

SAP/GIS Integration Case Studies & Techniques

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Abstract:

In recent years businesses have been striving to optimize their processes and improve efficiency by using ERP systems for workflow management and GIS for location based information management. Many advances have been observed in both fields but no direct integration was accomplished due to the complexity involved in handling each system. This resulted in loss of opportunities to leverage spatial analysis capabilities of GIS and business transaction management tools of ERP systems such as SAP. This paper discusses different integration techniques of SAP ERP system with Enterprise GIS. The paper discusses the benefits gained from SAP/GIS integration and demonstrates case studies to improve business workflow and data management of oil companies in the Kingdom of Saudi Arabia

Keywords: GIS, ERP, SAP, SAP-PM, EH&S, ArcIMS, ArcSDE, EAI, RFC, SCADA, WebMethods, XI, Interfaces, Geo-Referencing, geo-processing

Introduction

In petroleum industry mapping and geography are instrumental elements in most decision making processes in oil production and exploration operations for site selection, routing, resource allocation, planning and asset management. Geographic concepts and techniques are used to create a common operation framework for different disciplines. With ability to combine a variety of datasets in an infinite number of ways, from routinely performing work-related tasks to scientifically exploring the complexities of our world, GIS gives businesses the geographic advantage to become more productive, more aware, and more responsive to daily business needs such as land management, site selection, facility maintenance, emergency response, construction activities, fleet management and tracking, equipment mobilization, pipelines routing and many others. As shown in Figure 1, GIS brings together graphical representation of natural objects (e.g. trees, houses, wells, roads, etc), attributes of objects and tools to manage behavior of the map objects. This makes, GIS goes far beyond the management of “background” mapping as it provides true positional awareness in support of conducting analysis across multiple sources of information.

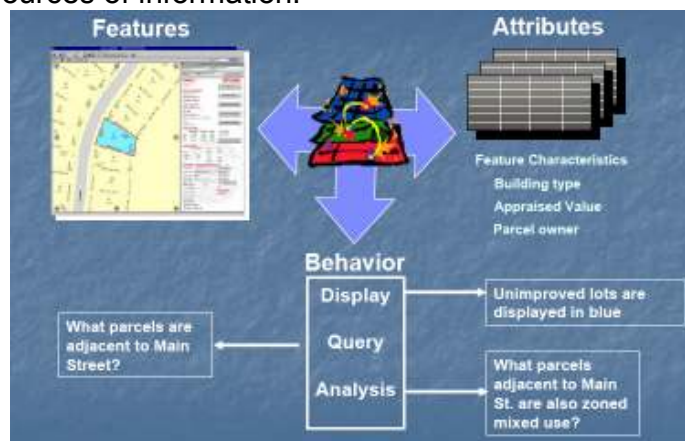


Figure-1: Example for three major elements of GIS

Enterprise Resource Planning (ERP) systems such SAP have become key tools in managing medium to mega size organizations in the past decade and continue to gain pace. ERP systems enable businesses to manage workflows, monitors key business indicators, help manage resources and material procurements, help manage people and information. It provides power platform for integrating data from diverse resources and bring them into one concise environment where all activities are tracked, secured and managed properly in addition to allowing for paperless data exchange.

Objectives

This paper sums up the possible integration methodologies between ESRI GIS and SAP ERP systems for large oil producing organizations. It discusses the different methods and points of integration between SAP and GIS. And it concludes with

illustration of different cases in integrating ESRI ArcGIS applications with SAP systems for environmental protection, medical analysis, plant maintenance and land management.

Methodology & Discussion

This paper follows the methodology of discussing the technology capabilities, the integration benefits, the methods and points of integration. It also highlights directions of industry leaders in both ERP and GIS. And provides demonstration of different examples of integration and concludes with recommendations. SAP R3 system and ESRI ArcGIS software are technology used to derive the assumptions and examples illustrated in this paper.

In recent years the level interest in integrating GIS with SAP ERP and legacy systems has grown significantly. This was observed since most business data have a geographic or spatial component that can be geo-referenced on a GIS map to visualize, understand and interpret data in ways not possible through a spreadsheet or table. By visualizing relationships, connections and patterns in business data, GIS helps in making informed decisions and increase efficiency. The power of ERP in helping to adjust to market changes, sensing and responding to customer requirements and extending processes beyond the organization, could be further enhanced with the integration of GIS applications into business workflows. This makes GIS and ERP systems integral part of a powerful IT strategy.

