Session #10

Cooperation and Patience:
The Key To A High Quality, Sustainable GIS

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ABSTRACT

GIS provides a powerful tool to transportation planners and engineers for a variety of analytical tasks. However, even with the advent of PC-based GIS systems and strong state and federal support, transportation planners and engineers in small and medium-sized communities face many constraints in finding the resources to pay for a GIS and in the development of a data base that can be used for practical applications.

The Lane Council of Governments (LCOG) has been a leader in the design, implementation and management of Geographic Information Systems (GIS) for almost three decades. The root of this successful implementation of GIS lies in the formation of multi-jurisdictional (cities, county, utilities, MPO), multi-application (transportation, natural resources, public works, assessment and taxation, land use planning) approach (termed the Common Mapping Project) and development of a Cooperative Project Agreement which has provided for sustained development of a parcel-level data base.

This approach has allowed LCOG's transportation planners to have access to a very rich database. For example, the GIS provides land use and demographic inputs to the system model and overlay analyses incorporating the transportation system (both supply and demand characteristics), natural resources (soils, topography hydrology, etc.) and other public works features (sanitary, storm sewers, utility lines, etc.). In addition, this approach has allowed LCOG to focus its transportation planning resources on the transportation system as other agencies have provided the resources for development and maintenance of other parts of the database. The 30-year history provides evidence of success of the approach.

Without this cooperative, long-term approach, it is doubtful that GIS would be available to transportation planners in the Eugene-Springfield area. Certainly, we would not have the rich database that has resulted from this integrated approach. This paper/presentation will describe the approach taken by agencies in the Eugene-Springfield area in the development of its GIS, the benefits of this approach to transportation planning in a medium-sized area, and the key lessons learned over the years.

Cooperation and Patience:
The Key To A High Quality, Sustainable GIS

The heart of Lane County is situated at the southern end of the Willamette Valley along the Interstate-5 corridor in western Oregon. At over 4,600 square miles, Lane County stretches from the crest of the Cascade Mountains in the east to the Pacific Ocean in the west. The Eugene-Springfield area, with a population of just over 200,000 people, is one of four Metropolitan Planning Organizations (MPO) in the state. The transportation planning effort in the region is coordinated by LCOG and includes participation by the Federal Highway Administration, the Oregon Department of Transportation, Lane County, the City of Springfield, the City of Eugene and the Lane Transit District. Elected officials provide input to local transportation planning efforts through the Metropolitan Planning Commission (MPC). In addition, LCOG receives a variety of state and federal grants to assist in such efforts as transportation corridor planning, land use model refinement and origin-destination surveys. The Lane Transit District serves an area about one-third the size of Lane County that also includes the Eugene-Springfield area. With over 100 routes, LTD provides transit service to over 22,000 riders a day. Known as a "bicycle-friendly" place, Eugene and Springfield have over 200 miles of on and off-street bicycle paths.

A BRIEF HISTORY OF GIS IN LANE COUNTY

The regional GIS started in 1968 as a project to create a consistent, digital grid for all of Lane County. In that year, a set of planemetric maps was used as a base for digitizing each section corner within Lane County. In 1970, the digital section data was used as registration points to digitize over 750 Assessment & Taxation maps for the Eugene-Springfield area. Known as the *Map Model System*, this effort established a parcel level mapping system by 1974 and was built primarily as a tool for land use planning. This initial effort established four important data groups:

1. Land parcels - consisting of tax lots and their internal land use polygons
2. Road-related information
3. A standardized set of site addresses for each addressable structure in Lane County
4. A set of overlay, or boundary files such as zoning, plan diagram, city limits and Urban Growth Boundary.

The parcel data base that was developed in the mid-1970's used a file structure that can keep track not only of individual tax lot boundaries, but can also depict individual land uses within each tax lot. This file structure has enabled planners to perform a wider variety of analyses that would not be available otherwise.

