

METROPOLITAN GIS

The Minnesota Metadata Mission

Tony Mathys

Discussions among GIS users about metadata — background information for a data set, or data about data — often leave out the important aspect of metadata implementation. Defining standards and providing effective software tools to create metadata are critical, but discussing implementation methods is also necessary.

Since its inception in October 1995, MetroGIS has navigated a course toward obtaining data and cost sharing agreements between all Twin Cities area counties and the Metropolitan Council. The council is a regional organization consisting of 17 gubernatorial appointed council members. It facilitated MetroGIS creation and provided a majority of the funding and impetus for the sharing of such information as street center-line and land use data sets

Using the Internet to perpetuate widespread metadata sharing, the St. Paul/Minneapolis MetroGIS MetaData Implementation Project provides a model for others to follow.

Currently, the best standards and software tools available may not entice data producers to sit down and document their data. Probably the least attractive responsibility tied to GIS and data development, metadata creation remains a low priority among data developers. The reasons are many, ranging from a lack of familiarity with the subject to time and resource constraints.

as well as submeter resolution digital orthophotographs.

Sharing information on the Internet

The future success of widespread data sharing activities in the region hinges on the development of Data Finder, an Internet site that MetroGIS project personnel launched in May 1998. Data Finder enables Twin Cities metropolitan area data producers and users to display and share information about available digital geospatial data sets (see Figure 1). The source for data-set information is metadata, using the Minnesota version of the Federal Geographic Data Committee (FGDC) standard. As a comparison the Minnesota metadata standard contains 101 elements, whereas the federal standard includes as many as 334 elements.

Currently, 77 metadata files populate the Data Finder Internet site. Of these, 35 are linked to data sets that can be downloaded from an FTP site free of charge. The metadata files are separated into such themes as cultural and natural

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MetroGIS and metadata

In the Twin Cities area of Minneapolis and St. Paul, Minnesota, GIS users are doing their part to further the data documentation cause. The MetroGIS Metadata Implementation Project provides data sharing assistance to counties, cities, and watershed and school districts, as well as to state, federal, regional, and nongovernmental organizations serving this seven-county metropolitan area. Nongovernment organizations include private utilities, foundations, GIS consultants, developers, nonprofits, and universities and colleges.

Contributor Category

County

Metadata File: [Dakota County Elevation Contours](#)

Contributor: Dakota County

Originator: Dakota County Surveying and Land Information

Abstract (first 1,024 characters): Elevation Contours exist for Dakota County, and are as current as the date of the aerial photography. Two-foot contours exist for the urban areas of Dakota County, for Lake Byllesby Regional Park and for Miesville Ravine Park Reserve.

Metadata File: [Parcels for the City of Andover](#)

Contributor: Anoka County

Originator: Anoka County GIS Department

Abstract (first 1,024 characters): Parcel boundaries for city of Andover developed by the Anoka County GIS Department. This file is an ArcView polygon shape file.

Metadata File: [Washington County Parcel Data](#)

Contributor: Washington County

Originator: Washington County Surveyor's Office

Abstract (first 1,024 characters): This data set is a parcel cadastre. It contains map features similar to those previously shown on hand drawn tax maps, drafted on linen with ink and printed for hard copy use. County Auditor's parcel descriptions were collected, interpreted and analyzed

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FIGURE 1. At the DataFinder Web site, users can access synoptic metadata information, as well as link to detailed data documentation.

resources, public works, education, environment, politics, property, transportation, utilities, recreation, and planning and development. Divisions of metadata files are also made based on the contributors. Through the Data Finder Web site, users can search for data sets by contributor name or theme.

Metadata, which drive all metropolitan area data sharing activities, represent the key to Data Finder's functionality and survival. Without data about data, GIS organizations lack the capacity to effectively exchange information about their data sets, seriously affecting a project's intended goal.

Implementation strategy

In July 1998, MetroGIS personnel implemented a project to spread the word to the Twin Cities many GIS organizations about the benefits of metadata. I was hired as a metadata assistant with the tasks of disseminating information about these benefits and documenting participants' reactions and feedback to explore ways to encourage metadata implementation.

