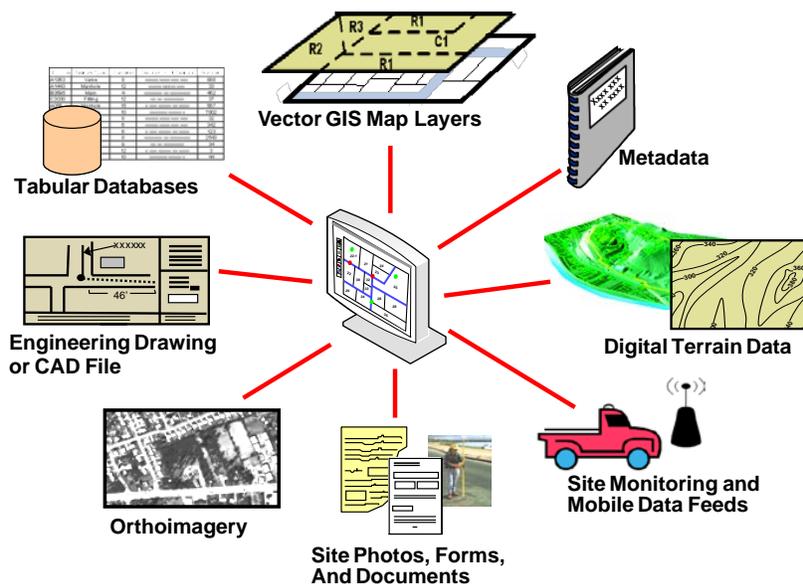


## GIS DESIGN AND IMPLEMENTATION SERVICES

Croswell-Schulte provides a full range of services for GIS design and implementation support. We are active in GIS industry research and standards initiatives, maintain GIS certifications and involvement in professional societies. We have expertise and maintain familiarity with the main GIS software and service vendors and methodologies for effective implementation of these products.

### GIS Database Design, Development, and Integration

Data represents the most valuable asset in a GIS program and it exists in many forms—including traditional vector map data but also encompassing a spectrum of other types of map and spatially-referenced sources as shown below.

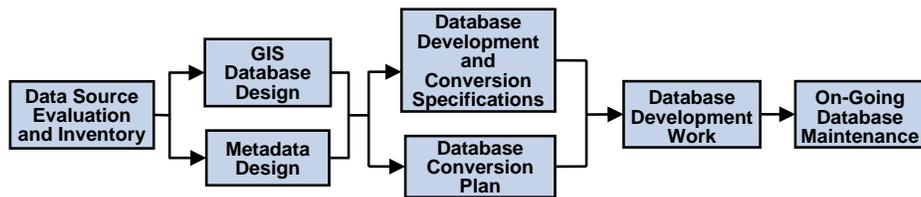


Croswell-Schulte provides support in all aspects of GIS database design, development, implementation, and integration. Our work is based on our expertise and familiarity with:

- Organizations' use of data and how it supports their programs and business processes
- Spatial data structures and technical standards
- GIS data collection and data conversion methods and tools (including aerial image and elevation data capture and field-based data collection)
- Data formats and architectures supported by leading GIS and database software products
- Use of appropriate data modeling and design tools
- Web-based applications supporting data collection and maintenance
- Standards, architecture, and methodologies for integration of GIS with external databases and services
- Firm grasp on data sources and processes for on-going update

Our GIS design services make use of state-of-the-art techniques and modeling tools suitable for database development with mainstream software packages. Specific products from our database design services include: a) source data identification, b) logical (entity-relationship) data models, c) definition of feature types, format, and spatial relationships, d) physical design of attribute databases including database keys and data element content, data constraints and domains, table relationships, e) database quality criteria, e) metadata design.

Our services address all major parts of the database design, development, and maintenance cycle as depicted below.