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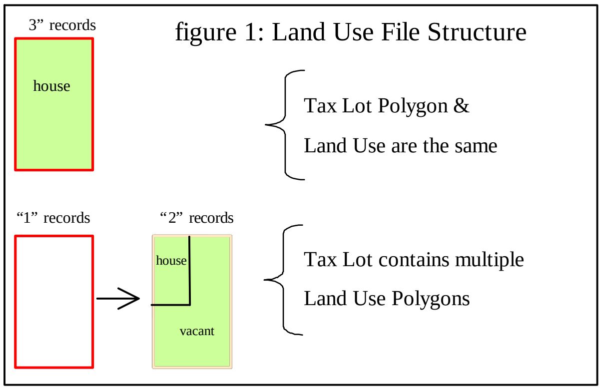

figure 1: Land Use File Structure

Projects using the land use data include:

- Vacant Land inventory
- Residential Land study
- Urban simulation modeling
- Impacted Forest Lands
- Redevelopment scenarios
- Transportation node-link modeling
- More . . .

The Map Model system remained in use up until 1982. The data was stored and managed on a large IBM mainframe computer and LCOG was the only agency that had access to the data and the only agency serving data, reports and map products to the participating government agencies. This period represented the "Central Processor - Single User" concept in place at the time.

In 1982 the partners began planning for implementation of the *Common Mapping Project* which used vendor-supplied software in a more shared environment. The mission of the Common Mapping Project was to develop a shared, integrated, commonly accepted digital base map of Lane County. In 1984 the partners purchased Synercom Technology Informap software and the City of Eugene, LCOG, Lane County, and the Eugene Water & Electric Board (EWEB) each purchased their own GIS workstations connected to a VAX mini-computer. The City of Springfield continued as a partner in the project but delayed their purchase of workstations until the region upgraded to the current ArcInfo system.

By now the regional GIS had evolved into a "Central Processor - Multiple User" environment, with the partners gaining their own access to the GIS, creating their own data layers and producing products using their own staff. In addition, the City of Eugene, City of Springfield and EWEB added municipal utility data layers to the GIS; such as storm sewer, sanitary sewer, and electrical system data. The GIS also evolved from being primarily a land use planning tool, to also serving the needs of the local utilities.

In 1992 the partners began looking at yet another upgrade to the GIS and in 1993 ESRI Arc/Info software was chosen by four of the five partners. EWEB has now chosen to use Small World for their GIS and still continues to use AutoCAD for much of their cartography applications. On the surface, this may appear to be a split among the GIS ranks, but the partners also established a set of values during that transition. One of the core values is maintaining good data and worrying less about the GIS and mapping products that make use of it. The GIS partners also use MapInfo and Maptitude and the engineering departments at Eugene, Springfield and Lane County continue to rely heavily on AutoCAD. This has proven to be a sound philosophy. It gives each agency the flexibility to chose the right GIS tool for their business and has not proven to be a roadblock to sharing and/or maintaining the data. Currently the Common Mapping Project is in a "Distributed Processing - Multi-User" environment. As the technology continues to mature the expectation is that a single data format can evolve that will allow any of the GIS systems in the region to access,

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update and manipulate the hundreds of GIS layers in use today.

Transportation planners in the region have been one of the big winners over the years in terms of having access to a variety of GIS data. And, as Figure 1 illustrates, transportation planning efforts have been able to leverage the GIS data created by other projects and initially for other purposes.

Figure 1 – Transportation leveraging GIS data creation efforts

Data Layer	Purpose	Created
Tax Lots	Land Use Planning	1975
Land Uses	Land Use Planning	1975
Zoning	Land Use Planning	1976
Comprehensive Plan	Land Use Planning	1980
Employment Data	Land Use Planning	1978
Site Addresses	Common Data	1977
Road Network	Common Data	1980
Transit Routes/Stops	Lane Transit District	1991

