INTERGRATION BETWEEN GEOGRAPHICAL INFORMATION SYSTEM AND SERVICE, APPLICATION AND PRODUCTS CONTRIBUTION TO GEOTHERMAL DEVELOPMENT

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ABSTRACT

Countries world over are seeking alternative renewable sources of energy which are cleaner and environmentally friendly. With the accelerated approach of the global climate-change point-of-no-return the need to address the pivotal role of renewable energy in the formation of coping strategies, rather than prevention, is more crucial than ever. Sustainability, green buildings, and the development of the large-scale renewable energy industry must be at the top of all development, economic, financial and political agendas. With estimated potential of over 7,000-10,000 MWe, geothermal energy from Kenya's geologically active Great Rift Valley forms the cornerstone of the government's initiative to realize 2000 MWe by 2018. To be able to achieve this, detailed surface exploration studies need to be conducted to be able to site good producer wells. The findings of the studies are then analyzed and interpreted by use of technologically advanced Information and Communication Systems housed at the Company's Laboratory. ICT systems can also be utilized to provide vital information during drilling at the rig and well testing on real time basis. Such interfaces are developed through proper integration of additional modules on both Geographical Information System (GIS)and the Enterprise Resource Planning software (SAP) to ensure that they are synchronized to communicate in a unified language. This abstract therefore outlays operational benefits of SAP/GIS/SCADA integration with well documented case studies discussed critically to suffice the reader with relevant information.

Some of the key points to be discussed are; (i) Integration dynamics between SAP, DMS, SCADA and GIS technologies in enhancing growth and development of Energy utilities and (ii) Communications network technology is needed to provide and support new operational applications (such as data acquisition and CCTV surveillance), enhancing efficiency and response time.

Keywords: GIS, SAP, WebMethods, EAI, geo-processing

INTRODUCTION

Geothermal Development Company is a newly formed government entity tasked with the responsibility of mining geothermal energy within the greater Rift Valley of an estimated 5000 MWe by 2030 in line with the Government's 2030 Vision. In such a dynamic environment, integration between key ICT systems becomes a necessity to facilitate smooth business flow of operation processes. Thus, integration of SAP, SCADA, DMS and GIS as the base is vital for GDC's core business operations ensuring that it meets its objectives.

In the mining industry, mapping and geography are most important decision making tools owing to factors such as routing, site selection, resource allocation, planning and asset management. GDC's mandate is to explore and mine geothermal potential power sites (GPP) in order to realize affordable and a continuous (renewable) source of power for Kenyans after which centralized power plants will be constructed harnessing power from the distributed wells within a geographical area. To accomplish this, geothermal drillings rigs have been acquired and commissioned in GPP sites lining the greater rift valley with a view of drilling wells generating a combined 400 MWe every year from 2013.

GIS therefore provides the base platform for which operations relating to daily business activities such as asset management, piping, site selection, etc are displayed graphically with their attributes and tools to manage the behavior of the mapped objects. GDC utilizes ESRI ArcGIS products

SAP is an ERP of choice when it comes to managing medium and large sized organizations. It enables businesses to make informed material procurements, generate workflows, monitor Key Performance Indexes (KPI), etc in-line with the company's objectives. SAP provides a unified platform whereby departments (Sales, Procurement, HR, etc) in an organization can access information form a centralized pool ensuring proper management, increased efficiency as well as productivity is achieved.

INFORMATION SYSTEMS AT GDC

GDC has already incorporated information systems in its activities within its short existence that is vital for its core business operations. However, much remains to be done with most of the information systems yet to be commissioned. Despite the setback, clear road maps have been identified and set in play that categorically covers all the information systems that the company intends to acquire for its activities.

GIS

GDC has implemented GIS for mapping and geographical work. The software (ESRI ArcGIS) is used quite extensively by the company's scientist in mapping potential well sites as well as displaying the topographical landscape of an area for routing purposes.

ERP (SAP)

The company chose to implement SAP due to its accommodative nature in mining operations. The modules selected by the company include:

Financial Modules

- FI (Financial Accounting) – Accounting and Financial processes
- AA (Asset Accounting) – Deals with Asset Management
- FM (Funds Management) – Manage funds in line with approved Budgets
- CO (Controlling) –

Logistical Modules

- PM (Plant Maintenance) – Used by Maintenance departments to run their activities and dispatch their work schedules with regards to mining and other related operations
- PS (Project System) – Used to manage large projects (water, mining, etc) and industrial projects
- MM (Material Management) – Used to facilitate procurement of materials with regards to forecasted demands, etc.