Advances in Internet technology and development of Service Oriented Architecture concept made it possible to embed GIS applications into common activities as well as integrating them with different systems such as SCADA and SAP. Introducing GIS into business process offers capabilities that fall into the following categories:

- Provision of geographic context to business decisions by integrating business data with geodatabases and feature tables.
- Linking business functions in ERP system with geoprocesses combined functionality that is distributable across the software architecture.
- Fusion of business and geographic information and functionality into the common operational picture on both high and low levels.

With both systems integrated, a user can visualize SAP application data within the GIS and get direct access to the GIS within SAP applications. Moreover, relevant data can be altered from SAP applications as well as by using the graphical functionality of GIS software.

Integration Benefits

From the hands on professionals, spending an hour on an integrated system a user can accomplish more as he has the ability to make decisions by visualizing the output of both systems on a screen without the need to switch between systems and correlate the data between several systems in a simple visible manner. With

systems linked, the user can do an array of functions that could impact corporate running cost by accomplishing the following:

- Improve resource utilization, analysis, safety and asset integrity through an ability to represent work orders and notifications at their exact location on a GIS map.
- Improve operational efficiency (e.g. safety, dispatching) by representing work activities that impact an area as polygons on the map and identification of shortest routes.
- Improve workforce productivity by providing broader browser-based access to SAP and GIS based assets, maintenance, and customer information.
- Reduce service costs by expanding an on-line self-service portal with essential business processes (e.g. report faulty equipments).
- Elevate customer service and decision-making with expanded access to ERP data from the GIS map

Integration Methods

Both GIS and ERP industry leaders have identified a number of integration options and methods. The options and methods are derived based on the system functions and SAP objects. Partnership between ESRI and SAP the industry leaders of GIS and ERP systems respectively, has resulted in identification of five main technical interfaces available for integration. The integration technical interfaces include: SAP RFC connectors, third-party connectors, SAP generic GIS connector, third-party Enterprise Application Integrators (EAI), SAP EAI and vendors partner solutions.

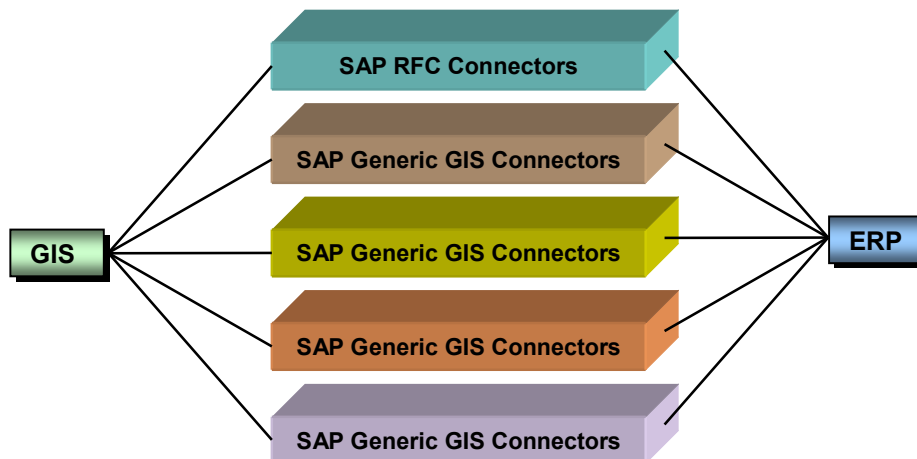


Figure 2: Different integration methods identified by ESRI & SAP systems
Source: ESRI Solutions

a. SAP RFC Connectors

RFC (Remote Function Calls) allow for remote calls between SAP ERP and any external system to SAP such as ESRI GIS software. BAPIs are specific sets of

linked Remote Function Methods (RFM) that are linked as methods of the business objects in SAP systems and released for use by third-party developers. Basic RFC can be used to integrate SAP ERP and GIS software as well as the higher level and more stable BAPI.

