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GIS Integration Based Energy Management

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Abstract

Geographic Information Systems (GIS) technology is a computer-based data collection, storage, and analysis tool that combines geographic or spatial information into easily understood maps. The oil and gas industry and other related sectors are heavily dependent on geospatial data to make decisions ranging from new exploration to day-to-day operations. Providing energy sector organizations with access to complete information significantly reduces project delays, administrative costs, cost of compliance, and ensures that project management is conducted more effectively. The savings in time, effort, efficiencies, asset performance, and overall management are considerable and relevant throughout the organization. Geographical information systems (GIS) simplifies access to information by leveraging the language of geography, providing oil and gas engineers, management, operations, maintenance, legal, and safety managers with faster, easier access to knowledge. Giving a user the ability to select a point on a map and then display a single view of all related information provides a way to quickly and effectively disseminate business information to a broader audience.

Keywords: GIS; integration; energy; management.

1. Introduction

Geographic Information Systems (GIS) have been called the language of geography, providing a formal means for communicating spatial information. Organizations use many kinds of data, e.g., written, photo, video, audio and any other contextual tool that translates thoughts into physical representation, to communicate [1-3]. Awareness of a document's geographic context is as significant as the information contained in the document. Knowing the geographic reference adds the contextual knowledge to the content of a document, allowing deeper understanding, faster decisions, and fewer mistakes. To achieve operational efficiencies, organizations in the energy sector strive to enhance their knowledge of corporate resources and assets, and make the information that relates to those assets seamlessly available across the organization. The concept of Geo-Asset Management pertains to the process by which the organization collects and maintains a comprehensive inventory of the items it owns, referenced by their geographic location. Geo-Asset Management inventories include items such as equipment, property, software and hardware. This data can then be used in conjunction with the functional aspects of ownership such as total cost of ownership, deployment, depreciation, maintenance, and insurance. Geo-Asset Management can be a powerful tool when the geographical asset location data is integrated with other organizational knowledge.

GIS level provides data and information management and completes choice functions, where detailed optimisation is not needed [4-7]. Modified optimisation level includes criteria creation phase, where decision principles are treated for the energy solutions. Master optimisation level is used to create the frames for the energy supply and demand in cases where co- or polygeneration takes place. Another goal is to finalise the optimisation of the plant after revised data from GIS-module. GIS software is a tool used to illustrate numeric data in geographical context. For example, energy (district heat, electricity, fuels) consumed for space heating and consequent CO2 emissions produced in the Concerto area can be analysed in terms of spatial distribution [8-12]. Therefore, numeric data used in GIS analysis, whether being collected from statistics or calculated by using simulation or optimisation, has to be linked with actual geographical entities, mostly buildings. There is at present a significant overlap between GIS and EIA, which justifies the interest of GIS practitioners in EIA studies, and of EIA practitioners in GIS support. However, both disciplines are evolving, which has implications for the relationship GIS-EIA. As we will see in the following sections, GIS and geo-information processing are becoming increasingly integrated into mainstream information systems.

Industrial and technological progress is always related to an increase in energy consumption. This increase in electric energy demand must be met by enlarging the capacity of transmission and distribution networks and building new power plants, but always respecting technical or environmental restrictions and pursuing the best economic goals. In this sense, the construction of small or medium size power plants near consumer locations will allow to minimize losses in electric power networks and increase the efficiency of the overall energy system. These power plants, built by the utilities or by IPP (Independent Power Producers), are the main elements of the well-known Distributed Generation (DG). GIS have been used in energy applications from resources allocation to infrastructures planning. In electric power applications, GIS have been used in energy planning, wind energy evaluation, solar energy and biomass resources, optimal sitting of wind farms and integration studies of these energy sources in remote areas. Using adequate software under the GIS platform, users can obtain useful information on the economic or technical viability of any distributed power generation facility. Governments, environmental agencies, utilities, private investors, financial corporations and local authorities can become users of these tools and active actors in the field of distributed power generation planning.

2. GIS Integration

How do you integrate Geographic Information Systems with your planning and operations systems so that you can maximize utilization of geospatial data? The business could benefit with: increased production yield–combining geographic data with data on business, economic, and risk factors could enhance long-term yield, not just short-term output. Improved facilities management–combining geographic data with facilities and equipment data, such as availability of repair rigs, greatly reduces operational down time. Efficient pipeline management–combining geographic data with transportation data can be utilized to monitor the condition and flow of pipelines and determine the best pipeline locations to transport oil and off the fields and to the refineries. There are a number of challenges to integrating and using GIS data, including: accessing disparate data sources–GIS data is only part of the equation. Accessing data from other upstream and downstream systems are also combining geographic and operational data–Once you access the disparate data, you need to integrate, join, or aggregate data to reveal insight. Delivery data to the decision makers–There are numerous applications that consume data using different methods.

3. Solution Architecture

The Composite solution federates and virtualizes GIS and other data to provide a contextual view. The solution architecture has the following characteristics: (i) geographic systems and data sources that require geospatial information overlay; geographic information systems; operational–production, management, monitoring; historical data; (ii) the Data Virtualization Layer: access geographic data for disparate sources; aggregate or virtualize data into a contextual view; deliver aggregated view for operation and management; (iii) operation and Management Applications: production–Oil and gas production; facilities Management–Manage facilities and equipment; pipeline Management–Monitor flow and transportation.

