

# GIS data make the world go round

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## A historical overview of GIS in local government

GIS (Geographic Information Systems) have played an integral and important role in local government. Back when the term GIS was not even coined, there was a need to associate places and attributes in a manner that the emerging data processing systems and their application users could comprehend. Major research programs were undertaken- most notably the federal effort to explore Integrated Municipal Information Systems in the early seventies. In what came to be known as USAC (an acronym standing for the federal agencies contributing to the effort financially- the Urban Systems Interagency Coordinating Council), several city and county agencies agreed to put their information on mainframe computers. Using the newly developed technologies of data base administration and multiple data access routines, they attempted to build application systems in Financial Management, Public Safety, Human Services and make information available across these application lines. And the guiding principle which emerged was a trinity of elements: People, Places and Dollars! As long as any transaction had non-null information for these three attributes, integration could proceed. So from this early era, the geography of place established a dominant role in local government operations.

But not only were geographic elements important in an operational data base design sense. PTI (Public Technology Inc.) developed a software tool called the Fire Station Location Package (FSLP) in 1972 which could help administrators, planners and other community leaders plan for the orderly expansion or retrenchment of fire service resources- manpower, equipment and fire houses. One of the first Decision Support Systems, the FSLP was based on the notion of studying response times which various station configurations could deliver and making budget and service level decisions accordingly. In order to develop and measure credible response times, one had to have an idea of where the streets and facilities were and what the distances and speeds were along the transportation network- an easy job for today's GIS but almost an impossible one for the emerging "EDP" shop of the seventies! In order to overcome this barrier, planning manuals were developed which helped thousands of fire fighters in hundreds of communities develop what were probably the first geographic networks at local level with common attributes such as "A node", "B Node", distance, speed and direction of travel. These rudimentary transportation networks brought the capacity of planning

to many governments for the first time in an effective and understandable manner. And, as a precursor to today's major themes, the FSLP also demanded an unusually high level of collaboration between agencies. Fire Department, Planning agency and budget office were brought together at the Project Team level and encouraged to collaborate towards a common goal.

As the notion of GIS expanded and became more prevalent, the pin maps and colored map sheets of the sixties gave way to flickering shaded screens and line drawings. Agencies saw the benefits of organizing their data with a geographic foundation, and many software applications began to look for uniform geographic organization. The raw data files which characterized "EDP" now began to be better organized with geography as the driving force. And with the existence of geographic attributes came a capacity to rethink aspects of agency operations that were not possible previously. The commonality of geography across departments gave administrators and politicians a way to compare, contrast and imagine integration of services in new ways- a capacity to think anew about service delivery and combination of effort. At the same time, of course, private businesses were also beginning to look at GIS as a means to improve their bottom line- from smarter location decisions of branch offices to organizing information around single locations for easy integrated customer service. And in their thirst for geography, they turned to government as a reliable and inexpensive source of raw data. This dual role of government as data user and data provider has and will impact the growth of GIS for a long time to come.

The evolution of GIS products is an exciting one full of new developments every year. Both in the hardware and software arena, technology has been rapidly developed and deployed. The capacity to quickly and inexpensively capture data, to process and integrate it with other existing data bases and to develop stand alone modules of capacity in the mapping arena has been growing in leaps and bounds. Many applications have also been given a strong analysis component, making them indispensable management tools for policy analysis. What has not kept pace with this pace of progress, however, has been our understanding of the organizational requirements for efficient GIS deployment, as well as for GIS use. Team approaches, interdepartmental agreements and multi-interagency implementation Task Forces are all instruments that have been developed in an ad hoc manner, infrequently used effectively and usually provide the reasons for GIS implementation failures. For this reason, the nineties brought along a commitment to organizational issues and the development of

manuals, training aids and contractual vehicles between the vendor community and their clients which emphasized organizational development. PTI's research division indeed undertook two efforts whose outcomes were organizational development manuals which prepared local governments for the institutional development investments which a successful GIS implementation effort requires (Ref 1 + 2).

