INTRODUCTION

Defining GIS

GIS, or geographic information systems, is a system of hardware, software and associated technologies used for storage, retrieval, mapping, and analysis of geographic data. Practitioners also regard the total GIS as including the operating personnel and the data that go into the system. Features, such as points representing fire hydrants, are stored in a coordinate system (typically latitude/longitude), which references a particular place on the earth. Information about those features, such as the water pressure of the fire hydrant, is associated with the spatial features shown in a spreadsheet or attribute database form. Spatial data and associated attributes in the same coordinate system can then be layered together for mapping and analysis. GIS can be used for resource management, development planning, emergency management, scientific investigations and many other applications.

Using GIS in small communities for big benefits

The range of GIS development across the State of Missouri varies widely. The dream of seamless, statewide GIS coverage will only become a reality when small communities can and do actively participate in the development of geospatial datasets. Geographic or geospatial information technology (GIT) is a "tool of choice" for informed local decision makers to study, understand and communicate past, current and anticipated conditions to staff, elected officials and the public.
GIT includes three distinct, but increasingly integrated forms of technology, including geographic information systems (GIS), global positioning systems (GPS), and remote sensing, which includes both aerial and satellite-based sensors and digital photogrammetry (i.e. air photos or imagery). In simple terms, remote sensing and GPS generate geo-referenced data that are often used with GIS software. GIS can be used alone, or in conjunction with these other forms, to manage, manipulate, display, and provide customized access to meet needs. Current GIT focus is on increasing the accuracy and quality of geographic information, web-enabling GIS for wider use by the public, as well as enabling tabular data to be displayed, integrated and analyzed geographically. Estimates state that between 80% and 90% of all government data can be geographically referenced, and in turn, can be used within a GIS.

GIT use is strengthened by other information technology advances, in particular such areas as the Internet and other networking; information storage, access and processing; and graphical display capabilities. However, a "digital divide" between the larger, more affluent communities and those smaller or with less resources and technological sophistication will impact nationwide adoption of GIT and implementation of "e-gov" NOTE 2 National Association of Counties, *Technology in America's Counties*, (Washington, D.C.: National Association of Counties, 2000).
This is particularly the case as goals increasingly include provision of "seamless" services by multiple governments.

Nationwide analyses of local government GIT conditions must consider that most Americans reside in, and receive services from, more than one local jurisdiction simultaneously. The country's land mass is governed by literally thousands of localities, some with few inhabitants. Inherent differences among states and in local government functionality directly impact the use, development, financing, and measurement of GIT.

- Most counties serve relatively few people (e.g. 74% have fewer than 50,000 inhabitants), but have jurisdiction over a larger land area.

- Almost half of all Americans reside in approximately 200 cities with more than 100,000 inhabitants.

- Of the remaining cities more than 2000 serve between 10,000 and 100,000 people, and over 16,000 jurisdictions serve fewer than 10,000 inhabitants NOTE 7 U.S. Department of Commerce, Bureau of the Census. 1997 *Census of Governments*, vol.1, "Government Organization," (Washington, DC: U.S. Government Printing Office, 1999).

- "Metro/urban areas can be defined using several criteria…nonmetro/rural is then defined by exclusion -- any area that is not metro/urban is nonmetro/rural…

- The Census Bureau classifies **61.7 million (25 percent)** of the total population as rural, OMB classifies 55.9 million (23 percent) of the total population as nonmetro.

- According to the Census definition, **97.5 percent of the total U.S. land area is rural**; according to the OMB definition, 84 percent of the land area is nonmetropolitan.

- USDA/ERS estimates that, in 1990, 43 percent of the rural population lived in metropolitan counties.(**USDA Rural Information Center** -- http://www.nal.usda.gov/ric/ricpubs/what_is_rural.htm)

Local government functions, roles, responsibilities and financial resources and mechanisms vary significantly by state and region. For example, townships may have important roles and responsibilities in some states concerning geographic information, such as property records management and assessment, similar to the roles and responsibilities of counties elsewhere. School and special districts also may use GIT and have important data roles. Some investigations also query regional entities such as councils of governments, metropolitan planning organizations (primarily to address transportation issues), and other regional planning organizations. [ICMA-12-22.doc]

This section will be a narrative describing why a GIS is important for small communities; the case for switching from analog to digital information management; validate the concerns of small communities considering a GIS or considering a new start at a GIS; identify key guidelines for success; .

