

## *GeoBase Space Utilization System*

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### ***Abstract***

The dynamic nature of Air Force base organizational composition and facility lifecycles offers unique challenges for base community planners, facility managers, and civil engineers. This paper discusses a set of applications developed with Davis-Monthan GeoBase. These tools allow the decision makers to better manage organizational realignment issues.

The foundation for any intra- or inter-base organizational moves is verified organizational data and current floor plans. Creating, evaluating, and presenting the compositions and layouts of realignment scenarios are the next critical steps in moving an organization into its new surroundings. This set of applications helps decision makers visualize their ideas and successfully turn them into a reality.

### ***1.0 Installation description***

Davis-Monthan AFB is located approximately 2,600 feet above sea level in the Sonoran Desert of southern Arizona. The base occupies 10,613 acres of Pima County within the city limits of Tucson. As the second largest employer in the Tucson area, D-M has an annual regional economic impact of over \$1.1 Billion.

The clear, sunny skies and hot, dry weather, which typifies the vast majority of days in southern Arizona, make D-M an ideal environment for Air Force flight training, while simultaneously serving as a long-term storage and maintenance facility for aircraft.

### ***1.1 Current mission and history of installation operations***

The City of Tucson, in its fascination with flight, built its first recorded municipal airport in 1919. The "city fathers" endorsed the selection as a site for an Army Air Base, and in 1925, the city proceeded to build a second airfield for this purpose using construction guidelines provided by the U.S. Army. The Army declared this second airfield suitable for military operations on 6 October 1925.

The Army did not station units at D-M until 1 April 1941. The first units were squadrons of the 31st Air Base Group, and on 3 December 1941, the base officially was named Davis-Monthan Field. Shortly after the Japanese attack on Pearl Harbor, two bombardment units from D-M deployed and entered the war. During the remainder of World War II (WWII), D-M was a center for training B-24 and B-29 flight crews.

After WWII, D-M served as a personnel out-processing center and as a storage location for excess aircraft, a mission which continues today under the management of the Aerospace Maintenance and Regeneration Center (AMARC).

The 355th Tactical Fighter Wing (now the 355th Wing - a composite organization) relocated to D-M on 1 July 1971. It was responsible for installation host activities for 10 years, when the 836th Air Division was activated and assumed those duties. The 836th Air Division was inactivated in May 1992, and the 355th Wing again assumed responsibilities as the host unit.

## ***2.0 GIS Application***

Two tool sets were developed to aid decision makers with the organizational reconfiguration process - the Field Tool and Space Utilization Tool. The tools aid in the two major steps in an organizational redistribution process. The first step is to verify the as-built floor plans and collect organizational data with the Field Tool. This tool helps the field collector verify the floor plans, collect organizational data, and report any discrepancies to an Engineering Assistant so changes can be made electronically.

The second step in the process is to create scenarios with the Scenario Builder in the Space Utilization Tool. These scenarios can be compared side-by-side with the existing conditions to help in the resource allocation process. The tools were created with ArcObjects using the ArcGIS 8.3 platform.

### ***2.1 Needs analysis***

A comprehensive process evaluation took place to obtain a better understanding of all of the contributing components in the organizational reconfiguration decision making process. There are two primary components of this process: obtaining a clear understanding of the current configuration and finalizing what the new configuration will be.

It was identified that four departments are involved in the data collection process for a space utilization request from the Deputy Base Civil Engineer's (DBCE) office.

- Real Property collects organizational data and is the primary contact that works closely with the DBCE through the course of the decision making process.
- Production Control runs the Facility Manager program which has responsibility for maintaining the Building Manager list and current as-built floor plans for each facility on base.
- Maintenance Engineering Drafting is responsible for maintaining a digital version of the as-built floor plans.
- GeoBase just seemed to get caught in the cross fire.

The organizations typically involved with the decision making process are the Deputy Base Civil Engineer, Real Property, Base Community Planner, Facility Managers and the leadership of the organizations impacted by the changes.

In evaluating the individual contributions to the data gathering process, it was apparent that portions of the process were not being properly maintained. This forced other groups to compensate for the absence of information and incur additional workload. Additionally the most current data was not always being utilized and a duplication of work was taking place to deliver the current picture. Often the base needs to respond quickly to unexpected opportunities forcing a short turn around for the space utilization data request. The rapid response nature of the data collection request is an underlying need that we designed this tool set to meet.

In evaluating the components of the decision making process, it was found that hard copy blueprints of floor plans were the standard means of documenting the process. The hard copy floor plans were being used in organizational data collection, manual square footage calculations, scenario discussions in the field, and throughout the consensus building process. In the consensus building process there would be a significant amount of translation of the decision makers' notes on the hardcopy plans into new plans for review, at which time the process was repeated.