Additionally, MetroGIS and Washington County, one of the seven metro area counties, agreed to help the county deal

with its backlog of undocumented data sets. This venture provided valuable insight into the methods, time, costs, and efforts involved in gathering information to produce metadata.

MetroGIS hopes to draw valuable lessons and information from this experience to establish a foundation for devising short- and long-term strategies that could be tailored to fit the aspirations and limitations encountered with each organization's response to metadata.

Reactions to metadata

As the MetroGIS metadata representative, I organized meetings with public and private organizations from August to November 1998. Most of the people in attendance were GIS specialists and technicians, surveyors, engineers, planners, and administrators. These meetings revealed a wide range of views and approaches to data-set documentation.

Among the 30 organizations that were contacted, a group of 11 provided some form of documentation for their data sets. At least half of this group wrote brief descriptions of their data sets; the remaining organizations attempted to create fully compliant metadata but had omitted information for some key elements or had populated the file with information about data subsets that would require their own metadata.

The remaining 19 organizations still had not taken steps toward implementing any data-set documentation policies because they were still in the nascent stages of data development, were unaware of metadata, or preferred not to document data-set information.

Reactions to metadata implementation varied, with the resounding concern being lack of time and resources. Other responses from participants included the following:

- ❖ laughed as they acknowledged that most of the data-set information was being stored in their heads;
- ❖ believed that their organization had too great a data-set backlog to overcome;
- ❖ felt that there were too few data sets to bother;
- ❖ preferred to wait for software technology to provide "one-key" solutions to metadata creation;
- ❖ expected that FGDC would change the metadata standards again;
- ❖ found that data sharing and management wasn't critical to their organization;
- ❖ viewed metadata implementation as a mandate from omnipotent federal and regional offices;
- ❖ preferred to develop a data catalog or write a shorter version for data-set documentation. Some organizations consider this approach as adequate, and do not see the need for producing compliant metadata;
- ❖ had concerns about liability issues; and
- ❖ considered the metadata process boring compared with producing and applying data sets.

On the positive side, most everyone involved concurred that metadata were important for internal data-set management. Several organizations, including two regional agencies, recognized metadata's potential for data sharing. Conversely, most organizations lacked the resources or desire to produce fully compliant metadata.

The prospect of making gains in metadata compliance appears remote

and sporadic in the distant future unless a variety of short- and long-term strategies are implemented that address the participants' stated concerns.

Workshops and interns

At all levels of government, the short-term approach to successful metadata implementation must involve the support

to collaborative departments and organizations. Especially important in this endeavor is targeting organizations that have extensive legacy data sets. As time passes, these data sets could become obsolete unless properly documented.

An effective strategy that could be used to encourage metadata implementation is to offer metadata workshops that teach

participants about metadata, metadata software, and the steps necessary to create metadata. Participants should be encouraged to bring information about an existing data set so that they can create metadata files during the workshop.

In conjunction with the metadata workshop, interns could assist with metadata implementation. Interns can acquire information about data sets through on-site interviews with GIS staff members or extract information from the data sets using GIS software. Organizations that send participants to the workshops could acquire access to these interns' services. Enticing organizations to send representatives would assure greater efficiency between the interns and an organization's staff when the process takes place. This step could also guarantee that at least one metadata file will have been created during the workshop.

A metadata workshop in January 1999, sponsored by MetroGIS, attracted a full house of 12 participants. Carver County sent three GIS specialists to the workshop. After the course, they proceeded to implement metadata development at their department. The Metropolitan Airport Commission, Scott County, Ramsey County, Anoka County, Local Government Information Systems, the city of St. Paul, Ramsey-Washington Watershed District, and the city of Coon Rapids also sent participants.

Dealing with a backlog

To further promote metadata implementation, MetroGIS, as noted previously, loaned my services to Washington County for several months as part of a collaborative effort to update the county's metadata files. MetroGIS hoped to use this effort to develop and implement ways to efficiently update and add metadata to data-set backlogs. The county's Department of Information Services organized the exchange with cooperation from the Department of Surveying and Mapping. The Surveyor's Department, the county's leading geospatial data producer, had already taken steps to produce a metadata file for their county-wide parcel data set.