b. Third-Party Connectors

Third-party connectors include the iWay Control Broker (CB) from Information Builders which is component-based and allows direct connection to packaged and legacy back-end systems. Control brokers provide an application level approach for greater control, performance and scalability. The benefits of integrating SAP ERP and GIS include no additional middleware, high performance and easy deployment.

c. SAP Generic GIS Connector

The SAP GBC (GIS Business Connector) is a passive middleware that mediates between SAP solutions (designed for use with SAP ERP 4.5 and higher) and ESRI GIS software. The method is best used when there is flexible processing modeling with existing methods in both applications. Development of custom processes requires further development capabilities.

d. Third-Party EAI

EAI (Enterprise Application Integration) is generally defined as the combination of platforms, business processes, standards and applications that result in the seamless integration of two or more enterprise systems. The EAI platform integration interface for SAP ERP and GIS can be utilized when there are non-standard processes that require custom development. This option is best utilized when there is longer implementation time frame due to the custom development requirements.

e. SAP Exchange Infrastructure

SAP Exchange Infrastructure (XI) is SAP enterprise application integration (EAI) software used to facilitate the exchange of information between SAP ERP and GIS software. SAP XI is considered an integration broker since it mediates between entities with varying requirements in terms of protocols, connectivity and format. Integration costs are reduced since the SAP XI provides a common repository for interfaces.

f. Pre-Packaged Solutions

Pre-packaged solution such as IMPRESS allows for integrating SAP ALM/PLM applications and ESRI ArcGIS software. The custom development opportunities are limited and fully supported solutions are preferred. This option best meets the needs of users with a short implementation deadline. Data consistency, synchronicity, and data linking are important pre-cursors to using this interface.

The SICAD-APX (application exchange) is another example of EAI (Enterprise Application Integration) solution from AED-SICAD (an ESRI partner) that integrates ESRI GIS with SAP ERP modules. According to AED-SICAD, the SICAD-APX solution is cost-efficient EAI software for small to middle-sized utilities.

Integration Considerations

The process of selecting an integration method and options depends on several considerations such as development cost and corporate directions for integration. Industry leaders have recommended the following selection criteria:

- Corporate standards in exposing business data either on real-time basis or using previously prepared reports from business warehouse.
- Data exchange technology adopted on the corporate level such as using Service Oriented Architecture and web services, application integrators or third party solutions.
- Business process requirements such as data visualization or data editing and updating.
- Technology availability based on the SAP objects to be integrated.
- Vendors recommendation methods such as SAP XI and ESRI ArcGIS servers geo-web services

In addition to these criteria, development cost plays an important role in the selection process. Whereas some solutions could provide rapid deployment but the cost of development, consulting and maintenance could be high and which impacts the technology and methods of integration. The diagram below shows the relative software and development costs associated with the different methods.

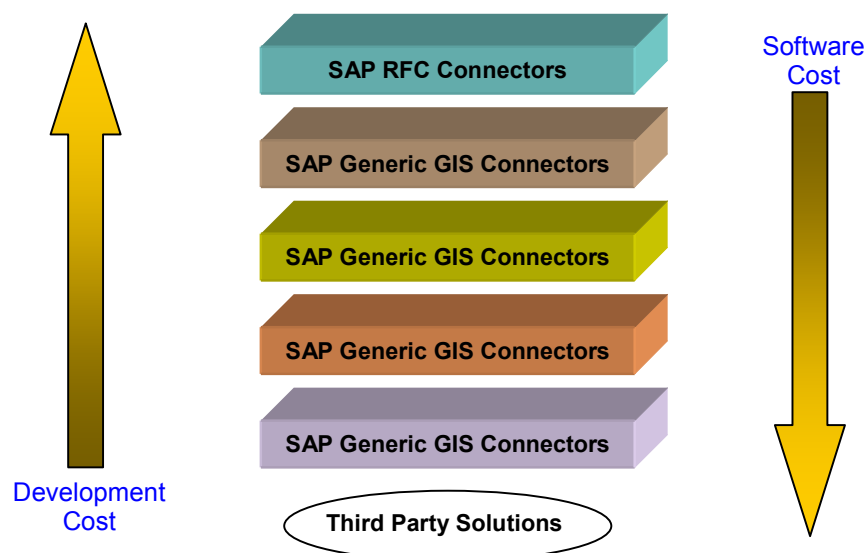


Figure 3: Development cost of integration methods identified by ESRI & SAP systems
Source: ESRI Solutions

