

## BIOGRAPHICAL INFORMATION

John Beets  
Senior Consultant  
GE Energy/PII Pipeline Solutions

### Specific Responsibilities

Joined GE Energy in 1994. Provides high-level technical support services to both the sales and project execution functions of the Integrity Services (IS) organization of GE Energy/PII. Mentoring of implementation and project management staff on GIS/data management and pipeline integrity related technical issues and software usage. Monitoring the development of relevant governmental regulations and industry standards in order to determine impact on current and future software products and relevant services. Works with the GE Energy/PII sales team in the development of sales presentations, responses to bids, and closing of sales opportunities.

### Past Experience

GIS Project Manager, City of Kansas City, Missouri, 1991-1994  
GIS Analyst and Forest Resources Inventory Supervisor, Westvaco Corporation, 1982-1991  
Research Associate and Instructor, University of Missouri-Columbia, 1980-1982

### Educational Information

B.A. – Geography, University of Kansas  
M.A. – Geography, University of Kansas

### Professional Memberships

GITA

## BIOGRAPHICAL INFORMATION

Jay Smith  
Senior Consultant  
GE Energy/PII Pipeline Solutions

### Specific Responsibilities

Joined GE Energy in 1992 and now works as a Data Management Consultant for Transmission Pipelines. Primary responsibilities are GIS project consulting, developing functional specifications, and providing high-level technical support services to both the sales and project execution divisions of the Integrity Services within GE Energy. He works with the GE Energy/PII sales team in the development of sales presentations, responses to bids, closing of sales opportunities and develops customer sales presentations based on a thorough understanding of client needs, available software capabilities, and necessary workflows.

### Past Experience

GIS Pipeline Implementation Manager, Cramlington, UK, 2004-2005  
ArcGIS Pipeline Data Model (APDM) Technical Committee, 2003-004  
ISAT Data Model Technical Committee, 2002-2003  
Research Associate, University of Missouri-Columbia, 1990-1991

### Educational Information

B.A. – Geography, University of Missouri

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# WORK MANAGEMENT SYSTEMS INTERFACE WITH GIS

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## ABSTRACT

As GIS expands and becomes more mature, companies are investigating other opportunities with regards to utilizing the data within other aspects of the organization. Operation departments are utilizing now or researching ways to perform work management using several of the existing current applications or sometimes building their own. Because these two systems contain a high degree of overlap with regards to the facility information, integration of these two key systems is attractive and many companies are or will be looking to perform this work shortly.

There are several existing work management systems currently in use within the pipeline industry, just as there are also different types of GIS'. All of these various combinations of interfaces face the same challenges:

Which system maintains which information?

How do the systems interact?

What are the workflow consequences and what must change?

What other major issues occur during implementation?

These questions will be answered and specific examples will be presented detailing results of specific research and investigations. The various work management systems that are available will not be compared, but will be presented as to some of the more specific requirements for interaction with a GIS.

### Terminology

As with most other computerized information technology areas, a number of acronyms have developed related to both GIS and work order management. To avoid confusion we will attempt to define and describe those relevant to this topic:

GIS – Geographic Information System. We will use the following, general definition of GIS obtained from the OPS National Pipeline Mapping System standards document: “Computer hardware, software, and geographic data used to capture, store, update, maintain, analyze, and display graphically referenced information.” (U.S. DOT, 2004)

WMS – Work Management System. This software solution organizes work assignments and provides mechanisms to track each assignment throughout complicated work flow processes.

CMMS - Computerized Maintenance Management Systems. CMMS usually consists of a hardware solution and a software package that allows an organization to manage the maintenance of equipment and facilities. Use of a CMMS package should improve

productivity, lower overall operating costs, and store valuable information about maintenance functions in an organization.

FAMS – Facilities Asset Management. The same definition as CMMS. Also known as EAM or Enterprise Asset Management.