Human Resource Module

- HR-PA (Human Resources – Personal Administration) – Assists in the daily operation of the work-processes of the department such as payroll duties, leave days, Medicare, etc)

SCADA and DMS

SCADA (Supervisory Control and Data Acquisition) is yet to be commissioned. It is a real time data management system that will be used to remotely control the functioning of equipments on the Reservoir tanks. The SCADA system stores the needed information (readings of the level of water towers, pumps, valves, piping data, etc) that assists in decision making. It also has an alarm feature which it generates when certain unfavorable conditions are met and thereby warns SCADA administrators via email, sms, etc.

SCADA systems (4th generation) run on an Ethernet/IP architecture of a WAN nature that could be on WIMAX or Broadband depending on the company's infrastructure level DMS (Document Management Service)

BENEFITS OF INTEGRATION

Integration of the systems (GIS/SAP) allows a user to visualize the output of both systems on a single view rather than to switch back and forth between the systems. Data between the two systems is correlated enabling decision making process easier and more effective.

- Increases operational efficiency as it assists in identification of shortest map routes to working areas displayed as polygons on the maps
- Facilitates effective asset manageability and resource utilization through accurate deployment of staffs/crew based on the generated work order to the exact location as displayed on the map
- Enhances decision making process with the user being able to accurately access information from both systems on a single view
- Increases productivity by providing browser based access to GIS and SAP based assets, maintenance and customer information

METHODS OF INTEGRATION

ESRI and SAP, industry leaders of GIS and ERP respectively have identified five main technical ways of performing the integration. The interfaces are:

- ➢ SAP RFC Connectors – Remote Function Calls (RFC) allows for remote calls between SAP and any other software such as ESRI GIS as well as Basic Application Programmable Interfaces (BAPIs).
- ➢ Third Party Connectors – Include iWAY Control Broker from information builders which is component based and facilitates direct connection to packaged and backend legacy systems. Easy to deploy, no additional middleware and high performance.

- ➢ Third Party EAI (Enterprise Application Integration) – Combination of platforms, business processes, standards and applications that result in seamless integration of two or more enterprise systems. EAI platform for SAP and GIS can be utilized where there are non-standard processes that require custom development.
- ➢ SAP Exchange Infrastructure XI– EAI software used to facilitate exchange of information between SAP and ESRI GIS through mediating between entities with varying requirements with regards to format, connectivity and protocol.
- ➢ Pre-Packaged Solutions – Solutions such as IMPRESS facilitate integration of SAP and ESRI GIS through providing bundled solutions that limit custom development opportunities. This interface is best considered for data consistency, synchronicity and data linking. Another fully supported solution is SICAD-APX developed by AED-SICAD that is cost efficient for small and middle sized companies.

FACTORS FOR CONSIDERATION

- Identifying Workprocesses/Business process requirements resulting from GIS/SAP link
- Type of data exchange technology already adopted by the organization (third party integrators, application integrators, etc)
- Current/Available technology based on SAP modules to be incorporated
- Vendor recommendation on best integration method
- Corporate procedures in relaying business information either on real-time basis or using previously prepared reports.

It is worth noting that the integration methods that do involve further development of the software may result in additional costs from consultations and maintenance not to mention time consuming. Rapidly deployed integration methods may be expensive to purchase but cheaper in the long run.

CHALLENGES FACED IN GIS-SAPLINK

- **Security Permissions -** The challenge here would be to allow authorized users access to data on either system without many security login screens. The SAP Logon ticket should be the default gateway for access when calling SAPGui which will make the process straightforward and user friendly
- **Client-Server Application/Browser Application –** SAP runs on client-server environment and ESRI GIS runs on browser environments, which are technically different therefore resulting in security and application issues. One of the ways to circumvent these issues is by working on an intranet environment which offers fair amount of security.

INTERGRATION OBJECTS

SAP and GIS modules use different object identifiers with a certain format. GIS uses polygons, lines and points to represent an object. Thus when performing the integration, the business identifier in GIS could match up with SAP easily as it provides a lot of flexibility and the process can be initiated during system development.

Some of the elements of SAP that can be linked with GIS include:

- Plant Maintenance (Work & Maintenance orders)
- Locations (Pipelines, Pumping stations, Plants, Rigs)
- Equipment (Valves, etc)
- Health care

CASE STUDIES

GIS/SAP – Plant Maintenance

GDC already has four rigs deployed and by Year 2012, it is anticipated that there will be a total of twelve rigs. This represents a lot of related work such as piping networks for every area (Suswa, Menengai, Longonot, Menengai, etc), pump stations, etc. As a result, a lot of work orders and maintenance orders arising from scheduled maintenance or breakdowns will be generated using SAP PM Module and every order will be identified through a unique number that correlates with the activity and in sequence (Figure 1). Orders for large project will be generated using SAP PS module and identifier recorded in sequence too.

