Enterprise GIS Projects: Challenges and Solutions

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- Business Process Management Approach

ABSTRACT. Enterprise GIS projects are complex. These projects involve coordination and communications between multiple parties. These parties include stakeholders, project teams, IT organizations and external vendors, etc. These projects start with stakeholder interaction and lead into complex techno-functional tasks associated with data conversion/ migration, software development, testing, acceptance and deployment. The teams are required to coordinate and integrate the deliverables from internal and external parties in a concerted sequence to achieve the overall objectives. This paper presents a unique process-based methodology, to establish the configuration management for enterprise scale technology implementation projects. In particular, this paper will cover task assignment and processes for communications, requirements management, environment utilization (dev / stage / test / prod), data loading/merge, data quality assurance and acceptance, backlog posting, software functional testing, software acceptance etc.

Note: The reader of this paper is assumed to have knowledge of ESRI technology and terminology. Some of the concepts and tasks described in this paper are technical in nature, assuming some knowledge of IT coordination, management and implementation. This paper attempts to identify the challenges in multiple areas but focus more on the process and collaboration needs. This paper also expresses several viewpoints of the author based on his experience.

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Introduction

Many organizations in federal, defense and commercial markets have implemented Geographic Information Systems (GIS) and/or are using the capabilities of GIS through contract or subscribed services. The initial utilization of GIS starts with the compilation of spatial datasets and standalone use with desktop applications such as ArcGIS Desktop.

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Sharing GIS datasets is achieved by distributing spatial databases through centralized file shares or configuring multi-user database environments such as ArcSDE databases. More recently, the utilization of GIS for data viewing and data sharing has been met with web-based technologies such as ArcIMS.

Enterprise GIS Projects

An ESRI enterprise GIS is an integrated, multi departmental system composed of interoperable components.(1) The focus at many organizations is to support line of business initiatives and improve business processes to realize more returns from the GIS investments. This focus results in the following type of projects:

a. System improvement projects
b. Process improvement projects

a. System Improvement Projects: These projects focus on re-engineering spatial datasets for content, quality and enhanced functionality of the GIS applications. The tasks associated with scuh projects include migration of data from existing data models to robust, standardized and comprehensive data models as well as integration with other enterprise systems. These projects identify the need for distributed ownership and also cover the new channels such as embedded applications and mobile applications.

b. Process Improvement Projects: These projects focus on the standardization, streamlining and the improvement of business processes associated with utilizing GIS technology. Their objectives center on improving productivity, efficiency, quality and performance by utilizing GIS technology.

Enterprise GIS is an organization-wide approach to GIS implementation, operation and management.[(2)] This approach identifies the need to establish a process framework, consolidating and/or integrating several isolated GIS database applications.

Enterprise projects require active participation and collaboration between the following:

- Leadership
- Governing bodies
- Process teams
- End users
- Process teams
- Project teams
- IT teams
- Business Analysts
- Software vendors
- Prime contractors
- Subcontractors

Challenges

According to Bonnie Hart-Johnson, a project manager overseeing a multi-year enterprise GIS implementation, "Technology implementations are easy but the people and process work associated with the projects are challenging." The complexities and challenges associated with enterprise GIS projects can be categorized and described as follows:

a. Technology
b. Process and Policy
c. Data Model and Data
d. Change Management
e. Cost and Schedule
f. Collaboration and Communication

a. Technology

Technology related tasks within an Enterprise GIS project include the assessment of alternatives, such as development of applications using tool kits (SDK's) or implementing out of the box products (OOTB).

This assessment involves a thorough analysis and decision making with system architecture (servers, network, redundancy, storage) and also choosing the technology to interface with other systems. In the enterprise context the teams are also required to adopt a standardized and comprehensive approach to support existing and future requirements.

The technical decisions made during the project contribute toward the life cycle cost of the system and in turn the return on investment from the implementation. For example the business requirements can be addressed by deploying ArcGIS Desktop, customizing ArcGIS Desktop, or developing a custom application using ArcObjects technology.