Finally, the advent of the Internet gave a connectivity tool that GIS advocates have been looking for a long time. The notion of making geographic attributes available to a whole host of applications without necessarily incurring the expense of individual data base creation and explicit interface system development came close to reality in the late nineties. One application could access the data bases developed for another, and the end user could be almost blind to this interfacing and enjoy the benefits of geography in a variety of applications. And with the connectivity of applications came a willingness to share, a desire to develop united fronts towards societal problems and a plethora of alliances targeted towards the effective use of GIS. Most recently the elected and appointed chief executives of local government agencies came together and agreed to begin "evangelizing" GIS applications within their membership through the Local Leaders in GIS alliance (Ref 3) which has established a web community of interests.

### GIS as an integrative force

It is not an accident that so much development and creation has occurred at the local government level. After all, to paraphrase Tip O'Neil, "all GIS is local!" It is at the local level that most accurate and timely data can be collected about geography and its attributes. A strong argument can also be made regarding the level at which GIS maintenance is most efficiently and effectively done. Local government agencies are the ones who know first when a subdivision is approved or a road rerouted because they are usually the ones who issue those approvals! If, therefore, someone was to look for the institution in society that offers the quickest and most efficient access to GIS information and its maintenance, this institution would undoubtedly be local governments. Similarly if one were to look at the financial, personnel and time investment made in GIS data base and application creation, once again the local government numbers would top all other investments made by other sectors of society. This importance of the local government constituency must be reflected

more and more in the platforms for GIS leadership, standards setting and creative development.

Local leaders have found that GIS technology is a management tool which can help illustrate trends in a convincing manner, present policy options clearly and without bias and give line managers the tool with which to see patterns and take proper action. But beyond these tactical advantages, GIS also has a latent yet rich capacity to act as an integrator across diverse data bases. No matter which application created a set of data elements, one transferable and common attribute that they will share with other data sets is geography. And a well designed GIS system can provide a mechanism that can painlessly aggregate, link and relate disparate management and policy information in a way that is quite independent of system, or existing function.

This integration ability is made even more powerful by newer developments in technology. GPS offers the ability to know location in real time and to a degree of accuracy previously only imagined (or available only to classified applications). The processing power of modern chips is capable of delivering enhanced imagery and 3-D renditions of geography which gives the user views and insights which are unavailable from the raw data. And Expert Systems can combine data in ways that bring policy choices to life. This explosion of management and policy support options brings GIS out of the shadows of "developmental technology" or "academic plaything" and establishes it squarely as a major contributor to modern public administration and business alike. Both Physical and Societal subsystems of an effective GIS can now take their place in the standard management tool kit. But it continues to be a challenge to establish and follow standards under which these two subsystems can be created and maintained effectively. The power of the marketplace to establish de facto standards for data systems is all too well known and rightly feared by many. What makes sense in a commercial transaction environment may not be best public policy, and it can be argued that the public sector, especially local governments, are not adequately represented in the policy debate which goes on about data standards. It was only recently that local governments were invited to sit on the Federal Geographic Data Council as it deliberates standards for not only federal agencies but by extension for all governments. This seat, although not yet carrying a loud enough voice, is a major breakthrough which establishes a formal dialog platform between the federal and local levels of government and should be enlarged.

## Policy choices

The establishment of public policy around GIS is important, and there are many issues that are not well understood or not very visible in this debate. Three that will be memorialized in the context of this paper are Privacy, Data sales and the Regional imperative.

Privacy is a major debate which is exploding in society today, and the GIS community is right in the middle of it. The gathering of geographic information permits the owner to relate diverse elements and create unintended views of reality, and this can produce unintended consequences for individuals and their privacy. Driven by the widespread use of the Internet and the increasing degrees of interconnectedness found in societal systems, the debate seems to have crystallized two opposing views: the Privacy and the Access advocates. The privacy advocates argue that people should have the right to keep their independence and freedom, and government's rights to gather, store and use data describing individuals should be dramatically curtailed. On the other side of the argument, the Access supporters insist that government should make everything available, especially if it was developed at tax payer expense, and that government should be open and never operate under conditions of secrecy. These two views are so antithetical that it is hard to imagine a reconciliation. And indeed perhaps it should be recognized that there is no "right" answer, simply a dialog which will continue for a long time, reflecting societal values and permitting people to appreciate the benefits of both arguments without giving in to any one totally. However, elected officials at all levels of government must become better versed in the vocabulary of the debate and develop policy positions that reflect the will of the citizens rather than respond to short term emotional issues that may arise.

