Infrastructure Data Management
Using ArcGIS and Hansen

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Purpose
We are here to discuss the process of achieving a complete and current asset inventory in the Computerized Maintenance Management System to record asset management activities.

Facts
The City of Virginia Beach is located on the eastern coast of Virginia. With a population of 432,423, it is the largest city in the state of Virginia and is the 39th largest city in the United States.

The Virginia Beach Department of Public Utilities mission statement is:
"To provide public water, including water for fire protection and public sanitary sewer, to the urban areas of Virginia Beach."

Some quick statistics about Virginia Beach's Utilities are:
- 1,365 miles of water lines
- 168 miles of water mains
- 1,949 miles of sewer gravity mains
- 392 sewer pump stations

Hansen Information Technology
Hansen was founded in 1983 and has grown to become a leader in government software applications. What began as a mission to help government agencies track and maintain their assets, has grown into a global company of more than 225 employees with solutions for asset management (water, sewer, storm, transportation), work orders, preventive maintenance, land management, citizen relationship management, utility billing, financials, and GIS integration. Hansen systems are installed in 12 of the 15 largest agencies in the U.S., including Austin, Chicago, Las Vegas, Louisville, Philadelphia, San Antonio, New York, and of course Virginia Beach, as well as in Johannesburg, Melbourne, the UK, and across Canada. Hansen's headquarters is in Sacramento, CA and has offices in London, Sydney, Melbourne, and Ontario Canada.
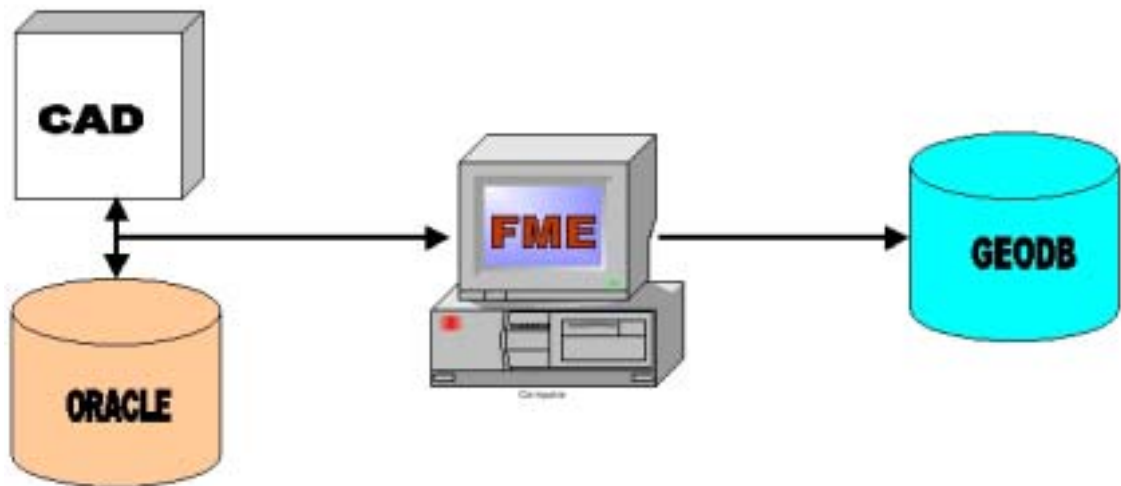
The 2003 Hansen Power Users survey revealed that Hansen systems are maintaining…

Service Requests Resolved	6,987,073
Initiated Work Orders	19,512,194
Completed Work Orders	18,496,166
Total Sewer CCTV Readings	4,302,301
Manhole Inspections	446,460
Sewer Mains	2,188,488
Sewer Manholes	2,154,760
Water Mains	1,002,404
Water Meters	2,273,826
Water Valves	1,105,700

History/Improvements

The Department of Public Utilities has been a full service GIS bureau since 1994. Public Utilities provides mapping for all water and sanitary sewer assets within the city's limits. The City of Virginia Beach has been a Hansen client since 1997. There were attempts in the past to try to migrate GIS data into Hansen for work order processing, scheduled maintenance, customer service, and eventually activity-based accounting. These attempts fell short of providing a complete and current record of the assets we had in our GIS, but our GIS did not provide for all the operational record keeping and scheduled maintenance. In essence, we had two systems not communicating or integrated in any means.