Purpose of this guide

- Address a lack of consistent and basic information for small GIS shops, particularly those operating in geographically isolated areas.
- Provide a common guide to encourage and support state-wide GIS development and maintenance
- Introduce or reinforce the existence of best practices and standards
- Provide strategies for funding and maintaining GIS
- Provide planning criteria and considerations
- Encourage data sharing and maintenance
- Identify key milestones for coordination and collaboration

1. BEFORE YOU START…CONSIDER

GIS PROGRAM PREPARATION

Many communities, particularly smaller population local government offices, have considered developing a GIS or tried to develop a GIS only to find the process and product to be daunting, disappointing and in rare cases disastrous. The process of developing an efficient and productive GIS is complicated and requires a great deal of investment, particularly staff resources. Important to understand from the beginning is that developing a GIS is a long-term, on-going program and the planning should reflect such an investment.

TOP 10 SIGNS YOU NEED A GIS?

- ☐ We need to identify and demonstrate the needs in our community for state and federal assistance.
- ☐ Coordination and collaboration with other organizations or agencies is limited because of the limited access to information
- ☐ Resources are shrinking and efficiency must be maximized
- ☐ Record-keeping is digital and we need to get on the bandwagon
- ☐ We need to know more about the places where we live and work
- ☐ We need to clearly identify and convey the issues facing our community to build effective community work groups.
- ☐ Institutional wisdom is currently stored in employee heads
- ☐ We want to share our infrastructure and information with potential investors or developers
- ☐ We need a better way to communicate with our citizens.
- ☐ Need help complying with federal accounting standards (GASB 34)

If you answered 'yes' to any of the above issues, then a GIS can help you.

A. What are your real business needs for geographic information technology (GIT)? (Check all that apply.)

- ☐ Store, search and retrieve
- ☐ Improve customer service
- ☐ Emergency preparation
- ☐ Tracking crime
- ☐ ID gaps in information
- ☐ Share information
- ☐ Evidence to leverage more resources (e.g. grant money)
- ☐ Analysis for quality & efficiency
- ☐ Reduce staff time
- ☐ Other_____
- ☐ Other_____

B. What in-house resources do you currently have to develop and support GIT? (Check all that apply.)

- ☐ Stakeholder supporters
- ☐ Primary GIT (Trained) staff
- ☐ GIT users
- ☐ Computer
- ☐ Office space for workstation
- ☐ High speed internet access
- ☐ GIS software
- ☐ Existing staff have basic computer skills
- ☐ Access to software training and retraining
- ☐ Other_____

C. What timeframe do you have in mind to apply and benefit from GIT? In other words, how long are you willing to wait for useful information? Keep in mind that shorter time needs will require more resources (Check one.)

- ☐ Less than 1 year
- ☐ 1-3 years
- ☐ About 5 years
- ☐ As long as it takes

WHO DO I NEED?

A. Who are the **needed** stakeholders? (Write in names.) Stakeholders are defined as people or organizations that could experience a cost or benefit from development or expansion of a geographic information program.