Not considering GIS, our opinion is that there is considerable overlap between the definitions provided above. To maintain simplicity, we will utilize the WMS acronym while discussing systems targeted at asset and work order management. A linkage between a GIS and a WMS is desirable to aid in the management and tracking of compliance related assessments and repairs to pipeline assets. In reference to integration of GIS and WMS within the pipeline industry, ESRI makes the following observation:

“Operations and maintenance personnel comprise a crucial component of the overall pipeline team. These staff must conduct a significant amount of work order management, routine and preventative maintenance, emergency maintenance, and various inspection activities. Geographic selection and display tools available in GIS software can help to visualize planned work, recurring maintenance problems, ongoing activities, and historical information.” (ESRI, 2005)

#### Examples of WMS Usage in the Transmission Pipeline Industry

As in many other industries, WMS is being utilized for various forms of asset and work order management. This section will provide illustrative examples of WMS usage within the transmission pipeline industry:

Compliance monitoring of valves and other OPS monitored facilities provides a good illustration. Federal regulations require that valves and other facilities be inspected for correct operation on a regular basis. A transmission system may have tens or even hundreds of these facilities that must be inspected. Automation of the operator’s maintenance and testing program utilizing WMS can greatly simplify what might otherwise be a monumental task.

One-Call ticket management provides another good example. Most pipeline operators in the US participate in One-Call centers in the states in which they operate. A One-Call center takes calls from individuals or entities planning an excavation. The caller provides information on where the excavation will take place, typically in the form of an address or public land survey location, but GPS coordinates are starting to be more regularly accepted. Underground utility operators in the area are then notified of the pending excavation. Many operators have GIS based One-Call software systems, which are utilized to map the location of the excavation and determine potential impact on their assets. These systems are particularly useful where pipeline systems traverse highly urbanized areas in which the operator can receive hundreds of excavation tickets every day. One-Call systems normally contain a WMS capability with which to track work orders generated in cases where a One-Call ticket is near the operator’s assets. The system can generate a work order, help the operator track the dispatch of personnel to the excavation site, aide in monitoring the excavation, and follow through with close out of the work order.

A more recent development and one of great current interest is the planning and tracking of integrity assessments to identified HCA segments. Following is a quick synopsis of the steps required for compliance with 49 CFR Part 192 Pipeline Integrity Management in High Consequence Areas:

1. Pipeline GIS database provides the data repository required for HCA/risk/integrity analysis
2. GIS is utilized to perform HCA segment identification
3. Threat analysis identifies threats to HCA segments (external corrosion, internal corrosion, third-party damage, etc.)
4. Risk analysis allows ranking of top 50% segments within HCAs
5. Based on threats and pipe segment characteristics, assessment techniques are assigned, creating a Baseline Assessment Plan
6. Segments are scheduled for assessment. If a linkage is in place, GIS can be utilized to generate maps of planned work, current work occurring in the field, and completed work.
7. Assessments are performed
8. Repairs scheduled and performed
9. Results of assessments and repairs updates GIS database
10. The operator must be able to document their performance in regards to their integrity program.

