

## PLANNING A SUCCESSFUL GIS IMPLEMENTATION

It is easy to become overwhelmed by the technical jargon and issues involved in establishing a multipurpose, local government GIS. One is tempted to assume that the worst is over after learning about "geodetic control", "base maps", "cadastral data", "attributes", "tabular databases", and "spatial analysis". Actually, that was the easy part. Now its time to roll up your sleeves, because the real work begins.

At this point—the planning stage—one must come to grips with many of the difficult and complex issues, such as securing political support and funding, identifying requirements, selecting an appropriate system, and convincing staff to use the MPLIS once it is operational.

**Growing a System.** The American Society of Photogrammetry and Remote Sensing (ASPRS) and the American Congress on Surveying and Mapping (ACSM) have defined GIS as follows:

*A system of hardware, software, data, people, organizations, and institutional arrangements for collecting, storing, analyzing, and disseminating information about the areas of the earth (Dueker and Kjerne 1989, 12).<sup>1</sup>*

As the above definition suggests, a MPLIS is not just a new computer software package. A MPLIS is a complex interrelated system. To successfully implement such a complex system, one needs an implementation plan and a strategy for realizing that plan to the optimal extent possible. Without developing and paying careful attention to such a plan, a local government could end up investing a considerable amount of scarce public resources to buy a proverbial white elephant or the Brooklyn Bridge. The intent of this section is to outline elements of a planning process to help plan for and facilitate the successful integration of a MPLIS into complex, multi-faceted local governmental organization. While the elements of an implementation planning process are presented here, they all can be modified to fit the specific needs and resources of a particular local government.

Successful implementation of a full-scale, multipurpose MPLIS is usually a long, complex process, which generally involves multiple agencies/departments and often costs hundreds of thousands, if not millions, of dollars. Wiggins and French, in their American Planning Association publication on planning for GIS implementation, describe GIS as "something, which you cannot buy, but must grow over a period of time."<sup>2</sup> Unfortunately when most organizations think about implementing a MPLIS, they tend to focus on buying the hardware and software. A review of the professional GIS literature reveals a widespread sentiment that, proportionally, there has been far too much emphasis placed on the technical components of GIS implementation compared to the data, people, and organizational components, which are also key to its success.<sup>3</sup>

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<sup>1</sup> Dueker, K.J. and D. Kjerne. 1989; *Multipurpose Cadastre Terms and Definitions*, American Society of Photogrammetry and Remote Sensing and American Congress on Surveying and Mapping; Quoted in Vanderhoe, Alan P., et.al. *Introduction to Local Land Information Systems for Wisconsin's Future*, Madison, WI: Wisconsin State Cartographer's Office, 4-5 p.

<sup>2</sup> Wiggins, Lyna L. and Steven P. French, August 1991; *GIS: Assessing Your Needs and Choosing a System*, American Planning Association, Planning Advisory Service Report Number 433, Chicago, IL, 18 p.

<sup>3</sup> Zink, Larry K, December 1994; *A Case Study of a Needs Assessment Process for a Geographic Information System for the Nebraska Game and Parks Commission*, University of Nebraska-Lincoln, A Master's Thesis, 9 p.

The reality is that while the hardware and software are certainly important components of a MPLIS, in most situations they are neither the most expensive nor the most complex components. For the first several years of most MPLIS implementations, data development or acquisition costs are likely to be the most costly component of MPLIS implementation. Over the long-term, the people, organizations, and institutional arrangements are likely to be both the most challenging and costly components.

Implementation of a MPLIS is where technology and people meet. One of complexities of the implementation process is that it is necessarily political. People have to learn new technology, and the organizations themselves have to change. Information flows change, and different people exert control over the data and information. MPLIS implementation failures are more commonly related to people and institutional issues, than they are to technology issues.<sup>4</sup>

**Importance of Planning.** The strong temptation to just buy the GIS software and hardware, build the databases as one goes, and get started is noted in Geographic Information Systems - A Guide to the Technology, a textbook by John Antenucci and other professionals in the field. They note, however, that while such approaches may succeed, more thoughtful approaches to MPLIS implementation minimize the risks, and match the direction and pace with available resources. They identified "rigorous" planning versus "run and gun" planning as one of seven factors that have contributed to successful GIS implementations over the last 20 years. In addition to the importance of planning, the other dichotomies they identified, and which should be considered as an implementation plan is developed include:

- rigorous *versus* "run and gun" planning;
- focused *versus* diffused requirements;
- realistic *versus* unrealistic appraisal of effort;
- dedicated, motivated, continuity in staffing *versus* turnover;
- adequate finance plan *versus* inadequate conjecture regarding funding;
- thoughtful *versus* rushed or prolonged time; and
- balanced *versus* exaggerated expectations.<sup>5</sup>

In a similar vein, Peter Crosswell, Vice President of Plangraphics, a leading GIS consulting firm, has attempted to define factors that contribute to successful GIS implementations. Crosswell conducted a content analysis of 39 articles selected from major GIS publications and assessed common problems and approaches to overcoming those problems. Based on that analysis he developed the following set of maxims to guide organizations in GIS development.