The increasing value of GIS has created a furor over the second policy issue: the question of ownership of geographic information and the ability of institutions or individuals to sell that information to third parties for financial gain. Again two diametrically opposing views hold here. On the one side stand the advocates of making all governmental information available free for the asking. Their argument is simple: the tax payer has paid for the data once, and should not have to pay for them again. On the other side are those who would like to see governments sell these data assets to willing customers. Their argument is one of stewardship: the tax payers have entrusted government with the responsibility to safeguard their investment. If

that investment has developed a value in the open market place, then government would not be carrying out this duty if they did not try to monetize the value and return some of this value in the form of lower taxes to the tax payer. These two views are not easy to reconcile, and advocates of one may not immediately see the wisdom of the other. Enlightened public policy mechanisms can develop a proper response which reflects local culture, the wishes of the people and the entrepreneurial attitudes of the elected and appointed officials. Public / Private partnerships rather than vendor-client relationships may also provide a different organizational approach to this important issue, under which both sides may invest and profit from a joint service.

The last policy choice has to do with the geographic scale of data collection and maintenance. Small municipalities who become convinced of the value of GIS are turned off by the cost of development or the requirements for sophisticated maintenance staff whose salaries may appear to be out of their reach. However, several jurisdictions have overcome this hurdle by banding together in regional compacts which enable the cost and staffing requirements to be divided amongst several customers. More importantly, such efforts to band together several administrative or political subdivisions have additional, far reaching and unforeseen benefits. Collaboration becomes second nature at the service delivery level when there exists a common geographic infrastructure which constantly reminds officials of the value of neighbors. In addition, facility location decisions, resource allocation decisions and service delivery boundaries have a tendency to become far more efficient when examined from a wider, regional perspective.

### Benefits of GIS to the policy makers

It is vital to appreciate that GIS must somehow leave the comfortable cocoon of the cartographer and data base manager and enter the realm of top management and policy making before it can reach its full potential. This migration from technology to management and policy foundations is difficult but must be undertaken with leadership coming from top management. The value of education is paramount in this arena, and all opportunities to reach high level officials with the message of GIS as a valuable policy tool must be taken.

Local governments have been using GIS systems for many years. Starting from simple data base structures that document the location of activities to highly sophisticated, three dimensional representations

of buildings, roads and governmental facilities, a strong GIS system establishes a foundation for management use. More than that, GIS can also become a new, refreshing and empowering attribute to an existing data base and develop unexpected or unforeseen insights. A file of police incidents can at once create depth and insight when given geographic attributes and displayed on a screen or plotted on a map. Events which involve people, dollars or places are the foundation of operational, as well as planning data, and GIS is the technology that can integrate and relate them in a practical and effective manner. The creation of Decision Support Systems and Executive Support Systems which organize complex issues using geography as a prime integrative element are slowly becoming the norm rather than the exception, further fueling interest in GIS growth.

Beyond the capacity to strengthen the analysis of management issues, GIS can also give policy makers the ability to "see" the impact of their policies without actually incurring the wrath of the electorate over bad decisions. Using 3-D renditioning, virtual reality and modeling of future events, GIS has given planners and policy makers alike the ability to create future universes based on assumptions and parameters which can be easily modified. The outcomes are visually stunning, but also vitally important to establish informed decision making. Planning boards can look at the visual impact of land use changes, social service managers can analyze the impact of increasing density patterns on service delivery levels and place-based inequities in resource allocation take on a clear and precise voice.

In order to foster and promote the widespread dissemination of this technology at the local level, many governments and their associations at the state and national level have organized Best Practice programs which encourage the documentation and sharing of GIS efforts among peer local governments. These Best Practice programs rarely involve the vendor community and academic researchers in a direct way, missing an opportunity for improved communication and opportunities for deepening partnerships.

### GIS as a linking technology

A GIS will usually be funded and developed to address a particular need of an agency. Once developed, however, the user quickly discovers a new and sometimes unanticipated benefit: its ability to act as a pivot point from one data base to another, thus providing additional value to both. Being able to relate elements in one data

base to those of another via a common attribute of geography gives the analyst, planner and decision maker the ability to broaden their investigation horizons and enrich their capacity to make better, more informed decisions. Taking a traffic count data base and relating it to an air pollution monitoring data base deftly creates policy choices in transportation planning and environmental management both- and at once develops an action platform for a generalist policy maker who perhaps would otherwise be uninvolved in each sectoral issue.