- ☐ Elected Officials:_____
- ☐ Administrators:_____
- ☐ Department Heads:
  - o Property Assessment:_____
  - o Taxing Agency:_____
  - o Road & Bridge:_____
  - o Water/Wastewater:_____
  - o Solid Waste:_____
  - o Emergency Mgmt.:_____
  - o Economic Development:_____
  - o Engineering:_____
  - o Public Works:_____
  - o Finance:_____
  - o Code enforcement:_____
  - o Planning:_____
  - o Human Resources:_____
  - o Parks & Rec:_____
  - o Other:_____
- ☐ Workers knowledgeable about the systems and information to be digitized or integrated:
  - o Property Assessment:_____
  - o Taxing Agency:_____
  - o Road & Bridge:_____
  - o Water/Wastewater:_____
  - o Solid Waste:_____
  - o Emergency Mgmt.:_____
  - o Economic Development:_____

- Engineering:_____
- Public Works:_____
- Finance:_____
- Code enforcement:_____
- Planning:_____
- Human Resources:_____
- Parks & Rec:_____
- Other:_____

☐ Community Partners:
- Public Health:_____
- Red Cross:_____
- Technology Centers:_____
- Academic Institutions:_____
- Volunteer Emerg. Response:_____
- Intel. Agencies:_____
- Tourism:_____
- Real Estate/Development:_____
- Other:_____

☐ State and federal agencies:
- United States Dept. of Agriculture:_____
- Department of Conservation:_____
- Missouri Spatial Data Information Service:_____
- State Emergency Management Agency:_____
- State Highway Patrol:_____
- Missouri Department of Transportation:_____
- Department of Health and Senior Services:_____
- Department of Natural Resources:_____
- Other:_____

☐ Others:_____
_____
_____

B. Who are the stakeholders most likely to be supportive?

Draw and asterisk (*) next to the names above of people most likely to be actively supportive of GIT development or expansion.

IDENTIFYING SUCCESS
Measures of success

Consequences of success

Consequences of failure

2. IMPLEMENTATION

WHAT DO I NEED?

HARDWARE	EST. COST	COMMENTS
Minimum		
Computer workstation	$1500.00	HP Workstation xw4400 w/ 17" flat screen; w/ basic software pre-installed
External HD	$150.00	Maxtor One Touch HD 500GB; See section on back-up options
Battery backup/surge protection	$299.00	SmartUps 750VA USB SER-120V
Handy additional equipment		
Plotter printer	$3500.00	HP 42" wide color plotter
Highspeed internet access	$100.00/mo	
GPS	$3500.00	Submeter GPS unit w/ ArcPad

SOFTWARE	EST. COST	COMMENTS
GIS options		
ESRI, Inc ArcView	$1200.00	Government pricing; add $3-400/yr maintenance
GRASS GIS	Free	http://grass.itc.it/
Quantum GIS	Free	http://www.qgis.org/
Handy additional software		
ESRI, Inc. ArcPublisher (extension)	$2000.00	Creates 'viewable' data packages for distribution; add $600/yr maintenance
Metadata production	free	http://www.fgdc.gov/metadata/geospatial-metadata-tools

DATA AND METADATA DEVELOPMENT

Data development literally refers to the gathering and consolidation of bits and pieces of information about locations into a GIS database. Some examples of this include: assembling a list of emergency shelter locations/addresses; using a GPS unit to identify locations of fire hydrants; or transfer owner names from a paper record to a digital format. The flexibility and broad scope of information that may be maintained in a GIS often means that the sources of information to be assembled are equally broad. In addition to the previous examples, information may also come from employees' heads, professional organizations, academic institutions, 'free' data clearinghouses, archived records or 'data for purchase' companies.

BASIC DATABASES

If you are diving into a GIS for the first time there are a few basic databases that you will want to concentrate on creating before all others. These databases create critical context and structure for nearly all other future databases, or information you would like to add to the basic set. The basic database set includes: Cite ESRI GIS Dictionary

- **Cadastre** (real estate parcels) – a public record of the dimensions and value of land parcels, used to record ownership and calculate taxes
- **Road centerlines** – a line digitized along the center of a linear geographic feature, such as a street or a river, that at a large enough scale would be represented by a polygon
- **Imagery** – a graphic representation of a scene, typically produced by an optical or electronic device such as a camera or a scanning radiometer
- **Point data** – a single X,Y coordinate that represents a geographic feature too small to be displayed as a line or area at that scale

The quality and accuracy of the information and locations represented in the database are the two most important and time consuming issues to be addressed when creating these databases. Several resources describing standards or guidelines are available to help guide the quality and accuracy of your databases.