It was determined that working through the decision making process with an up-to-date digital floor plan and collecting the comments and changes in organizational configurations in a digital format would save a great amount of time and resources. This tool set was designed for higher level decision makers to be able to use with a minimal amount of training to be able to evaluate multiple scenarios. A potential solution could be quickly distributed to all of the members involved in the process.

## ***2.2 Design***

This tool set is designed to support the existing workflow at Davis-Monthan. The tool set was developed within the software and hardware systems of the Civil Engineering Squadron at Davis-Monthan. This required the tool set to work with the SDS compliant ArcSDE data layers, CAD supported floor plans, and ArcMap (ArcInfo and ArcView) 8.3 object models. These tool sets were developed as stand alone .dll's with clean interfaces offering only the tools that the end users will need to complete their tasks.

The data collection effort requires a moderate level of technical capability in setting up the database and .mxd's correctly so that the end users of the products, the building managers and the decision makers, can utilize these resources with a minimal level of technical knowledge.

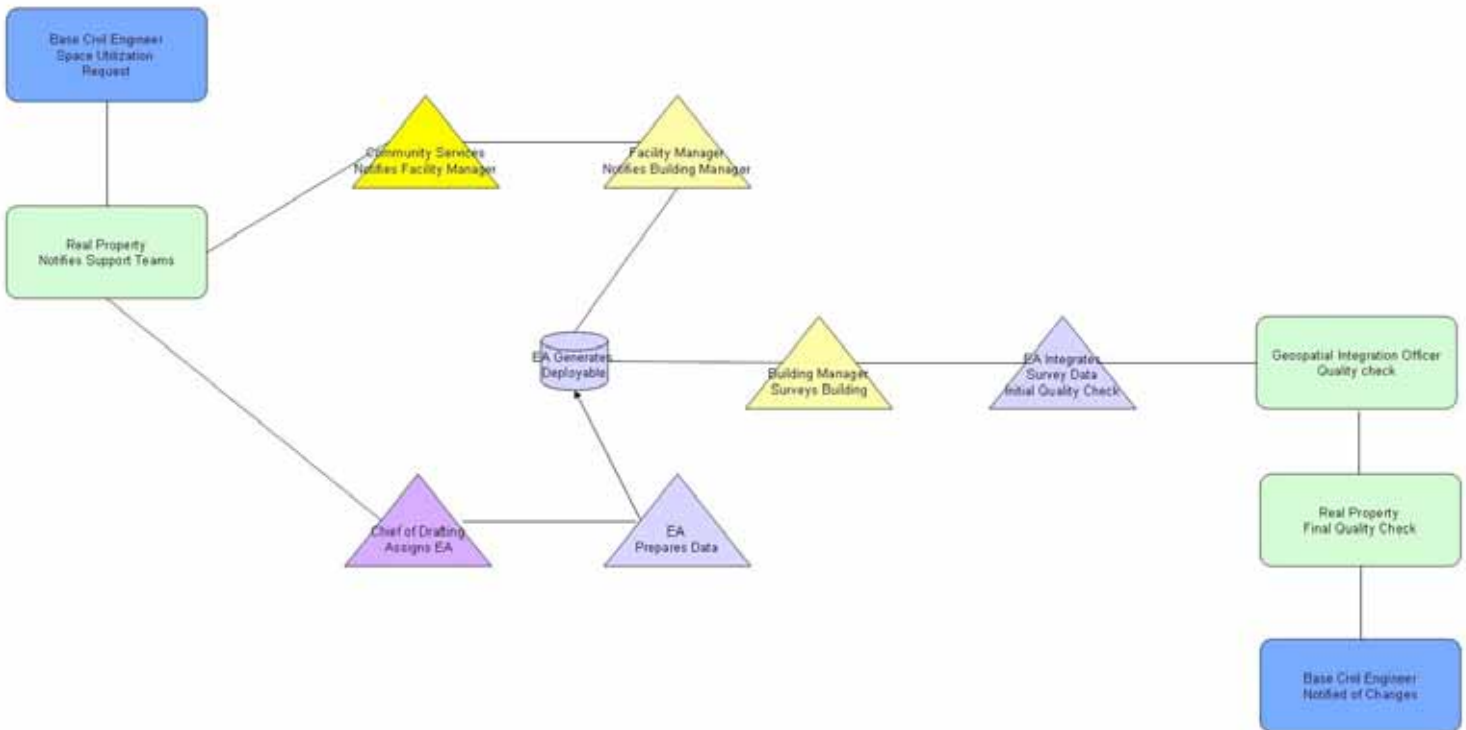
Some of the organizational data that needs to be collected does not fit within the SDS compliant database and needs to be maintained outside of the system in an Access database (orgutil.mdb). The orgutil.mdb is linked to the SDS compliant data in ArcSDE via a unique identifier for each room based on a concatenated value representing building id, floor id, and room id. Additionally the as-built CAD floor plans need to be correctly imported into the SDS compliant database with the rooms blocked out as polygons.