- Perform an initial evaluation of organizational risk.
- Get commitment from management.
- Assign a GIS manager early in the project.
- Adopt a structured approach to system development.
- Involve users in system design.
- Formulate a goal-oriented plan and schedule.
- Develop a project organization that encourages cooperation and consensus.
- Allocate sufficient staff time.
- Keep users, managers, and constituents informed.
- Provide education and training at all implementation stages.<sup>6</sup>

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<sup>4</sup> Aronoff, Stan, 1989; *Geographic Information Systems: A Management Perspective*, WDL Publications, Ottawa, Ontario, Canada, 249 p.

<sup>5</sup> Antenucci, John C., Kay Brown, Peter L. Crosswell, et al.: *Geographic Information Systems - A Guide to the Technology*, Van Nostrand Reinhold, New York, NY, 214, 235 p.

While the above outlines provide two somewhat different perspectives on the factors that contribute to successful GIS implementations, it is important to note that rigorous, realistic planning is a key factor in each list. This view is widely reflected in the written literature about GIS implementation. Most experts in the area of GIS implementation planning would advocate laying out detailed plans for organization-wide GIS implementation. However, planning efforts should be scaled to the type, size, and complexity of your governmental jurisdiction, and to the breadth and nature of political support available. A statewide survey of the successful local government MPLIS implementations in Minnesota found that most had developed implementation plans, however the plans that they commonly developed had a narrower focus and were simpler than what a professional consultant might have developed. The important thing is to "touch all the bases" in some way. In many cases the consideration of each planning point can be rather informal, but each of the issues should be considered.<sup>7</sup> A local government implementation group must balance the need for rigorous planning against the competing need to avoid getting too bogged down and overwhelmed by the planning process itself.

**Learn About MPLIS.** It is not necessary to become a MPLIS expert or even have any "hands-on" experience with MPLIS to help guide a successful implement of MPLIS in your organization. Implementation leaders don't have to know everything—just enough about the various aspects of MPLIS to effectively deal with others involved in the process. Leaders of any local government implementation effort must become sufficiently informed about the technology to describe its benefits to potential users and elected officials. Likewise a sufficient understanding is needed to help lead the organization through the processes of making intelligent choices about priorities, standards, hardware, software, staff and consultants. This Guidebook will provide some of the background information needed. You should also do additional reading (see Appendix - Suggested Readings), talk to other colleagues who are now using GIS, and attend GIS workshops or conferences. In Nebraska, two relatively low-costs learning opportunities that should be considered are the biennial Nebraska GIS Symposiums and the regional Mid-America GIS Symposiums. These two area GIS symposiums are held on alternating years.

**Organize for GIS Investigation, Planning and Coordination.** Nearly every successful GIS implementation owes its success to a relatively small working group who are willing to commit themselves to the long-term effort of promoting MPLIS and overseeing its coordinated implementation. A study of the successful implementations in Minnesota suggests that these working groups frequently included:

- an organizational champion(s) with enough influence or authority to get the necessary resources,
- technical people who made the technology produce results, and
- a small circle of supporters and cooperators.

These working groups frequently start out as informal groups that cross organizational boundaries. As the planning progresses, a formalization of the structure, such as a MPLIS Committee, should be considered to provide an organizational entity for the group's activities and cause it to be recognized by the larger organization.

This working group, or MPLIS Committee, should focus its work in two key areas.

1. Building organizational and political support for a local government MPLIS.
2. Creating, then overseeing implementation of a plan for MPLIS development.

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<sup>6</sup> Croswell, Peter L., 1991; Obstacles to GIS Implementation and guidelines to increase the opportunities for success, *Journal of the Urban and Regional Information Systems Association*, Vol. 3, No. 1. 51-53 p.

<sup>7</sup> BRW, Inc. for the Intergovernmental Information Systems Advisory Council (IISAC), October 1996; *Implementation Guide for Parcel-Based GIS*, Minneapolis, MN, 5 p.

These two tasks are highly interrelated. The type and level of political support will determine how ambitious the plan can be. The quality of the plan and the incremental success of the implementation will add to or detract from the political support.<sup>8</sup>

Importance of Champions. The importance of having one or two champions for this process is emphasized in much of the literature about MPLIS implementation. These champions take the lead in "selling the vision" to the organization. Someone must be willing to organize the meetings, to explain the concepts (or bring in experts who can), to make at least the initial choices about the scope of the project, to decide who to include in planning and design sessions, and generally to promote and facilitate change. These facilitator(s), in conjunction with the working group, must put in place a mechanism to deal with the difficult institutional issues such as long-term funding commitments, restructuring of an organization, new relations with other organizations data security and access, and so forth.

The champion(s) might also have technical expertise or might work with someone who will be responsible for technical aspects of implementation. The champion must be an effective spokesperson and organizer, and in many cases must be willing to take some risks. Without such facilitators, a MPLIS implementation may be impaired and the benefits of land record modernization limited. However, because the ultimate goal of most successful local government MPLIS implementations is to have the technology broadly distributed throughout the organization and directed by the users, the champion(s) must also be prepared to "let go" of the process after successful implementation.