STANDARDS, GUIDELINES AND BEST PRACTICES

Missouri has adopted several state standards for GIS datasets. These ought to be followed as a 'best practice'

- Cadastre numbers
- Road centerlines
- GPS – web link

If Missouri does not currently have a standard to address your needs, there are many appropriate standards from surrounding states or national standards that may be used as a guide.

- Cadastre
- Imagery

TIMEFRAME FOR DATABASE DEVELOPMENT

Anecdotally we know that time and resources (e.g. people time, funding, office space) are the most significant obstacles toward database development. While the time for development of basic files will vary, here are some general guidelines to keep in mind.

- Cadastre and Road Centerlines will take approximately 1-year for about 15,000 parcels and about 1-year for the road centerlines for about 700 miles – with one person working very consistently.
- Imagery will take several months, depending on time of year, accuracy and additional features (elevation data included).
- GPS point data varies enormously based on distance between points (i.e. travel time), additional on-site data collection, GPS unit quality, environmental conditions. Time on-site with a mapping grade unit varies between 30 seconds and 3 minutes. Add in travel time between sites for a more accurate estimate.

BASIC DATABASE DEVELOPMENT

Cadastre

Methods of development:

- 'Heads up' digitizing imagery (HU imagery) – use reasonably accurate imagery (2 foot per pixel in rural areas; 6 inch per pixel in urban areas) to draw in parcel boundaries according to fence lines and other landmarks

- 'Heads up' digitizing maps (HU maps)– scan existing real estate parcel maps; rubbersheet the digital picture of the map; trace each parcel; verify quality of the existing versus created parcels
- 'Heads up' digitizing deeds (HU deeds)– gather real estate parcel deed descriptions; start from appropriate reference points; draw in real estate parcels according to the legal descriptions
- COGO (coordinate geometry) (COGO)– automated mapping software used in land surveying that calculates locations using distances and bearings from known reference points and legal deeds

METHOD	COST	ACCURACY	TIME	ACCEPTABLE USES
HU imagery	Low*	Low (est. 5+ ft at best)	Low (est. 6 mo.)	Tracking land use, land marks
HU maps	Moderate	Moderate (est. 0-6ft)	Moderate (est. 12 mo.)	Rural real estate property assessment; ownership
HU deeds	Moderate	Moderate**	Moderate (est. 18 mo.)	Rural real estate property assessment; ownership
COGO	High	High***	Moderate (est. 12 mo.)	Professional surveyor quality; urban real estate property assessment

*Assumes imagery is free.
** Depends on the quality of the deed legal descriptions.
*** Requires high quality, verified surveyed legal descriptions.

Applications for database:
The cadastre database in its most basic form is typically used for property valuation for taxation. Substantial information can be added to the database to broaden the scope of use to include anything associated with the ownership or address. Examples of information that could expand the use of this database include: parcel zoning, rental status, quality survey, code violations, crime offense, vulnerable residents, hazardous materials, flood zone status, voting district assignment.

Standards:
Missouri:
- Cadastre standard is in development.

Tips:
The cadastre database requires the most preplanning of all the basic database set. Carefully consider the current needs you are trying to satisfy; future needs; the quality of your existing information; and what quality of information can reasonably be maintained into the future. The cadastre database is typically, initially created for use in the assessor's office. The quality of the existing information in the assessor's office is critical to consider – hence the phrase 'garbage in, garbage out'. Many rural areas have not and do not require surveys by licensed surveyors. Further, for the scattered surveys that are completed, they are not verified for quality. If your community fits this description it would be impossible to create and maintain a COGO-quality database. 'Heads up' digitizing in the map or deed options poses complications as well. In many

rural counties the parcel maps do not necessarily match the deed descriptions. Over time the parcel maps represented the deeds to the best fit possible, creating the visually acceptable description of land. Each creator needs to determine what is possible to create and maintain based on the existing information and expected benefits.