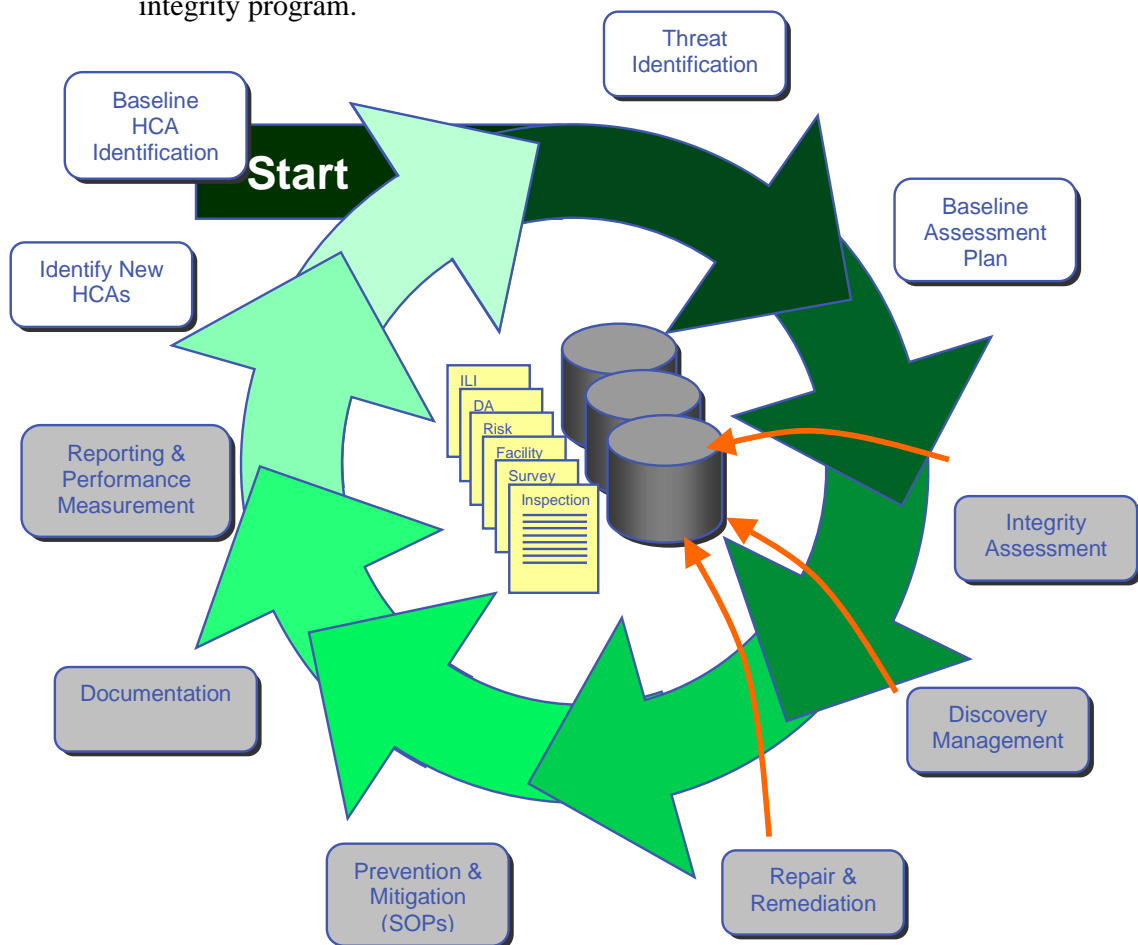


Figure 1

Figure 1 provides a graphic representation of the steps in the integrity management process that can be followed to comply with the OPS regulations. WMS provides capabilities that can be quite useful in the execution of the steps highlighted in gray in this figure.

### Major Applications for GIS in the Transmission Pipeline Industry

GIS is finding application in virtually all aspects of the operation and maintenance of transmission pipeline systems. Initial use of the technology in the industry came in the mid to late 1980's with the development of facility inventory databases linked to automated mapping systems. The mapping systems often utilized CAD software, but featured continuous (projection based) mapping capabilities. Important early applications of these systems were facilities (asset) management and automated alignment sheet generation. Other application areas include:

1. ROW management
2. Tax analysis
3. Marketing
4. One-Call
5. Class location analysis
6. Risk/Integrity Analysis, including HCA generation

Risk/Integrity is now the most significant “driver” and is pushing the implementation of GIS within many companies. It is also a major factor in the drive to integrate the capabilities of GIS and WMS.

### Why Integrate GIS and WMS

We would like to propose that the ability to store and manage the spatial location of features and the resulting mapping capabilities has naturally led to GIS being a foundation technology upon which other applications are either built or integrated. The advantages of developing a seamless linkage between the two technologies are self-evident. GIS generated displays/maps allow users to view/query the location of past and present work orders. The spatial distribution of future maintenance requirements can be viewed as required. It becomes possible to visualize HCA segment integrity assessments for the up-coming year and see where mitigative measures have been taken. With the appropriate GIS data layers available (such as a detailed street centerline), routing capabilities (available in most GIS systems) can generate cost effective, time saving route schedules for performing preventive maintenance or integrity assessments.