At many organizations, GIS technology is supporting real time and business sensitive applications. In these cases the availability of GIS applications becomes critical. To support these requirements, the technology teams are faced with supporting and designing the underlying infrastructure with appropriate relational database systems, application servers, terminal server technologies, synchronization system, storage systems and restoration technology.

b. Process and Policy

As the GIS evolves from individual to departmental and organizational level, the processes and policy requirements enter the scope of implementations.

The high level policy associated with data sharing, viewing, maintenance and elaboration of requirements become crucial to the design of the system. The databases are transitioning into multi-user environments to support enterprise GIS needs, where users from multiple departments and organizations have the ability to view, update and manage the data. This path requires protocol definition with policy and process for distributed data maintenance, management and conflict resolution.

The implementations will be challenging without adequate support and guidance from the leadership and process teams within the organization.

c. Data Model & Data

GIS is a data intensive application. The functionality of the application depends heavily on the quality, accuracy and latency of the underlying spatial and tabular data. The modeling complexities of the enterprise GIS increase with the diversity and the type of uses expected from the system. The level of abstraction expected from a user base (e.g., an engineering department) may not be same as the abstraction expected from a different user base (e.g., a planning or environmental department).

The data model workshops and sessions are time consuming and require active participation from end users and business analysts. It is challenging, yet important, for all team members to not only understand concepts such as feature class, subtypes, domains, relationships, annotations, annotation subclasses, labels, symbology, data sets and history but also the choices, associated constraints and future impacts. The teams also need to make decisions associated with business rules such as relationship rules, connectivity rules, topology rules, annotation rules, etc.

The versatility of ESRI's ArcGIS environment offers many alternatives and options to model the business data. For example, the same business object can be modeled as a point and/or polygon. The modelers have the flexibility to model a number of attributes on the business object or build relationships with other business objects. These technical decisions directly impact the performance and future functionality of the GIS and also constrain the policy for distributed data maintenance.

The ArcGIS data models offered by ESRI are excellent starting points to build an enterprise GIS. However these models need a thorough review and engineering exercise to meet the needs of an enterprise.

Many geospatial data sources are available in the industry. These data sources are compiled over years in the commercial, defense and public domain to meet the specific requirements of an organization. Although these data sources often function as a great resource, they often require restructuring and migration before they can be effectively utilized for other needs. The maintenance requirements and options have to be assessed before a third party data is chosen as the source for enterprise GIS needs.

d. Change Management

The change management needs of enterprise GIS projects are enormous. Tasks include the coordination of business process changes, standardization of map products (symbols, annotation), training, knowledge management and transitioning of projects to functional teams. The change management teams also function as liaisons to carry out the policy and process changes expected from the leadership of the organization.

e. Cost and Schedule

In some organizations the budgets for GIS activities are distributed across multiple projects. This distributed approach limits the synergy and momentum required to transition towards enterprise GIS implementations. At other organizations the dollars assigned to GIS projects span multiple years. In either of these cases, a strategic plan that moves the organization, incrementally, towards the enterprise GIS goals is critically important.

In the commercial markets, enterprise GIS projects are funded with tangible project goals in mind. The process aspects of the requirements often become the least accounted factors but play a vital role towards the overall cost and schedule for implementing a successful enterprise GIS.

During implementation, the lack of effective collaboration tools results in cost over runs and delays in schedule. The lack of these tools also impact the maintenance of enterprise GIS with deteriorating quality and in turn the inability to achieve cost savings and improvements anticipated from the investment.

f. Collaboration and Communication

The most critical contributor to the success or failure of an enterprise GIS is collaboration and communication between all participants. In the absence of an effective and timely communication and collaboration strategy, the challenges described in technical, process and policy, data modeling, data conversion, change management areas are compounded. This often leads to undesirable results with cost, schedule and the overall enterprise GIS implementation. For example, a business decision to model history in GIS impacts all other areas of the implementation including technology, process and policy, change management and cost. Similarly the data model change to add a new field to a feature class has an impact on the developer building the application and also the data conversion or migration specialist integrating the datasets.

