“TRENDS IN INTEGRATION BETWEEN GIS AND EAM SYSTEMS”

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Abstract:
EAM and GIS today is being conceived and viewed as one system that starts with planning, design, operations and maintenance throughout the asset life cycle. Still, a seamless integration between GIS and Enterprise Asset Management systems is an age-long struggle. This paper talks about tweaking the traditional cumbersome integration approach which uses a series of background data processors, database links and batch jobs and instead embracing the Service Oriented approach.

With the support from ESRI major EAM systems are quickly adopting the new service oriented approach and are not only providing plugins for spatial integration of data but are also becoming spatially aware. The integration is not just limited to assets but also for work order tracking, service requests and so on.

This paper also explores the spatial features that are provided by modern EAM systems and encourages organizations to embrace the service oriented approach to integrate their GIS and EAM systems.

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Introduction

A typical EAM system manages all aspects of asset management such as inventory, tracking, analysis and reporting of assets. It also helps in managing and tracking work-related information across an organization.

EAM systems provide a host of benefits to an organization which includes:

(i) Improved performance and life of assets
(ii) Tracking of asset condition and minimizing the asset maintenance costs
(iii) Improved workforce management and utilization
(iv) Decision support for vendor and contractor performance evaluations and material usage

In today’s era the spatial location of assets has become an indispensable aspect of asset and work management and many organizations have adopted GIS systems in their asset and work management workflows.

Spatially enabling asset data and implementation of a GIS system has the following added advantages for an EAM system:

(i) GIS helps in spatially tracking down all infrastructure assets
(ii) Work orders created in an EAM system can automatically fill in the location data for field crew to ensure that the job is performed at the correct location.
(iii) The knowledge of “where” also helps the supervisors and field crew plan their work more efficiently and reach the work locations using optimized routes
(iv) Real time GPS location combined with maps helps field workers to confirm that they are at the right location
(v) The analytical power of GIS can help organizations gain a better understanding of how the assets are performing
(vi) GIS really helps in dealing with emergency situations such as leaks
(vii) GIS provide spatial analytics and acts as a decision support system to plan new projects

However, achieving a seamless integration between the GIS and EAM systems has never been easy in the past and has often posed tremendous challenges to organizations. The traditional approach they used to adopt in integrating the two systems involved a lot of custom development, a series of background data processors, database links, ETL and batch jobs and a lot of housekeeping.

Fig: 1 – Traditional GIS-EAM Integration approach
This approach had many problems and disadvantages and a few are as listed below:

(i) Difficulty in tracking data edits and changes and maintaining synchronicity between the two systems
(ii) Considerable delays in data propagation between systems
(iii) Additional development and maintenance efforts
(iv) Lack of a unified view of data as GIS and EAM act as two independent systems

With support from ESRI major EAM software providers aim to simplify the process of integration by adopting a service oriented approach and providing inbuilt spatial capabilities thereby closing the gap between the two system of records.

**Service Oriented Approach**
This approach leverages the REST based services and capabilities provided by ArcGIS, such as Feature Services for editing and data synchronization, Workflow Manager Services to create data editing and verification jobs, Map Services for displaying base maps, Geocode Services for locating addresses, Network Analysis for Routing and Directions.

With the ability of modern EAM systems to interface with ArcGIS REST API’s and feature services using the ArcGIS Server’s published URLs, the EAM systems now support near real time, two-way synchronization of data and support both bulk and incremental transactions. Some EAM systems even provide support for ArcGIS Online web maps.

Fig: 2 – GIS-EAM Service Oriented Integration approach
The spatial plugins provided by modern EAM systems typically provide:

(i) A Spatial Configuration Module
- Configuration of Map and Feature services
- Mapping Feature Services to Asset Types
- Mapping of EAM and GIS Attributes, Domains and Subtypes
- Configuration of queries, filters, polling frequency or triggers
- Setting layer permissions for viewing and editing
- Configuration of geocode services and so on

(ii) A Map Viewer
- A map viewer within the EAM system adds a geospatial context and helps users dynamically visualize the assets on maps and the spatial relationship between assets and other features around them such as roads, buildings, utilities etc. making the integration seamless
- Some systems also provide geocoding, routing and the visualization and analytical capabilities provided by ArcGIS
- Users can search assets based on spatial location or based on attributes stored in both GIS and EAM systems
- Users can identify assets on the map and get a unified view of both GIS and EAM attributes. Querying and viewing data from relationship classes are also supported.
- Some systems are also providing editing capabilities as part of their Map Viewers. Even if an EAM user may not directly edit the location of assets, the editing capabilities can certainly be used to add the location of work orders, service requests, or update attributes, attach files, suggest corrections or perform redlining etc.