Change does not come easily in most organizations; persuasive arguments about the benefits of a technology may be a necessary part of the implementation process. There is growing evidence to support claims for improvements in efficiency and increased equity in decision-making as a result of land record modernization. But it will be necessary for a champion to transform technical jargon into decision-maker's own frames of reference. The champion's approach during an introduction to a MPLIS must emphasize the efficiency or effectiveness of new methods, rather than presenting information that may sound like abstract or arcane technical concepts. Once a commitment to implementation has been made, technical experts can start introducing specific concepts and terms in a formal or informal training process.<sup>9</sup>

It was noted earlier that MPLIS is a *system*, and that key components of that system are the people, institutions and organizational arrangements. The local MPLIS working group must take the lead in intentionally addressing these people/institutional components of MPLIS and in establishing a climate of broad ownership and cooperative problem solving. It is important to remember that most MPLIS implementation failures are related to people or institutional problems rather than technical. As was noted earlier, one of Peter Crosswell's maxims to guide organizations in GIS development was "*develop a project organization that encourages cooperation and consensus.*"<sup>10</sup> Throughout the process, as different approaches are considered for addressing a variety of needs or problems, consideration should be given for how these different approaches might support or detract from the development of these new institutions, organizational arrangements and a climate of cooperative problem solving.

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<sup>8</sup> BRW, Inc. for the Intergovernmental Information Systems Advisory Council (IISAC), October 1996; *Implementation Guide for Parcel-Based GIS*, Minneapolis, MN, 7 p.

<sup>9</sup> Ventura, Stephen J., April 1991: *Implementation of Local Land Information Systems in Local Government - Steps Toward Land Records Modernization in Wisconsin*, Wisconsin State Cartographer's Office, Madison, WI, 7 p

<sup>10</sup> Crosswell, Peter L., 1991; Obstacles to GIS Implementation and guidelines to increase the opportunities for success, *Journal of the Urban and Regional Information Systems Association*, Vol. 3, No. 1. 51-53 p.

**Set Goals and Review Frequently.** Another of Peter Crosswell's maxims to guide GIS development is, *"formulate a goal-oriented plan and schedule."* The importance of defining goals (also known as vision or mission statements) and reviewing them frequently was also found in the survey of the successful local government MPLIS implementations in Minnesota. That study found that the most successful and cost effective MPLIS implementations are those that proceed, according to a well thought out plan, toward clear goals, while maintaining and increasing political support. The study report also noted the importance of establishing some goals that can be achieved relatively quickly and that will demonstrate the value of MPLIS. But it also noted a caution of not getting side-tracked from key long-term goals in the pursuit of rush projects.<sup>11</sup> The nature of your goals will change as your implementation process progresses and should therefore they should be reviewed and updated frequently.

**Build Support.** As was noted earlier, one of the key focus areas of the MPLIS working group should be, *"building organizational and political support for a local government GIS."* Most MPLIS implementations will require significant front-loaded investments for the development or acquisition of data, hardware, software, staff, and training — while the majority of the payback occurs over a much longer period of time. This coupled with the frequent need to make changes in the ways that existing organizations collect, administer, and share data means that intentional efforts to build and maintain support for this long-term, occasionally disruptive, process must be a high priority. This focus is consistent with another of Peter Crosswell's 10 maxims to guide GIS development, *"get commitment from management"*.

It is particularly important to building this support in two sectors: the various departments of local government and elected officials. With government departments, learning the uses they make of spatial data, problems they have, and the major resources they consume can be useful in shaping your persuasive approaches. Attempt to illustrate how MPLIS can assist them in carrying out their responsibilities without creating major disruptions to their operations. Concentrate on department heads. Facilitating their visits to similar departments, in other jurisdictions, that are currently using GIS can be very helpful.

The support and/or involvement of one or more elected officials can also be very useful. To the extent that an elected official is able to articulate the benefits of a MPLIS in public policy and budget forums, the implementation process will be enhanced. Practically speaking, few elected officials will have as much time to get into the details of MPLIS planning and implementation, as might representatives from departments. Demonstrating how MPLIS can help in areas of key concern or the pet projects of elected officials is a good way to build support from those officials.

If you can generate sufficient interest or support from department heads or elected officials, try to involve them in the MPLIS Committee. Giving them specific roles and responsibilities will likely increase their ownership in the MPLIS implementation process. It is also important to realize that one must not only initially build the support, but also work to maintain it over a considerable period of time. Most MPLIS implementations require several years before the initial development cycle is completed. During this period it is likely that there will be several struggles over funding and organizational arrangements. Therefore, it is important to keep your supporters informed and involved in the process. Elected officials also come and go and it may also be necessary to educate and gain the support of those officials who replace them.

**Scope of the Project.** One of the early decisions that the MPLIS Committee or working group will need to make is related to the scope of the initial research and planning activities upon which the MPLIS

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<sup>11</sup> BRW, Inc. for the Intergovernmental Information Systems Advisory Council (IISAC), October 1996; *Implementation Guide for Parcel-Based GIS*, Minneapolis, MN, 7 p.

implementation plan will be developed. Which agencies, departments, individuals or applications will be considered in initial needs assessment activities?

Much of this Guidebook is based on the assumption that the group or individuals responsible for local government MPLIS plan development will 'cast its net' broadly, to involve many departments and agencies in a land information system that provide benefits for a broad group of public and private users. Of course, it is possible for each department in a jurisdiction to decide to go its own way and develop its own GIS independently (or not at all). However, there are a number of benefits, which accrue when a GIS system is shared by several departments. In particular, a shared map and geographic attribute database eliminates the redundancy of maintaining and updating separate map records in several departments. It should also provide more consistent information than many dispersed systems. Having multiple users on a common system also lowers training costs and ensures that expertise in system operation is not limited or isolated in one department.

