

# Spatial Informatics: The Key to Regional Economic Development

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## ABSTRACT

One of the greatest challenges to local economic development is to assess and analyze a wide array of economic data, usually gleaned from wildly disparate sources, which manifest various levels of spatial autocorrelation. Indeed, some studies purport that over ninety percent of all decisions are controlled by some spatial aspect (distance, direction, location, spatial decay functions or temporal decay functions). Even when economic data is distilled to easily understood indices, trying to analyze the spatial variance of the data is usually beyond the abilities of the local end user yet this geographic criterion plays a significant role in the process of successful decision making.

There is a need at the municipal, county, and state level to develop an informatics infrastructure that allows seamless data translation at multiple spatial and temporal scales. In addition, a central repository of regional economic and allied data should be available that can be analyzed in both terms of econometrics and spatial attributes and provided to local entities to aid in the decision making process. Such data is usually exceptionally dense and, in many cases, ephemeral in nature requiring rapid updating and re-analysis. It is the intent of this paper to explore the use of Geo-Information Science (GIS) coupled with econometrics to aid in the analysis and visualization of complex economic-spatial relationships. Further, we will provide examples of how this synergy is utilized in education, regional planning, economic development and occupational skills training to achieve very different ends, but employs the same theoretical foundations.

**Keywords:** Spatial Science; Informatics; Regional Planning; Economic Development; Education; Training

## INTRODUCTION

As more organizations, municipalities, and other types of agencies seek new and creative ways to manage their budget amidst a fiscal crisis, many are turning toward spatial informatics, namely Geo-Information Science (GIS), to aid in the analysis, visualization and forecasting of complex spatial relationships.

Spatial Informatics is a generally accepted term that implies integration of scientific, economic, and socio-cultural concerns with GIS planning and analytical tools. In the context of this paper the GIS acronym itself stands for both Geo-Information Science or Geographic Information Systems, which are defined the same in many instances. The following quotes offer various definitions of GIS:

1) *"In the strictest sense, a GIS is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e. data identified according to their locations. Practitioners also regard the total GIS as including operating personnel and the data that go into the system."* [1]

2) *"A geographic information system (GIS) is a computer-based tool for mapping and analyzing things that exist and events that happen on earth. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps."*[2]

3) *"GIS is an integrated system of computer hardware, software, and trained personnel linking topographic, demographic, utility, facility, image and other resource data that is geographically referenced."*[3]

In essence, GIS is a rapidly growing technological field that incorporates graphical features with tabular data in order to assess real-world problems. The reach of GIS expands into all disciplines and has been used for such widely ranged problems as prioritizing sensitive species habitat to determining optimal real estate locations for new businesses [4].

Instrumental to this technology is the key word "Geography", implying a spatial component or proportion to the associated data that is in some way referenced to locations on the earth. Integrated alongside this geo-references data, lies attribute or tabular data. Attribute data generally provides additional information about each of the features tied to spatial or geo-referenced data. A widely used example of this would be schools. The spatial data is the actual location of the school. The attribute data provides the additional information about the spatial data. In this case, the number of students attending the school, primary language of instruction, school name, and level of education are some of the possibilities. The effectiveness of

this tool as an exceptional decision-making and problem solving aid is in the ability to access and query the spatial and attribute data simultaneously [4].

GIS operates on many levels and at a variety of scales, although it employs the same theoretical foundations. On the most basic level, GIS is used as an electronic mapping tool (i.e. computer cartography). At the other end of the scale, and perhaps its greatest application, is through using spatial and statistical methods to analyze attribute and geographic information. These types of analysis can yield a variety of results such as “derivative information, interpolated information or prioritized information” [4].

There are countless applications of GIS but the scope of this paper is to explore the functionality in terms of regional economic development. Three case studies will be explored in which GIS was utilized in an endeavor to create more cohesive and economically effective planning and development initiatives. Conclusions are then drawn based not on the individual cases, rather on what can be learned and applied from their efforts.

## CASE STUDIES

The three case studies that will explore uses of GIS include a workforce training program, a municipal economic development plan, a community emergency response effort, and finally a discussion on how these initiatives have furthered a regional economic development plan in a traditionally parochial area.

### Contextual Background

There is a need at almost every municipal, county and state level around the globe to develop an informatics infrastructure that will allow seamless data translation at multiple spatial and temporal scales. The case of the North Shore, Massachusetts is no different and suffers from an historical lack of cooperation and coordination between and among the various political levels. The North Shore is not a political boundary per se as it extends through various counties immediately north of Boston, incorporating 34 cities and towns. Rather, it is a geographic area that has long needed a clear and strong voice for the economic development of the region. In fact, in 2008 a call was put forth to hire an outside consultant to summarize “their understanding of the economic development issues facing the North Shore and the problems/opportunities to be addressed”. GIS was found to be a key solution to successful regional economic development.