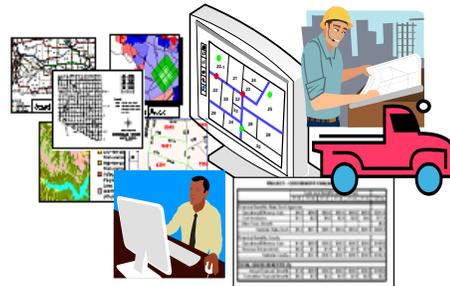


We provide the technical specifications for GIS data collection and conversion and work with our clients and database contractors to support high-quality GIS database development. We help our clients plan and put in place database update workflows, applications, and management practices to ensure an efficient, sustained GIS database maintenance program. Croswell-Schulte GIS database design and development services encompass the following areas:

- Inventory and characterization of data resources and sources
- Development of database standards and quality criteria
- GIS database conversion specifications and project management support
- GIS data modeling and physical design
- Metadata assessment and design
- Design and specifications for integration between GIS and external systems/databases
- Database development specifications and plans
- Quality assurance processes and plans
- Design of database maintenance procedures and organizational responsibilities

## GIS Application Design and Development Support

A GIS application is an automated process that generates a spatially-oriented product or result needed by a user. GIS applications may include: map update or map production, data query and display, spatial analysis, or other processes that use GIS software and geographic data. These applications give users in the office and in the field effective and easy-to-use ways to access information, answer questions, generate products, and support decision-making. For public sector organizations, GIS applications are integrated with other systems (e-government, document management, permit tracking, asset management) to support operations and serve the public.

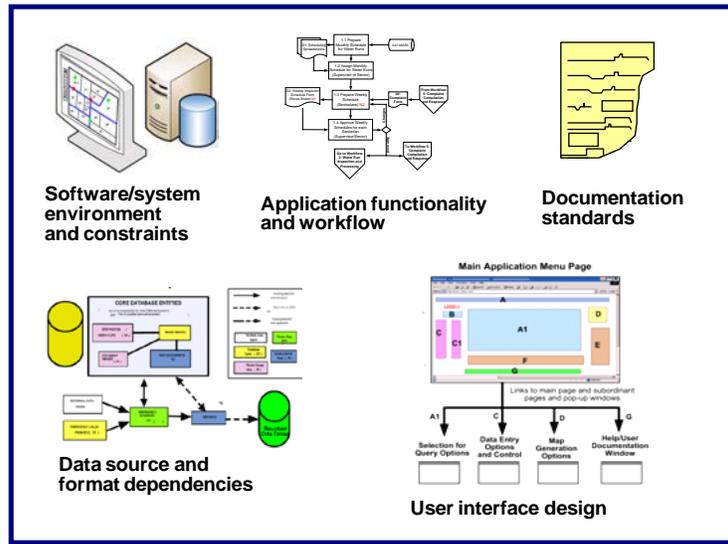


GIS software packages come with a range of “off-the-shelf” functions that may be used without significant customization. Often, however, GIS users find it beneficial to use software configuration or development tools to create custom applications that support specific user needs. Our work in GIS application development work includes the design and development for Web-based, desktop, and mobile platforms employing a range of customization activities:

- Configuration of new or modified user interfaces
- Automating access and integration with other systems
- Incorporation of Web-based and Cloud-based services and systems supporting GIS applications
- Developing “intelligent” forms to support efficient data entry
- Developing application scripts for complex application workflows
- Configuring tools and communication services for mobile applications (for smart phone and tablet computers)
- Creating custom design templates for map displays and reports
- Creating a library of standard queries that can be accessed through menu selections
- Programming complex analysis applications using GIS and other software development tools

Croswell-Schulte provides services for the design of GIS applications and defines procedures for their development and deployment. Our application designs typically include the following components shown at right.

We are familiar with accepted application development methodologies and the tools and application development capabilities of current GIS software packages. Following the application design work, we provide resource and budget estimates for development and deployment. We work with our clients to help support in-house development or to provide these services on a contract basis. Croswell-Schulte will also accept full management responsibilities for the entire development effort and subcontract and/or oversee the work of other firms providing the application services.