While a shared system can provide a number of additional benefits, it is important to acknowledge that such a strategy also has potential drawbacks. In their article on GIS implementation planning, Wiggins and French note some of the organizational issues which make the development of a multi-department system much more complex than a single department system. Questions of who will own, have access to, and maintain various parts of the database must be considered. Most importantly, since various departments have different responsibilities and missions, the types of analytic capabilities that they require naturally differ. This suggests that a multi-departmental system may not be the best way to meet the individual analysis needs of each department. Various departments may also require different levels of map and attribute data accuracy and resolution. It is essential, therefore, to determine through a user needs assessment whether a shared system is possible and desirable. However, after noting all of these additional complexities, Wiggins and French still recommend that the goal of a shared system be seriously considered because of its advantages.<sup>12</sup>

It is suggested that, at least initially, the scope of the project should not be limited until at least a preliminary comprehensive survey of spatial data users has been completed and analyzed. This approach will minimize the risk of losing potential contributing participants, data sources, or other resources if preconceived constraints or hasty benefit/cost analyses limit the scope. Once agencies' interests, data, resources, and so forth have been sketched out, the scope of the project can begin to take shape.<sup>13</sup> Based on an analysis of the information gathered in an initial broad user needs assessment, it may then be prudent to focus initial detailed planning efforts on a few key agencies and look to integrating others in latter development stages. Or in some cases, because of issues such as: significantly different needs; a lack of management support for a cooperative development initiative; or major personality and/or management style conflicts — it may ultimately be wise to decide to not include some agencies or departments. An organization must find a balance between including enough participants to achieve the benefits of an MPLIS and keeping the project small enough to be manageable and affordable.

**Technology Introduction.** Another of Peter Croswell's maxims to guide organizations in GIS development is, "*provide education and training at all implementation stages.*" It was noted earlier that the MPLIS leadership team should learn about GIS so that they can be more effective in selling the vision of and leading the MPLIS planning and implementation process. Following Croswell's maxim, it is also important to introduce the potential users in the broader, local government community to GIS technology,

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<sup>12</sup> Wiggins, Lyna L. and Steven P. French, August 1991; *GIS: Assessing Your Needs and Choosing a System*, American Planning Association, Planning Advisory Service Report Number 433, Chicago, IL, 11 p

<sup>13</sup> Ventura, Stephen J., April 1991: *Implementation of Local Land Information Systems in Local Government - Steps Toward Land Records Modernization in Wisconsin*, Wisconsin State Cartographer's Office, Madison, WI, 11 p

early on in the planning process. In their writings on GIS implementation, both Aronoff<sup>14</sup> and Ventura,<sup>15</sup> describe this "technology introduction" as an important early step in which the people of the organization are made aware of GIS technology and the potential uses and benefits it offers the organization.

As was noted for the MPLIS leadership team, members of this broader potential user community should be encouraged to read background material, attend area conferences, and visit similar departments that are currently using GIS. However, it is frequently not realistic to get many of the key department people that you want to be involved in planning process to take these initiatives on their own. An alternative, or supplemental, approach to reaching a large audience is to organize a local demonstration/seminar on GIS and a variety of applications. With advance planning and a small budget for expenses, it is probably possible to arrange for a few outside presenters to travel to your area to demonstrate general GIS concepts and a range of sample applications appropriate to local government. Potential presenters include staff from area local or state government agencies that currently use GIS; GIS higher education programs in the area; consultants and/or vendors. In recruiting consultants or vendors for this type of seminar, it is important to be aware of their likely bias towards specific solutions.

The organization of an on-site seminar can also be used to facilitate a several other implementation steps or objectives. One widely recommended implementation steps is the conducting of a user needs assessment (*see section on Conducting a User Needs Assessment*). Such an assessment frequently involves surveying or interviewing potential users from a wide variety of departments. If possible, efforts should be made in advance of a local seminar to identify and encourage the attendance of those from each department who are likely to be surveyed or interviewed as part of the user needs assessment. This allows future interview respondents to start thinking about how GIS might be used to solve some of the specific problems in their departments. Information seminars also save time for the interviewer who might be asked many of the same general questions about GIS by respondents. Department heads and elected officials should be encouraged to attend as part of the GIS working group's on-going effort to build support among these leaders. And lastly, in keeping with Croswell's maxim to, "*keep users, managers, and constituents informed*", the seminars can be used as an occasion to outline for the broader community the anticipated MPLIS planning and user needs assessment process.

**Identify Needs.** Numerous writers recommend that planning for GIS implementations should be based on and begin with a user needs assessment. This is consistent with Croswell's maxim to, "*involve users in system design.*" Wiggins and French outline the following potential benefits of a user needs assessment:

- Reduction of costs;
- Improvements in organizational coordination and information flows;
- Improvements of standards and consistency between departments of both maps and databases;
- Increased awareness of GIS potential among decision-makers and staff;
- A stronger basis for evaluation of alternative proposed system designs; and
- A basis for preparation of a long-range implementation plan, including setting priorities and schedules for database acquisition and development.<sup>16</sup>

A user needs assessment is a process that involves a systematic effort to solicit from potential users information that will be used to design the MPLIS system. The process frequently involves written

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<sup>14</sup> Aronoff, Stan, 1989; *Geographic Information Systems: A Management Perspective*, WDL Publications, Ottawa, Ontario, Canada, 250 p.