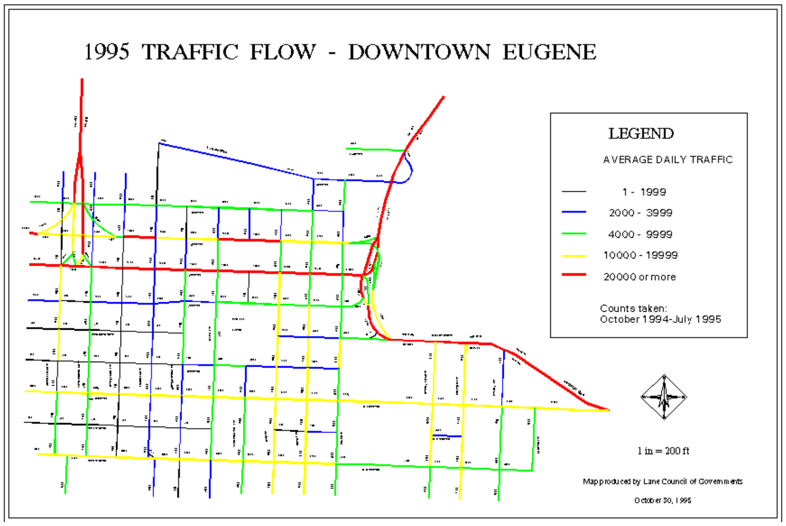
GIS and TRANSPORTATION PLANNING

LCOG is currently using a variety of Environmental Systems Research Institute Technology (ESRI) products for our GIS work. These products include Arc/Info for managing and maintaining the data and ArcView for providing easier access, mapping and some basic analysis. Transportation planners at LCOG use emme/2 software for the transportation modeling work. Output from the emme/2 model can be handed off to an ArcView extension product known as M2View marketed by the Travel Model System Group. This software works within ArcView and builds shapefiles from the emme/2 node-link model output. Additional work remains to be done to better integrate the modeling process with the GIS.

Products and Mapping

Early efforts at using GIS data for transportation purposes included producing computer-generated maps. The earliest example of this includes the production of the traffic flow map for the Eugene-Springfield area as shown in figure 2. This map was initially drawn by hand and updated once a year from information provided by Eugene, Springfield and Lane County traffic engineers. The computer version of this effort has evolved to the point where today, a GIS coverage exists that contains the volume information for each arterial and collector street in the metro area. The arcs representing each collector/arterial have an attribute field, which contains the volume data as reported by the local transportation engineers. This tabular data is updated once a year and the resulting changes to each street segment are automatically reflected in the newer version of the traffic flow map. This process has saved countless hours of manual labor and is now, in fact, the only way to produce this map since LCOG no longer employs any traditional cartographers.

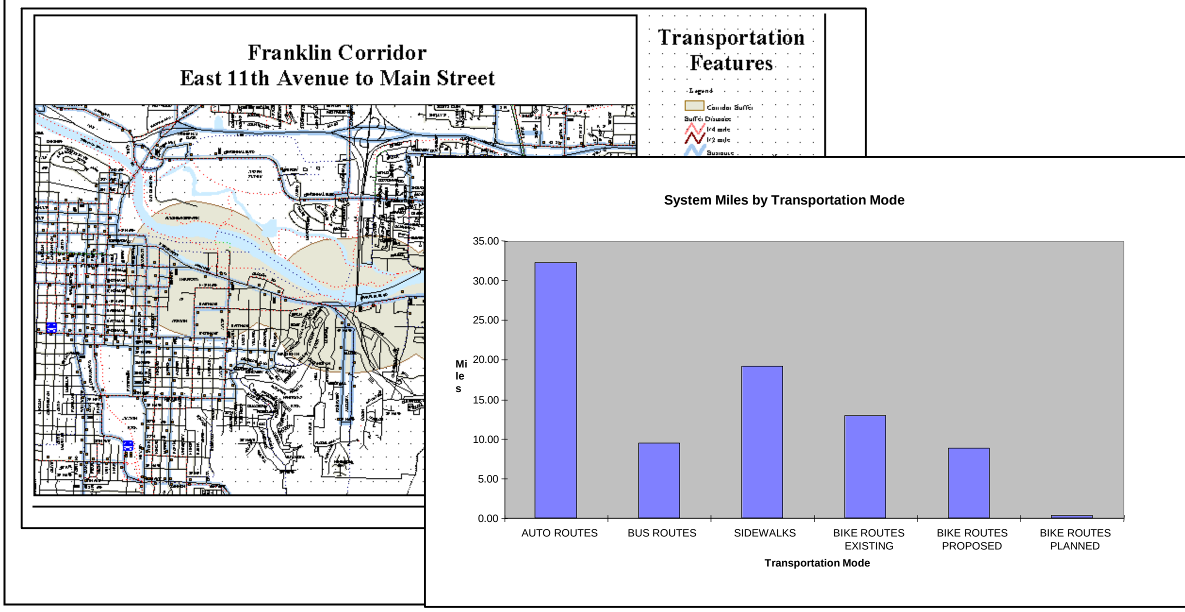
The computer mapping process for a transportation project was recently taken to a much higher level when LCOG, working under a grant from the Oregon Department of Transportation (ODOT), produced an atlas of the state road corridors within the Eugene-Springfield area. The mapping was done entirely in ArcView and involved creating 10 different themes for each of the 23 corridors identified in the metro area. Information provided by the GIS allowed LCOG GIS staff to create a quarter-mile buffer along each corridor that was expanded to a half mile at each major intersection. The corridor buffer was displayed as a reference so that the companion GIS data could be examined in relation to the corridor area. The ten themes are:



- Road and base data
- Transportation features
- Land Use
- Vacant land by comprehensive plan
- Employment data
- Population Density
- Natural features - water, flood, wetlands, topography
- Storm Sewer system
- Wastewater (Sanitary) system
- Non-Private ownerships

In addition, a companion chart was generated by analyzing the tabular data associated with each theme and exporting the results to an Excel spreadsheet where the business chart was produced. An example of this is shown on the following page in figure 2.

Figure 2 – Urban Corridor project

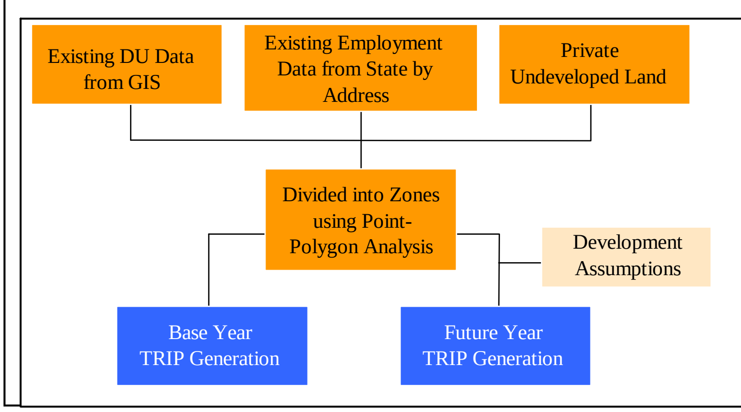


Other examples of mapping transportation data using the GIS include creating a set of bus stop inventory maps for LTD and generating a bicycle path condition/volume map for the metro area.

GIS and Transportation Modeling

The transportation modeling effort takes place within a piece of software known as emme/2; however the GIS was used extensively to populate much of the information used for the model. The initial node/link data was extracted from the GIS and converted to an AutoCAD .dxf file for import to the emme/2 software. Creating the trip generation and trip attraction characteristics for each transportation analysis zone involved a fair bit of geoprocessing within the GIS environment. The diagram in figure 3 depicts the basic process for doing this.

Figure 3 – Trip Generation Model



In the 1980's LCOG staff created a GIS coverage of transportation analysis zones (TAZ's) for the metro area.

Trip generation characteristics were applied to each TAZ by using the parcel-based GIS land use layer. The regional GIS has information for each tax lot which includes a breakdown of the number and type of land uses for each parcel. Each residential land use was assigned to a TAZ through a process known as geocoding. This resulted in providing the emme/2 model with the number and type of each residential unit for each TAZ in the metro area.

Trip attraction characteristics were created by geocoding the employment data with their respective TAZ. Since 1976 LCOG has taken the state employment file for Lane County and assigned a coordinate to each employer location. Even if a business has multiple locations within Lane County (such as a major grocery store having multiple stores) the state only reports a total for each employer. This has meant that LCOG GIS staff have had to disaggregate the employment data to depict proper site locations.

