

# GIS Management Strategies and Issues

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*Keynote address presented at the 8th Colloquium of the Spatial Information Research Centre,  
University of Otago, New Zealand, July 9-11 1996*

## Abstract

GIS management issues are often cited as being the most important factors in GIS success. Yet, there is also a general impression that these issues are not well understood. What do we really “know” about GIS management? Some successful methodologies have emerged over the 2-3 decades that organizations have been implementing GIS. While not represented by rigorous study and description, this knowledge still forms a valuable resource for developing GIS management approaches. Many other issues, however, remain to be examined and developed. This paper outlines the GIS management practices that have emerged as successful methodologies, and identifies some of the areas where further study and development is most urgently needed.

## Introduction

It is generally recognized that management approaches and issues are crucial to the success of a GIS effort, yet organized and reliable information on these matters can be difficult to find and to evaluate. There is a great deal of information concerning GIS management, yet it is often difficult to derive knowledge from the information. There are many slogans that are repeated, several approaches that have proven successful for many organizations, and many more issues that are not yet clear.

There is an increasing availability of information on GIS management. Most of this information is found in project descriptions, case studies and “how to” GIS papers and articles. This means that many of these prescriptions are based on a sample of one. Common “success strategies” that are often cited include:

- Establish executive level leadership.
- Have a project champion.

- Establish an identity and visibility for the GIS project.
- Form committees, workgroups or teams.
- Formalize the budget for the whole GIS project.
- Hire pre-trained staff.
- Establish a GIS job class.
- Conduct an initial GIS educational event.
- Perform pilot projects.
- Provide early deliverables.
- Build your database on the highest accuracy data you can.
- Bootstrap the GIS with inexpensive, low accuracy, high utility data.
- Establish a GIS department.
- Initiate GIS in a low-level work unit.
- Use an enterprise GIS model.
- Start small.

Some of these pointers do hold up as good advice. They have worked for many organizations. Other strategies that might have been successful for one organization, and are therefore promoted by that GIS manager, however, could prove disastrous for another organization. As Wellar (1989) observes, samples of one hardly form a sound basis for knowledge. While some studies that would provide a sounder base of knowledge are just beginning to appear and progress, there are some aspects of GIS management that have emerged as successful practices.

## GIS Management Strategies

As things stand today, one of the best indicators of what we know about GIS management is how many organizations have used any particular strategy successfully. Hundreds of organizations’ experiences have indicated certain strategies that work in certain situations. Many

individuals share these experiences in various forums in the GIS industry. While we await a more rigorous approach to the study of GIS management practice, the accumulated weight of many organizations' experiences provides much valuable information and guidance. The strategies identified here are based on this accumulated experience, drawn from GIS, IS and management literature, discussions with hundreds of GIS managers and users, and experience with dozens of GIS projects.

In addition, GIS can draw upon applicable principles from a variety of other fields. We do not need to reinvent the wheel. Many of the basic principles of GIS management are derived from project management, information systems development and management, organizational design and development, business process re-engineering, technology implementation and business management.

While GIS management approaches share many common characteristics with other technologies and management issues, they also have some unique aspects. The special characteristics of GIS and its relationship to the organization require attention to specific aspects of management and the development of some specialized strategies. There are several key elements to successful GIS management strategies. The GIS management strategies outlined here represent the approaches that appear repeatedly and significantly as successful approaches or "best practices" in GIS management.

### **GIS Implementation Process**

The basic steps of the GIS implementation process are planning, requirements analysis, design, procurement and development, and operation and maintenance. This process appears to be fairly well understood as discussed in the literature, however, in practice it is often not applied. While some well planned variations on the process can benefit an organization, much of GIS success depends on performing this process correctly. Many organizations have demonstrated the benefits of following a good implementation process, and many have demonstrated the problems encountered when it is not followed.

In particular, some aspects of the GIS implementation process are more developed than others. Current methodologies for planning, requirements analysis, concep-

tual design and some classes of application development have resulted from the experiences of similar organizations, and owe much to principles from other areas of IS development and management practice.

### **Strategic Vision, Scope and Organizational Impacts of GIS**

To provide direction for the GIS and for all implementation and operations activities, it is necessary to establish a vision that defines the role GIS plays in the organization, its scope, and its relationship to business operations. Establishing a strategic vision and goals for GIS is critical to its success, whatever the scope of the implementation. In a large, multiparticipant GIS effort, it is crucial that all participants fully understand and share that vision, as they will be responsible for making it a reality. Developing a common vision and ensuring that everyone fully understands it and buys into it may be time consuming, but the benefits are well worth the effort. Many GIS problems and failures can be traced to a single source — conflicting ideas concerning what the GIS should be.