<sup>15</sup> Ventura, Stephen J., April 1991: *Implementation of Local Land Information Systems in Local Government - Steps Toward Land Records Modernization in Wisconsin*, Wisconsin State Cartographer's Office, Madison, WI, 7 p

<sup>16</sup> Wiggins, Lyna L. and Steven P. French, August 1991; *GIS: Assessing Your Needs and Choosing a System*, American Planning Association, Planning Advisory Service Report Number 433, Chicago, IL, 8 p.

surveys and/or interviews with a wide variety of potential users to collect the following types of information.

- What maps do they use, when do they use them?
- What map needs are unmet by current practices?
- What tabular data do they use, when do they use it, why?
  - What tabular data needs are unmet by current practices?
- What potential links to map locations currently exist in their tabular data (PINs and street addresses are the most common)? How complete and accurate are these potential links?
- How much of this map and tabular data is currently in digital form and in what digital formats?
- Who maintains the map and tabular data in what ever form it is in? How available is it?
- How complete and accurate is the map and tabular information they use? How complete and accurate should it be?
- How often must you create maps and tables of information? How important is the ability to do this easily?
- What are the main challenges the department must cope with now and in the foreseeable future? Does or can spatial information play a role in meeting these challenges?<sup>17</sup>

This list is not exhaustive. These questions will invariably elicit other questions related to concerns such as standards, procedural changes, organizational changes, etc. The information gathered through the needs assessment process will provide much of the basis for the MPLIS system design and implementation planning that follows. The information gathered through a user needs assessment is also frequently very helpful in building support for the MPLIS by illustrating the need for and benefits of an MPLIS. Outside of the conversion of cartographic information on paper maps and manually stored attribute data to digital form, the needs assessment process is likely to be the most time-consuming task in the systems development life cycle of an MPLIS project.<sup>18</sup> For these reasons, this Guidebook has devoted a separate section to *Conducting a User Needs Assessment*. This section provides additional discussion, suggestions and sample tools for conducting and analyzing a user needs assessment.

**A Broad Conceptual Assessment.** When a significant portion of the user needs assessment has been completed and analyzed, the MPLIS working group should turn its attention to an assessment of how the needs identified will be met. This assessment will need to take place on both a broad conceptual level and a detailed level. The conceptual assessment provides information that will be used to build the institutional and economic components of the MPLIS. Decisions made regarding the broader conceptual assessment will ultimately impact many of the detailed assessment outcomes. Therefore a discussion of these broader institutional issues should take place prior to investing further resources in detailed system design and implementation planning. Among the issues to be considered in a conceptual assessment are the following:

- The goals and objectives of the MPLIS; for example, is it primarily a land records system, a planning system, an engineering system, or some combination?
- The bounds of the project; who is included, how do they access and use the system, what is the geographic extent, what "layers" are included, etc.
- General time lines and development stages; for example, it can be used to set priorities for applications development;

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<sup>17</sup> BRW, Inc. for the Intergovernmental Information Systems Advisory Council (IISAC), October 1996; *Implementation Guide for Parcel-Based GIS*, Minneapolis, MN, 8-9 p.

<sup>18</sup> Federal Geodetic Control Committee [Huxhold, William E.], January 1992: *Multipurpose Land Information Systems, The Guidebook*, "Getting Started: How to Organize Your Improvement Efforts," 16-1,2 p.

- The connections of the MPLIS to other information systems or databases within and outside of an organization; and
- The responsibilities of each of the participants in multipurpose systems.

Because there is likely to be differing perspectives on some of these broader conceptual issues among the MPLIS working group itself, it may also be helpful to discuss these issues prior to commencing the formal needs assessment. The working group's thinking can then be revisited and updated based on information gathered as part of the needs assessment process.<sup>19</sup>

In addition, there are also issues related to how the GIS resources will be provided to meet the needs identified in the needs assessment. The Minnesota study identified four options:

1. Doing all GIS processing, data conversion, and viewing & mapping in-house.
2. Doing much GIS processing, data conversion, and viewing & mapping in-house and obtaining the balance from others.
3. Obtaining GIS processing services and/or data from others while developing viewing & mapping capabilities in-house.
4. Obtaining all GIS services from others.

The Minnesota study found that most local governments were pursuing either option 1 or 2, but they also noted the following caveat regarding the need for a minimum investment for GIS processing capabilities.

*"This minimum would include a powerful PC, PC based GIS processing software, and a full-time GIS professional to do the work. Do not get involved in GIS processing (data conversion and the creation of GIS data sets) if you cannot devote at least one full-time staff member to it"*<sup>20</sup>

In some cases it may best to start with option 3, with plans to move to option 1 or 2 as your MPLIS matures. It may also be useful to examine these options from the perspective of the different agencies or departments that may be part of your MPLIS. For some departments, they may never need more than options 3 or 4, as part of their participation in the broader MPLIS.