#### 1) CAMEO

One of the most prevalent and important uses of applied spatial informatics is planning for and managing emergency operations. To that end, a commonly used GIS is CAMEO (Computer-Aided Management of Emergency Operations) which is designed primarily for responding to chemical emergencies. This GIS is actually comprised of three software programs: CAMEO which is a chemical database; MARPLOT which is the cartographic program; and ALOHA which is the

spatial modeling engine. The programs were designed by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) and can be freely downloaded from the CAMEO website. The primary users of CAMEO are First Responders including fire and police departments, emergency response personnel, primary and secondary industries, and retail outlets among others. Indeed CAMEO is specifically designed to meet the requirements of the Emergency Planning and Community Right-to-Know Act (EPCRA).

Ideally, every fire department within the US should have CAMEO installed and have information about chemical hazards (reported to them, their states, and the Federal EPA annually by the entities that manufacture, transport and/or use the chemicals) within their community populated in the CAMEO database. Should a chemical hazard incident occur emergency response personnel can engage the CAMEO system to determine the type of chemical threat and model the chemical release footprint thus allowing for the proper emergency response implementation (evacuation, shelter in place, etc. etc.). Additionally, and of equal importance in reacting to a chemical hazard event is planning a response to them. CAMEO has been developed so that emergency response personnel and other community officials can run an endless number of scenarios to prepare necessary resources in case of a chemical accident.

Unfortunately, at a community level, installing and maintaining CAMEO can become difficult with the ever tightening municipal budgets. However, on the North Shore of Massachusetts a program has been initiated between municipalities and Salem State College where as part of a GIS course students install and implement the CAMEO system for fire departments. While still in its infancy the program has integrated CAMEO into five municipalities and students are working within the North Shore to develop a CAMEO regional response capability employing spatial informatics. Such a program produces a mutually beneficial outcome as students are gaining necessary system analysis and implementation skills and CAMEO systems are being populated throughout the North Shore. Perhaps of equal importance is as students work with First Responders and municipal leaders they become more invested within the community thereby creating an anchor point to stay within the region as viable contributors to its economy and culture. Additionally, as the number of municipalities maintaining CAMEO increases the spatial information derived from EPCRA required data allows for more efficient municipal, environmental, and economic planning. Indeed, in better managing chemical hazards a region can minimize the economic impact of an event through rapid and effective response.

#### 2) Workforce Training and Education

As more municipalities are utilizing GIS to analyze everything from zoning, infrastructure, and taxation to open areas for green space, recreation and water resources, they are finding a lack of skilled people to employ. If regions are looking to use GIS they also must offer the appropriate level of training in some capacity. There are graduate degrees in GIS, undergraduate offerings, and at some high schools an introductory course or two may be offered. However, there is a large disconnect of training at the technician level where a gap exists in programs

and relatively low numbers of students are enrolled in degree granting GIS programs because of a lack of understanding what exactly it entails. Many more jobs are posted in any given area than there are qualified people. Some specific areas requiring GIS training with local jobs currently posted include: Agriculture; Biotechnology; Education Research; Financial Services; Groundwater; Health Care; Insurance; Local Government; Manufacturing; Media; Natural Resource Management; Software; Utilities. These jobs offer employment as a GIS Technician; Specialist; Analyst; Analyst/Programmer; Coordinator; and Technical Marketing Analyst.

There are countless opportunities for people with GIS training as it can be applied to virtually any industry and in any context. For example, along with nanotechnology and biotechnology, Career Voyages has named geospatial technology one of the three emerging industries. Career Voyages is a collaborative effort between the U.S. Department of Labor and the U.S. Department of Education with the focus of providing information and resources about different career paths. Additional areas include: Geographic Information Systems (GIS), Global Positioning Systems (GPS), Photogrammetry, Remote Sensing, Image Processing, Computer Science and Related Technologies and Sciences.

A recently established ARRA funded initiative is seeking to re-train individuals around the North Shore, Massachusetts with GIS skills in order to have a more diverse workforce. The hopes are not only to provide more employment opportunities to those individuals, but more broadly, it will also provide an increase in the skilled labor force which could translate into more economic development opportunities for the region by wooing companies that require these skills.

### **3) Analyzing a City's Economic Development Potential**

A report was recently prepared for the City of Salem's Economic Development Committee in an effort to synthesize information from recent studies and highlight current ongoing efforts of the City of Salem. The aim was to maximize the City of Salem's economic development potential and provide recommendations for future directions. Various GIS software were utilized to explore best practices, benchmarks and lessons learned from a comparative analysis of successful like-communities with the intent to provide suggestions and recommendations and serve as a basis for formulating a strategy to capitalize on the identified opportunities.

Using zoomprospector.com, a tool that employs GIS to analyze communities and economic development, a like-community comparison was performed against Salem. Criteria of similar characteristics included population size and composition, education levels, commute time, household income and many others. Possible matches included all cities and town in the USA, and revealed a list of like-communities in terms of demographics and potential for growth, and in particular, those seen as successful based on specific economic criteria such as revenue growth. Comparison locations were then filtered based on similarities in climate, since comparing successful communities from warm locations would have competitive advantage based on opportunities that may not be available in a colder climactic region. As such, three successful locations and one less successful, but similar in demographic profile to Salem, were compared and analyzed.