Once the trip generation and trip attraction characteristics for each TAZ are known, then base data can be loaded to the emme/2 model. The model is calibrated by actual data from various traffic engineering departments to verify that the model accurately depicts traffic volumes along the same streets.

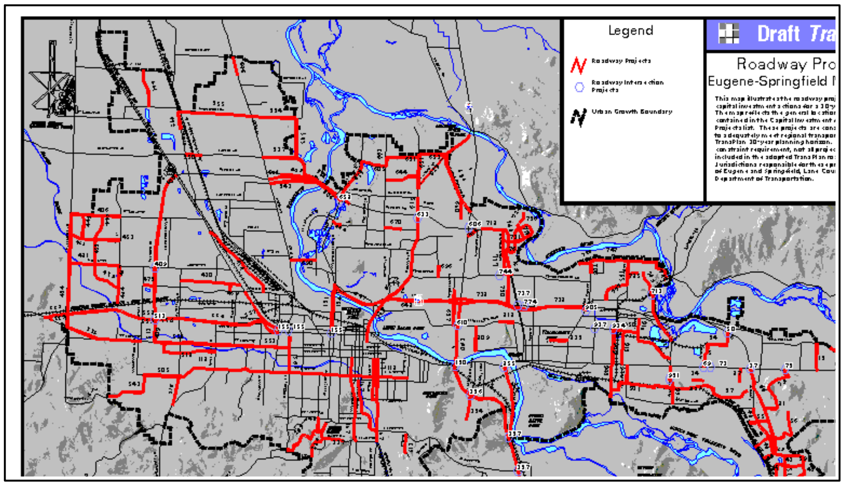
To calculate the future year trip generation the emme/2 model is loaded with future year projections for residential dwellings. This is derived by selecting the vacant land from the GIS land use layer and geocoding each vacant parcel with the projected plan designation. Plan designations are a planner's view of how the metro area will develop at some future point in time and, in the case of residential plan designations, at what density. This "look into the future" is loaded into the emme/2 model to predict what the transportation network loads will look like out to the year 2015.

Transportation Plan Project

The Eugene-Springfield Metropolitan Area Transportation Plan (TransPlan) serves as guide for regional transportation planning within the metro area. The plan predicts where, and when, a variety of regionally agreed-on transportation projects are needed over a 20-year period. As part of the formulation of the TranPlan document, a series of six maps and a variety of analytical work was provided by the GIS group to this project.

One of the key components of TransPlan is a detailed description of the transit, road, intersection and bicycle system improvements that need to occur within the metro area. Transportation planners created a MS Access database containing project identifiers and a detailed description of what each project would accomplish. Missing from this database were the actual project lengths necessary to calculate road project costs. LCOG GIS staff worked with transportation planners to standardize the project numbers within the Access database and applied the same identifiers to the set of street segments (arcs) in the GIS representing individual projects. The GIS then calculated project length and produced a report, which was then used to update the project length field in the Access table. The next step was to create a set of six maps, which not only integrated the Access data, but also used a variety of GIS layers as reference information, including a shaded relief map of the metro area. Figure 4 on the following page is an example of the format, type of map and data used to produce the TransPlan maps.

Figure 4 – TransPlan Roadway Projects Map



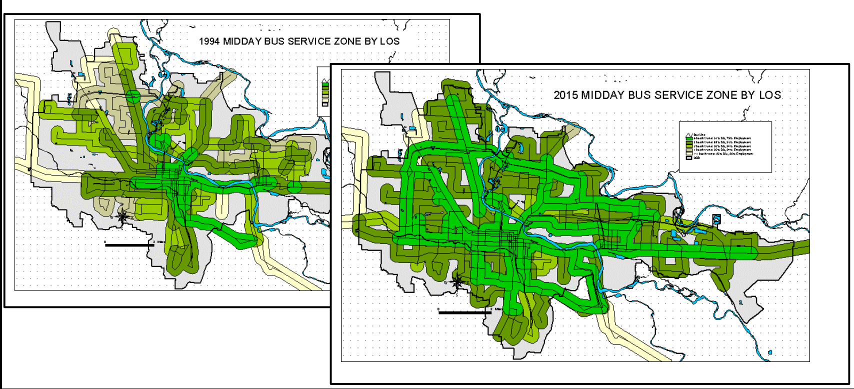
The availability of this information in GIS has allowed transportation planners to produce maps of specific neighborhoods for use in public involvement efforts.