**Estimate Costs.** With at least a preliminary analysis of the results of a user needs assessment in hand and a rough consensus on the broad conceptual assessment on the MPLIS project parameters and institutional arrangements, it is then timely to begin estimating the likely project costs. One of your best allies in this effort will probably be other local governments in your area who have already implemented a MPLIS. Discussions with your counterparts in these local governments can help you weigh the pros and cons of various hardware, software, and data development/acquisition choices. These local governments can probably give you cost figures on hardware, software and some training. However, a caution is urged, in that these costs may not reflect the most current technology nor current prices.

The Minnesota survey of successful local government GIS implementers found that few of them really knew the complete cost of their GIS implementation. The study report also noted that the hardware and software costs represent the smallest part of the full costs of GIS implementation. In the end, more will be spent for staff, staff learning (both formal and informal), and data. The Minnesota report suggested

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<sup>19</sup> Ventura, Stephen J., April 1991: *Implementation of Local Land Information Systems in Local Government - Steps Toward Land Records Modernization in Wisconsin*, Wisconsin State Cartographer's Office, Madison, WI, 15 p

<sup>20</sup> BRW, Inc. for the Intergovernmental Information Systems Advisory Council (IISAC), October 1996; *Implementation Guide for Parcel-Based GIS*, Minneapolis, MN, 8-9 p.

that investments in GIS will contribute to success in the following order: staff/learning, data, software, hardware.<sup>21</sup>

**Software, Hardware & Systems.** The decisions made in your broad conceptual assessment will be major factors in influencing the cost estimates in this area. Discussions between the MPLIS working group and other local government MPLIS implementers will provide good starting points for outlining the various elements needed for this technical area. These suggestions should then be discussed with multiple vendors to solicit their feedback on system components and price quotes. If you receive conflicting advice return to the successful local government implementers for assistance in sorting through these conflicts. If you have had a consultant assist you with your needs assessment process, they can also be very helpful in this area.

**Data.** Data acquisition and development will likely be the most costly component of initial MPLIS implementation. One of major products of the user needs assessment should be a catalog of data needs and data sources. Based on this analysis, initial efforts to develop cost estimates should focus on determining what digital geospatial data, for your geographic area, might already exist from state, local, regional, and federal agencies or private entities. Determine what of this existing data will meet your identified needs. Then, for those datasets that will meet part of your data needs, determine the costs for acquisition and use of this data. In the process of determining the costs and availability of existing data, be sure to explore any restrictions on the use of the data that might impact on meeting your needs (i.e. limitations on sharing it with your MPLIS partners, etc.). If the data is dynamic in nature, explore how updates will occur and if you will have access to those updates. In the process of exploring access to existing data, don't overlook the possibility that entities which have data that might help meet your needs might also be interested in data that you have or will be developing. The possibility of arranging for data sharing or exchange might exist.

For those needed datasets for which there does not appear to be an existing source, GIS data conversion or development contractors can provide rough budget estimates for the costs of data conversion or development. If you are seriously considering contracting for this work, they will provide precise numbers. To get an accurate estimate, it is very important to be fairly specific on the standards and parameters you will require in the dataset to meet your specific data needs. Conversion costs will depend upon the quantity and quality of the sources of information to be used, the conversion methods employed, and the levels of positional and factual accuracy you require. Contractors will need to see a representative sample of the data to be converted to provide a realistic cost estimate. Here again, discussions with other local governments who have gone through this experience can help avoid costly mistakes. For those datasets, which must be developed, it is useful to consider other entities that may also have an interest in this data, and therefore may be interested in a cost-sharing arrangement to develop the data.

**Staffing.** It is helpful to remember that one of Peter Crosswell's 10 maxims to guide GIS development was, "allocate sufficient staff time".<sup>22</sup> Also, as was noted earlier, the Minnesota study of successful local government GIS implementations recommended that for each GIS implementation that will involve in-house GIS processing, at least one full-time GIS professional should be hired. They further suggest that this person should have formal GIS training together with a good understanding of and aptitude for computers, databases, and geography. They noted that while colleges and technical schools are

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<sup>21</sup> BRW, Inc. for the Intergovernmental Information Systems Advisory Council (IISAC), October 1996; *Implementation Guide for Parcel-Based GIS*, Minneapolis, MN, 11 p.

<sup>22</sup> Crosswell, Peter L., 1991; Obstacles to GIS Implementation and guidelines to increase the opportunities for success, *Journal of the Urban and Regional Information Systems Association*, Vol. 3, No. 1. 51-53 p.

producing individuals who have been exposed to GIS technology, a closer examination of the specific programs are warranted. For many programs, a limited exposure is about it, with the student having only one or two courses. While an individual graduating from these programs may have skills to offer your organization, caution should be used in hiring these green grads as the lead GIS technician for your organization's GIS implementation. Your implementation process would be on much more solid ground if these "green grads" would be assigned to assist a more experienced GIS professional, either on-staff or a consultant.

The Minnesota report suggested that the technical knowledge and ability of your GIS staff is more important than what hardware and software you have. They note that very good GIS technicians can do more with relatively simple PC based GIS capability that inexperienced technicians can do with the best hardware and software. Over the long haul, GIS staff will likely cost more than any other single component of one's GIS investment. However, scrimping in this area can render all the other investment in GIS a waste.