Road Centerline Database Development

Methods of Development:

- GPS the road centerlines with a mapping grade GPS unit (see GPS standards) – most mapping grade units can create 'lines' that are a result of a 'dot to dot' of GPS points located along a route; vehicle-based, voice activated GPS equipment may also be available on loan from MODoT. See 'Resources' in Appendix X.
- Trace the road centerlines over imagery that is at least 2 foot per pixel – the newly available 2 foot per pixel imagery for the entire State of Missouri can save a great deal of time and money (particularly fuel costs)

METHOD	COST	ACCURACY	TIME	ACCEPTABLE USES
GPS	Moderate to High	<6 feet	High (est. 12-18 mo.)	calculate needed surface materials; calculate distances; use as framework for 'rubbersheeting' cadastre mapping; track naming
Trace Imagery	Low*	10-15 feet	Low (est. 6-12 mo.)	Calculate distance; track naming

* Assumes that free and appropriate imagery (2-foot/pixel rural; 6-inch/pixel in urban) is available.

Standards:

Missouri standard
FGDC

Tips:

Development of the road centerline database is valuable not only as a product, but equally valuable as a process. The key elements of a road centerline database will require careful scrutiny of road names/spellings, private versus public access and length. In many communities, resolving this information is more complicated than first considered. Unless a pre-existing source can confirm the information, confirmation will usually come from a variety of sources, including: field investigation, communication and negotiation.

One of the key elements missing from the 'trace imagery' method is 'calculating needed surface materials'. Consider the value of being able to precisely calculate the amount of materials needed to maintain roadways. Resources for maintaining roadways come from several sources and knowing the details of roadways helps to inform the needs and requests. Detailed information about the exact extent and location of road surface type is also very useful for emergency management agencies with response vehicles that are vulnerable to muddy or otherwise compromised roads.

Imagery

Methods of Development:

- Contract with private vendor for imagery production (See Appendix XX for example RFP)
- Existing imagery can be purchased in a variety of forms and formats. The imagery may or may not be current.

- Missouri has produced state-wide imagery which is free and available for download. This imagery is expected to be updated on a 3-year rotation and includes a local 'buy-up' program for communities that would like imagery with more than a 2-foot/pixel resolution. See below for more details.
- Use free imagery provided by state or federal programs if the quality meets your needs – in rural communities 2-foot/pixel will generally suffice, unless you are in a high development area

METHOD	COST	ACCURACY	TIME	ACCEPTABLE USES
Private Vendor	Moderate to High	Varies (inches/pixel and up)	Weeks during appropriate season	Imagery is purchased to meet all appropriate uses
Existing imagery	Low to High	Varies (inches/pixel and up)	Varies	Imagery is purchased to meet all appropriate uses
MO imagery	free	2-foot per pixel	Immediate	Rural cadastre, road centerline and feature mapping; emergency response
Other	free	2-foot to multi-meter per pixel	Immediate	Above 2-foot, feature mapping; emergency response

Standards:

Missouri approved standard: appendix or weblink?

Federal Geographic Data Committee (FGDC) National Standard: appendix or weblink?

Tips:

Imagery can provide a uniquely important context for conveying and showing data. Imagery can also be an important for creating some databases. Consider several factors when determining the imagery appropriate for your community:

- What quality of imagery will meet your current and future needs? Resolution, color/black or white, leaf on or off…
- What quality of imagery will control points (a point on the ground whose location has been determined by a horizontal coordinate system or a vertical datum) in your community accommodate?
- How often will you need new imagery? Purchasing from a private vendor will meet any timeframe, on-demand. Free imagery may follow a longer schedule, political changes or budget constraints.
- What resources can you devote to acquisition of imagery? Can these resources be reconstituted as quickly as would be required to meet the needs? Even if you can afford to purchase 6"/pixel imagery now, consider whether those same resources will be available when you will need updated imagery.
- If you choose to purchase imagery, have a plan for an independent and capable person/agency to check the quality of the imagery product BEFORE you pay for the final product.