Not only is the linkage important between data bases. There is a far more pervasive linkage under way in the new millennium, and that is the ubiquitous Internet and its ability to reach people and varied applications through the common access technology of the browser. As more and more applications develop an Internet front end, more users can access them on the 'Net; GIS becomes a key which unlocks a wealth of services that can be delivered using a geographic attribute as an entry point. As federal, state and local governments adopt a citizen-centric approach to service delivery, geography takes its rightful place as the key linchpin, able to deliver a connection between a service request and an agency organized to deliver that service.

## PRICING ISSUES

The advent of the Internet and new technologies of connectivity such as cell phones and the Wireless Application Protocol will put on major pressure on data providers to make available geographic information which can empower or embellish consumer applications. The idea of place as a determining factor in consumer choice is not unknown, but is developing new dimensions every day with the advent of personalized, "right now" technologies such as cell phones and wireless PDAs. A driver with an on-board GPS being told that she is driving past an outstanding restaurant serving her favorite dish; an alarm system able to broadcast the precise location of a vehicle involved in an accident to responding authorities; these are two of the hundreds of applications that are developing an insatiable appetite for geographic data. And who will produce, provide and maintain this overwhelming amount of data? One can make the argument that local governments will have a major role to play in such an equation. Not only do local agencies create, document and store information which includes geographic attributes; they also are the ones who know quicker and with less cost when these geography attributes change because of roadworks, land use changes and new development. Local agencies are the ones who issue necessary permits before this type of

work can be done, and are therefore the natural low-cost producers of GIS maintenance information. A research manual issued by PTI in 1996 (Ref 4) attempted to develop these arguments and provide a snapshot of current policy initiatives.

In a policy-neutral, economic model, this capacity of local governments would probably automatically assign to them the role of GIS data sellers. However, in the realistic public policy arena, this is not the case. Two arguments have emerged which frame a difficult debate. One the one had is the "taxpayer has paid" argument which goes like this: if a GIS database has been developed with tax payer funds, it has already been paid for by the public. Subsequent uses of this data by taxpayers (and by tax payers the holders of this view will include commercial vendors of information) should be allowed with no additional payments due. The other argument can be described as the "taxpayer stewardship" argument. The taxpayer has indeed paid for a public GIS data base, and the public officials serving that tax payer have a sacred responsibility to seek maximum value for that taxpayer investment. If the GIS data base develops a value in the marketplace that is higher than its development cost, this difference can be converted into a positive net gain of revenues that can be used to recover the earlier investments and eventually reduce the taxpayer burden. These two arguments are difficult to reconcile- both contain true statements and the ultimate resolution depends on the community values and the direction given to staff by elected officials as public policy. However, it is clear that GIS will increasingly be seen as a valuable asset, and thought must be given to establish a public policy on deriving value from this asset consistent with the community and its values.

## FUTURE TRENDS OF TECHNOLOGY IN LOCAL GOVERNMENT

The explosion of GIS over the last decade has to be seen within the context of a larger, long-term trend of technology development in the local government marketplace. Going well beyond automation of existing functions, technology has begun to be seen as the tool which enables citizen-centric governance and gives government officials the opportunity to redefine procedures and "reinvent" a more responsive style of government. Three major trends are emerging:

1. Smaller is better

Breaking with the tradition of major systems development efforts of the 70s and 80s, technology development options are now more oriented towards smaller scale, networked solutions. Energy generation options, for example, are now appearing on the market in a Distributed Generation mode, where several small, neighborhood based energy generators using cleaner, more available fuels can power up small areas and network their output in a virtual grid with power export and revenue potential. Similarly applications development efforts in the software arena are "chunked" in small modules that can be independently tested, then networked with others as an entire system is developed.

GIS development is directly affected by this trend. Instead of traditional large scale development efforts where budgets were appropriated years in advance and the development occurred behind closed doors with no user interaction for years, GIS development is scaled down to small modules that can show results quickly and build funding support. The value of small pilots that can show operational benefits can lead the way to larger implementations done in a modular fashion.

## 2. Let others pay

New developments in telecommunications technology and data security now permit police officers to use off-the-shelf pagers to access criminal records from state and federal agency data bases. This means that public sector investments do not have to be made in new telecommunications infrastructure, and future applications can simply piggy back on private sector investments made to date for other purposes. In another popular arena, many of the new "E-Gov" initiatives find private companies eager to contribute the start up capital necessary to develop Internet portals for service delivery directly to their potential government clients.