The Minnesota report also noted the difficulty of attracting and holding a good GIS professional. This is likely to be particularly true in the rural areas of Nebraska. They note that job turnovers can be very costly and lead to lengthy delays in a GIS implementation timeline. The report suggests that this reality may be an incentive to train existing and presumably more stable current staff members. However, they suggest that if one elects to train a current, computer-literate staff member who already knows the workings of the department, you should allow for a number of months of intensive study and on-the-job practice before expecting much productivity. They further suggest that the optimum approach may be a pairing of a current employee who knows the workings of the department, with a GIS professional who knows GIS and they can learn from each other. This has the additional benefit of continuity, should one of these individuals chooses to leave.

As with data costs, conferring with other area local governments with GIS capability is probably one of the best way to get a reasonably accurate estimate of the current market for GIS professionals in your area.

Training. It is relatively easy to get prices for software training courses, however it is more difficult to estimate costs for overall training. These costs will vary considerably depending upon what level of GIS responsibility and processing that the person(s) will be assuming, their learning rate, and their previous experience with computers and mapping. If you will be training a primary GIS technician to be responsible for GIS dataset creation, processing and maintenance, figure ten full days of classes and at least six months of full-time participation in the GIS, at minimum. Those who will be using simple GIS data viewing and mapping software may come up to speed with a couple of weeks of regular use. While it is possible for some people to learn to use GIS software on their own, training is more efficient and should be included in your implementation plan and budget. As you make decisions regarding a budget for training costs, remember that one of Crosswell's 10 maxim to guide GIS development was, *"provide education and training at all implementation stages"*.

Applications. Most GIS software packages are designed with a "tool box" of functions that can be used to conduct a wide variety of displays and analyses of the data. However, the correct use of these "tool box" functions frequently requires a fairly extensive knowledge of the software. Most GIS software packages include the capability of being customized, via programming, so that specific types of repetitive analyses can be simplified so they can be easily performed by users without a great deal of experience or training. Consultants can be hired to do this additional programming or "applications development" and they will provide cost estimates for this service. In some cases, you will not know what you will want or

need in terms of application development and so you may wish to set aside an "applications development fund" for future use.<sup>23</sup>

**Building on What You Have Learned.** If the planning steps were roughly followed, as outlined in this section, a local MPLIS organizing committee will gather and outline a considerable body of information that will be useful in further defining implementation plans. Needs will have been identified, costs estimated, and a broad conceptual blueprint for a MPLIS project will have been defined. Based on the committee's work up to this point, it would probably now be useful to step back and reflect on what has been learned and determine how the committee can best build on that knowledge. One useful starting place for reflection would be the project goals that were established earlier.

**Review Goals and Set Objectives.** Early in this implementation planning section, you were urged to set goals to guide your implementation and to review them frequently. After your MPLIS working group has identified your needs; defined a shared, broad conceptual outline of the overall MPLIS project; and estimated the likely costs to meet specific needs, it is time to collectively review and, if necessary, to revise those goals and to define specific objectives to meet them. Your goals (vision or mission statements) should be the broad guidelines that help keep your implementation effort on track. As your MPLIS working group establishes specific, realistic objectives to meet those visions, you will need to reconcile need and cost. How important is each need to achieving your goals or mission? Which are critical and which is merely 'nice to have'? Which will cost more than they are worth? Are there conflict between the implementation approaches that would be required to satisfy specific needs and the agreed upon broader conceptual outline of the project? This is the point where you will streamline, rationalize and prioritize your needs list. This list will then be used to formulate specific objectives for your GIS that are in balance with your resources and will realize your goals. As one of Peter Crosswell's maxims says, "*formulate a goal-oriented plan and schedule*".

**Organize for Implementation.** Earlier in this section, it was recommended that an interdepartmental MPLIS working group or committee be formed to:

1. build organizational support for the MPLIS effort; and
2. develop an implementation plan.

If such a MPLIS group was formed, was relatively successful in its pursuit of these objectives, and it appears that one or more potential departments/agencies are prepared to move forward with implementation, it may be an opportune time to review the MPLIS committee's organizational structure. As it transitions from an initial focus on research and support building to a role of overseeing implementation, an intentional effort to review your MPLIS committee's structure and optimize it for actual implementation coordination will likely facilitate the overall process. As part of this review, consideration should be given to what has been learned and/or concluded in your earlier planning efforts, such as:

- the needs that have been identified in the needs assessment;
- the broad conceptual outline defined for the overall MPLIS project; and
- the specific goals and objectives adopted.

In the process of reviewing the structures of your coordinating bodies, it is useful to remember one of Peter Crosswell's maxims for successful GIS implementation, "*develop a project organization that encourages cooperation and consensus.*"

**Policy Team.** Each jurisdiction must organize itself as seems most appropriate for the particular individuals and circumstances involved in their implementation process. A model that has worked in

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<sup>23</sup> BRW, Inc. for the Intergovernmental Information Systems Advisory Council (IISAC), October 1996; *Implementation Guide for Parcel-Based GIS*, Minneapolis, MN, 14 p.

many places involves the organization or evolution of three groups: a policy team, a technical team, and a users committee. In this model, the policy team would be responsible for policy direction and makes organizational and cost allocation recommendations. It works to seek cooperation and participation from all departments and external stakeholders. It also plans for the allocation of GIS services among the various interested parties, sets policies, and determines priorities. Expenditures and contracting issues are also the responsibility of the policy team, as well as the legal aspects of data sharing.