### 2.2.1 Conceptual Design

In working through the needs assessment, the following workflow was identified as being the most effective means of collecting clean data across the entire base. The data collection flow chart illustrates the roles of all of the parties involved in the process. A key component of the work flow is relying on the building manager to collect information on their building. It was identified that this available workforce required a nontechnical tool set and a support structure to ensure quality data is collected for the decision makers.

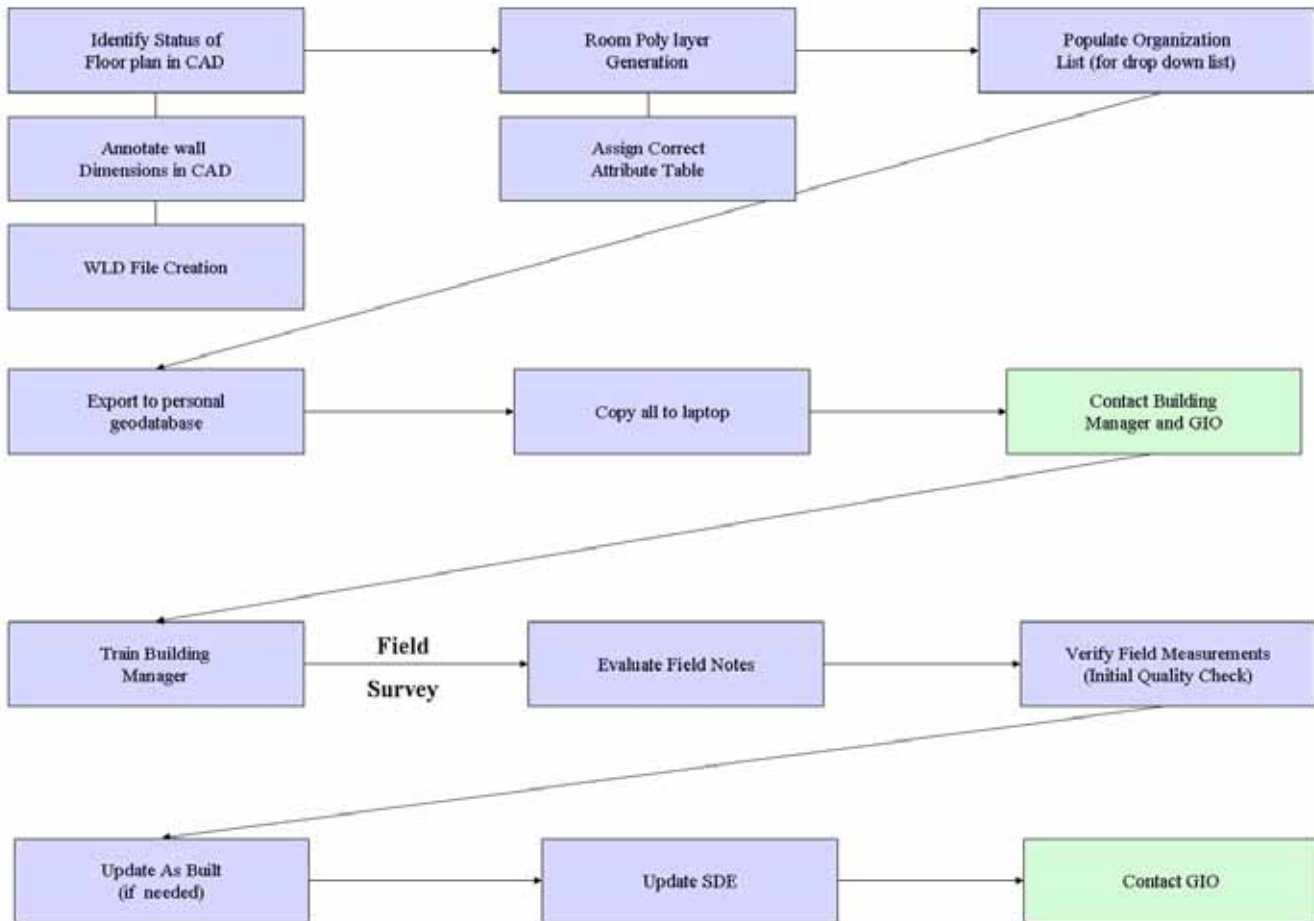
The majority of the individuals associated with this process primarily do not have a technical background, from the data collectors to the decision makers. The tools are designed with these nontechnical end users in mind.

### Proposed Base Space Utilization Data Collection Flow Chart



A major component of the support structure for the building managers and ultimately for the base's decision makers relies on Engineering Assistants (EAs) performing the backend data structuring and cleaning. The EAs will use existing CAD software, Microsoft Access, and ESRI's ArcCatalogue. An extensive handbook was developed to step the EAs through the process of preparing the data for the field collection process and integrating the field input for use by the decision makers. The following flow chart identifies the EA's responsibilities.