Washington County and MetroGIS targeted 43 data sets and subsets for metadata creation. The subsets repre-

5 tips for encouraging metadata implementation

- 1 Emphasize the benefits of metadata as a data management tool.
- 2 Tie metadata compliance directly to an employee's work duties or job description.
- 3 Apply peer pressure to organizations that use their own documentation methods to encourage compliance with standards.
- 4 Provide more attractive options and uses of metadata and employ more graphics to relay information.
- 5 Encourage cooperation between the public and private sector.

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sented separate files linked to GIS projects and two digital map atlases. As many as 24 of the data sets had metadata files; however, most contained inadequate or missing information.

We initially targeted data sets without metadata files for completion, but first we had to generate a metadata template file. This template contained information about the data-set contact, distributor, and person responsible for creating the metadata file. For some data sets with similar conditions, we extracted access and user constraint information as well as liability clauses from the existing metadata file for the Washington County parcel data set. The parcel metadata file also provided data-set ordering instructions and spatial reference and coordinate system information.

Because we sought to fill in our metadata templates completely, I was constantly contacting people by way of phone or e-mail for more information about each data set. When possible, Washington County sent data sets as attached files to e-mail messages. The files, which could be opened in a GIS program, provided respondents with access to data-set information, thus clarifying what information we desired and enabling us to prepare more concise questions. Having access to the data set allowed people to make more inferences about a data set's theme. If attributes were encrypted in code, respondents could send a list of codes to Washington County for clarification. When complete files were returned, we could generally extract attribute information for the metadata file more easily. All this made it more time-effective and manageable for the Washington County staff to complete metadata files.

I conducted a final review of the metadata files upon completion, checking for inaccurate entries and missing or inadequate information. I then resolved any inconsistencies or errors with follow-up correspondences.

Finally, I created a metadata tracking sheet for interdepartmental Washington County data users. The sheet contained the names of the data sets and their respective metadata files, status, availability for documentation, and internal contact names.

After the Washington County project, the Ramsey County Department of Public Works and Surveying also requested my services to help update their metadata files to comply with FGDC standards. GIS specialists, planners, and surveyors from the city of Roseville, Anoka County, Hennepin County, and the city of Minneapolis have likewise expressed interest.

Long-term strategies

As the MetroGIS implementation Project continues, it is becoming increasingly important to develop long term strategies for metadata implementation. Perhaps one of the best ways to ensure long-term metadata implementation is through cooperation with educational institutions. Federal and state agencies involved with data access issues and metadata must

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establish contact with the respective departments at universities, colleges, and technical schools to discuss measures to incorporate metadata into classroom material. The diverse disciplines and professionals that work in and with GIS would necessitate a multidisciplinary approach geared toward the fields of geography, urban planning, civil engineering and surveying, business marketing, or any discipline that may handle geospatial information.

Additional ideas for long term metadata implementation strategies in the Twin Cities area arose during my initial research and literature review of relevant material (see "The Psychology of Metadata Implementation" sidebar), as well as at some of my subsequent meetings with key local municipalities, agencies, and organizations targeted for the MetroGIS Metadata Implementation Project. The following are some suggestions for encouraging metadata implementation

based on that research and feedback:

- ❖ Tie metadata compliance directly to an employee's work duties using job descriptions and performance reviews. This approach goes directly to the individual, and can include a GIS manager, another staff person, or all the people in a department. The individual(s) must be made accountable for producing metadata with the understanding that organizational support for this endeavor exists. (A recent scan through 200 job postings at the GIS Web site www.gjc.org yielded only two positions that included metadata in the job description). Their efforts can be acknowledged through recognition, favorable pay increases, and other perks.
- ❖ Include, if necessary, an organization's financial or policy administrator in the process to assure implementation. Though administrators may not understand all the concepts associated with data sets, GIS, and metadata, they can easily understand the importance of metadata in the context of cost and management. Administrators are also keenly aware of the effects associated with staff turnover, and explaining metadata in the context of maintaining continuity through transition provides an alluring case to support the time and effort required for their GIS staff to maintain metadata. A case can also be made for metadata because they provide a valuable link to local and regional data sharing activities, thus augmenting and adding value to in-house data sets. An administrator should be convinced that both outgoing and incoming data sets have metadata files accompanying them. This approach can be implemented through a contract that has a metadata clause written into the agreement.
- ❖ Use GIS managers as important contacts, especially during transitions that involve staff turnover or internal restructuring. The experience of spending time to locate and identify undocumented data sets provides a convincing testimony for metadata's value to a GIS manager, technician, or administrator during staff or organizational transitions.
- ❖ Apply peer pressure to organizations, especially those that use their own documentation methods that do not comply with the FGDC-Minnesota standards. If the MetroGIS short-term, student-intern strategy is effectively implemented among