### GIS and WMS Integration Issues

There can be considerable overlap with regards to the ability to store and manage facility information in both systems. In many organizations, GIS has become the focus of facilities data integration. With the maturation of facility maintenance and data integration tools in commercially available transmission GIS systems, it is reasonable to place this function with that software application. Maintenance of transmission GIS features can be a complex undertaking. Normally, a linear referenced centerline model is utilized, requiring sophisticated tools for the

performance of maintenance activities such as coating replacements, pipe change outs, and centerline reroutes. These types of tools are not likely to be found in generic WMS systems. In addition, numerous applications, such as automated alignment sheet generation, have been developed within the GIS environment, requiring efficient access to the rich base of information stored there. Duplicate information between the two systems should not exist and great thought should be given to reasons why certain attributes must be duplicated.

Integration of these two systems will require tight synchronization of features in both environments. Strict rules must be developed to identify which features must exist in both systems and control how they are created, managed, and edited. A common facility for identifying features across systems must be developed. Features in a transmission pipeline GIS system can be identified by spatial location, such as X, Y coordinate location or linear referencing. It is also not uncommon for GIS features to be assigned an ID, but it is often only an integer number unique within the particular feature table. A WMS will normally require the assignment of an asset ID that is unique across the enterprise.

Following are primary issues that must be considered in GIS/WMS integration:

1. Determine features to be tracked across systems. Examples:
  - a. Compliance related maintenance on valves, CP features, and other facilities
  - b. Repairs related to in-line inspections
  - c. HCA segments for integrity management
  - d. Incidents such as pipeline encroachments and leaks
2. Determination of unique asset/feature IDs. More likely assigned by the WMS software.
3. Synchronization
  - a. Actions triggered from one or both systems
  - b. Workflow updates including create, delete, and modify
  - c. GIS interface, WMS interface, or both?
  - d. Communication between applications
  - e. Push back from one or both systems to each other?

In recent years, considerable progress has been made in open standards development in an attempt to improve the way application integration is accomplished. The need to share data between legacy enterprise systems has led to the development of a whole new set of software tools. This new computing paradigm is commonly known as Enterprise Application Integration (EAI). According to SearchWebServices.com, "EAI encompasses methodologies such as object-oriented programming and distributed, cross-platform program communication using message brokers such as Common Object Request Broker Architecture (CORBA) and COM+....enterprise-wide content and data distribution using common databases and data standards implemented with Extensible Markup Language (XML), middleware, message queuing, and other approaches." (SearchWebService.com, 2003) These types of technologies are now being utilized to integrate GIS and WMS in a reasonably seamless fashion.

## Summary

The integration of GIS and WMS can provide pipeline operators with the ability to maximize the efficiency of their work operations. GIS routing software, for example, can develop optimal routes to work locations to minimize drive time, resulting in lower operating costs and considerable manpower timesavings. The new integrity regulations will require operators to perform integrity assessments and accompanying remediation/mitigative treatments to threatened pipeline segments in HCA areas. This work must be tracked on a potentially large number of segments for many years into the future. The intense data management requirements of risk/integrity systems are necessitating their development in tight assimilation with GIS. The ability to synchronize these systems with WMS can provide optimal benefits:

1. A one-stop shop for spatially organized asset management and control
2. An efficient platform for initiating and tracking work requests
3. Provision of a visual display of the distribution of work orders and asset features, thus reducing the possibility of duplication
4. Provide an enhanced environment for planning and scheduling functions

The implementation of GIS within a pipeline operator's organization can result in the development of comprehensive facility databases. GIS systems do not typically contain rich functionality for scheduling, managing, and reporting on asset management and work orders. Increasing demands for work order management, i.e., risk/integrity, are driving the need for comprehensive integration solutions between the two systems. The information management industry is recognizing the need for enterprise application integration in the development of open data and application standards such as CORBA, XML, and SOAP. Major GIS and WMS vendors can ease integration heartburn by providing general interfaces that are compliant with key standards.

## References

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