## EA Responsibility Flow Chart



### 2.2.2 Interface Design - Field Tool

The field tool is a simple interface that supports inventory data collection on a laptop computer. This application allows for the organizational classification of room polygons. Additionally it allows the user to place points or lines on the floor plan layer that can be associated with a note about the feature. This note tool is intended to be used for indicating discrepancies between the electronic floor plan and the real world. The note description is entered into the table on the right side of the screen.



In order to attribute a room's organizational composition, the user selects the "Classify" tool and clicks on a room on the floor plan. The record in the table on the bottom of the screen is selected and the user can then classify the organizational data from a drop down list.

**Organization Classifier:**

Room ID	Room Type	Organization 1	% Utilization	Organization 2	% Utilization	Organizational
U04	Office	12 AF	50	355 CES	50	
105	Office	355M-GS	50	355 CES	50	
U01	Office	355M-GS	50	355 CES	50	
U02	Office	355M-GS	50	355 CES	50	
U03	Storage Warehouse	355M-GS	100		0	
101	Office	355 CES	100		0	
102	Office	355M-GS	100		0	
106	Office	355M-GS	100		0	

**Building Description:**

Select Your Floor:  1  2  3  4  5  6

Current Floor:

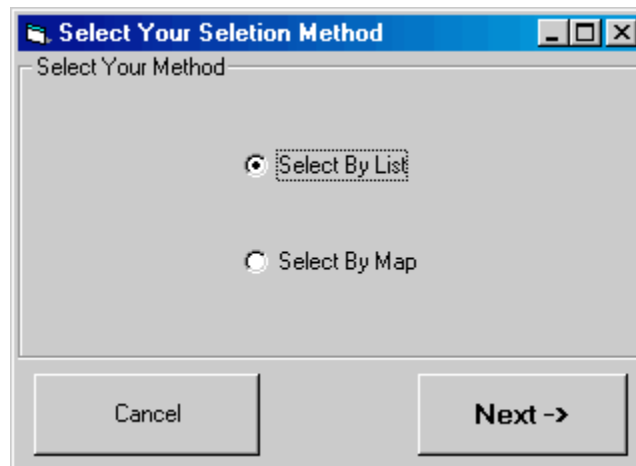
Building Name:   
 Facility Manager Name:   
 Facility Manager Phone:   
 Last date of Verification:

This tool is designed to be very rudimentary so that a novice user can start collecting data after a 10-minute orientation. Additionally the tool can be easily adapted to collect inventory data on other room characteristics by simply adding a data field to the table.

Once the tool is returned from the field, the EA can click on the "Generate Report" button. This initiates a Crystal Report template to generate a single report for each floor inventoried showing the locations of the notes, and their associated descriptions allowing easier review of the digital floor plan.

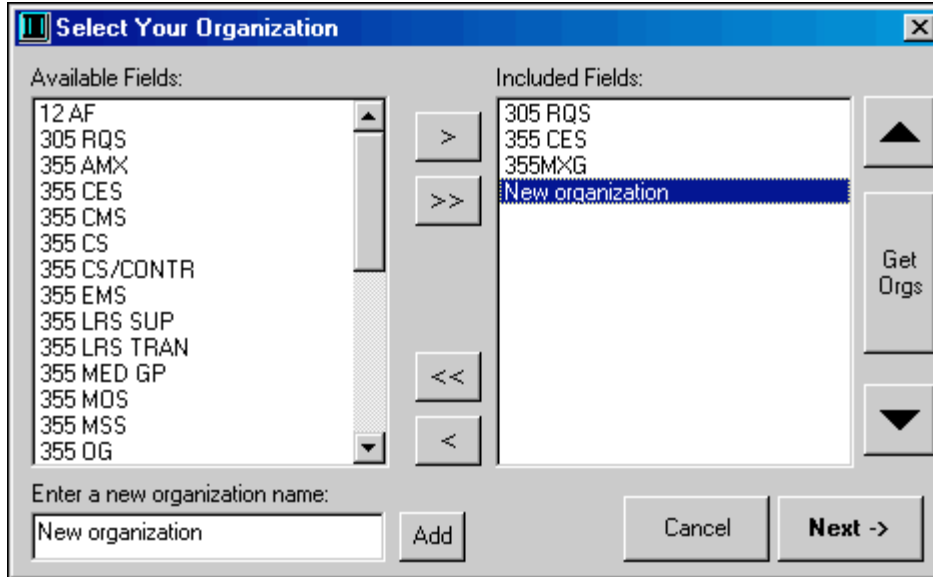
### ***2.2.3 Interface Design - Space Utilization Tool***

The Space Utilization Tool has a similar interface design to assist decision makers in creating and modifying organizational configuration scenarios. When the user opens the program they are directed to select the buildings they are interested in evaluating. The buildings can be selected either by a list or through a map interface.