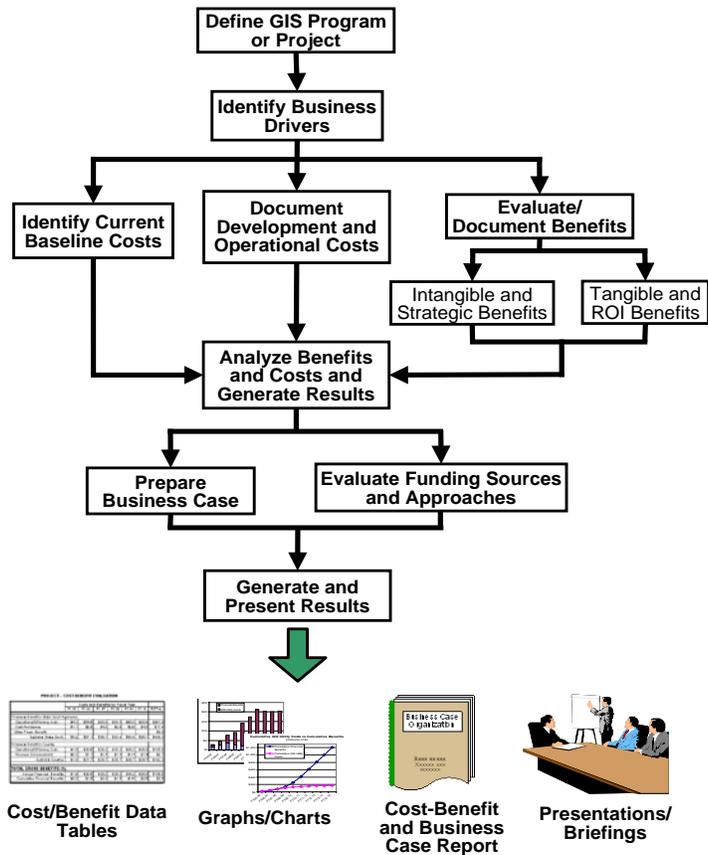


## GIS Project Financial Analysis and Business Case Preparation

Successful GIS programs and projects provide real benefits to users. They are dependent on accurate resource estimation, budgeting, a well-articulated business justification, organizational support, and sound funding. Croswell-Schulte excels in carrying out cost-benefit evaluations, crafting effective business cases, developing funding strategies, and garnering senior support for GIS initiatives. Our work in this area is depicted in the general project workflow at right.

Croswell-Schulte accurately estimates development and operational costs for GIS projects and programs. We carry out cost-benefit studies with a focus on real benefits—both tangible and strategic. Our work in business case preparation helps focus work on priority areas, it conveys business value, and establishes senior-level support for GIS projects.

We also provide support in preparation of budgets, evaluation of funding sources, and development of funding strategies. We examine traditional funding approaches (e.g., general fund allocations) as well as an array of less-conventional funding approaches available to public sector and non-public organizations including: service fees, multi-organization licensing and cost-sharing, CIP funding, program-related transaction fees, project sponsorships, external product/service sales, and grant programs. We work with our clients to craft effective funding approaches that ensure a sustainable funding base for GIS projects and programs.