Many technical and functional decisions have broader impact, requiring timely and effective communication with other participants. This collaboration and communication becomes even more challenging when the implementation efforts are distributed across internal and external resources from multiple organizations and the distribution of work among prime and subcontractors.

Solutions

a. Traditional Approach

The collaboration requirements for enterprise GIS projects grow with the increase in the size of teams and resources supporting the implementation. The traditional tools used in many projects are as follows,

- Meetings
- Status reports
- Emails
- Conference calls
- Web-EX sessions
- Project websites
- Scope documents
- Project charter
- Earned value management
- Audits, etc.

These traditional tools serve the need but often fall short, leading to communication gaps and delays in schedule with increase in costs. The very nature of these tools identified about is that they are standalone, disjointed and scattered. The project websites used for Enterprise GIS projects attempt to bring these pieces together but can lack critical features such as workflow and version control.

b. Process (BPM) Approach

A careful examination of the tasks executed during the implementation and utilization of a typical enterprise GIS identifies several repeatable steps and processes. If these tasks and steps are orchestrated, executed and controlled, the collaboration and communication requirements become much more manageable.

In today's market, this planned orchestration of processes is successfully met by using the modern business process management systems (BPMS). These systems are well integrated applications that support process executions in a multitude of environments. This technology provides a powerful collaborative environment with the capability to design, execute, monitor and improve the processes across users, teams, departments, divisions and organizations. Some of the modern BPMS suites offer the following functionality as integrated web portals:

- Process
  - Design
  - Execution
  - Monitoring
  - Improvement
- Tasks and assignments
- Reports
- Documents with version control
- Discussion forms

Each participant is provided with secure access to attend their tasks and collaborate through integrated document center, knowledge center and discussion forums.

BPMS suites, when applied to managing the implementation of enterprise GIS, offer efficiency, productivity, control and the opportunity to address the needs of both the system improvement projects as well as process improvement projects.

Following are some of the GIS processes that are effectively managed using BPMS,

- Requirements management
- Open issues management
- Data loading/merge
- Data quality assurance and acceptance
- Map production
- Spatial data analysis
- Environment utilization (dev/stage/test/prod)
- Software functional testing and acceptance
- System enhancements
- Distributed data maintenance, etc.

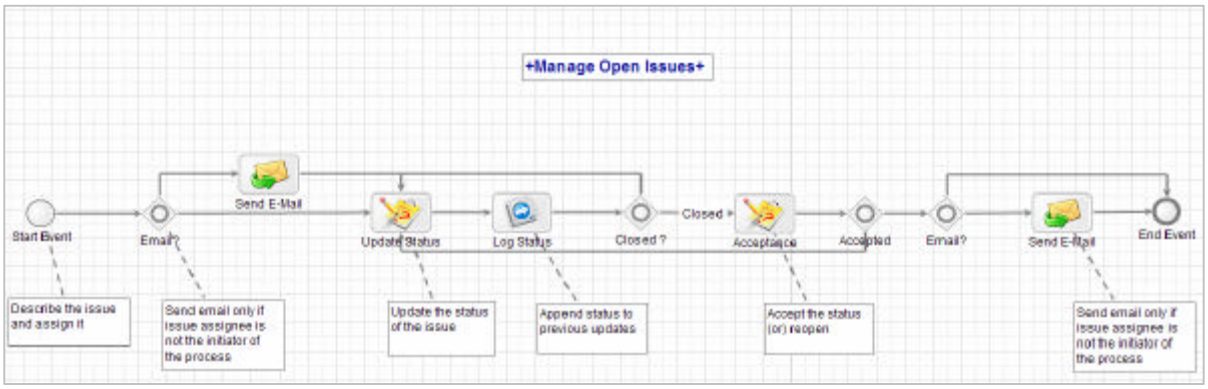
Sample Process I – Manage Open Issues

Enterprise GIS projects involve execution of several technical and functional tasks. These tasks can be system building tasks such as creating a database or installing software or researching a process change with the process owner. The project teams conduct planning sessions and technical workshops or use traditional tools to coordinate and manage these tasks. The open issues process serves as an effective tool to coordinate the tasks associated with technology, process and policy, data model and data, change management and cost and schedule. Often times, these open issues have inter-dependencies and the status of an open issue is important for multiple parties.