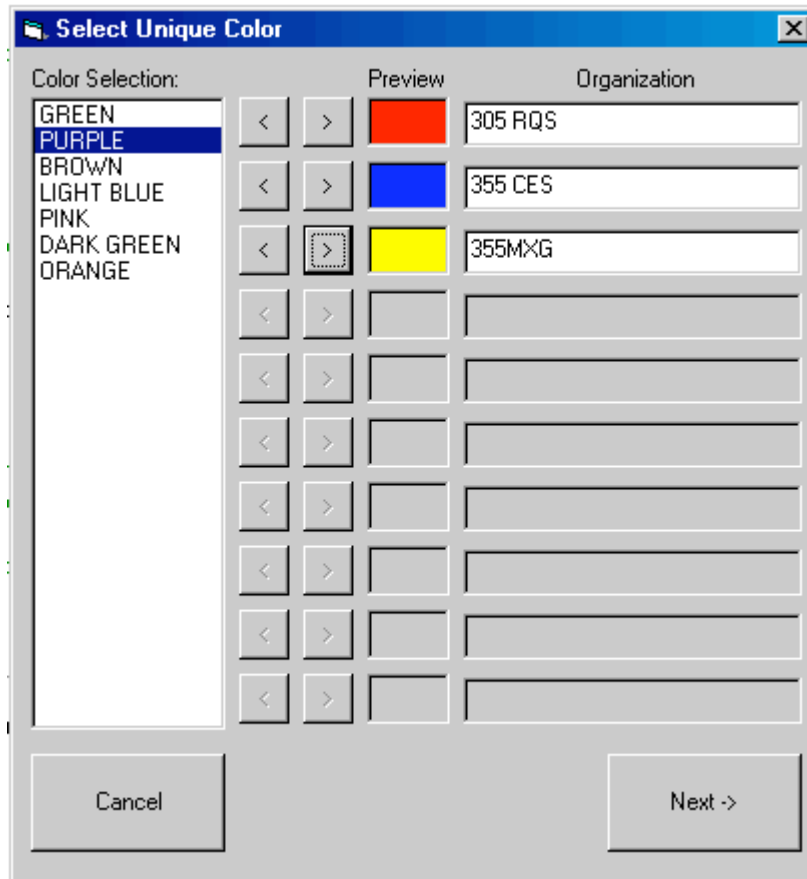


Once the buildings are selected, the user is directed to select the organizations that are going to be involved in the restructuring. This list will be the drop down list used in the scenario creation process. The user can select the "Get Orgs" button to include the organizations that are currently associated with the selected building set. The user can select an organization from the list of all of the organizations on the base. The user can also add a new organization that does not currently exist on the base in the bottom left corner of this window. Once the organizations involved in the restructuring process are identified, they can be ordered according to relevancy in the restructuring process with the arrows on the right side of the window.



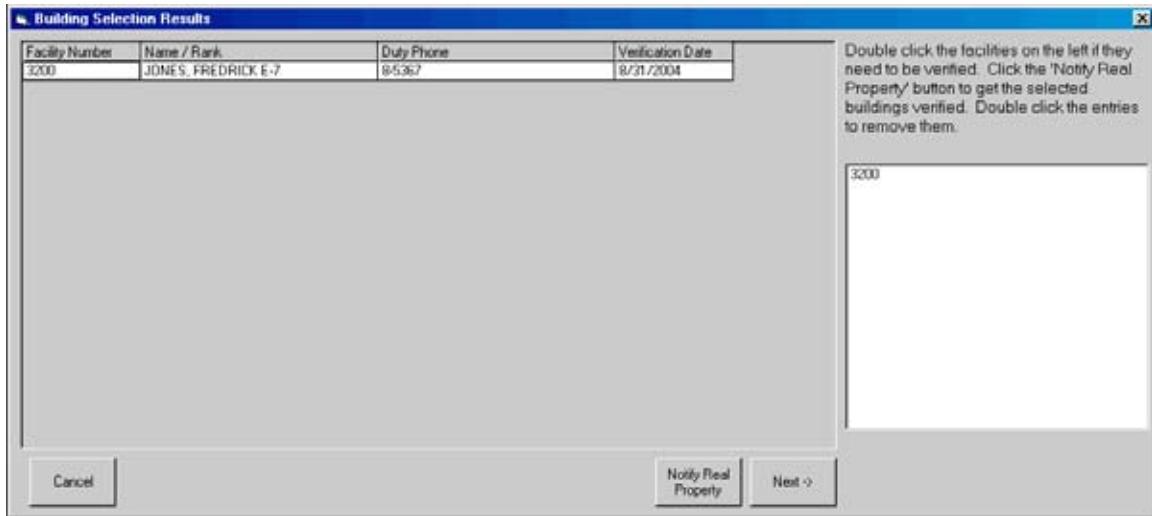


Once the organizations are selected, classifying colors needs to be established. Classifying an organization's color establishes a consistent symbology to be used during the scenario creation process and in evaluating the comparison report.