Metro Area Transit Applications

A GIS coverage for bus routes and bus stops was initially created as a means of creating a bus stop inventory map for the Lane Transit District. LTD is also exploring ways to integrate their passenger count data with the bus route and stop data so that passenger volumes can be displayed on a map. In the meantime, LCOG staff have worked through a series of steps to map the level of service that is provided along the LTD bus route system.

To map levels of transit service, LCOG transportation staff created a model in the emme/2 environment that could depict the 1994 transit system and what it would look like in the year 2015. A set of transit lines for the year 1994 and another set of transit lines for the year 2015 were created from the model output. This data was translated into Arc/Info coverages and quarter mile buffers were generated for each transit route for the two scenarios. Each buffer was used to select the residential dwelling units and employment sites to calculate how well the transit route served households and businesses within a quarter mile. Map output from this information is shown in figure 5.

Figure 5 – 1994 and 2015 Midday Level of Service (LOS) maps



Proposed LTD Service Boundary Expansion

The Lane Transit District began providing bus service to the Cities of Creswell and Cottage Grove which are located south of the Eugene-Springfield area and also south of LTD's service boundary. City officials in Creswell and Cottage Grove, and LTD staff, needed to know the impact of imposing a six- percent payroll tax on all employers that fell within a 2.5 mile buffer within the proposed service area expansion. The GIS was used to generate such a buffer, which was then used to select all employers from the 1994 employment file. The employment file contained total payroll for each employer which was summarized for the 2.5 mile buffer, for the city limits, the city UGB's and the north and south half of the buffer area. These numbers were then used to generate the total payroll tax by the various areas within the 2.5 mile buffer.

There are numerous other examples of how the regional GIS is used as a tool for transportation planning within the region. An interesting observation is that transportation planning was not an initial purpose for building and maintaining the GIS in Lane County.

PARTNERSHIPS - A KEY TO GIS SUCCESS

Much has changed over the 30-year history of providing GIS services within the region. What started out as an "experiment" with GIS has now evolved as a standard way of doing business. Over this period just about everything involving GIS has changed. Technological changes have been incredible. People working on the project have come and gone, funding sources have been altered and data capture methods have evolved.

But two constant factors stick out as key elements responsible for the success of GIS in the region:

- The focus has remained on the data. Data created 30 years ago is still in use today. This is not a bad investment when you can amortize the cost of collecting data, which is a huge cost, over a 30-50 year period.
- Early on, the partners constructed organizational frameworks to keep the lines of communication open, provide a forum for solving GIS problems and allowing partners to get information on shared efforts.

GIS Nirvana

GIS projects rarely work in a perfect environment. GIS projects must compete against other disciplines for limited resources, which are allocated in a political arena. A vision for the perfect GIS environment would include the following concepts:

- There is unlimited funding available for GIS projects
- Everyone cooperates to the highest degree possible
- Perfect data has been created and is available to all users
- Any product can be created - immediately
- GIS projects have the most capable staff
- GIS projects have the most current technology - and it works
- Policy makers believe GIS is indispensable.

Our region has not yet reached a state of GIS Nirvana. But a series of "successes" during each of the GIS project phases mentioned earlier has led to a continued growth of GIS in the region.

First Generation Successes: 1968 - 1982

The initial start-up phase of any GIS project can be risky. This was especially true in the late 1960's when our region embarked on this "GIS Experiment." What turned out to be key elements to keeping the GIS afloat then are true today for any GIS project just getting underway. For our region these successes included:

1. Early Project Champions

   These are the people who see GIS has an important way of doing business and are in a position to dedicate both staff and fiscal resources to making the GIS a reality. Without these folks, GIS can not gain a foothold.