Integration Objects

Selection of any integration approach between SAP and GIS is mainly dependent on the objects used to link the two systems. SAP module determines the integration objects used for linking with GIS because each module has its unique identifier and follows certain format. On the GIS side spatial features such as points, lines or polygons always represent a real life object. This provides a lot of flexibility when performing the integration between GIS and SAP since the GIS business identifier could match SAP during system development or could be derived based on a pattern. The following elements demonstrate the SAP objects that have been linked to GIS features from the practice of large oil producer:

- Functional Locations (e.g. pipelines, utilities, facilities)
- Equipment (e.g. valves, manholes, etc)
- Notifications & Work orders
- Work Areas (e.g. incident locations)
- RE-FX & Case Management Objects
- SAP Health Care (e.g. patient records)

Case Studies

a. GIS/SAP Environmental Health & Safety (EH&S)

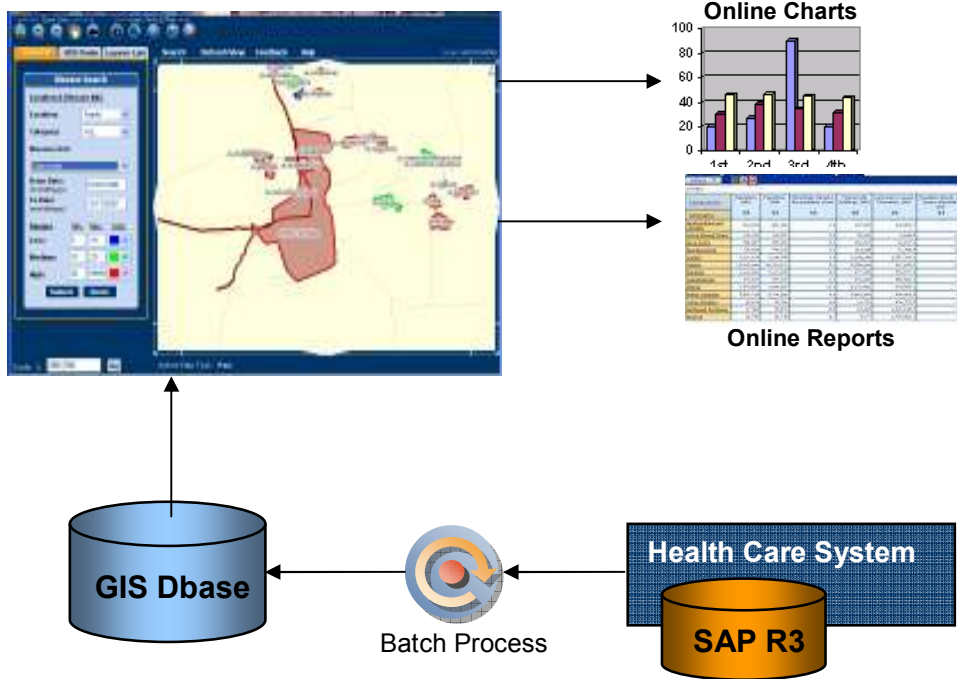
SAP EH&S case study is an example of benefiting from GIS spatial analysis tools for environmental protection and safety in tracking hazardous materials in support of oil production while managing business workflow in SAP. In this application GIS is used to build hierarchy of SAP work area objects based on their spatial location in a region, city, work zone and facility. A work area is a SAP object representing a location at a work site whereas certain business process is undertaken to manage site inspection for hazardous wastes and safety. Rather than having to generate look-up-tables of work area hierarchy and store them in SAP, GIS spatial analysis capabilities was used to identify all parent polygons in which as work area is located and send the data back to SAP real-time. This solution saved work area creators a lot of time in identifying parent work areas and reducing the time spent in searching for work areas on a paper map which in turn has improved the turn over time in tracking materials and improving safety. For this project, an ArcIMS based GIS web application was used for creation of work areas graphically on a map using ArcSDE Java API's online. Once the polygon is committed into GIS geodatabases, a background process was triggered calling a WebMethods function to automatically create a work area object in SAP EH&S system. A simple map viewer was also embedded inside SAP interface to allow work site inspectors to visualize the location of work areas on a map with up-to-date satellite imagery in the background. This solution saved the effort of having to switch from system to another to verify the location than creating the work area manually in SAP and ensured data integrity during the process of creation. Five WebMethods functions calls were developed to create, update, delete, set history and identify parent area. In this application