The second phase took data from a variety of separate studies and plans that had been created and implemented for geographically separate areas within the city of Salem. While it is certainly an advantage to having an in-depth analysis of any economic sector, it was found to be counterproductive to have a development plan for one area in isolation from its surroundings. An insular approach to economic development, both within municipal boundaries and extended beyond to a wider region, is ineffective and unrealistic. Development rarely is confined by cities boundaries unless the permitting, zoning, and taxation are extremely different "over the line". Thus, in the same city there must be a cohesive plan that takes into consideration all potential areas, areas of growth and areas in decline, to achieve a healthy economy and happy residents.

Bringing together the Open Space and Recreation Plan, Winter Island Study, Salem Harbor Plan, Downtown Revitalization Plan Housing and Community Development Block Plan, may sound like an onerous task, but using GIS as a visualization tool provides as a starting point in a city-wide economic development plan. It allows a visual representation of barriers as well as possibilities for joint efforts to create better linkages.

GIS was also used to collaborate with private land owners and developers to establish an inventory of properties within the City that may be bought/sold and slated for future development. This directive will also work to build partnerships and align interests between the City, local and regional stakeholders.

Other GIS-related work:

- Developing a database to keep taxation information and the City's competitive position up-to-date. Review the competitive advantages of the City as it relates to a number of variables including taxes, especially for commercial and industrial properties.
- Ensuring that new and existing planning policies support smart growth, a mix of uses, increased densities, and directing growth within the City's existing service shed.
- Continuing to coordinate and obtain infrastructure updates and the maintenance of existing systems such as waste management matters, waste water treatment, water treatment, traffic management, and other areas -and integrate these into the visual plan.
- Increase and encourage capital investment in recreation and leisure facilities, including walking/biking trails, skateboard parks, bike parks, and other recreational areas.

It was determined that the City of Salem does not necessarily need more studies to become successful in their economic development initiatives, rather a plan to collect feedback on a regular basis and produce an annual update, taking the temperature of the community. The results should then be shared with the broader region and re-evaluate efforts annually with the feedback. Use the education and training connections already established in the City. Much of the needed research can be ascertained with a partnership between City departments and the educational/training organizations.

## DISCUSSION

Similar issues surfaced with each case study, with the primary findings highlighting the reliance on spatial correlations to make decisions. Even when social or economic data were distilled to easily understood indices, trying to analyze the spatial variance of the data was found to be usually beyond the abilities of the local end user even though this geographic criterion played a significant role in the process of successful decision making. Training individuals in GIS is a good start but does not enable advanced analytics that are necessary for a region-wide economic success story.

A central repository of regional economic and allied data should be available that can be analyzed in both terms of econometrics and spatial attributes and provided to local entities to aid in the decision making process. A region-wide vision and plan would allow each municipality to retain traditional economic development strategy elements of business retention, expansion and attraction. While at the same time, infrastructure and services could be managed on a regional basis thereby loosening the fiscal noose that many cities and towns are now facing. Indeed, if properly implemented with a rapid response spatial informatics system employing shared data, many of the municipalities would become sufficiently nimble to react to a greater number of Federal grant opportunities available to them individually or as spatially defined sub regions.

After the vision has been established, an in-depth look at recently completed studies of available current relevant socio-economic and demographic information should be integrated to highlight the competitive advantages of the region. Ensuring that existing infrastructures (physical, governmental, virtual, and educational) and cultural nuances (innovation, entrepreneurship, and collaboration) are evaluated, these measures can be mapped using GIS. This Asset Map should then become the basis for future marketing and economic development efforts of the region.

Working together with the various community partners and stakeholders would produce a regionally focused economic development strategy by streamlining their efforts and creating a more unified approach, and perhaps more importantly ensuring regional “buy in”.

The proposed economic development strategy would use spatial informatics to:

- Provide direction – Which potential businesses should be targeted for retention and attraction?
- Set an overall framework – How will they be targeted?
- Build consensus – Everyone is working towards the same stated goals.
- Propose an implementation and action plan – Create tangible action steps, including crucial first steps, goals for each, objectives and implementation suggestions.
- Provide focus– Utilize the various resources as efficiently as possible by focusing them on areas of greatest importance and greatest impact.

It could also be expanded to focus resources on the emerging growth sectors of the economy, to support region-wide initiatives, necessary improvements or enhancements, infrastructure analysis, and the logistics of coordinating a unified program.

## CONCLUSION

While the case studies detailed above are relatively recent it is apparent that spatial informatics holds great promise in helping to maintain the economic viability of a geographic region. The use of spatial informatics to define new economic opportunities through the analysis of place and create efficiencies by effectively defining and managing regions is essential in the current economic environment.

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