GIS developments can be aided by similar private investments. Whether assembling alliances of utilities, delivery companies and others interested in the same geographic attributes and thus reducing development costs by sharing the early investments or developing joint ventures to monetize the value of public data, partnerships are an ideal way to quickly bring on the benefits of GIS. Local governments can be the leaders who bring these partnerships to fruition and organize the flow of investments and returns in creative, new ways.

### 3. Networked Management

The management principles now pervading government have shifted away from hierarchical structures to networked, collaborative ones. This is evident as the word "governance" is being seen more and more to replace the word "government", indicating a shift to a broader definition which includes private industry partnerships, non-profit organizations and the faith-based community. This network approach to government is putting a premium on methods that can manage diverse information coming from a variety of sectors, platforms and applications.

Once again GIS is an ideal technology that can support this shift to a networked environment. Whether it is the establishment of a common vocabulary for policy decisions based on place, or the creation of integration pivot points between varied data bases, GIS has indeed emerged as the technology of choice to manage the network of activities called local government service delivery.

#### BARRIERS AND CHALLENGES

Are there barriers ahead for the wide spread use of GIS? The very promise of GIS to act as the integrator of existing data bases and applications will not be fulfilled unless and until there is true interoperability between applications. Interoperability is conceptually very attractive to users, vendors and researchers alike, and yet has been an elusive hope unfulfilled for many years. Market forces, personal vanity and competitive advantage perceptions have kept the industry in turmoil and separate. Recently the advent of the Open GIS Consortium and the broadening of the FGDC to include State and Local representatives are two developments which are positive and point to a stronger chance for interoperability.

And it is not only the interoperability of computer systems that is at the heart of this argument. PTI believes that hardware and software issues account for only 20% of a technology investment strategy. Fully 80% of any project implementation are related to "Orgware" expenses between individuals and organizations- the expected friction between competing factions, the job security and hierarchical dominance arguments which crop up in any organization over time as new technology is being deployed. These Orgware issues can spell the

undoing of an implementation unless managers and users alike pay special attention to people's emotions, expectations (that go well beyond system expectations) and personal potential contributions. In short, the successful GIS implementation effort must be anchored in a collaborative, people oriented environment of nurturing management.

Financing of a GIS effort continues to be a challenge for local governments; given the multiplicity of potential data providers, as well as end users, creating and implementing a financing mechanism which reflects this complexity is not easy. Recently there has been an effort supported by the FGDC and OMB which breaks new ground in this field. Emphasizing collaboration and a notion of end state value of an integrative GIS, the report titled "Financing the NSDI" (Ref 5) makes several concrete suggestions worthy of serious consideration by all levels of government and the private sector.

## PARTNERSHIP POTENTIAL

The partnership potential within GIS is truly unbounded. Academic researchers, private sector entrepreneurs and government officials can come together and establish new mechanisms for collaboration, joint product and service development and ultimately new methods of delivering value to consumer and citizen alike. Public Technology Inc. has a unique role that it can play in this partnership puzzle. Organized thirty years ago by the major associations of local and state government and given an explicit mandate to bring the benefits of technology to the local level of government, PTI stands ready to be a convener of private and academic resources to develop new value. Forums such as the ICIS conference and the long term institutional platform of action that ICIS provides are ideal mechanisms to pull together the many sectors in GIS and produce value for society at large.

Exchanging information between the local government world and academia could well be the first step in a collaboration between the ICIS network and PTI's network of local government leaders. Indeed a Local Leaders in GIS network (LLGIS) was recently established by the major local government associations, and PTI has been asked to operate it, establish a web site for it and promote the value of GIS (Ref 3). Perhaps a collaboration between ICIS and PTI's LLGIS network could produce a Business Case based on effective information exchanges and develop an ongoing model of collaboration between Academia and Local Government- a much needed partnership!

Ultimately significant breakthroughs can be made at the application level of new GIS systems, and more importantly at the management and policy modeling aspects as well. Pilots that can allow experimentation under sheltered conditions, with inputs from a variety of stakeholders can produce models of success which can drive a GIS market onward with support from all sectors. In order to set up such a learning environment, it is vital that communications patterns between Academia and Local Governments be increased- a good first step for ICIS and PTI to focus on!

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