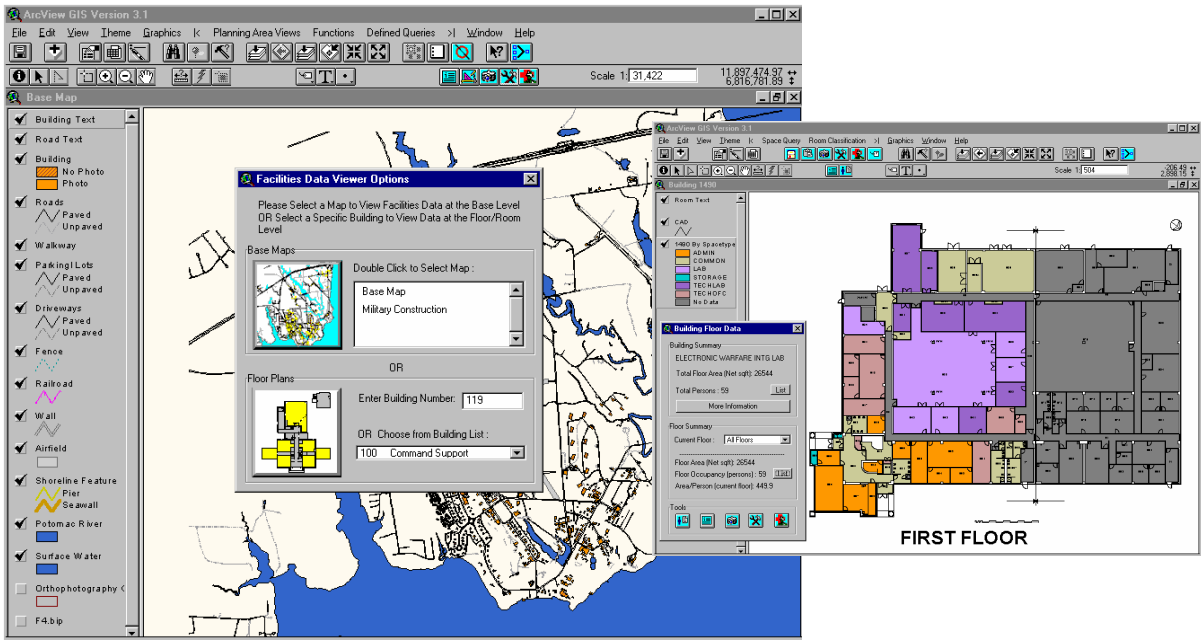
- Ability to view/query and edit GIS as well as CAD data
- User-friendly interface much simpler than CAD or ArcInfo
- Easy to customize UI with RAD tools using Avenue and Visual Basic languages
- Easy to link to external databases (SQL server connections)
- Lightweight application