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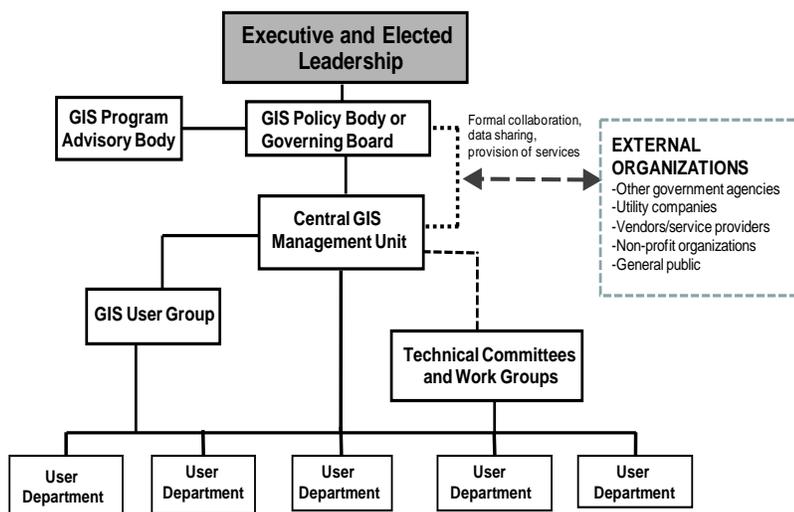
## GIS Program Organizational Development

The emphasis today on enterprise GIS programs demand organizational structures and management practices that enable and support organization-wide participation and coordination. Building on advances in organizational models and practical experience gained over the past 25 years, Croswell-Schulte evaluates requirements and designs organizational models and management structures for enterprise GIS programs that typically include the elements shown below.

With our help and support, our clients put in place successful GIS program environments that address critical issues of governance, operational management, and multi-Departmental coordination. We are especially sensitive to existing organizational culture, structure, and policies that impact GIS program coordination. We are also skilled with the creation of procedures and legal mechanisms for collaboration with external organizations (government or private firms).

Croswell-Schulte is knowledgeable about the laws and policies that enable and impact organizational structures and governance in public agencies and the optimal approaches for GIS and IT coordination and management. We examine options for appropriate levels of centralization and decentralization of GIS management and operations to create an environment that meets enterprise GIS goals while responding to the specific needs of individual user groups. This informs our work in designing and putting in place organizational structures, GIS program governance, and coordination vehicles that support enterprise GIS programs.

“Model” Organizational Structure for Enterprise GIS Program



**GIS Governing or Policy Board:** Senior representatives from multiple Departments with a policy setting, guidance, and policy setting role. The extent of governing authority will vary depending on the type of organization and its executive management.

**Advisory Body:** Sometimes created for GIS programs to get participation, ideas, and support from a wide range of stakeholders both inside and outside the organization running the GIS program.

**Central GIS Management/Coordination Unit:** Formal office with a GIS manager and staff responsible for coordination and management of GIS program and usually with certain operational and user support responsibilities.

**Technical Committees and Work Groups:** Formal groups established, with a designated chair and membership from entire organization, with a defined role to investigate and oversee critical program GIS initiatives

**User Group:** a formal or informal body of users established to share ideas and applications, support user education, and to provide input to GIS management

Croswell-Schulte offers the following GIS organizational development services:

- Analysis of current organizational structures and policies
- Identification of internal and external stakeholders and their GIS program roles
- Evaluation of options for GIS management and creation of management structure and practices
- Define structure, role, and participation in governing and advisory bodies
- Evaluation and definition of staffing requirements and roles
- Support in establishment of a full GIS organizational structure
- Preparation of internal or inter-organizational agreements establishing a basis for sharing of resources and GIS program participation
- Preparation of budgets for GIS development and operation
- Development of policies that enable and support the GIS program

## GIS Policies, Standards, and Best Practices Development

Formally stated and communicated policies, standards, and practices form the basis through which GIS programs function, provide support to users, and impact all elements of a GIS program: system infrastructure, data, applications, and organizational structure). They direct and govern effective GIS planning, design, system development, system administration, and service delivery. Development of policies, standards, and practices is a core service of Croswell-Schulte and our work in this area focuses on specific opportunities and benefits:

**Effective Management and Coordination**—Well-defined roles, responsibilities, and workflows that support an effective, highly collaborative work environment

**Interoperability**—Allowing smooth integration and flow of data among different hardware devices, networks, and software packages facilitating enterprise collaboration and efficient use of system resources