WebMethods was used as an application integrator for data transfer between GIS and SAP systems along with Oracle tables for temporary data storage while transferring and authenticating user requests.



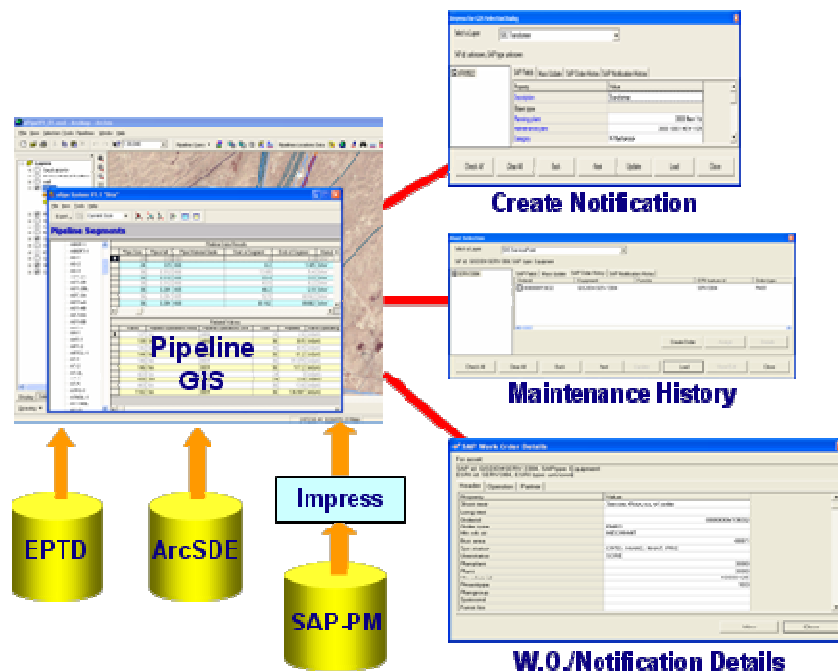
b. GIS/SAP Health Care

This case represents an example of linking GIS with SAP Health Care system for tracking communicable and epidemic diseases on a map for company employees and their families. This case shows the use of GIS for Public Health and disease tracking to ensure healthy employees. The application used in this example is a based GIS web application that helps epidemiology specialists in visualizing and analyzing distribution of communicable diseases between company employees on a GIS map based on service area sectors superimposed upon the base map. The analysis tools provided in the application allowed the user to color code the service area polygons by disease type, date range and patient location of work or residence. In addition reports tools are utilized to list patient information by service and generate line and bar charts online in a browser window. Since all patient information resided into SAP Health Care master data, a nightly batch process was developed to push case data and Locational information of the patients into the GIS database in order to use in color a map generated using ArcIMS internet mapping server. The batch process was based on WebMethods function calls which wrote the data into Oracle RDBMS system every night. This application has tremendous benefits to the medical support staff of the company as it helped them to visualize the areas for concentration of selected disease type on a map. This helped the medical team in prioritizing staff deployment in response to epidemic emergencies such as birds flue, salmonella infection and others. In this case GIS impact was significant in simplifying a tedious business process that was based on browsing through spreadsheets and paper map.