### **Assessment of Organizational Risk**

Performing an assessment of organizational risk at the outset of a GIS project can increase the chances for success. Croswell (1991) comes to this conclusion based on his observation that organizational culture, lack of understanding of GIS and unpreparedness are often cited as obstacles to GIS implementation. Many GIS managers are frustrated by what they see as inexplicable or illogical resistance to GIS. They make various assumptions about the source of the problems and the possible solutions. An organizational risk assessment provides a structured and analytical framework for examining the organizational components that hinder GIS implementation. Gibson et al (1984) discuss formal procedures for evaluating risk and suggest that project implementation strategy be based on the results of the risk assessment. (Croswell, 1991)

### **Coordinating GIS Participants and Users**

The organizational structures and techniques that are used for coordinating multi-participant GIS and AM/FM projects are strikingly similar among organizations, particularly in state and local governments. Many organizations have adopted identical basic structures and

methods, adding variations for their circumstances. Committees and team approaches are frequently employed for multi-participant GIS projects as a means for coordinating participants and guiding project development. The common model addresses participants' GIS interests at three levels — policy, technical development and usage — and establishes a committee at each level, coordinated by the GIS manager. This model also facilitates lateral communication and cooperation within the organization. The fact that similar models are used so widely is an indication that they work well. Of course, the organizations and situations must be suitable to the model. (Somers, 1995c)

### **Managing the GIS Committee and Team Environment**

To make the GIS committee or team environment successful, several other aspects must also be managed. Some organizations establish what would appear to be good committee environments, yet they do not work as planned. The reasons for this can often be traced back to these other aspects of managing the committee environment.

Each committee must have a clear charter regarding the types of issues it will address, and must remain focused on these issues. There should be a clear plan regarding the matters to be addressed by each committee — as well as by the GIS manager — and regarding how information, recommendations, approvals and directives are to flow among the committees and staff. The appropriate committee composition follows the GIS project definition.

Organizational and professional interests should be appropriately represented according to the role of GIS in the organization. The most successful committee arrangements involve teams that are limited to a workable size — usually 6 to 8 people. When committees are very large, some success can be achieved by establishing subcommittees to address specific issues.

Finally, committee members, particularly those on the technical workgroup, must make adequate time commitments. GIS related activities could consume 25-100% of team members' time for significant periods. GIS projects are delayed when committee production, reviews, and approvals fall behind schedule because

members could not contribute enough time to the project. Committee members' resource commitments must often go far beyond just attending meetings. Successful GIS efforts usually involve committed individuals. (Somers, 1995)

### **Communication and Providing Information**

Communication is crucial to the success of a multi-participant GIS environment. It can be time consuming: communication requirements grow according to the number of participants, and differences in applications, professional backgrounds, priorities, organizational interests and personal agendas. All involved parties — future users, as well as committee members — must be kept in the communication network from the time they are first contacted through the entire project lifecycle.

In order to participate usefully in the GIS effort, participants need adequate information regarding GIS and the project goals. They must receive the right kind and amount of education and information at the right times. Different participants from different application areas and levels of the organization have different interests, backgrounds and needs related to understanding GIS. For example, the type of information required by the Mayor will differ greatly from that required by an assessment clerk. GIS education and orientation must be tailored to the specific audience. This often means conducting several events for different groups from various application areas, professional backgrounds and levels in the organization. Furthermore, education will be an on-going need throughout the GIS project. (Somers, 1995)

### **Leadership and Support**

In a large, multi-participant GIS project, two types of leadership are crucial to success: someone to manage the GIS implementation and operation and someone to provide support and influence at the policy level.

A large GIS effort must have a focal point. The GIS manager coordinates the network of committees and participants. Among the many technical and managerial qualifications a GIS manager must possess, he or she must manage this complex environment. The ability to work with diverse individuals and groups, manage teams, educate, motivate and lead are critical to the success of the GIS.

Another key ingredient in an extensive GIS effort is a project champion who provides executive level support and influence. This factor is cited repeatedly by "successful" GIS projects, however, many projects still suffer from the lack of leadership. The project manager can function in a dual role as an effective project champion only if he or she is placed high enough in the organization. The project champion's support and efforts ensure continued political and financial support in the face of pressures that would erode the project's resources and delay its implementation. (Somers, 1995)

### **Management and Control of GIS**

Basically, control and management of GIS may be centralized or decentralized. In an enterprise GIS, an organizational unit may be established to manage the GIS environment and run the core system, while usage is decentralized. In an environment where GIS is used occasionally by various users, it may be set up as a separate service with a designated group that manages the GIS and also controls applications services for users. In an environment where GIS is used as a limited business tool, management and control may be decentralized to the user business units. (Somers, 1996b)

In an extensive GIS environment involving committees, a GIS staff, and many different users, special concerns regarding GIS control and management arise. Whatever the committee or team set-up, the organizational location of the GIS manager is considered the location of the GIS itself. In any organization, there are implications involved in the location of the GIS. Its location can be an important factor determining the success of the GIS, or at least the ease with which success can be achieved.