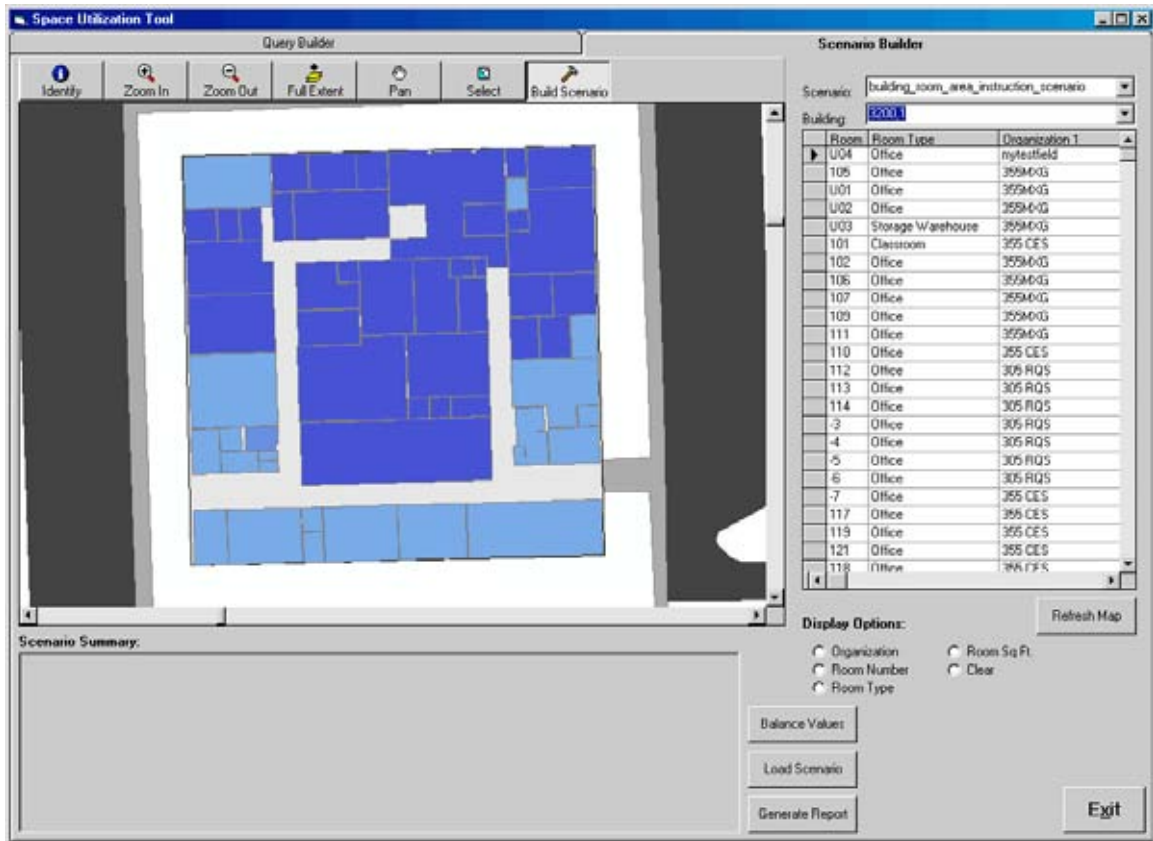




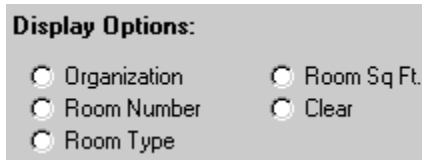
The next step of the process evaluates the Facility Manager database to see how recently the organizational data was updated for the selected buildings. This window allows the user to evaluate the last revision date and identify whether or not it is current enough or if a field data collection effort needs to take place. If it is decided that the data needs to be updated, the user can select the desired building record and click on the "Notify Real Property" button. This will send an email to the appropriate individuals at real property. The context of the email and the addresses are in an established text file on the users C drive.



If the data is current, the user then proceeds to the workspace.



Here the user can view characteristics of the existing conditions of the buildings through selecting different display options on the Scenario Builder tab:

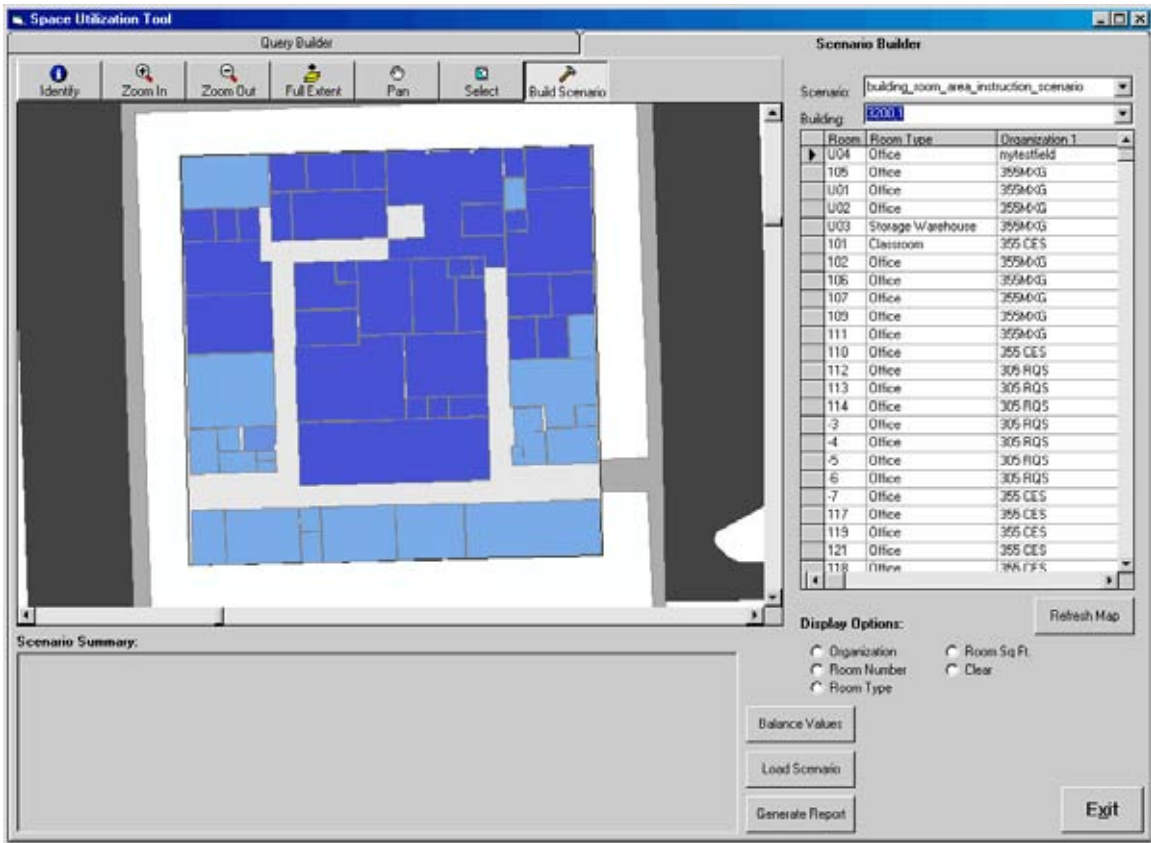


Or the user can select the Query Builder Tab and select different reports that provide information on the existing conditions to get a better understanding of the current organizational layout. Additional reports can be created in Crystal Reports and added to this interface by clicking on the "Load Report" button.

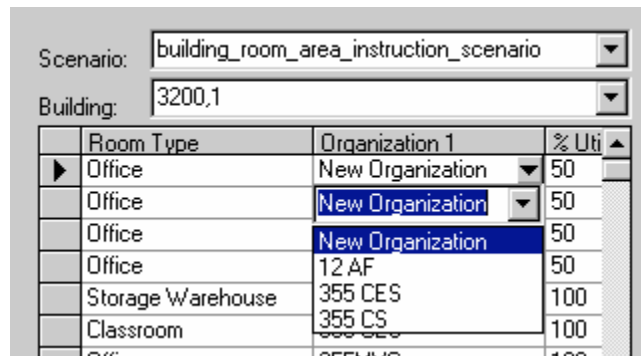
The screenshot shows the 'Space Utilization Tool' interface. The 'Query Builder' tab is active. On the left, there is a list of reports to view: 'cb\_current\_bld.rpt', 'cb\_current\_bld\_fr.rpt', and 'cb\_existing\_conditions\_bld.rpt'. A 'Load Report' button is located below this list. The main area displays a report titled 'Square Footage of Organizations by Building for Current Layer'. The report contains a table with the following data:

	3200	5313	Total
	146,351	28,714	175,065
305 ROS	12,299	0	12,299
355 CES	21,343	6,074	27,418
355MXG	7,471	1,104	8,576
mytestfield	56	0	56
Total	187,920	35,893	223,813

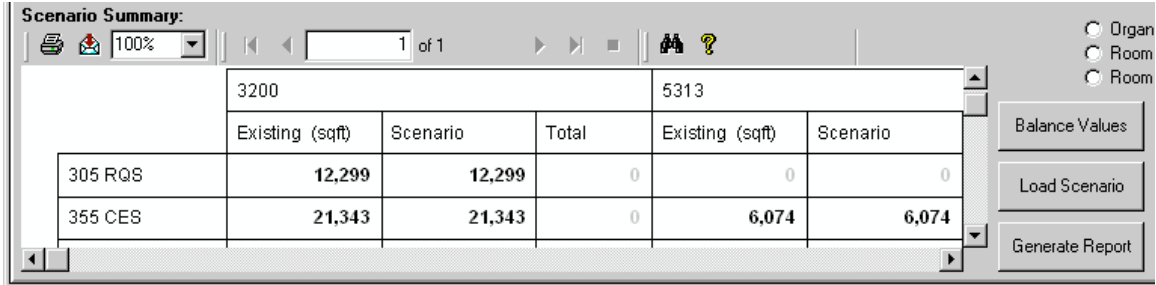
By going back to the Scenario Builder tab, the user can click on the "Build Scenario" button and start evaluating the implications of potential changes.