Focusing on the User: Protyping, Tools and Features

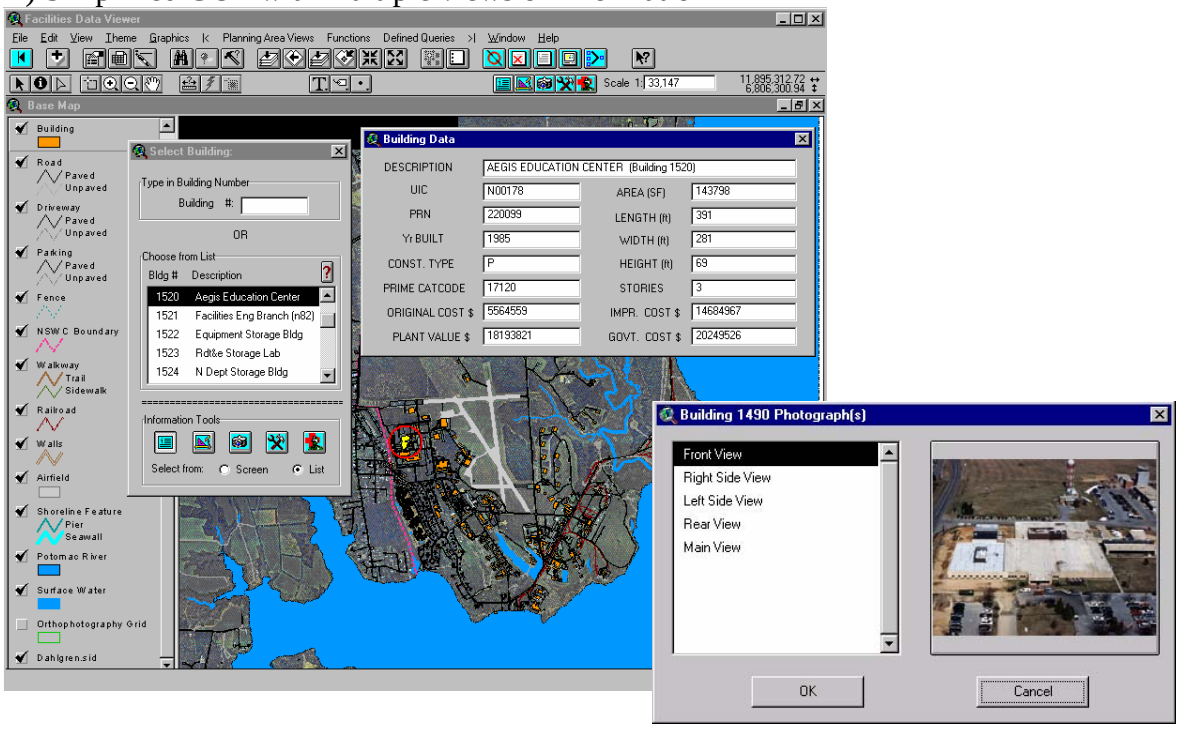
The development of CADModule and FDViewer placed great emphasis on the end-user input. A number of simple JAD (Joint Application Development) sessions helped in defining the basic GUI structure and emphasized Navy-centric language that was important to the users. Working with the user representatives helped minimize the learning curve for using the application at the time of implementation and more importantly, helped instill a sense of ownership of the application in the user group.

A number of key functions were implemented specifically tailored to the needs identified in the interview process and JAD sessions. The goal was to keep the application lightweight yet flexible to enhancement in the future. The following are some examples of key features:

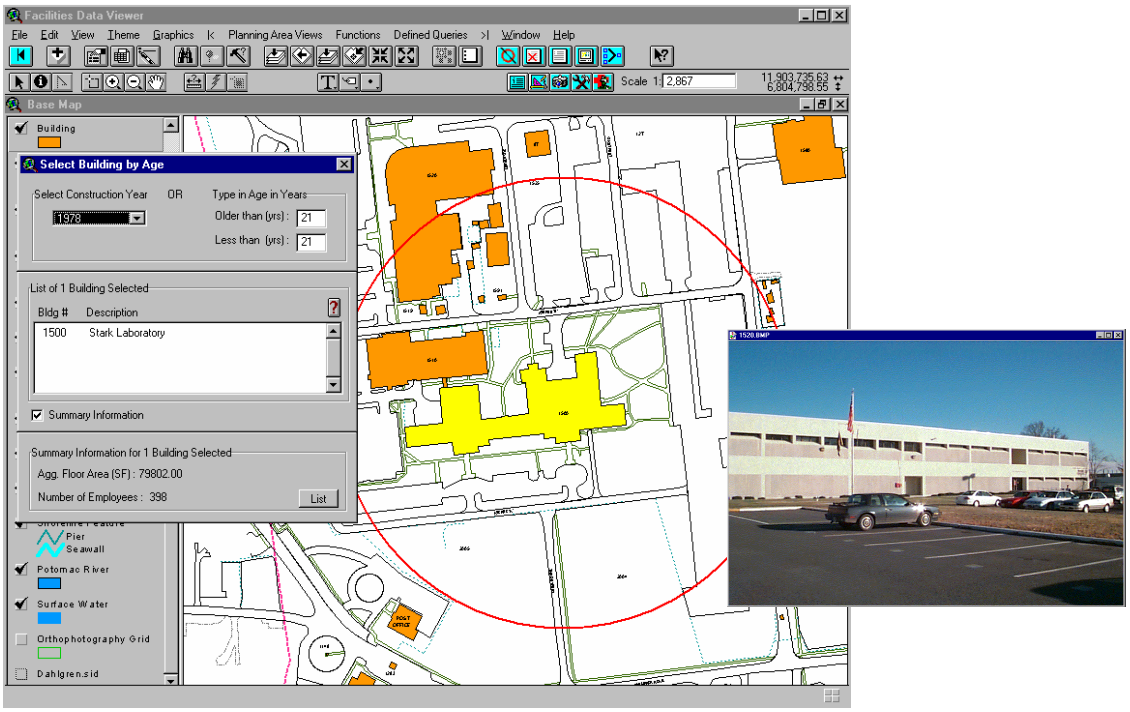
A) Seamless integration of Base level and floor-plan information in the same application:



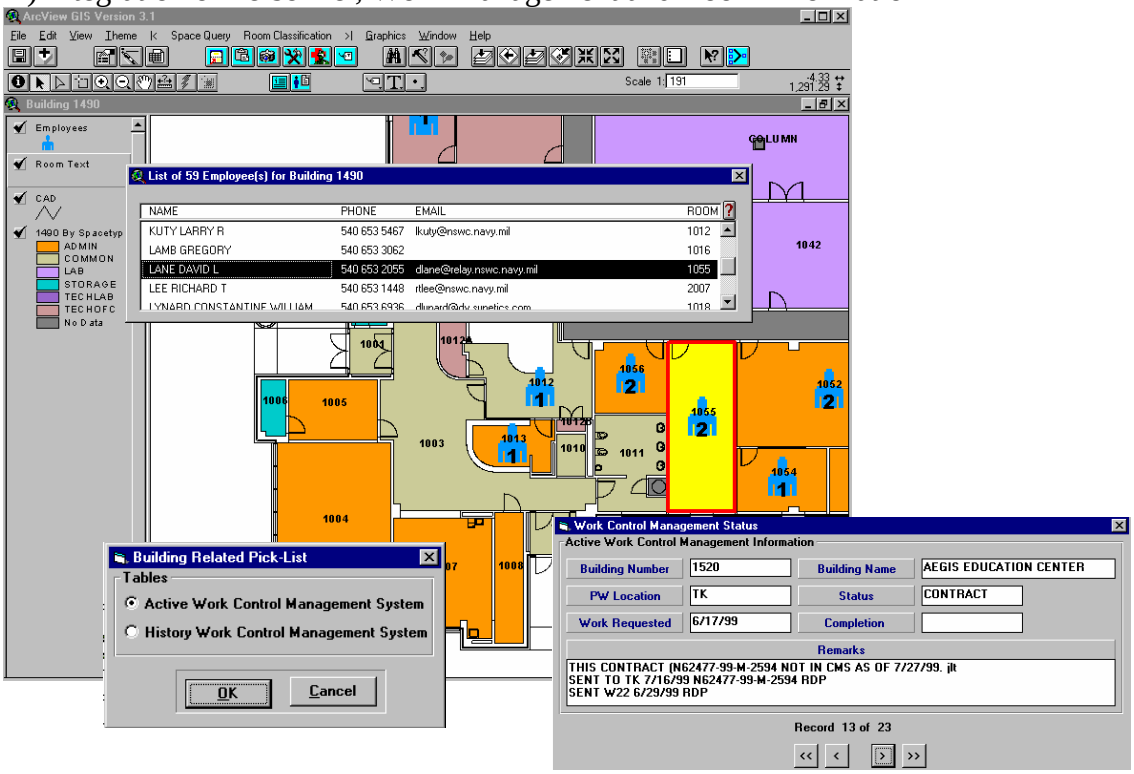
B) Simplified GUI with multiple views of information