Point

Methods of Development:

- Private Contract by GPS
- Field Collection by GPS
- Feature ID by imagery

METHOD	COST	ACCURACY	TIME	ACCEPTABLE USES
Private Contract	Moderate to high	Survey to mapping grade	.5-3 minutes per point + travel time	Sub-centimeter locations for surveying to water meters
Field Collection	Moderate to high	Survey to mapping grade	.5-3 minutes per point + travel time	Sub-centimeter locations for surveying to water meters
Feature ID by imagery	Low*	Depends on quality of imagery	Seconds/point	Location of buildings, water bodies, soil types

* Assumes the imagery is available for low or no cost.

Standards:

Missouri approved standard: appendix or weblink?

Federal Geographic Data Committee (FGDC) National Standard: appendix or weblink?

Tips:

Point database development is a relatively quick and essential way to gather, store and analyze information. The required accuracy of the information will typically determine the cost of the data collection. If the need for accuracy is high, then the quality (and cost) of the equipment, operator training and method of collection will also be costly. Weigh the options carefully.

In addition, operating GPS equipment accurately and well is often underestimated. Both training and implementation of a short 'pilot project' are key to full project success. Quality control of data quality and error checking are also important. Consider that the expense of collecting a data point will automatically double if a point has to be recollected.

Existing Databases for download and purchase

There is an ever-growing list of sources for data for free download or purchase. The utility of the data, however, depends on the needs of the application. Not all data is available, especially cadastre and road names. Some data can get you started, such as the Missouri Department of Transportation road centerline database. As such, all data has a limit of usefulness. Review the metadata to learn more about the quality and utility of the information. If no metadata is available, exercise caution when using the data or making claims about its utility. Remember that properly collected local data nearly always results in a higher-quality database.

CATEGORY	TITLE/AGENCY	ADDRESS
Government-sponsored	Geospatial One Stop	www.geodata.gov
	National Map	http://nationalmap.gov/
	National Atlas of the United States	http://www-atlas.usgs.gov/
	FGDC – National Geospatial Data Clearinghouse	http://clearinghouse1.fgdc.gov/
	National Historical GIS	http://www.nhgis.org/
	USDA	http://datagateway.nrcs.usda.gov/
Missouri	Missouri Spatial Data Information Service (MSDIS)	http://www.msdis.missouri.edu/
	CARES	http://cares.missouri.edu/default.aspx
	Upper Midwest Environmental Sciences Center	http://www.umesc.usgs.gov/
Private or purchase	TopoDepot	www.topodepot.com
	GIS Data Depot	http://data.geocomm.com/
	Geography Network	www.geographynetwork.com

THE VALUE OF METDATA

Two very similar paintings of circus performers by Picasso from 1904 are put on the auction block; one brings tens of millions of dollars, the other hundreds of thousands. What is the difference? In one case, the ownership of the painting can be traced through sales slips and auction house records back to the estate of Picasso's dealer. The other painting appeared suddenly on the art market. It looks almost identical, but lacking documentation, how can one be sure it's authentic?

Just as a work of art can change hands many times, so can geospatial data. Once created, data can travel almost instantaneously through a network and be used for any number of different kinds of spatial analysis. Thus transformed, these data can be retransmitted to another user. Change is the essence of geospatial data in a networked environment. Metadata can benefit the primary creator and secondary users of the data by maintaining the value of the data and assuring their continued use over a span of years through data and personnel changes.

What are Metadata?

The concept of metadata is familiar to most people who deal with spatial issues. A map legend is pure metadata. The legend contains information about the publisher of the map, the publication date, the type of map, a description of the map, spatial references, the map's scale and its accuracy, among many other things. Metadata are simply that type of descriptive information applied to a text file that uses a common set of terms and definitions to make the information sharable.

Why bother with Metadata?