In this scenario, GDC will utilize a pre-packaged solution and in particular IMPRESS software to link GIS desktop tools with SAP PM hence allowing planners to schedule work orders and view maintenance history live from GIS. IMPRESS software will be used to create data mapping between SAP PM functional location and

GIS identifier for pipelines, valves, pumping stations, etc. The identifier also has a unique connection number that is represented as an attribute of the connection feature.

IMPRESS Geo I. Application a module of IMPRESS software will be used for the data mapping activities offering additional functionalities such as process scheduling and email alerts to support persons.
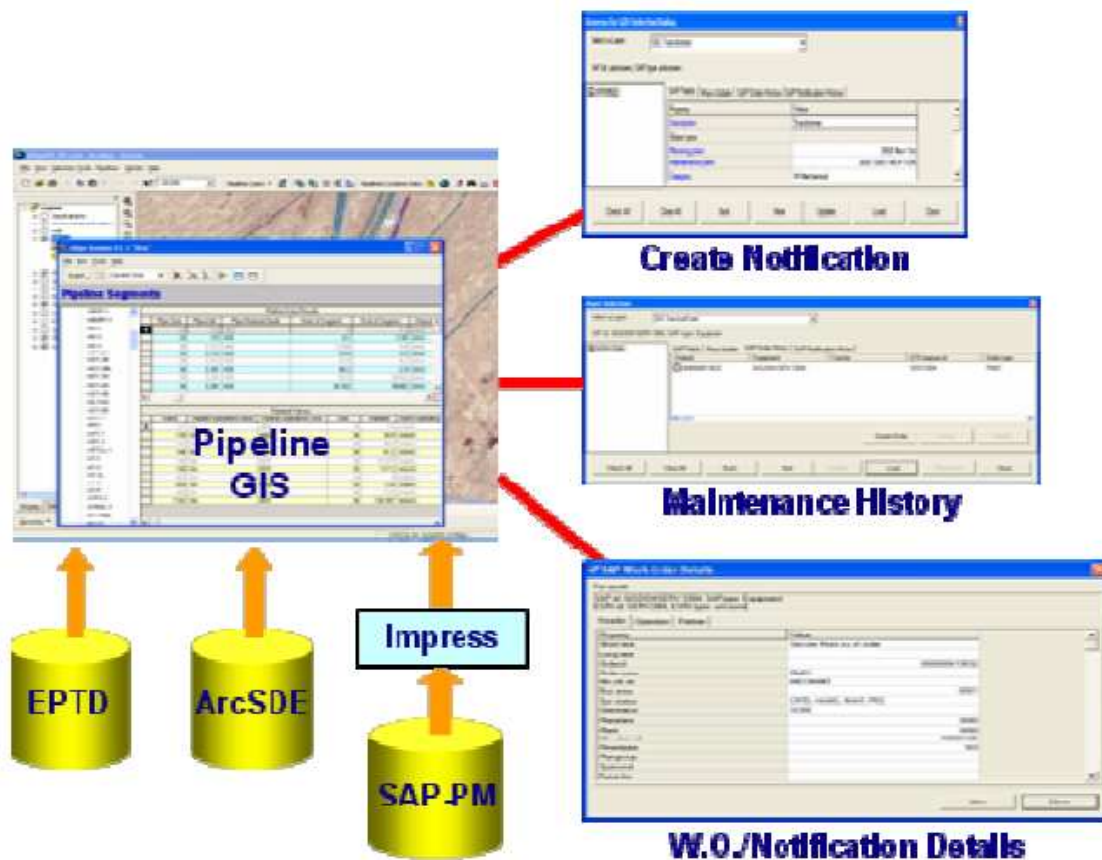

Figure 1: SAP/GIS Integration Using SAP PM Module. Source: Saudi Aramco Co.

GIS/SAP – Functional Locations

GDC has a lot of infrastructure in various regions of the country. These are office buildings, pumping stations, water reservoirs, rigs, and well-heads which in SAP are represented as **Work Area** which is a location of a work site. These elements are also represented in GIS and so the link with SAP can be generated by adding the work area ID as a feature attribute.