The Psychology of Metadata Implementation

In my search for solutions to the metadata implementation dilemma, I discovered a paper by Shawn Callahan, David Johnson, and Paul Shelley presented at the 1996 Institute of Electrical and Electronics Engineers conference in Silver Spring Maryland. The paper, entitled "Data Set Publishing — A Means to Motivate Metadata Entry," addressed the issue of metadata implementation and the factors that influenced an individual's behavior.

The authors cited a 1938 behavioral study by H.A. Murray, *Explorations in Personality*, that identified the primary and secondary factors influencing or motivating an individual's behavior. The primary factors were linked to biological requirements such as the need for air, water, food, and sex. The secondary factors were not linked to biological needs, but instead pertained to learned or acquired psychological factors.

Of the 28 needs Murray identified, Callahan, Johnson, and Shelley listed several that they believed were relevant to metadata implementation. These include the need for acquisition (for example, monetary reward), achievement, recognition, exhibition, autonomy, affiliation, order, cognizance, and exposition. My meetings with 30 GIS organizations made it apparent that metadata implementation didn't meet any of the needs criteria Murry identified, let alone the ones singles out by Callahan, Johnson, and Shelley.

Another portion of their paper discussed a theory describing the factors that influence an individual's behavior within an organization. According to the authors this theory specifically addresses "why the individual chooses certain alternative courses of action in preference to others, and thus it might properly be called a theory of choice behavior." To achieve some success with implementing metadata, it is necessary to identify metadata's benefits to an organization so that these can be translated into motivational tools that influence an individual's decision process in determining the amount of time and energy spent on metadata production versus time spent on competing tasks.

A reasonable argument could be made that metadata implementation offers an organization a considerable amount of order, autonomy, affiliation, recognition, acquisition, and sense of achievement, thus meeting several of Murray's secondary needs criteria. Providing order seemed to offer the strongest case for using metadata because it would allow an organization to effectively manage information. Some degree of autonomy would also be possible for an organization if it uses metadata because it would reduce the amount of time individuals in an organization spend on the telephone with potential users. A metadata file would divert potential users to the contact or a data download site, if a information transfer is necessary. Individuals in a department would be liberated from administrative duties and would have more time to focus on interesting and enterprising GIS tasks, thus increasing their sense of achievement. Metadata would also meet the criteria of affiliation, recognition, and acquisitions by creating opportunities to exchange data between organizations.

These recognized human needs merit serious evaluation that can be applied to short- and long-term metadata implementation strategies. They can serve as a valuable tool in evaluating and encouraging an organization's perceptions about metadata projects and tasks.

organizations having large numbers of data sets, it will provide a valuable resource that can encourage others to participate. With the Data Finder Internet site carrying hundreds of metadata files from participating organizations, non-compliant organizations will want to become affiliated with this movement, especially if data sharing becomes commonplace.

