

GIS: The Challenge of Upgrading

GISCafe.com – October 2001

Background

A challenge facing many organizations is whether or not to update existing GIS installations and the best approach for updating. Several considerations are important and require evaluation to ensure successful updating that provides for the continued effectiveness and efficiency of spatial systems to meet future geo-spatial needs and changes.

Upgrades can originate from existing systems that have been installed for quite some time or upon those systems that have been in place for shorter periods of time. The purchase of a GIS system for an organization that has not previously used GIS can be considered an upgrade, particularly if the organization has been using spatial data though not owning or operating a GIS.

Strategy & Upgrading

GIS upgrading necessitates several considerations. The primary issue when considering upgrading a GIS will be to determine if the current GIS in place is meeting the organizational strategic goals – meeting, enhancing and extending them. Many earlier GIS installations were not included in the organizational strategic planning process, that is, they were not viewed as ‘mission critical’ to the organization. As GIS became more main stream a greater recognition of the value of GIS in the business process occurred, however, the strategic planning cycle had not always included GIS. Thus an evaluation of the organizational needs for GIS must be again determined. A few questions can provide important clues toward indicating type and need for upgrading a GIS. This is often referred to as a ‘User Needs Analysis’.

- What does the organization do that requires GIS?
- What functions of a GIS does the organization need?
- A SWOT analysis (strength, weakness, opportunity and threat) or Value Chain Analysis can provide clues.
- What budget and resources exist for upgrading?
- Where does the organizational information / data originate? In what form?
- What data gathering geo-technologies are currently in use (internal / external)?
- Can the organization import / export data effectively (formats)?
- Is maintenance and operation of the current and proposed new upgrading considered and supported (training and funding)?
- Can the organizational geo-spatial needs be supplied internally more effectively than externally (consulting, confidentiality, security)?
- Have human relations issues been considered (training, costs, needs)?



These questions might also be extending to include other issues emanating from outside the organization such as:

- What are the latest trends in GIS software, hardware and applications?
- Where is legislation heading with respect to geo-spatial information?
- How will we measure the value and effectiveness of the GIS upgrade proposed?
- Are telecommunications issues to be considered?



In answering these questions individuals and organizations can quickly identify and develop an understanding of their existing GIS needs and capabilities. Strengths and weaknesses are readily identified allowing for a more robust approach toward GIS strategic planning to be set in motion.

***‘do not let technology drive the GIS upgrade process
focus on the organizational needs and objectives’***

The tendency to buy hardware and software without considering ‘GIS strategy’ will also be reduced while a focus is immediately oriented towards successful implementation during the upgrade process. The real costs of maintenance, support and training also become part of the planning process.

Four scenarios (below) are provided that indicate possible existing GIS systems and their respective capabilities prior to upgrade.

<i>Current GIS</i>	<i>Company A</i>	<i>Company B</i>	<i>Company C</i>	<i>Company D</i>
<i>Single user licence GIS</i>	yes	yes	no	no
<i>Site user licence GIS</i>	no	no	yes	no
<i>GIS users in organization</i>	5	5	5	5
<i>Hardware</i>	486 Intel	PIII Intel	486 Intel + PIII Intel	PIII + PIV
<i>Software</i>	Old version of GIS software	New version of GIS software	Old and new versions of GIS software	New version of GIS software
<i>Extensions and or add-ins</i>	No	some	no	Yes
<i>High resolution graphics</i>	no	yes	Yes	no
<i>Map serving</i>	no	yes	no	yes
<i>GPS remote sensing software</i>	yes	no	yes	no
<i>Visualization capability / software</i>	no	no	no	yes

Company A: The organization has an older version of GIS software running as a single user licence on an older computer. The computer hardware cannot process large amounts of data quickly and no extensions for analysis have been added, precluding geo-processing, spatial analysis. There are no high- resolution graphics – again hardware related. Map serving is not present the company has GPS capability and likely collecting high-resolution data (< 1.0 m). There is no visualization component.

Summary – the computer is outdated for GIS applications, updated GIS software is needed and will coincide with new hardware. Thus would allow the organization to capitalize upon the high-resolution GPS data it is collecting. New hardware will allow the organization to become positioned for map serving – which requires speed and memory.

Company B: The organization has an older version of GIS software running as a single user licence on a new computer. The GIS software is the latest version and there are some extensions available allowing for extended spatial analysis. The output is readily displayed on high-resolution graphics and map serving currently exists. However, the organization does not handle GPS or other outside data well and has no visualization capability.

Summary – This organization has good GIS capability but operate a map server on the same computer as its single licence. If the serving application is ‘mission critical’ then this is not desirable. The updated hardware and software permit extended applications and in all likelihood the organization uses GIS moderate to heavily. A likely upgrade path would include purchase and installation of more extensions, allowing for further analysis and rounding out the existing spatial analysis software. Additional hardware should be considered along with a site licence. The organization has good analysis capability but cannot move into visualization and may not be able to accept data from alter sources and analyze the data (i.e. remote sensing).