b. GIS/SAP Plant Maintenance

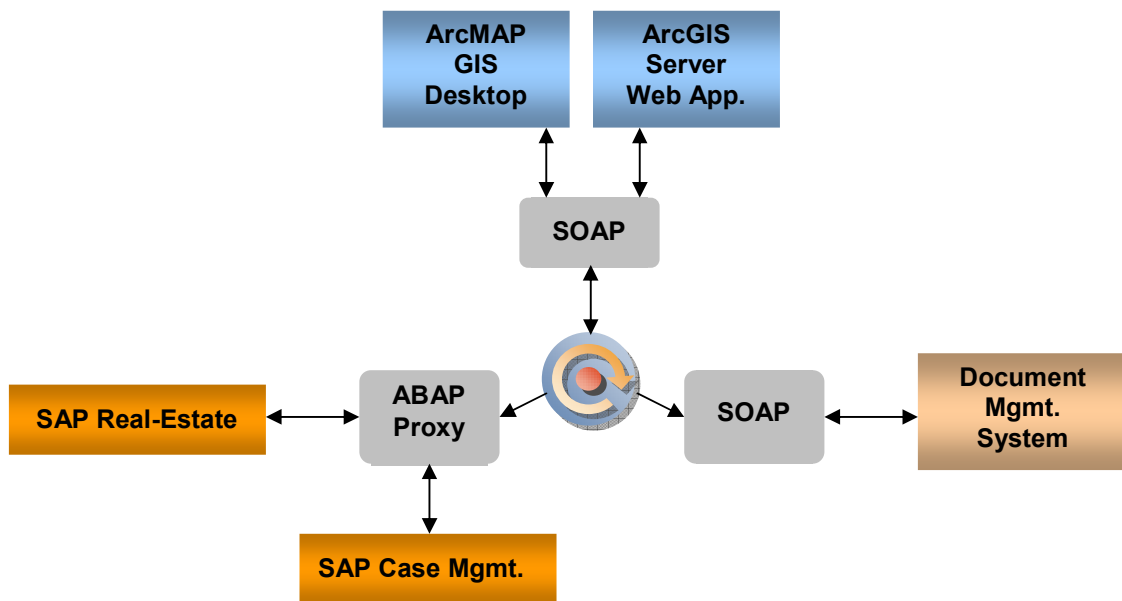
This third integration case was conducted to integrate the Pipeline Monitoring GIS desktop tools with SAP-PM using IMPRESS pre-packaged solution to allow maintenance planners to create notifications from GIS into SAP systems, retrieve work orders information and view maintenance history live from GIS for pipeline asset management. In this project, IMPRESS for GIS server was used to create data mapping between SAP-PM functional location and GIS ID's for pipelines and valves. The challenge in this case was the development of mapping algorithms between SAP and GIS for data synchronization and object mapping. IMPRESS Geo I.App application helped in breaking the data mapping barriers in addition to providing process scheduling capabilities, email notifications to support staff and a customization environment. The system worked based on IMPRESS BAPI's and RFC's that were installed on SAP.



c. SAP Real-Estate & Case Management

This case demonstrates an example of using SAP Exchange Infrastructure (XI) for linking five different systems for land management. The five systems involved in this exercise are SAP Case Management, SAP Real-Estate, Documentum for document management system, ArcGIS Desktop and ArcGIS Server web mapping application. XI is used as services broker responsible for passing information between systems using SOAP API's. ABAP programming was also used to embed GIS mapping application inside SAP user interface (UI) and SAP logon ticket was used for authorization. Embedding the GIS map inside SAP and the use of ArcGIS Server services with AJAX allowed cartographers to perform map editing and feature creation online from SAP UI without the need to switch to ArcEditor to edit the map

while in the middle of SAP transaction. XI helped in exposing intermediate web services for communication between the different systems for data transfer, document loading in PDF format and creation of SAP objects in both Case Management and Real-Estate systems. This project was a real success as all system communicated perfectly, as XI supported messaging services that ensured no loss of data whenever any of the systems components becomes off-line. The graphics below shows a diagram of the different systems with XI as the integration broker.



Conclusion

From the case studies and the industry leaders recommendations, this paper concludes with the fact that Enterprise Services are the direction for systems integration for the future. Service Oriented Architecture in the form web services should be the technology to follow by which each system ensures to perform its intended functionality. Composite applications are the next wave in GIS/SAP integration because they bring GIS closer to the operations and processes that drive businesses on a daily basis. These composite applications will not replace stand-alone GIS tools. Rather, they will make the functionality offered by them more readily available. By embedding GIS functionality within operational applications and processes that drive the business, these composite applications will make GIS more operational, easier to use.

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