2. Access to "unlimited" computing power

   The regional partners had the foresight to provide equal access to the mainframe computing resources for the various regional projects; GIS included. Without this commitment GIS would have been left begging at the door.

3. Data was removed from the political arena

   Once the initial databases and GIS coverages were built and verified, planners in the region were able to focus on the policy decisions surrounding the data; rather than spend long hours arguing over whether the data was accurate or not. GIS proved to be a great tool for focusing discussion away from the data accuracy and more toward substantive policy issues.

4. Initial products could be produced

   Even before all of the first phase work was completed the GIS was turning out products. These included simple maps, tabular reports and mailing labels. Producing a product gave the policy makers confidence that GIS could really have a return on their investment.

5. Long-term funding was secured

   Our region established a Cooperative Project Agreement (CPA) in 1975, which has been renewed each year since. The CPA provides a detailed budget and work plan for the shared GIS tasks that will occur during the fiscal year. Quarterly progress reports are provided to the partners and each agency has opportunity to provide input to the work plan and make "course corrections" numerous times during the fiscal year.

Continued Successes: 1982 - 1998

As mentioned, in 1982 a major shift in technology and the distribution of the user base created numerous changes in the way the partners approached GIS. These "growing pains" were overcome by several additional key factors that kept the GIS moving forward.

1. The financial and user base was broadened.

   The utility partners were brought into the GIS project along with the public safety agencies. The utility folks brought additional, and more stable, funding sources; and public safety folks began building applications that depended on GIS. This, in effect, started a move to institutionalize the use of GIS in the region.

2. Partners recognized that data is a corporate asset.

   Just as public works agencies realize that a bulldozer or road grader is an asset, so too did the GIS partners realize at this time that they had a huge investment in GIS technology, data and staff that should be protected through long-range GIS planning efforts.

3. Partners committed individual resources to the overall GIS project.

   The success of any agency's GIS project is directly proportional to the number of GIS staff they have on hand. During this period a substantial growth in GIS personnel occurred within virtually each agency. Those departments that failed to "hire-up" were left lagging behind in their use of the GIS technology.

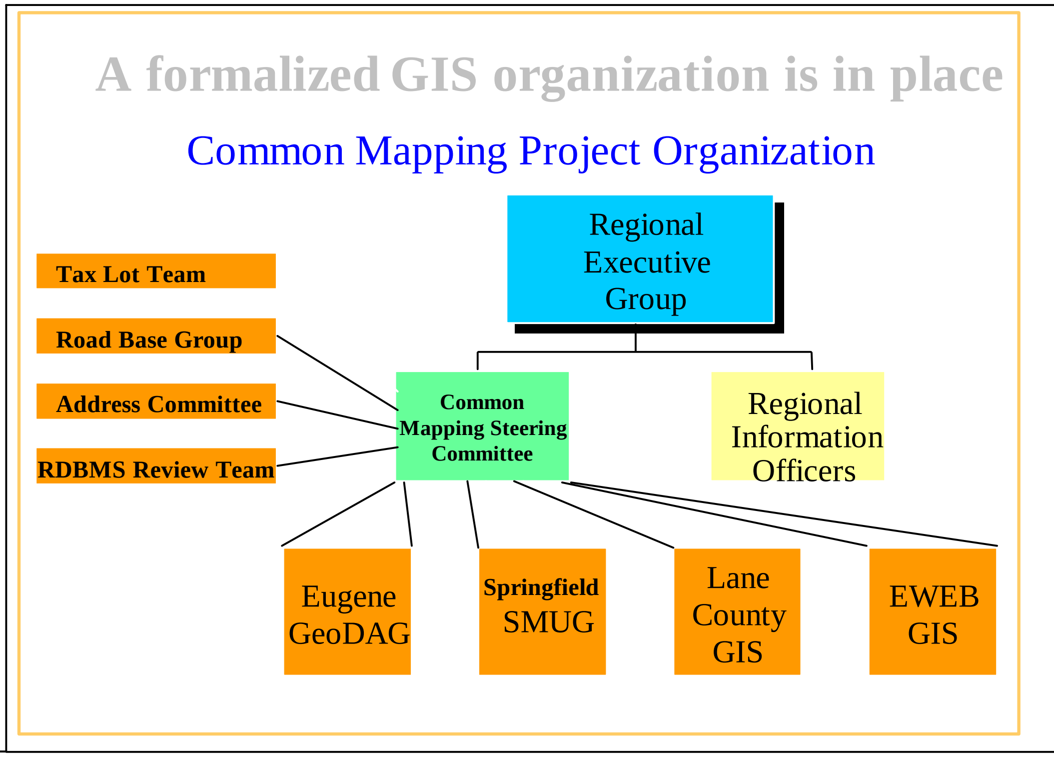
4. More extensive products became available