There are three basic areas in which the GIS management could be placed — in a line organization, in a support area, or at the executive level. Each of these locations has its advantages and disadvantages. These relate to budget autonomy and power, visibility, executive support, impartiality, authority and ease of coordination. Experiences of many organizations have demonstrated these advantages and disadvantages. In the past, many GIS projects were initiated in line departments because of the inherent advantages of being tied directly to an operational need and a budget line item,

as well as the direct support and control of a manager who saw the need for GIS. As such projects expanded to serve other departments, coordination difficulties arose. More recently, in recognition of the multi-participant nature of GIS and the need for better coordination and funding mechanisms, many GIS projects are started at the support or executive level. These projects, in turn, have suffered from the disadvantages at these locations. Another problem with GIS at the executive level is that GIS may evolve into a department, leading to big problems if this was not the intended organizational configuration. GIS projects and programs often move within the organization over time. The common move is "up" from line levels to support or executive levels. In the development of multi-participant projects, there is a trend to initiate them at higher levels in the organization. GIS management may also move when the project passes from the developmental stage to the operational stage. (Somers, 1990; Somers, 1994.)

The appropriate organizational configuration and placement of GIS management and control within an organization depends on the role and scope of the GIS, the organization model used and the specific operational aspects of the organization.

### **Personnel issues**

Personnel issues are currently heavily discussed topics in the GIS field. Much is made of the importance of staffing issues — perhaps too much. Most of this discussion derives from the traditional view of a large, multipurpose GIS in a public sector setting. In this type of environment, personnel issues are more important than they are in organizations where the GIS has a more limited organizational impact. Regardless of the extent and impact of GIS within an organization, however, the basic personnel issues must at least be addressed. These issues include staff responsibilities, staff configuration, position requirements, position descriptions and pay scales, job classes and career paths, staffing and training. Most components of these factors are the same for GIS as for any professional or operational area. Factors that make the GIS personnel issues unique relate largely to the relative newness of the technology within the organization, and in general. Again, GIS shares this phenomenon with many technologies. GIS personnel planning for any organization relates directly to the role

of the GIS and its design and operational characteristics. These will drive the staff needs, position descriptions and qualifications, the staffing process and the training needs. (Somers, 1994)

### **Timing**

Much of successful timing in GIS is an art. When developing implementation schedules, certain technical and organizational dependencies are inherent. Technically, certain components must be completed before dependent one can be developed. Organizationally, components must be prepared before technical changes can take place. There are many technical and organizational aspects whose timing must be coordinated.

Beyond the obvious scheduling dependencies, however, successful progress, adoption and use of GIS is the result of strategic timing that takes into account a variety of factors. For example, strategic timing of GIS project initiation can determine whether the project ever gets off the ground. A related issue is project formalization. Many GIS efforts have developed successfully by starting quietly, without formalization of activities or funding, and then formalized the project and obtained funding once they had shown some results. (Somers, 1995) Related to this issue is the timing of committee formalization. Committees and large numbers of project participants often are the source of project delays. In some cases, it may be better to start small with GIS for only one user or application, and involve others once momentum has been established. Likewise, the timing for moving from isolated GIS applications to coordinated operation must be carefully considered. Other issues of timing include the rate of development and expansion, and when to publicize GIS. In a business environment, GIS timing must not only take into consideration cost/benefits and internal operations issues, but competitive ones as well. (Somers, 1996b)

### **Integrating GIS into an Organization's Operations**

Successful adoption and integration of GIS into an organization's operations depends on all of the above issues. Each issue must be considered by itself and in combination with the others. Organizational and management issues must be addressed in concert with the

technical ones. While the technical tasks involved in system design and implementation are occurring, the organizational issues that facilitate the design and affect the implementation and adoption of the GIS must also be addressed. The key to success is coordinating all the goals, activities and impacts.

The primary factor in integrating GIS into an organization is to understand the role GIS will play in the organization. The scope, purpose and vision for GIS in the future of the organization will drive the development of organizational plans. A major issue regards the impacts of GIS on work processes and business operations. GIS could change all work processes and reconfigure the operational environment of the organization, it could just be added to selected operations, or it could have impacts anywhere in between.