Company C: A site licence exists but some of the computers and software have not been upgraded – which is why perhaps they have not moved into map serving. These types of organizations have some new and some old workstations indicative of an upgrade path oriented toward individuals rather than the organization. The extended capabilities of add-ins are not present again, due to the fact some of the organizations computers cannot process them effectively. GPS is present though likely not fully integrated.

Summary: This organization is the most prevalent found – in GIS terms. The mixture of both new and outdated equipment prevent the organization from capitalizing upon the site licence with respect to analysis, map serving and additional visualization capabilities. This is the ‘weakest link’ syndrome. Upgrading should consider the organizations overall goals. Outdated hardware platforms should be replaced and extensions purchased, allowing the organization to capitalize upon hardware and data holdings.

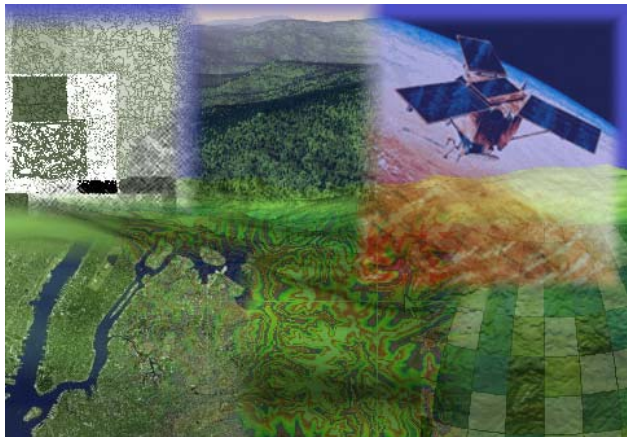
Company D: This Company is unique! I purposely said it does not have a licence but has the software – for a reason, it is still in the box. The hardware is first rate, there are extensions, the graphics could be upgraded but has not been likely due to the fact no one has done any heavy graphical work yet. They have visualization and map serving software but maybe do not know about GPS. Most of us would envy the hardware and software in this organization, but wonder what is going on!

Summary: Someone on the top purchased GIS, there are no GIS trained people so they bought what they thought would be good. They do not know how to install it or how to operate it and maybe not even knowing what is supposed to do. I am pretty sure some of the readers have seen this happen. Upgrading for this organization involves developing a strategic plan and training the employees. It may involve bringing in outside consulting to get things rolling. Graphical displays will need to be upgraded later, but the focus is on operating the system – since all the hardware and software are in place.

Functionality

As stated previously, GIS functions include data capture, management, analysis and display. These functions have been extended substantially in the last few years. New data capture tools have become more prominent including; GPS, high-resolution imagery, LIDAR, instrumentation, PDA's and total stations (EDM). Applications that include real-time telecommunications are becoming widespread, particularly in the transportation and emergency sectors. Does the current GIS support integration with these technologies?

In the area of databases and management, several advances have recently occurred including data storage devices, software, access speeds, object databases, COM, DAO, JAVA, ActiveX, UNIX, SDE and network updating. Does the current GIS allow for integration and use of these functions / devices effectively? Or, is the organization unable to actively and fully access and manage its data holdings – including distribution? Other data management functionality includes the ability to restructure and transform spatial data. Who is handling metadata and has it become a high priority within the organization?



The modelling of spatial data is becoming increasingly important. A spatial analytic model is taken to mean a set of numerical expressions implemented in stand-alone software principally for describing, explaining, and possibly predicting some particular, special aspect of past, present, or future geo-reality (Nyerges, 1992). Examples of models coupled to GIS include hydrological, ecological and business models. The coupling of GIS to models often requires consideration of interface

technologies that allow for the movement of numerical data directly into a GIS. Database flexibility is highly desirable where alternate data structures that originate from models and are to be integrated into a GIS.

Modelling and advanced spatial analysis tools and advanced display and visualization capabilities are likely the areas where many organizations will find they need to upgrade. Modelling tools provide a means to examine alternate possibilities and understand spatial data. Visualization tools allow for exploration and the communication of new ideas and understanding potential possibilities. New technologies and higher resolution datasets are increasingly becoming available and most data will be displayed in 3-D and 4-D. Artificial intelligence and robotics will become increasingly important and require quick and faster telecommunications capability.

Data analysis functions have grown in recent years, largely due to improved software. Spatial operators (some) including spatial filtering, interpolation, tessellation, distance operators overlay operators may not currently be part of an organizations existing GIS but would be useful for existing and future projects. Dependent upon database size, many of the functions require computing speed and memory – which require close consideration of hardware upgrading.

Each of these functions will place increasing pressure on existing systems and legacy data structures. Hardware and software will need to be evaluated and there will be an increase in the complexity of the organizations GIS functions as new alternatives and ways of doing business are revealed.

Implementation

GIS is an enterprise technology and ought to involve all personnel within the organization during the planning, implementation and operation phases. Without support of top management, GIS upgrading may fail. A clear understanding of costs and strategies is needed and time lines need to be established for evaluating and monitoring that allow flexibility. How do you meet the upgrading challenge? Lets go back to the organizations previously mentioned and provide some answers.