With a new scenario created, the user reclassifies the rooms to reflect a new occupant by selecting the organization from the drop down list in the table on the right side of the window.



Once some of the alterations have been made the user can run a balance report and evaluate the impact the changes have made on the overall organizational distribution across the multiple buildings. This report can be viewed on the lower corner of the window.



The screenshot shows a software window titled "Scenario Summary". At the top, there are navigation icons, a zoom level of 100%, and a page indicator "1 of 1". Below this is a table with two main columns for building numbers "3200" and "5313". Each column has sub-columns for "Existing (sqft)", "Scenario", and "Total". The table contains two rows of data:

	Existing (sqft)	Scenario	Total	Existing (sqft)	Scenario
305 RQS	12,299	12,299	0	0	0
355 CES	21,343	21,343	0	6,074	6,074

To the right of the table are three buttons: "Balance Values", "Load Scenario", and "Generate Report". At the top right of the window, there are radio buttons for "Organ", "Room", and "Room".

If the user has made all of the changes needed for this Scenario, the user can share the new configuration with colleagues. A comparison report can be created by clicking on the "Generate Report" button.



This button will produce a .pdf visually comparing the existing condition and the scenario condition floor plans. The balance table showing the changes in the square footage across the organizations and buildings is attached at the bottom of the individual floor comparison sheets.

**Space Utilization: Existing vs. Scenario Comparison**  
 Scenario Name - CES Move Option A

Building: 3200 Floor: 1 Existing Condition      Building: 3200 Floor: 1 Scenario



	3200			5313			Total
	Existing (sqft)	Scenario (sqft)	Total	Existing (sqft)	Scenario (sqft)	Total	
12 AF	56	56	0	0	0	0	0
305 RQS	12,299	10,994	-1,305	0	443	443	-862
355 CES	21,343	24,260	2,917	7,179	6,738	-443	2,474
355MXG	7,471	5,860	-1,612	0	0	0	-1,612
Total	41,170	41,170	0	7,179	7,179	0	0

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Total	41,170	41,170	0	7,179	7,179	0	0
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### ***2.3 Implementation***

Establishing the work flow proposed in this project required the refinement of a few processes. The Facility Manager database needed to be updated to accurately portray the Building Manager contacts at the buildings across the base. Production Control dedicated personnel to cleaning this database and establishing a new Facility Managers program that would ensure the maintenance of this dataset.

The electronic or hard copy status of the building floor plans was established. A priority list was developed that identified which building floor plans were going to be evaluated in the near future. An over hire has been brought on and is dedicated to generating the as-built digital floor plans for the buildings on base.

Three training sessions were conducted with the EAs and their supervisors in which the elements of the handbook were discussed. Additional training sessions on the use of the Field Tool were conducted.

A series of hands-on training sessions with the Space Utilization Tool took place. The first training session involved the production team - GeoBase and Community Planning personnel. The second training session included the first class members (the production team) and a larger set of users - Real Property personnel, a Group Facility Manager, and upper level Civil Engineering personnel. The final session introduced the working version of the tool to the Deputy Base Civil Engineer. This small session only included the Deputy Base Civil Engineer, the Community Planner, and the Geo Integration Officer.

### ***3.0 Future Expansion and Potential Applications***

It was established in the early stages of the development process that this tool is a basic inventory and analysis tool set that can be modified at a later date to incorporate other inventory processes. In generating a solid as-built picture of the base, many applications can be supported with minor adjustments to this software.

Once organizational data is collected at the room level across the entire base, distribution of the electrical bills can more effectively be associated with energy consumption based on floor area. Floor covering data can be collected that supports the development and evaluation of existing and future maintenance contracts. It was also identified that this tool set would be helpful in collecting the locations of the Communications Squadron's com-ports.

### ***4.0 Conclusion***

This project evaluated the steps involved in bringing an accurate picture of organizational distribution across a number of facilities on base. A few steps in the process needed some attention and simply required an updating of databases. Other steps in the process however, needed to be reworked and redefined.



The tools were developed to assist the steps that needed redefining. The Field Tool assists in creating the current picture in a digital format. The Space Utilization tool allows for a faster turn around on analyses of organizational restructuring scenarios, and the output of .pdf comparison reports provide a more efficient means of communicating an individual's concept to all of the group members.

The most valuable component of this project is the renewed commitment from Davis-Monthan to establish digital as-built floor plans that contained organizational data. This proactive step of data generation and maintenance better prepares GeoBase in addressing requests as they arise.

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