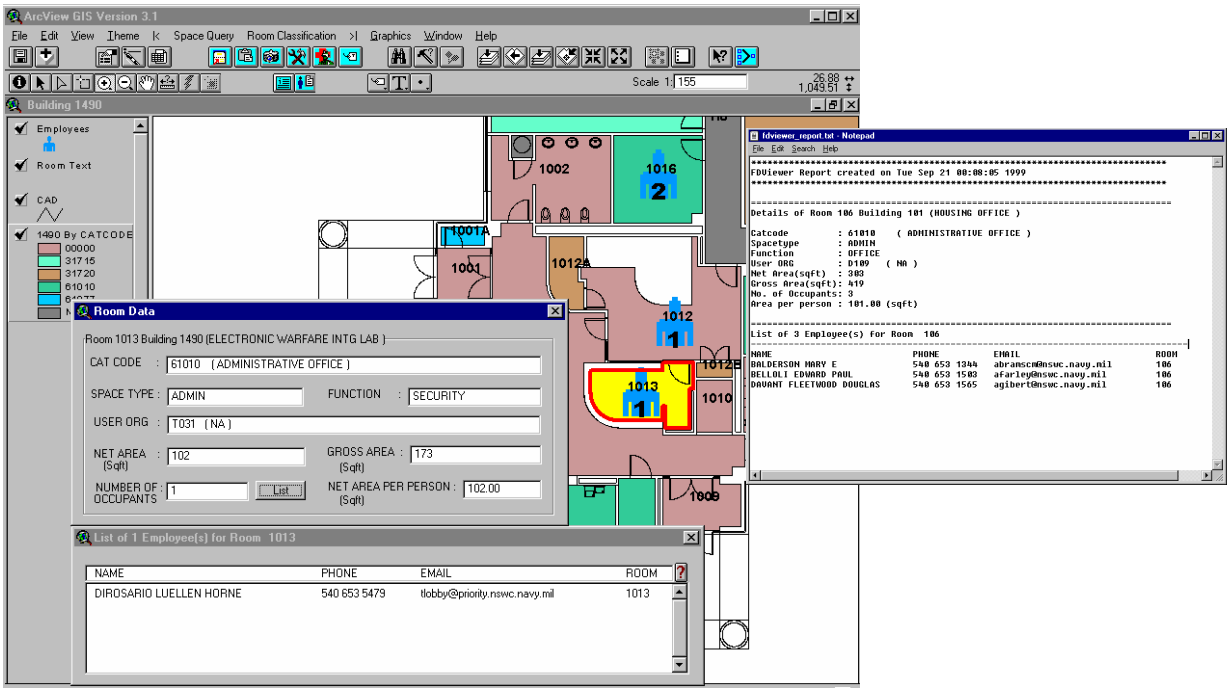
C) Interactive information tools along with custom queries



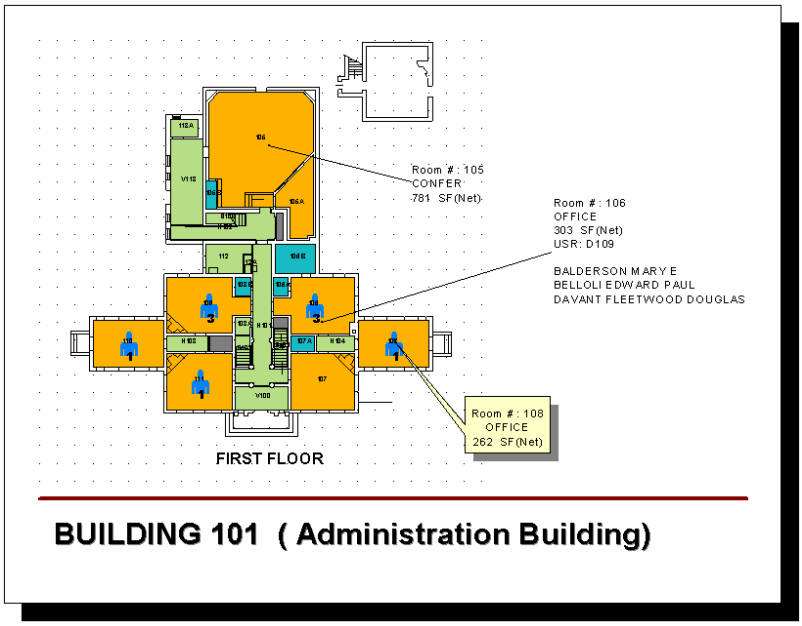
D) Integration of Personnel, Work Management and Room Information