**Integration and information sharing**—Allowing applications and databases to be easily accessed, and data can be exchanged in a transparent manner

**Portability**—Allowing data, software, and custom applications to be easily usable and transferable to multiple hardware and software platforms and to avoid duplicative and redundant development and system maintenance

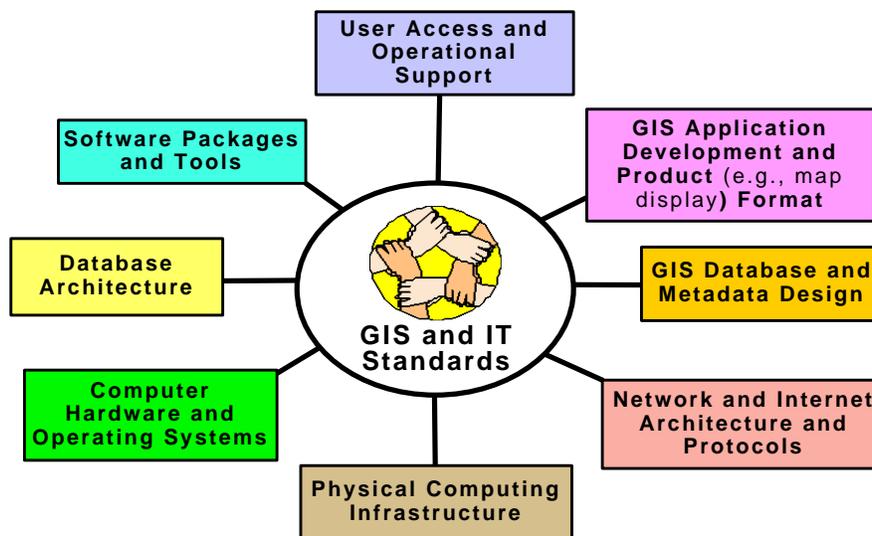
**Quality**—With a focus on compilation and maintenance of up-to-date, complete, and accurate data and applications that adhere to required levels of quality in which users have confidence and which supports business needs

**Efficiency**—In operations and reduction of staff time and calendar time needed to maintain data, build applications, and support users

**Consistency**—With a goal for uniformity in data, practices, procedures, and appearance of GIS products and applications.

We evaluate internal policies and mandates and appropriately apply the work of recognized government and independent standards bodies, professional associations, and other organizations including: ISO, ANSI, NIST, FGDC, OGC, National Academy of Sciences, URISA, ASPRS, GITA, AWWA, IAAO, other IT and GIS bodies.

Our work in the design and development of technical standards covers the following GIS and IT domains:



We develop formal policies and practices that help support and direct GIS planning and operations—taking into account existing systems, policies and organizational culture.

Policy and best practice development encompasses a full spectrum of GIS management and operational areas:

- GIS Personnel and Professional Development
- GIS and IT Standards Compliance
- GIS Procurements, Contracting, and Financial Management
- Project Coordination and Management
- Project Partnerships and Collaboration
- Data/Product Access and Sharing
- User Support and Help Desk Services
- System Administration and Network Security
- Data Maintenance Procedures and Responsibilities

Croswell-Schulte services in the area of GIS standards, policies, and best practices include:

- Evaluation of the organization’s current IT and GIS standards, policies, and practices
- Research on GIS and IT standards trends and impacts