Another of Croswell's maxims that relates to organizing for implementation is, "*assign a GIS manager early in the project*". This maxim speaks to the importance of having some clear lines of authority and accountability in the complex process of implementing a multi-departmental MPLIS. If it is not practical to hire someone for this role, the responsibility and authority should be clearly assigned to someone currently on the staff, or at the very least to an active working committee such as the policy team.

**Technical Team.** The technical team would be responsible for making recommendations on the technical aspects of implementation, such as hardware, software, staffing, data layers, database design, data access, and data security. Some technically-related issues such as data standards, accuracy, precision, and control inherently involve a mix of technical and policy concerns, and as such demand the active involvement of both the technical and policy teams.

**Users Committee.** The users committee is comprised of all the interested parties and identifies user issues and makes recommendations to both the policy and technical teams. A users committee provides an important communication mechanism that should fill Croswell's maxim to, "*keep users, managers, and constituents informed*".

**Detailed Implementation Planning.** Up to this point, this section of the Guidebook has provided some general principals and steps to help guide a local government MPLIS organizing committee through a process of developing a GIS implementation plan. By following these steps (in a manner most appropriate to a given situation) a local organizing committee will hopefully realize all, or most of, the following objectives:

- Educate themselves about GIS;
- Organize a MPLIS committee and achieve formal recognition from the larger organization;
- Define goals, visions, or mission statements to serve as broad guides for overall MPLIS implement;
- Introduce the potential, broader user community to GIS technology and its potential for their areas of responsibility;
- Involve those potential users in a systematic effort to identify their current practices and needs;
- Compile and analyze those needs across departments and agencies;
- Develop a rough consensus around a broad conceptual model related to the scope, developmental stages and institutional arrangements for a MPLIS project;
- Develop costs estimates for the various components of a MPLIS project;
- Review goals and establish goal-related objectives based on needs assessment results and cost estimates;
- Build support for and receive commitment from the management for a MPLIS project; and
- Review the existing MPLIS organizing structure and make plans for optimizing the structure to oversee GIS implementation.

When these objectives have been realized, a solid foundation will have been laid to commence with detailed planning for the GIS implementation. If, for some reason, one or more of these objectives have not been realized, the local organizing committee should step back and assess the reasons those

objectives were not met and the likely short and long-term impact on GIS implementation. The local organizing committee must ultimately decide when sufficient support exists and sufficient groundwork has been laid, so that it makes sense to invest additional resources in detailed implementation planning.

Much of the background information needed to develop a detailed implementation plan should be provided by following the steps in this section and the *Conducting a User Needs Assessment* section. At this stage in the implementation planning process, it may be very helpful to engage the services of a consultant to assist with the development of this detailed plan. The need for this outside assistance depends largely upon the knowledge and experience of local personnel and/or committee members. However, it is important to consider that based upon this detailed plan, the larger organization will be making significant long-term investments in both time and money resources. It may be a sound investment to secure some expert assistance in developing the plan. While a detailed implementation plan is beyond the scope of this Guidebook, the checklist on the following page will provide some guidance on the issues that should be considered in developing such an implementation plan. This checklist is based issues raised in the Minnesota study of successful local government GIS implementations.<sup>24</sup> Other publications listed in the appendix of this Guidebook can provide additional guidance.

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<sup>24</sup> BRW, Inc. for the Intergovernmental Information Systems Advisory Council (IISAC), October 1996; *Implementation Guide for Parcel-Based GIS*, Minneapolis, MN, 16 - 51 p.

## A CHECKLIST FOR DETAILED IMPLEMENTATION PLANNING

- **Institutional Relationships** - must be a continued focus; department letters of understanding; staff and funding commitments; relationships with external groups; etc.
- **Service Delivery** - establish priorities; control expectations; deliver service to build support
- **Software & Hardware** - computer that is upgradeable at reasonable costs; expandable for CPU and peripherals; vendor support; compatibility with existing systems; software support; vendor stability; other users in area; availability of knowledgeable technicians; data model translatable; data and learning investment preserved in expansion to more powerful system.
  - Hard Drive Capacity
  - Backup and Data Exchange
  - Processing Capacity
  - Video Display
  - Plotters and Printers
  - PC vs. UNIX Workstation
- **Systems Topology** - GIS processing vs. GIS viewing; stand-alone vs. file server/workstation vs. file server/computer server/X terminal configuration
- **Software and Hardware Support and Upgrades**
- **Revise Cost Estimates**
- **Funding** - start up vs. on-going maintenance; cooperative models
- **GIS Design**
  - Standards
    - ? Coordinate Systems and Projections
    - ? Datums
    - ? Geodetic Control
    - ? Accuracy (topological, relative, positional, determinates)
    - ? Precision - single or double
  - Data Layers - base maps and other layers
  - Naming Conventions - dataset files; data features
  - Tabular Data - data field definitions; data field standards; data field links to digital maps; error tracking and correction procedures
  - Tiling - standard geographic area subsets for digital maps
  - Parcel Identification Numbers (PINs)
  - Metadata - standardized documentation of data; "data about data"
  - Data Ownership
  - Data Maintenance
  - Security and Archiving
  - Legal Issues - liability; distribution; copyright; charging for access