A simple process as shown at the bottom of this page is modeled and executed in a BPMS to manage the open issues for a commercial enterprise GIS project. This process provides the functionality to track the open issues, establish clear assignments, record metrics on the execution of the task and also allow live status reports to all team members. The following sample screen is presented to the team members to log and track the open issue,

This process also addresses status updates so the interested user can query the status of the open issue as and when needed rather than waiting for a meeting or conference call.

This approach ensures clear accountability and tracking of open issues. This process also accommodates an acceptance task by a qualified member so the open issue is closed only after needed verification.



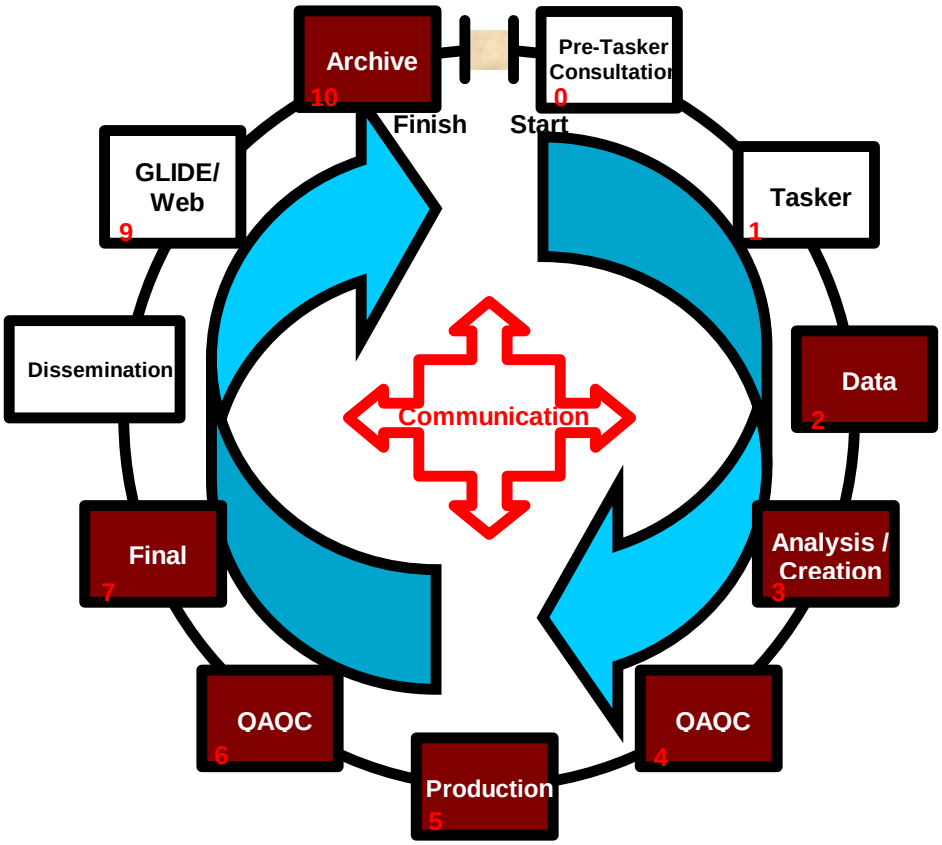
Sample Process II – Spatial Data Analysis and Map Production (GeoINT)

Spatial data analysis and map production is a fairly common activity in the utilization phase of GIS systems. The GeoINT process as shown in the diagram below is carried out to support a number of map products for a defense customer. The data selection (step 2) and spatial analysis tool (step 3) vary depending on the type of map product. The GeoINT project supports critical missions and the deliverables are time sensitive.