There are many other important issues affecting GIS adoption, including:

- Educating users. Everyone must receive the appropriate information and education in the right format at the right time. (Somers, 1988, 1989-96)
- Training. Education and training are different functions, and different users will need different combinations of both. If users feel uncomfortable with training or use of the GIS, it will not be easily adopted. A good training plan will facilitate GIS implementation. (Somers, 1994)
- Involving users in the planning and design of the system. The future users of the system must participate in the planning and design phase if they are to fully accept the delivered system. Concepts related to user-centered design of information systems, such as those discussed by Eason (1988), are very relevant to GIS. The challenge in this area is to include enough user participation to ensure valid design and user acceptance, while not impeding the progress of system implementation.
- Transitions in operations. The manner in which GIS is phased-in affects its success. The transition to the use of GIS must often be planned so that it does not disrupt operations. This can be particularly difficult to achieve if GIS implementation entails extensive business process redesign and organizational changes.

- **Organizational changes.** Organizational change can be very difficult to effect. Organizations are naturally resistant to change. This resistance has many sources, including bureaucratic operating procedures, personal resistance and habit. The design of the target organizational configuration and operation is derived from the GIS design. Making the changes to put the new organization into effect, however, can be very complicated. Issues involve multiple transitions to achieve the desired state, preparing individuals, establishing evaluation and reward systems that re-enforce the changes, and many other issues addressed by research and literature in organizational design and development. Some organizations use an organizational change agent or manager to effect the organizational implementation. (Somers, 1989)
- **Personnel and career issues.** Users must see the benefits of GIS from a personal perspective, not just from organizational or business ones. Personal acceptance and support of GIS can be a crucial factor in the success of its adoption. (Somers, 1988, 1989-96)
- **GIS support services.** A major factor in user acceptance is the technical support environment. If GIS is well supported, the system and database run smoothly, the environment is user-friendly, and response is timely, then it will gain favor with the users. The GIS must make the users' lives better, not worse. (Somers, 1988, 1989-96)

Organizational issues are as important as technical issues, and the organizational design and implementation plan and process deserve as much attention as the technical design and process. The two plans should begin at the same time and proceed together. Many organizations concentrate on the technical plans and ignore the organizational issues until it is too late (thus providing us with valuable lessons through their misfortune). (Somers, 1996)

### Remaining Challenges

There is still more to learn about GIS management than there is already known. The major reason for this is that there is currently very little in the way of critical, rigorous or research-based studies that evaluate GIS

management approaches. Some authors have discussed the state of research, or rather lack thereof, regarding GIS management approaches. Wellar (1988, 89) observes that most of the management "musts" in this field are based on an experience of one, and Craig (1991) further comments on the absence of any true research-based guidance. Campbell and Masser (1995) have studied the implementation of GIS in British local governments. Crosswell (1991) performed an analysis of several published papers regarding GIS and IS implementation and derived some "maxims of success". His conclusions coincide with many of the management strategies discussed above. Recent research efforts are encouraging.

While it can be argued that each GIS implementation is unique, and that methodologies are changing quickly in response to technological changes, there are still some significant areas where further development is needed. These include the following:

- Integrating GIS into the organization.
- Performing reliable cost-benefit analyses.
- Measuring GIS success.
- Managing GIS implementation and operations in a dynamic environment.
- Keeping the technology perspective under control.
- The appropriate organizational models for GIS (enterprise vs. others).

There may be various ways we could build our knowledge base:

- Look to other fields. We have seen that many principles from other fields apply to GIS. Some authors, such as Medyckyj-Scott and Hearnshaw (1993) have conveyed some of these principles. Beyond that, however, GIS practitioners must be more aware of these knowledge sources and how to apply them.
- Rigorous study and analysis of GIS management methods and results. Too much of GIS "lessons learned" is taken at face value, and it is difficult to separate opinion and advice based on limited experience from proven methods. Little in GIS management has been "proven."
- Post-implementation studies. Many GIS managers will admit privately that things did not work out at all the way they planned, but very little is written or

shared formally in this regard. It is often disadvantageous for a manager to go back and evaluate his or her own project. Outside evaluation of GIS results, however, could be very useful to the organizations involved as well as to others in the GIS field. Campbell and Masser (1995) have made some progress in evaluating GIS in practice.

- Comparative studies. Analysis that examine how similar organizations implement and manage GIS as well as how different groups or classes of organizations do so could be very illuminating.

## Summary

What we “know” about GIS management today is generally derived from informal analysis of many organizations’ experiences. Some successful methodologies have emerged from these experiences, and these can be very useful to GIS practitioners. Many challenges remain, however, in solidifying our knowledge base and moving forward.

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