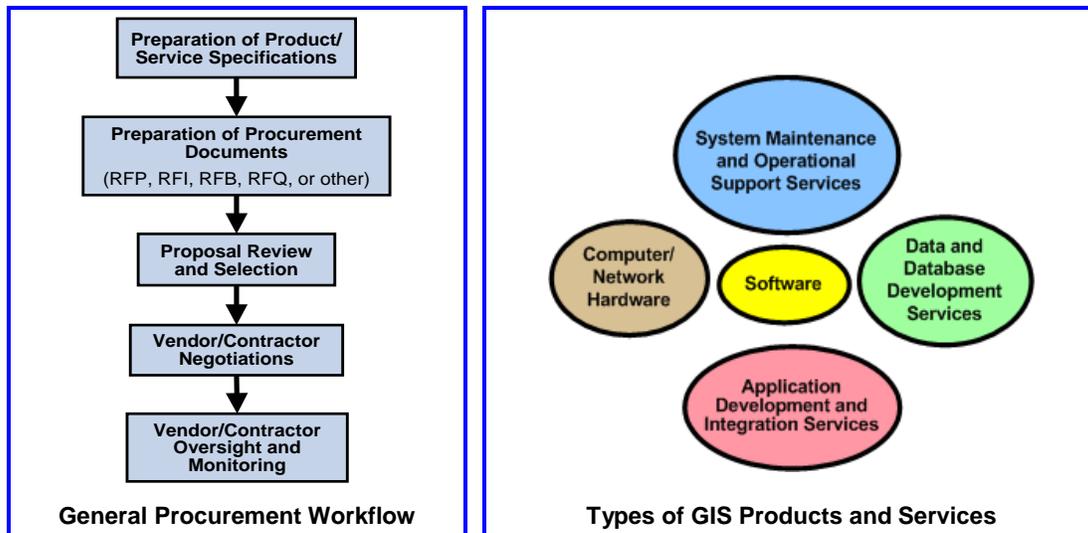
- Preparation of formal standards and best practices
- Preparation of formal GIS policies and internal procedures for policy adoption, revision, and communication
- Support with internal education and adoption of standards, best practices, and policies

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## Support in GIS Product/Service Procurements

Croswell-Schulte stays up-to-date with products and services of the IT and geospatial industry and the companies that provide them. We are familiar with bidding and purchasing rules and the administrative procedures in the product/service selection and procurement process. Our work helps ensure that specifications meet the organization's requirements and that cost-effective decisions are made in regards to vendor and contractor selection. We provide support to our clients all major elements of the procurement process.

Steps and Elements of GIS Product and Service Procurement:



In support of GIS product and service procurements, Croswell-Schulte provides the following services:

- Industry research and prequalification of products, vendors, and contractors
- Preparation of technical specifications for systems and IT services
- Procurement document preparation (RFP, RFB, RFI, RFQ)
- Preparation of procedures and tools for vendor/contractor evaluation and selection
- Support in vendor/contractor proposal evaluation and selection
- Risk assessment for GIS development projects
- Management, monitoring, and documentation of the procurement/vendor selection process
- Procurement contract preparation and negotiation
- Vendor/Contractor oversight and performance monitoring

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## GIS Project and Program Management Support

Croswell-Schulte is well-positioned to carry out objective evaluations and support existing GIS projects and programs. Our independent status and extensive experience is the basis for sound recommendations for technical, administrative, and management improvements. We help organizations examine and solve problems, make changes when necessary, and achieve higher levels of performance.

We examine the critical elements of a GIS program:

- Technical components (systems, data, networks, applications)
- Staffing and management
- Project plans and performance measures
- Contracted services
- Internal and external coordination and communications
- Financial factors
- Support and involvement from senior officials

Our work results in specific recommendations for improvements. We present the results of our evaluations with management personnel and work with them and their staffs to implement changes and monitor performance. We also provide general management and technical support and advisory services to augment existing personnel and to provide an independent perspective on GIS program challenges.

Specific types of GIS program and project review, audit, and services which Croswell-Schulte provides include:

- Troubleshooting to ascertain causes and offer solutions to technical and operational problems
- Coaching, support, and orientation for improved management practices and techniques
- Examination and oversight of contracted services (e.g., database or application development) and recommendations for improvement
- Review of project scope, schedule, budget, and performance measures and identification of adjustments
- Evaluation of staff levels and roles with recommendations for changes or enhancement
- Support with change management helping GIS programs respond to and take advantage of internal and external change agents

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