GIS spatial analysis feature will be used to identify parent polygons which will be classified as work areas and the data is sent back to SAP in real time. These will save a lot of time that would have been used to generate look-up-tables of work area in SAP. For this case an ArcIMS based GIS web application program will be used to design graphically the work areas with the assistance of ArcSDE Java API's online. A batch process will be triggered calling a Web function method to generate a work area in SAP once polygon is loaded in the geodatabase. The web function method calls to be developed will include create, delete, update, identify parent area, etc. Also a simple map viewer will also be embedded in SAP interface which will allow users to view the work areas instead of having to switch from system to system to verify location which safeguards data integrity during data entry.
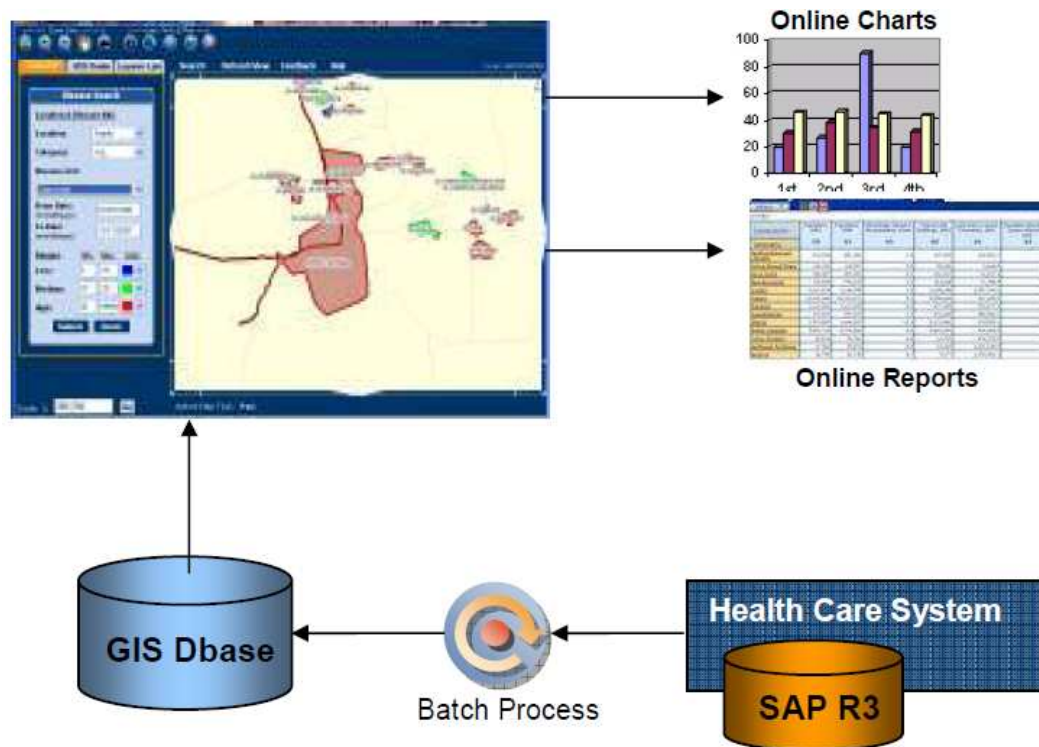
GIS/SAP Healthcare

GDC has a staff capacity of about five hundred and is set to increase to one thousand by year 2011. The staffs are situated at various parts of the country and the healthcare system in place processes requests from main office.

The integration of SAP with GIS allows users to track and manage communicable and epidemic diseases of the company employees granting management the ability to accurately analyze the distribution of the diseases based

on a GIS map superimposed upon the base map in SAP (Figure 2). The analysis tools provided in the application allows color coding of the service area polygons by disease type, data range and patient location by work or residence.

A batch process will have to be developed which will push data from SAP HealthCare Master Data to GIS database on a scheduled basis using a Web Method Function calls which will write data into the Database. This process will assist in staff planning and deployment averting crises related to epidemic.

Figure 2: GIS/SAP Integration Displaying Healthcare System Using SAP R3. Source: Saudi Aramco Co

CONCLUSION

Enterprise services are beneficial when system integration is implemented correctly. With adoption of web services become the norm, the functionality of the systems broadens. As vector data is increasing in GIS, more analysis possibilities become available, supporting management in the decision making process. The myriad of possibilities GIS has to offer is not only restricted to network management, but can also perform thematic applications. Keyword for the future is further integration, respecting every information systems qualities and specific functionalities, but making this massive amount of information quickly available to the users via an intuitive connection between information systems.

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