Since 1994 the Public Utilities GIS had been maintained in an MGE platform. On top of this modular GIS environment was a customized program called Map Maintenance. Map Maintenance was created from a combination of Visual Basic, .mdls, and pearl scripts to create a rule based CAD environment before such a thing existed. Many of the rules and behaviors found in Map Maintenance are now out of the box in ArcMap. This customized system made it very difficult to do analysis or model data, or to synchronize with Hansen. A modular system such as this was not flexible for changes of any kind. FME or Feature Manipulation Engine has made it possible for Public Utilities to extract out the water and sanitary sewer data and convert it into a format that can work easily with both ArcMap and Hansen. Below is a simple diagram showing the conversion of this data.

The Geodatabase structure was a major part of the success of this project. FME facilitated the creation of fields to help synchronize the two systems. Another major part of this process was ArcObjects. Without the ability to script inside of ArcMap natively this process would have taken more time to create. ArcObjects gave Public Utilities the ability to take the point features (manholes, valves) on the ends of every main and place those Unitids into the corresponding fields required by Hansen. Creating a buffer at the end points of every line segment is how this process was completed programmatically.

The code was based off of the digitized direction of the line. Below is a quick example of this:

In June of 2002, Public Utilities purchased Hansen's GeoAdministrator software, an ArcGIS extension. This solution helped to facilitate the migration of over a half million assets into our Hansen system, where work orders and preventive maintenance could then be managed properly. Before this integrated GIS tool, work orders could not be processed properly because we did not have a thorough inventory of our utility system in the CMMS. The small amount of information that did exist in Hansen was either incorrect or not up to date. This was caused by not having a synchronization tool in place for the two systems. Long hours were spent filing through paperwork to find the exact work order needed to complete a task. With the time and resources available to the Department of Public Utilities it was not possible to manually enter over a half a million assets into Hansen. Only a fraction of the inventory was available to Hansen users before the purchase of the GeoAdministrator.

Because of the success of this project the Department of Public Utilities has saved both time and money with regards to asset inventory and work management.