   The GIS began to offer more functionality and became a tool to provide a higher level of analysis to a wider variety of projects.

5. A formalized GIS organizational structure was adopted.

   Figure 7 depicts the current organizational structure within the region. This diagram is shown here only to illustrate that GIS is part of a regional forum that extends to the chief executive officers of each partner agency. The City Manager from each city, the County Administrator, the EWEB and LCOG directors serve on the Regional Executive Group (REG) whose purpose is to provide policy-level direction on how the shared computing resources within the region will be maintained. Not the least of those resources is the GIS. Another key point about the organizational structure is that each agency has an internal committee that meets to discuss their own GIS issues. This information is brought back to the regional Common Mapping Steering Committee (CMSC) which serves as the oversight committee for GIS in the region and makes recommendations to the REG. And finally, the CMSC directs the formation of special tasks groups and subcommittees to work on special GIS issues. The regional ethic is that once these committees have completed their mission, they are disbanded in order to avoid falling into a rut of having a meeting with no real purpose.

Figure 7 – Regional GIS Organizational Chart



CONCLUSION

Today, the challenge is to hold on to the sense of purpose that caused our region to form a GIS partnership in the first place. With the advent of cheap computing power, the growth of inexpensive desktop GIS software and the ever-evolving distributed nature of the GIS data; partners are left wondering why they must continue as a partner in a large project. The regional GIS project has certainly had its share of detractors and renegades over the last 30 years. We have not seen the end to some agencies questioning why they should participate in a shared venture when they can provide GIS services to their organization quicker by going it alone.

As a partnership we are still promoting that "glue" which serves as reason for holding us together. That glue today includes:

- The need to develop, maintain and share common data
- We must plan together in order to reduce redundant data collection and maintenance practices. This requires a team effort.
- Shared application development can reduce individual agency costs.
- Marketing GIS products has great financial potential and can be done more efficiently as a group rather then as individuals. And the result will be better service to the partners, to other levels of government and to the public.

Additional work is being done to make GIS-T more useful within our region. This includes:

- Creating better integration with GIS and the modeling processes. An example of this would be performing the network editing in Arc/Info and passing the results automatically back to the emme/2 modeling software.
- Expanding the transportation model to cover a greater area beyond the Eugene-Springfield MPO to include the surrounding small cities.
- Create and maintain an integrated, multi-modal GIS-T which would include:
    - road geometry – lane, turns, direction of travel
    - pavement type and condition
    - traffic counts
    - bus stops and bus routes
    - sidewalks
    - bicycle routes for on and off-street paths
    - planned improvements on all systems

  This data currently exists in a variety of electronic forms and by pulling it together in a GIS-T environment it can be used to :
    - identify and track transportation-related issues
    - develop multi-modal solutions
    - track the implementation of proposed solutions

GIS-T is a powerful tool and its application has evolved in Lane County to become an integrated part of the region's transportation planning efforts. Today, essential inputs to the network model are organized and processed by GIS. Moreover, GIS-T serves, through mapping and data organization, as a tool to create outputs useful for informing the public about transportation issues. The GIS-T provides a graphic framework that creates relevancy in the public decision-making process for the regional transportation system.