4. Composite Solution

Composite provides an elegant solution for GIS integration. The Composite Data Virtualization Platform leverages best practices principles including abstraction, decoupling, reuse, and more, while also supporting a range of internal and industry data standards to integrate geospatial data with operational systems to improve productivity and efficiency. It involves access GIS, operational systems, data warehouses, files. Databases–Connects to standard databases. Integrate GIS data with information systems into a contextual view. Deliver combined information for planning, analytics, and real-time action for database objects to visualize data models in the form of views and procedures for consumption via services (especially designed).

5. Benefits and Advantages

Benefits and advantages includes agile architecture–integrate GIS with numerous, involving operational systems; easy to add/remove–various operational systems and data stores; scalable–to support increasing data sources and data volumes; improved–analytics and richness of results; short deployment time–for quick time to solution; and reduced custom development–to minimize complexity. GIS manipulate data in a digital model and many times it is necessary to gather these data and digitize them in the most appropriate model for GIS. These models of digital support are the raster data model, the vector data model and the surface data model. The raster data model divides the studied area into a regular grid of cells where each cell contains a value and a geographical position. The contained value corresponds to a variable of interest. Each cell is georeferenced by means of a coordinate system, the cell size in real-world distance and the real-world location of the reference point of the whole grid. Each set of cells and their associated values constitute a layer and several layers can constitute a complete database, where each layer represents different variables (land use, elevation, solar radiation, etc.). The raster data model is the most adequate format for arithmetic operations among cells of the same layer or cells from different layers with the same geographical position.

6. Principle of GIS Based Energy Management Tool

The content of the term "Energy supply and demand management" differs in domains of the user. In the large cities provided with district heating system and several cogeneration energy production plants, the main aim of the energy sector is to find economically and environmentally best possible production structure and operational cogeneration between the plants and at the plants to cover energy consumption and demand. An individual house owner thinks of a little bit different issues, even if the economy and maybe also environmental impacts are the top issue. GIS analysis of electricity consumption and production can be useful if there is a closed electricity grid in the area with possibilities of expanding the grid considered combined with decentralized local electricity producers.

7. Conclusions

GIS integrated system is useful in providing common reporting formats for evaluating all relevant factors of actual and planning energy data for mapping demand and supply; conducting quantitative and qualitative analysis of the performance of the demonstration site installations; monitoring and validating the outcomes of individual and overall applications, a common reporting format for collating relevant demand and supply data; data mapping and resulting tool for Energy supply and demand management; implementation principle of the actual and planning data into the Energy Management System; and database within the EMS leads to mapping of the demand and supply sides and serves as references for further simulation and optimisations. There is a trend towards the application to plans and policies and towards more flexible, comprehensive environmental management schemes. GIS at present is mainly a stand-alone application, which is only partially integrated into the information management of organisations. There is trend towards more general systems, which include geoinformation as part of a universal data management approach. At present, GIS is mainly used as a support for the analysis of geo-data, the modelling of impacts, the visualisation of results and the production of support cartography for EIA. There is a growing number of applications which incorporate the innovative use of technology to make traditional EIA more effective. Similarly, there are several examples of innovative environmental management applications that exploit traditional GIS and achieve more effective environmental analyses.

References

[1] Schiffer, M.J., (1993), Augmenting Geographic Information with Collaborative Multimedia Technologies, Proceedings of AUTO CARTO 11, Minneapolis.

[2] Scholten, H.J., Bijtelaar, B. (1993), GIS and Multi media: how to integrate. Technical aspects of a prototype, Workshop on Multimedia and GIS, CNIG, Lisboa.

[3] Openshaw, S., C. Wymer, M. Charlton (1986), A geographical information and mapping system for the BBC Domesday optical disks. Trans. Inst. Geogr. N.S. 11, 3, 296 -304.

[4] Furst, J., Girstmair,G., Nachtnebel, H., P. (1993), Application of GIS in Decision Support Systems for GroundWater Management, Proceedings of HYDROGIS, IAHS Publication No. 211, Wiena.

[5] Goddard, J. B., P. Armstrong (1986), The 1986 Domesday Project, Trans. Inst. Geogr, N.S. 11, 3, 290 -295.

[6] Jorissen, J. and R. Coenen (1992), The EEC Directive on EIA and its Implementation in the EC Member States, A.G. Colombo (ed), Envirinmental Impacte Assessment Vol I, pp 1-13.

[7] U.S. Environmental Protection Agency, “Mercury and Air Toxics Standards” (Washington, DC: March 27, 2012), website www.epa.gov/mats.

[8] U.S. Environmental Protection Agency, “Cross-State Air Pollution Rule (CSAPR)” (May 25, 2012), website www.epa.gov/ airtransport.

[9] ExxonMobil, 2010 Financial & Operating Review, Table entitled: “Oil and Gas Exploration and Production Earnings,” p. 70.

[10] Mehta, Aasha Kapur and Menon, Nikhila, 2001, „Drinking Water‟, *Alternative Economic Survey*.

[11] Parikh, Kirit. India Development Report, 1999-2000, Oxford University Press, New Delhi.

[12] Planning Commission, 2006. Report of the Working Group on New and Renewable Energy for the Eleventh Plan. Available at: planningcommission.nic.in/aboutus/committee/.../wg11_renewable.doc