E) Basic Metrics and Reporting Functions:



F) Interactive Labeling and Automated Map Layouts:



Evolution rather than Revolution into the Next Generation

Though it has been five years since their initial development, applications like FDViewer are still actively in use. The main reason for the extended lifecycle of the FDViewer application is that it fit the business needs and workflows of the users so well. Being a lightweight application that is easily modified, users have themselves made several enhancements and added functions over time without the involvement of the initial third-party developers. FDViewer was developed on a solid foundation of enterprise data (Space, Human Resources, Custodial, Project Planning, Land etc.) and business process integration – buzzwords that are common in FM systems today. Hence it was able to maintain relevance and currency. Obviously, there have been significant changes in technology since FDViewer was initially developed. ArcView GIS has evolved from 3.x to 9.x versions, CAD systems have become integrated with databases and there have been significant improvements in the Internet technologies. Having already embraced a relevant and well defined core functionality, the next generation of FDViewer, rather than process re-engineering, can focus on the following :

Embracing new technology :
Internet technology is now the current and future platform for FM. Undoubtedly the next generation of FDViewer will be internet based. Experts agree that the next generation of FM tools will continue to be internet based and will more likely involve GIS technology. Internet technology will also create the possibility to have 'smart' objects (equipment, bio-monitors, sensors etc.) feeding information directly into the FM databases. Having integrated GIS at the onset, FDViewer is already a step in the right direction. PWD Dahlgren has always been a leader in incorporating IT systems in its activities and has already been working on a prototype web-based next generation of its FM system. The new web-based system utilizes Arc-IMS internet mapping technology along with Microsoft's .net Framework. It incorporates most of the original FDViewer functionality and extends FM capabilities regionally across all the installations of the Washington Naval District. NSWC Dahlgren has also employed "smart building' technology with the utilization of the DDC (Direct Digital Control) system to remotely monitor facilities. This will be eventually integrated into the FM system.

Intelligent Business Metrics:
Facilities management is leaning to be more performance based than ever before and the collection, review, analysis and reporting of performance information is crucial to FM managers and other decision makers. CAFM systems need to be more than just facility-information storehouses and viewers but provide key business metrics that relate to strategic organizational priorities by utilizing intelligent computer models, trend analysis etc. The next generation of FDViewer will need to focus on reporting and presentation on a range of metrics and comparisons with benchmarks. Examples of some of these metrics are :

Space utilization per person or department
Occupancy rates
Cost per gross area.; cost per building vs. replacement costs
Energy use per building or per space type or per department
Maintenance backlogs per building; service call turn-around times

Conclusions

The success of FDViewer and CADModule was largely the result of using a business based rather than technology based solution. Using this approach resulted in increased Return On Investment (ROI) and longer duration in the application life cycle. Using a familiar and lightweight application platform such as ArcView GIS that was easy to use and to customize helped minimize the learning curve for the users and their involvement in the development process helped create a sense of ownership that contributed to its success. A summary of the lessons learned would include:

- Do have an overall vision and plan as a guide; carefully consider business processes using FM rather than a technology solution that forces a change in established practices.
- Use a risk based approach to define requirements, don't aim for the ultimate do-all solution
- Don't aim to create more work than you need to – focus only on those tools & metrics that you really need
- Take small bites and build from small successes
- Don't forget the human factor – well designed GUI's, respect for established workflows and culture are crucial to success
- Aim for Evolution rather than Revolution in life cycle planning

Though the use of GIS in facilities management and the integration of land and facility into one application were tried for the first-time, this proved to be a successful model. The significant advancement of GIS technology since the development of CADModule and FDViewer can only make it easier for future FM systems to be GIS-based rather than CAD-centric especially for those systems requiring a holistic view of land and facility information together. New technologies such as ESRI's ArcObjects based ArcGIS Server will make it easier to integrate GIS into internet/web-based applications. The incorporation of 3D visualization capability into the core GIS functionality is also an exciting area that can bring GIS-based FIMS to a new level of use. GIS technology is more than ready for FM - It is up to the FM industry to embrace GIS in a more substantial way.