Metadata helps people who use geospatial data find the data they need and determine how best to use it. Metadata benefit the data producing organization as well. As personnel change in an organization, undocumented data may lose their value. Later workers may have little understanding of the contents and uses for a digital data base and may find they can't trust results generated from these data. Lack of knowledge about other organizations' data can lead to duplication of effort. It may seem burdensom to add the cost of generating metadata to the cost of data collection, but in the long run it's worth it.

How can Metadata be produced?

The information needed to create metadata is often readily available when the data are collected. There are several standard formats (or data forms) that will lead the data creator through the process of filling out a metadata file. Many of the most common GIS software packages include a metadata utility to encourage and support easy metadata file creation.

Why use a standard?

First, metadata is most valuable for those who are least familiar with the data (i.e. new personnel, data purchasers, emergency responders, government agencies). Utilizing a standard format to outline the details about the file allows these secondary users to understand all of the most important information about a file without even communicating with the file creator directly – saving time and effort. Second, metadata is an insurance policy for the institution maintaining the data. Sudden loss of personnel who maintain data leaves the value of the data at risk if the new personnel cannot interpret the existing data.

3. PROGRAM ADVANCEMENT

DATA DISTRIBUTION AND USE

HOW DO I GET THE INFORMATION OUT AND USED?
All of the planning, resources and data available will not result in a successful program. Useful database information must be available and accessible for users. There are several general considerations: who are the users? Where are the users? How can I distribute the information?

A. Who and where are you distributing the information to? (Check all that apply.)

- ☐ Internal to organization and building
- ☐ Internal to organization, but outside the building
- ☐ Among several organizations and buildings, for free
- ☐ Among several organizations, for a fee

B. What is the technology skill level/capability of the user(s)? (Check all that apply.)

- ☐ No computer experience.
- ☐ Basic email, internet and word processing
- ☐ Comfortable with organizing computer directories, moving information, using spreadsheets
- ☐ Makes computers get up and dance!
- ☐ Mixed capability

The next step in database distribution is getting the information used. The key considerations are skill/capability of the users and meeting the publishing needs. In general, an agency or organization ought to first consider what kind of technology will be the most accessible without training intervention. First, employees and volunteers need to feel comfortable in order to use the technology and data. Choosing technology that greatly exceeds their skill tends to squelch use. Second, choosing technology that is immediately accessible 'in-house' is the most affordable approach. When starting in GIT, the sky is the limit, and staying in the budget is key to keeping the broadest range of people comfortable. There are plenty of affordable options for distribution and use before diving into the snappy, but expensive, options. Finally, the literal location(s) where data needs to be accessed or distributed to matters in your choice. Small communities tend to have a very 'tight knit' group of GIS users. If all of the users are in the same building and never do field work then they can easily get away with burning CDs and walking them down

the hall to the next person. If an organization has the luxury of a networked server system, this will be the best method and open up the option of more new users in time – access typically translates into use. The table below shows a list of options for the most common ways to distribute information. The comments provide some direction about use and maintenance.

EQUIPMENT	COMMENTS AND DETAILS
Server	post databases for users to access or download at local terminals on a network
Global Positioning System (GPS) unit	Used particularly by field users, mobile units can store, edit and retrieve context and data to be changed in the field; this unit can also collect satellite location data
Workstation	Identify computer GIS terminal, with appropriate security in place, for users to update, view or save data to a media device
Personal Digital Assistant (PDA) unit	Used particularly by field users, mobile units can store, edit and retrieve context information and data to be changed in the field; this unit cannot collect satellite location data
SOFTWARE	
Data Viewers	e.g. ESRI ArcReader, ArcExplorer; TerraGo GeoPDF; these software packages allow users to view and query data, but not to edit data; these are typically free, but some require the creator to purchase software to publish the viewer databases
Indexing	create map indices for easy printing of plat books, utility system atlases
MEDIA	
CD/DVD	label the media with date and file name; include disclaimer and use statement
Flash drive	
External Hard Drive	
Paper	print maps at cartographic quality