The time savings can be seen by performing a simple "Look up" in Hansen and finding a complete work order history associated with any water or sanitary sewer feature. The cost savings can be seen in the reduced amount of man-hours it takes to complete a service request. This process has also helped Public Utilities attain a new level of quality control. To be able to find discrepancies in our inventories and correct them is priceless for those who use our data every day. Many private and public organizations use the City of Virginia Beach's Utility information to tie in new subdivisions, clean pipes, or perform rehabilitation work.
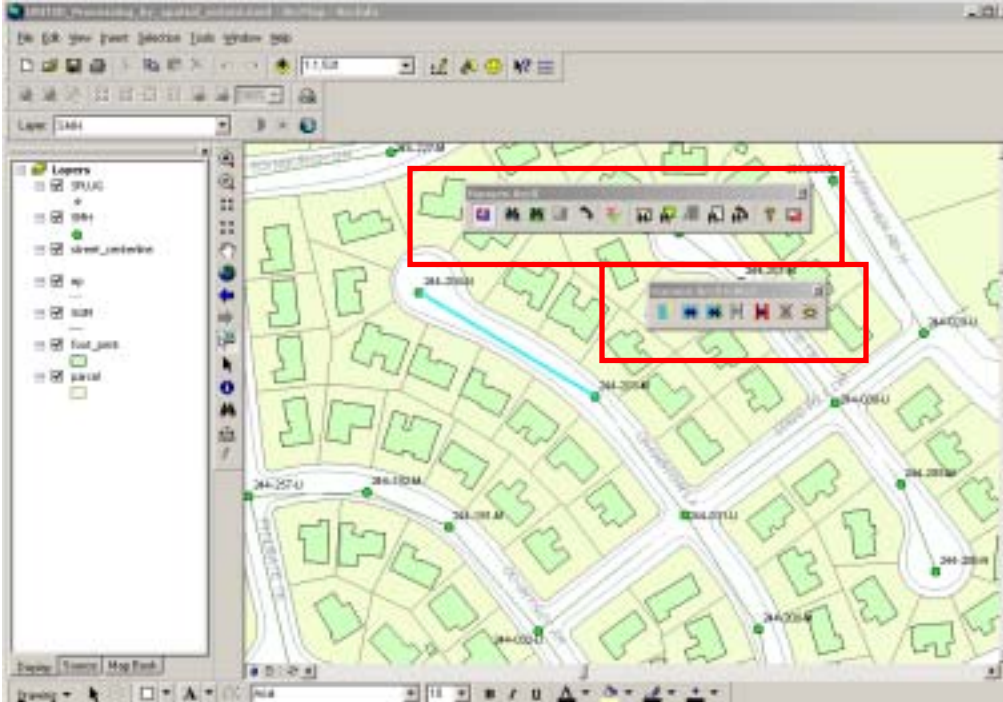
The Process
In the past all GIS data had been maintained in a non-ESRI environment. All information had been drafted in CAD drawings with unit IDs and attribute information attached. This process has made it very hard to perform any type of analysis, much less provide updated GIS information into an asset management system such as Hansen. To provide this data in a geodatabase format that will work with Hansen we use FME. FME stands for Feature Manipulation Engine. This software allows the GIS bureau to:
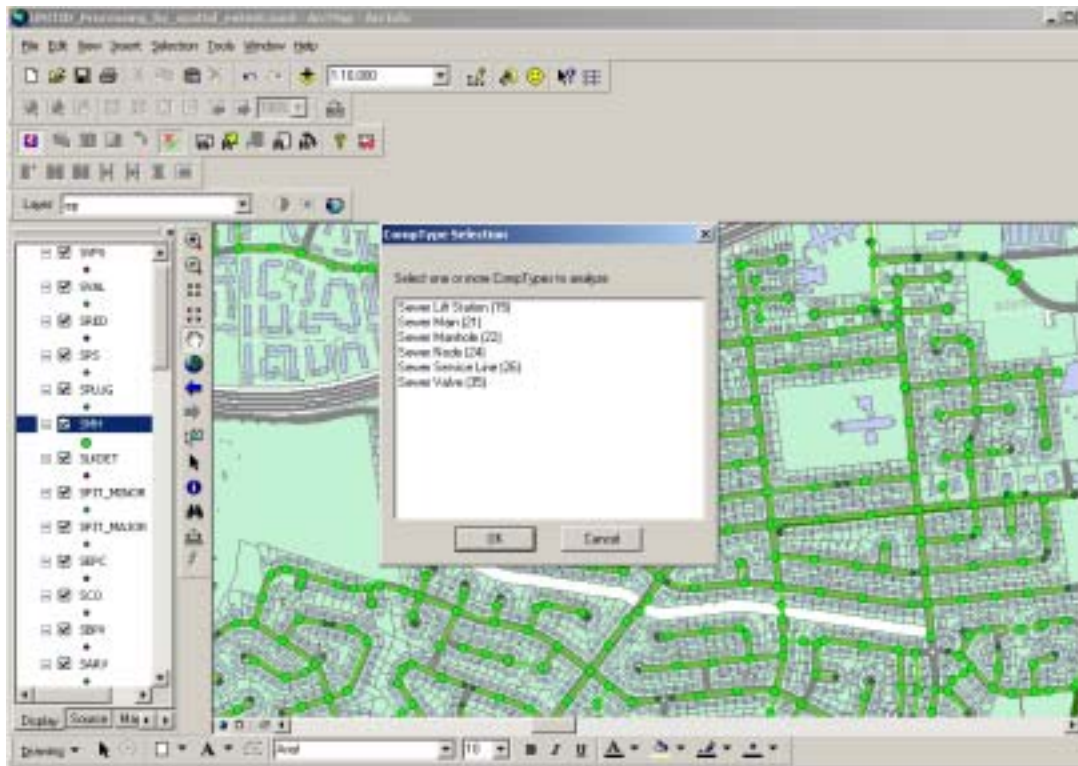- Create
- Concatenate
- Change data types

Certain fields have to exist in your data for it to migrate successfully into Hansen. These fields are:

- Comptype
- Compkey
- Unitid
- Unitid2 (linework)

FME allows all utility data to be pushed into an ESRI compatible format, as well as, add the Hansen fields. This process is assembled into a batch file for automated creation. Once the geodatabase was created it was time to synchronize the data with Hansen.