Fig: 3 –Spatial Map Viewer provided by one of the EAM systems

(iii) Support for Linear Referencing
Many Utility companies are implementing Linear Referencing as part of their GIS. Esri’s Utility and Pipeline Data Model (UPDM) has full and implicit support for Linear Referencing of pipes. This gives EAM systems a great opportunity to use the Service Oriented approach to push event data
directly to GIS using feature services and visualize events along linear assets in real time on their Map Viewers.

Some EAM systems even have implicit support to create events and visualize dynamically segmented linear assets on the map.

Below are a few areas where linear referencing and the service oriented approach can add value to the EAM systems, but the possibilities are endless:

- Work orders and their status
- Service requests
- Asset maintenance status
- Asset conditions
- Construction status
- Incidents visualization

### Suggested Editing Workflows
Data accuracy, consistency, efficiency and standardization are some of the key goals of a streamlined editing workflow. But it requires additional effort and consideration to keep two system of records in sync. ArcGIS feature services and the Spatial plugins within EAM systems have made it possible to automate (or semi-automate at least) this process with minimum modification in existing data editing workflows.

Although there are many ways to achieve the end goal, the following diagrams show one such suggested semi-automated data exchange workflow between the GIS and EAM systems based on the service oriented approach:
(i) New Assets - GIS Initiated

**Fig: 5 – Suggested workflow for Assets created in GIS**

Assets are created in GIS using a typical GIS editing workflow. The EAM spatial plugin continuously polls the configured feature services for new data and pulls any newly added assets along with their GIS IDs by querying feature services. The assets received are assigned EAM Asset IDs. The EAM Asset IDs are then automatically updated in GIS for matching GIS IDs using a feature service update, thereby linking the asset in both the systems.

(ii) Asset Updates - GIS Initiated

**Fig: 6 – Suggested workflow for Assets updated in GIS**

Assets are updated in GIS using a typical GIS editing workflow. The EAM spatial plugin continuously polls the configured feature services for data updates in GIS and pulls any modified assets along with their GIS and EAM Asset IDs by querying feature services. The EAM system can then find matching assets using the EAM Asset ID and update any attributes edited by GIS in its database.
Adding a new asset in EAM triggers a corresponding feature service insert. All the information about the newly added asset required by GIS editors along with the EAM Asset ID is saved directly into a staging feature table in GIS. The editing workflow can be tweaked to create jobs for each set of new assets saved in the staging table by EAM. The GIS editors can use all the information in the staging table to create corresponding assets in GIS and retain the EAM Asset IDs. Once the data is reviewed and posted to the base version in GIS, these records are picked up by EAM automatically (through polling). Assets with matching EAM Asset IDs are updated with the GIS IDs and other attributes from GIS in the EAM database, thereby linking and syncing the asset in both the systems.

(iv) Asset Updates - EAM Initiated

Asset updates in EAM triggers a corresponding feature service update and can directly update the EAM related attributes in GIS using the matching GIS IDs.
Conclusion

ArcGIS as a platform has matured to a point where almost all of its capabilities across its products, extensions and offerings are exposed as REST based services. Integrating any system with the ArcGIS platform is way easier today thanks to ESRI’s well planned and architected roadmap.

Modern EAM systems are quickly realizing the importance of GIS in all aspects of Asset and Work Management throughout the lifecycle and capitalizing the robust service oriented framework provided by ArcGIS to become spatially aware. This is the right time for Organizations using EAM systems to fully embrace GIS in their day to day business and use the spatial features of modern EAM systems and the integration approaches suggested in this paper to improve the efficiency of their workflows.

References

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