Currently, the spatial analysis and map production tasks are carried out using various geospatial technologies and the collaboration tasks such as pre-task consultation and task assignment are performed using email.

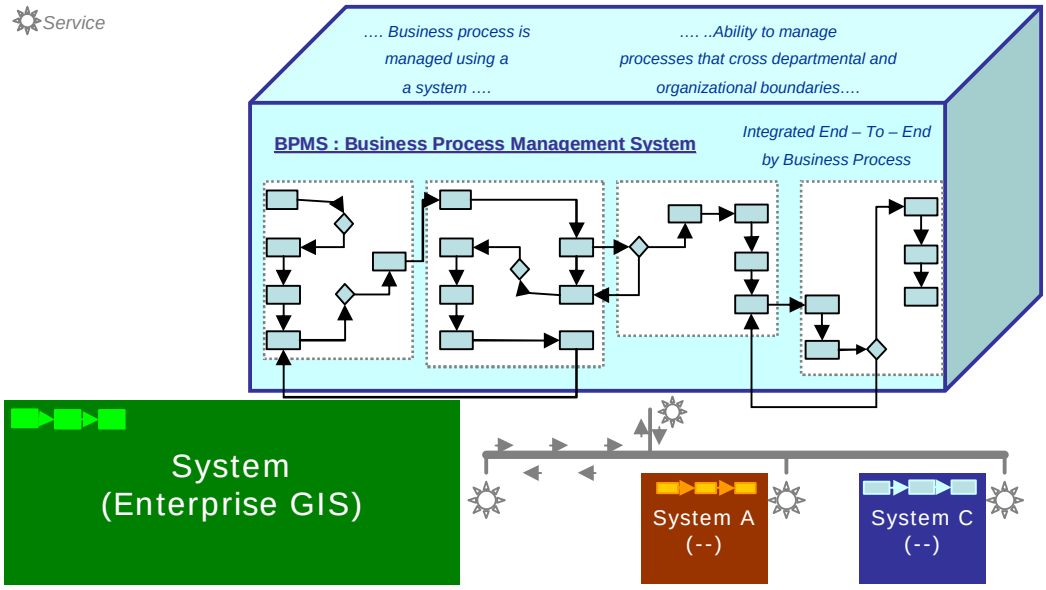
The integration of GIS with a BPMS is being proposed to manage the GeoINT process. This integration facilitates modeling and executing various process models based on the type of map product. The process models are expected to guide the analyst through the appropriate data sources based on map product, ensure all of the essential steps are carried out and loop to previous steps when adequate information is unavailable, thus ensuring high quality map products.

This approach is anticipated to improve the productivity and reduce the training needs for analysts.



Process Architecture

The diagram shown below illustrates the process architecture offered by BPMS to orchestrate GIS business processes. These business processes often need coordination among resources and systems within and external to the organization



Summary

The GIS LoB (line of business) initiatives[3] from the system/process improvement projects can be achieved by integrating GIS and other enterprise systems, utilizing SOA and orchestrating processes across organizations by utilizing BPMS.

Conclusion

Enterprise GIS has high collaboration needs. The process (BPM) approach to manage and maintain enterprise GIS offers many benefits. This approach contributes towards the successful implementation and maintenance of enterprise GIS by,

- Improving communications
- Reducing risks associated with cost and schedule
- Improving productivity
- Improving and sustaining data quality
- Achieving documentation requirements
- Achieving greater returns on investment (ROI)

In the authors view, the traditional approach by providing training and leaving GIS in the hands of end-users is inadequate. The return on investment from enterprise GIS is achieved only by modeling users, organizations and their roles as business processes and orchestrating such processes using modern business process management systems (BPMS).

References

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