The "Analyze and reconcile database links" function goes through each feature class in our map document and analyzes the asset type and unit ID to find which inventory the feature class matches in Hansen and makes the relationship link. If orphan geometry is found, this tool allows us to create asset inventory in Hansen. If orphan inventory is found a list is generated and we can drill down to find more details, then create geometry in ArcMap and link it to the inventory records quickly. Below is a screen capture of the QAQC process:
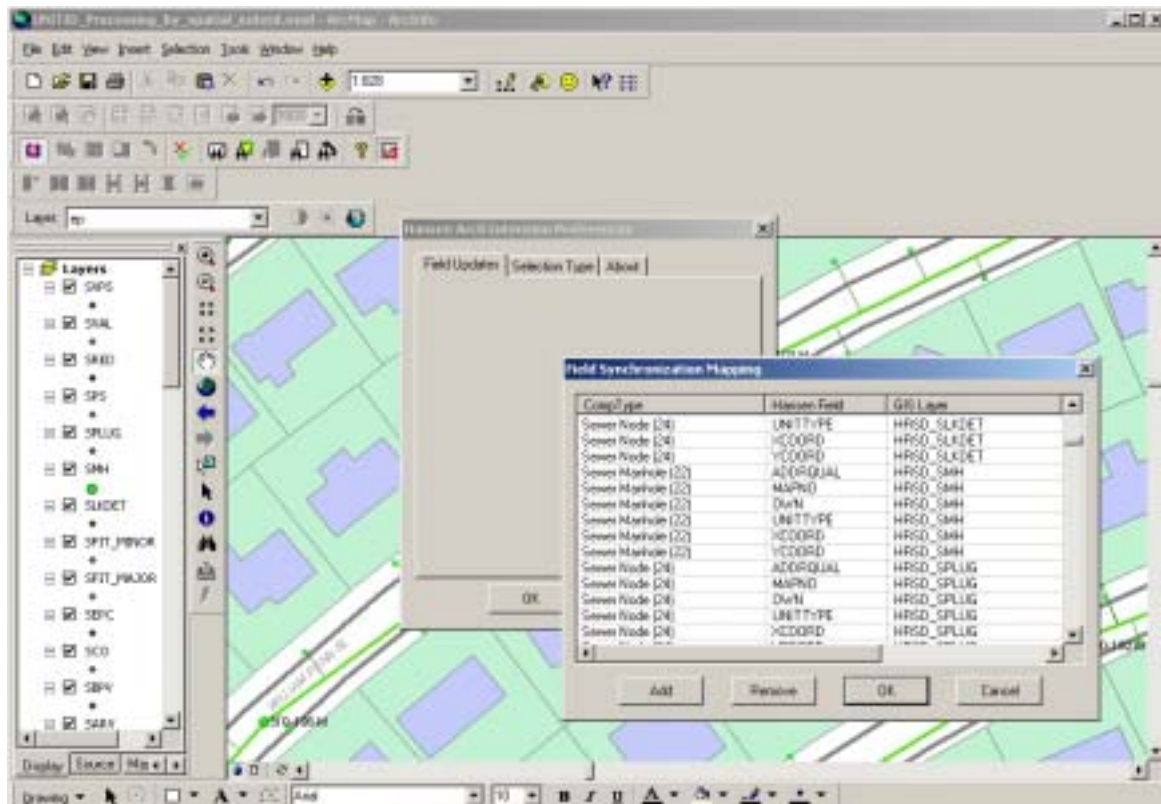
Once this process has been executed we are given a detailed list of the following:

- Orphan Hansen Assets
- Orphan GIS Features
- Changed Compkeys
- Bad Data

Orphan Hansen Assets are assets that exist in Hansen, but do not have a GIS feature associated with it. Orphan GIS features are the exact opposite. They are features that exist in your GIS, but do not have a Hansen record associated. The Changed Compkey tab shows the user where you may have assets in both systems (same ID), but different Compkeys. Because Hansen can be run with or without GIS integration, unique identifiers are generated by the relational database management system. It is the Compkey that is the main link between a Hansen asset inventory record and all of the work orders, service requests, scheduled maintenance, groups, and of course the geometry. The Changed Compkeys tab gives the user the option to correct the "changed" compkeys. This will push the Hansen driven compkey into the selected feature class or shapefile.