	<i>Company A</i>	<i>Company B</i>	<i>Company C</i>	<i>Company DH</i>
<i>Hardware</i>	Upgrade older computers; min. 128Mb RAM	NA	Upgrade older computers; min. 128Mb RAM	NA
<i>GIS software</i>	Contact existing GIS vendor and purchase upgrade for site - alternatively, compare current software with other vendors	Evaluate and purchase extended GIS software for analysis	Partial upgrade for some GIS; Purchase extended GIS software for analysis	NA
<i>Map Serving</i>	Evaluate and demo map serving software	NA	Evaluate and demo map serving software	NA
<i>Visualization</i>	Evaluate and demo visualization software	Consider - evaluate visualization	Consider - evaluate visualization	Consider higher resolution graphics
<i>GPS</i>	NA	Determine GPS needs within organization	NA	Consider at later date
<i>Telecommunications</i>	Evaluate GIS networking	NA	Evaluate GIS networking	NA
<i>Training</i>	Required for updated software / serving	Required for analysis and visualization software	Required for analysis and visualization software	Emphasis on training and using consultants
<i>Strategic Planning</i>	Re-evaluate GIS strategic plan	Unlikely	Unlikely	Develop strategic GIS plan

Keep in mind that there are numerous variations of existing GIS and not all upgrade paths are the same. Many organizations have differing budget allocations for GIS dependent upon the role GIS plays in their strategic plan. In some cases alternative products may actually provide a better solution – for budgetary, functional or support reasons.

Implementing a GIS upgrade usually takes a champion – someone in the organization who recognizes the value of GIS upgrading toward meeting the organizations strategic goals. So what steps can be taken in the human relations side of the process?

- Involve geo-spatial employees in the strategic planning process.
- Establish an upgrade project leader; reports to geo-spatial, middle and upper management on all upgrade issues; coordinates process; allocate authority for purchasing and scheduling
- Bring in vendors and consultants to exhibit and discuss their products and services.
- Begin initially with weekly meetings within the geo-spatial group discussing the upgrade, problems, concerns and technical issues.
- Begin bi-weekly meetings with employee representatives from other organizational groups; discuss problems, concerns and applications.
- Begin monthly meetings with middle and upper management; discuss applications, strategic goals and budgets.

Challenges

There exists a whole group of GIS users in organizations that implemented GIS some time ago. These organizations have learned through experience (and headaches) some of the difficulties with implementing and operating a GIS system. They tend to know the capabilities of their existing systems and have reached what might be referred to as - ‘maturity’. Perhaps they have worked so hard to get the system working they have become comfortable and focused on what is exists, minimizing the need for upgrading. Upgrading requires change!

Those organizations that have never purchased a GIS before are also faced with change if a GIS system is being introduced into the organization. They would nevertheless benefit by following the strategic approach towards planning and implementation. Some of the common pains and pitfalls associated with upgrading include:

- Not following the strategic plan as identified and constructed
- Inability to get employees to work together across organizational lines
- The assumption that the ‘GIS people’ will solve all the problems
- No follow up and monitoring of the installed upgrade
- Knowledgeable employees leaving the organization

- Inadequate or changing budgets in mid-stream

Conclusion

Upgrading a GIS is a major organizational objective that requires careful strategic planning. Current systems will require evaluation with respect to meeting current and future organizational objectives. Trends in technology, ability to use and share data, from alternate sources are important needs for an organization dependent upon spatial information. Employee involvement that considers both the enterprise and business process is directly related to upgrading considerations. Common pitfalls include under funding and having a short-term view of the upgrade process, that may in fact be continual and which must be incorporated along with other organizational objectives. The future is exciting for GIS and spatial related products and services. A successful GIS upgrade can be identified by the new ideas and excitement generated as the organization is able to ‘see’ and participate in many new challenges and solutions.

Other Information / Reading

Paper	GIS Implementation and the Un-Theory: Some useful concepts from ANT.
Presentation	GIS Implementation Tactics
Information	Open GIS Consortium
Information	Phases of Implementation
GIS Cyber City	City of Grande Prairie, Alberta, Canada
Book	The GIS Book: Understanding the Value and Implementation of Geographic Information Systems

References

Goodchild, M.A. 1992. What is GIS? Unpublished manuscript. 44 pp.

Nyerges, T.L. 1992. Coupling GIS and Spatial Analytical Models. Proceedings, 5th International Symposium on Spatial Data Handling, Charleston, SC. IGU Commission on GIS, 524-533 pp.

Poiker, T. et al. 2000. Organizational and Social Aspects of GIS. Course 11 Notes. UNIGIS, Postgraduate Certificate in GIS. Manchester Metropolitan University, UK.

Star, J. and Estes, J. 1990. Geographic Information Systems: An Introduction. Prentice Hall, Englewood Cliffs, New Jersey. 303 pp.

Jeff Thurston – is European Director, Integral GIS, Inc of Seattle, Washington and lives in Berlin, Germany. He previously taught GPS, GIS and photogrammetry in Canada. Jeff specializes in geo-technology integration, visualization as well as writing and delivering courses internationally. He is a free-lance writer internationally. Integral GIS, Inc is an international GIS consulting company involved in business, entertainment, environmental, anti-terrorism and construction GIS.