DATA MANAGEMENT CONSIDERATIONS

DATA STEWARDSHIP

The data layers comprising a GIS are never 'complete', they are either 'in maintenance' or 'in stewardship' unless they are explicitly a short-term, one-time project. This distinction in terminology will serve to build the understanding and expectations of users and non-users alike. Stewardship is the person and/or organization that acts to consistently maintain and update the GIS database(s) as needed. All of the information in the GIS is subject to change or update; people move, homes are built, roads are closed and water meters are installed. Identify a person, or people, in your organization who have agreed to both supply the new information and make the database changes to reflect the updates according to the agreed database standards. Establish a schedule of approximately when databases will be updated to build a sense of expectation for participants at all stages of development and use. In addition to planned data maintenance, also keep in mind that training regular users to identify database errors and how to report them is a very efficient strategy for continuous data improvement.

BACKING UP DATA

The primary issues to consider when deciding about data backup include security, cost, long-term recoverability, accessibility and time. Even if you decide to take advantage of the cheapest options

available, redundancy (i.e. use multiple free or cheap options), stored off-site can provide a substantial amount of data security as long as you can consistently keep the stored data up to date. Keep in mind that storage security refers not only to file corruption, but also natural/man made disasters. The two objectives to meet when deciding on a backup method(s) are: 1.) maintain a way to access data locally at all times; 2.) maintain a consistent protocol with SEMA (State Emergency Management Agency) to store the most critical databases.

CHECK	METHOD	EST. COST	COMMENTS
	MO GIS Clearinghouse (MSDIS)	Free	Metadata strongly preferred; designate 'public' or 'no public' access; direct SEMA access
	CD/DVD media	$52.00/yr	Once/week; catalogue disks off-site
	External Hard Drive	$100-200	Once/week; keep off-site except for updates
	Off-site network server	varies	Daily
	Off-site private network server	varies	Daily to persistent

PROGRAM ADVANCEMENT

Expanding database holdings

- Some of the reasons organizations expand their database library include: data needs for special projects (e.g. grant applications, planning exercises), increase or broaden data usability and applications, enhance data accuracy, achieve new data standards, accommodate collaboration or cost-sharing arrangement with another organization
- Adding data to the operational database without adequate justification or planning – just for the sake of doing so or "in case you need it one day" - is a data maintenance work multiplier and should be avoided when possible. Data acquisition should be well thought out and integration into a maintenance schedule considered.

Collaborations, cost-sharing, coordination, consortia

- Developing and maintaining a GIS is inherently a collaborative process. Generally, the more data you have in your library, the broader your collaborative circle – and vice versa.
- Reasons to expand your collaboration and coordination include: desire to share database information; cost-sharing projects; cost-sharing programs and technical or staff expertise issues.
- Your state advisory committee or a local user group should be able to provide contacts for collaboration and coordination and – possibly – consortia opportunities.

Training – backing up and enhancing your institutional knowledge

- Options
    - Travel to training centers of your software provider
    - Local education institutions (e.g. community college)
    - Coordinate with other regional GIS users to pay a trainer to hold a local class; this option lowers the travel costs
    - Many software providers offer on-line classes for tuition or for free
    - Take advantage of workshops and conferences provided at low or no cost by your state advisory council and its partners.

Cost recovery, selling databases and licensing

- There is an ongoing discussion on the efficacy of trying to recover even some of the costs associated with data development across the wider GIS community. The Missouri GIS Advisory Committee has also struggled with establishing their position on this issue.
- We are currently not aware of any government agency recovering all of their GIS development costs from selling databases.
- Selling databases opens the door to many management complications you will need to address that giving databases away for free may not require. On balance though, giving data away for free may create other issues, some of which may also need to be legally explored.
- Legally licensing database holdings, whether you sell the data or give it away, may be worth considering in order to clarify proper use of data, track usage of the data and establish institutional standards for managing the data.

DATA USE AND SHARING POLICIES

- Key components and considerations for assembling such policies
    - Data sharing – MGISAC recommendations
    - Data licensing and ordinances – components of licensing agreements and example
    - Cost of development and selling data