The last tab is the Bad Data tab, which shows the user features that may have different Unitid's, but the same compkey. This tab also gives the user a way to pull these records up in Hansen, as well as, in ArcMap to repair discrepancies. One feature that makes the GeoAdministator a great tool that has helped the Department of Public Utilities is the ability to export the information found in the previously discussed tabs in a detailed list of discrepancies that are used by GIS technicians and Hansen administrators to clean up the two systems.
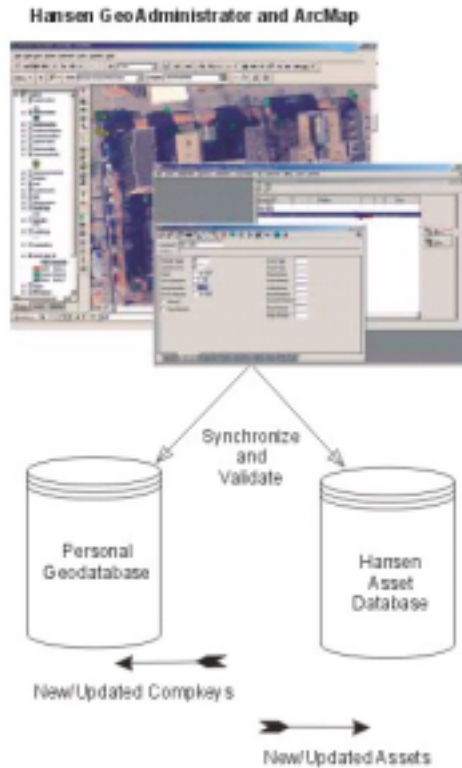
Once the features have been created from the GIS to Hansen it is time to push down the "secondary" or supporting information. Examples of this information would be the diameter, material of a manhole. With the GeoAdministrator we have been able to populate many of these fields in Hansen. It gives non-GIS Hansen users the ability to quickly write quality work orders without having to bring up GIS information every time. All of the pertinent information is on the Hansen inventory form. Below is a screen capture of the dialog box that appears when the user selects to synchronize data between Hansen and GIS.

In the case of the Department of Public Utilities, all of our data resided in the GIS, again, originated from CAD. We needed to push these attributes into Hansen. GeoAdministrator can push attributes to Hansen or from Hansen to GIS. If you look at the above image you can see which GIS layer corresponds to which Hansen layer. It also shows the Hansen field name that will be populated.

GIS and Hansen field names do not have to match in order for this process to work. A good rule to follow is to have your migrating fields match as to minimize confusion on larger datasets. The user will only have to do this once per feature class. Once the fields the user wants to push have been matched it is time to run the synchronization. The GeoAdministrator gives the user the ability to push only selected features of the entire feature class. Once the user has their selected set chosen the "Synchronize Database Fields" button needs to be toggled. The user will have to make the choice of whether to push data from Hansen to the GIS or from the GIS to Hansen. The Department of Public Utilities currently only pushes from the GIS to Hansen, but this may change in the future. When that time comes we have the ability to do so.

The last step in this process for us is to migrate the compkeys back into the MGE environment.   This can be done using update statements in Microsoft Access using an ODBC connection to our MGE server. Using the MSLINK as the unique identifier it is a straight push of the updated compkeys. Below is a simple diagram showing this process:

The success of this project can be easily measured by the amount of information now in the Hansen system, as well as the increased response time by staff to the public's needs. The Department of Public Utilities would not have been able to do this without the use of ArcMap or the GeoAdministrator. To be able to perform analysis and migration on the entire utility system from the desktop has proven to be extremely beneficial been for our inventory and work management process.