- ❖ Encourage cooperation between the public and private sector, especially for government agencies that lack the resources to produce their own metadata. Most of the private sector has recognized the importance of metadata and has taken steps to produce detailed documentation for managing their data sets and those developed for clients.
- ❖ Consider using data catalogs as a medium for storing data-set information. If a request is made for the data set, the catalog could be updated or converted to a fully compliant metadata file. Though this approach falls short of MetroGIS's objectives, a step-by-step

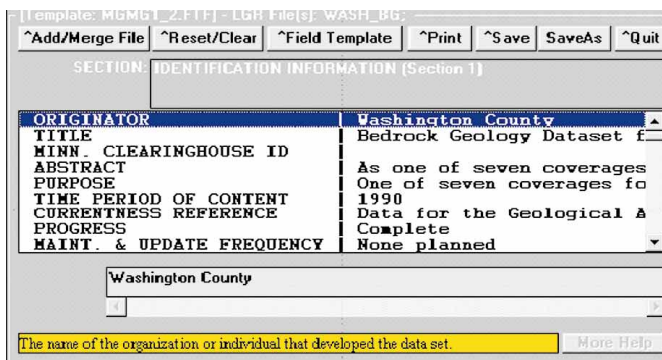


FIGURE 2. The MetroGIS metadata program allows users to access and manage information about a data set's status, purpose, and source.

process may be required to get more organizations involved.

Some users expressed displeasure regarding updates and changes in the FGDC–Minnesota standards. They voiced concerns about the limitations associated with the metadata software that MetroGIS promotes and distributes free to public and nonprofit organizations (see Figure 2). The software provides adequate support for metadata production, but, as critics point out, there are some problematic limitations for users. For example, if another area code is added to

the Twin Cities metro area (as was recently the case), an organization using the software would need to enter each metadata file to update the phone numbers fields. The same would be true if a contact person were to leave for another job. Professionals are looking for fully functional metadata software tools including those that are capable of producing files with little to no human effort.

- ❖ Continue emphasizing the benefits of metadata while keeping in mind an organization's needs. Regional GIS organiza-



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tions recognize the data sharing benefits. Other organizations value metadata as an internal or intradepartmental data management tool.

❖ Finally, regarding the conceptual side of metadata, provide more attractive options and uses for metadata. Some consideration must be given to documenting map products and tabular data sets. Frequently, maps will be displayed but no one will know which layers were used or the steps taken to create the map. Tabular data sets must also be documented because they can add value to geospatial data sets. Using more graphic representation of information would make metadata more attractive, too. An example would be including a metadata link to a status map that displays the spatial limits of a data set.

Continuing the dialog

There are no easy solutions for metadata implementation. A combination of short- and long-term strategies are needed that involve cooperative efforts, incentives, and new ideas to make metadata part of GIS's mainstream activities. Although this article concerns metadata implementation on a regional scale, many of the issues we faced at MetroGIS are relevant to all levels of public and private organizations. Job diversity and priorities, however, can create circumstances that may be unique to a given group. Indeed, individual, departmental, or organizational perceptions and resources must be identified before introducing measures to encourage metadata implementation.

Currently, most metadata efforts focus on concept rather than implementation. It is critical that organizations engage in discourses and share their metadata implementation experiences so that others might learn and gain insight. Only through sharing will GIS professionals know how metadata implementation is progressing throughout the world.

Acknowledgements

The author would like to thank Rick Gelmann, GIS coordinator at the Metropolitan Council, for reviewing this article and providing information about the MetroGIS and Data Finder Internet sites. ❖

Web Sites

- ❖ MetroGIS Data Implementation Project: www.metrogis.org
- ❖ MetroGIS Data Finder Internet Site: www.datafinder.org
- ❖ St. Paul/Minneapolis Metropolitan Council: www.metrocouncil.org

References

- ❖ Callahan, S., D. Johnson, and P. Shelley. 1996. "Data set Publishing — A Means to Motivate Metadata Entry," in the First Institute of Electrical and Electronics Engineers Metadata Conference Proceedings, Silver Spring, Maryland, April 16–18, 1996.
- ❖ Murray, H.A. 1938. *Explorations in Personality*. New York: Oxford University Press.

Manufacturers

MetroGIS licensed and employed DataLogr metadata software tools from the not-for-profit **Improving Michigan's Access to Geographic Information Networks** (Farmington Hills, Michigan). **Lynne Bly & Associates** (Chisago City,

Minnesota), an environmental management, planning, and communications consulting company, developed the DataFinder Internet site using **Microsoft** (Redmond, Washington) Access, Front Page, and Visual Basic.

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