RURAL TOWN GEOGRAPHICAL INFORMATION SYSTEMS: ISSUES IN INTEGRATION

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ABSTRACT

Vermont's 1988 Growth Management Act (Act 200) established a geographical information system (GIS) to facilitate land use planning. Since then, 65 of the 254 towns in Vermont (26 percent) have taken advantage of the Vermont GIS services and an additional 81 towns (31 percent) have expressed interest. Heralded as one of the few multi-governmental, multi-organizational Geographical Information Systems in the nation, the Vermont GIS could not have made as significant headway without local and regional support. There have been, however, some complications. Privacy issues, fee schedule directives, budget cuts, and town mistrust of state intentions have made the past two years rich with experience.

This thesis looks at several rural towns in Vermont to see how GIS can be transferred to local governments to facilitate operations, management, and policy functions as delineated in Huxhold's pyramid. It establishes the rural town context, describes the Vermont Office of Geographic Information Services, and follows one rural town's progress as it became the leader in Vermont GIS data coverage. Recommendations include assigning traveling GIS assistance units, in-depth training sessions, and establishing GIS impact fees to help rural towns use GIS as the Office of Geographic Information Services begins the second half of its mission and as rural towns consider developing in-house GIS capacity.

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I know no safe depository of the ultimate powers of society but the people themselves; and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion by education.
-Thomas Jefferson

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I also wish to thank the members of the Capital Projects Board and Don Rich of Randolph, Vermont.

INTRODUCTION

This research focuses on a rural town as it integrates a geographical information system (GIS). I was a technical facilitator hired by the state of Vermont to investigate issues arising in the integration of GIS in Vermont communities. Vermont is implementing a multi-governmental, multi-organizational GIS. The state's efforts to incorporate GIS into rural town planning are numerous. Vermont's Growth Management Act (Act 200), passed in 1988, offered tremendous opportunities for the Regional Planning Commissions to involve rural towns in regional planning activities. Act 200 recommended the establishment of a geographical information system to facilitate and coordinate data usage at all levels of government. Two and one half years after its passage I had the opportunity to observe and participate in a Vermont town as it became the leader of the most complete data coverages in the state. This research provides a glimpse of rural towns in the Vermont GIS context and makes recommendations for how geographical information system users should proceed, as more and more rural towns in Vermont adopt GIS technology.

Chapter One delineates the objectives and expected significance of this research. It investigates various approaches to information and computer use, and whether "geoprocessing" is possible in a rural town, and how geographical information systems (GIS) can be embedded in its management. Huxhold's conceptual information pyramid is introduced and applied to the rural context, as is Dutton and Kraemer's conceptual model.

Chapter Two defines the context of this thesis by examining rural towns and rural town planners. Recent growth in rural areas is slowing, but the rural town is still the predominant form of municipal government in the United

States. Rural towns are woefully understudied and misunderstood, yet they, and the complex issues they are facing with limited staff, are vitally important to America's future. Although computers may involve an additional layer of complexity, this chapter recommends a geographical information system as an essential component of any computer based planning system.

Chapter Three examines the experience of one rural state, Vermont, as it attempts to fulfill a land use planning act and comply with an executive order to facilitate data sharing at the local, regional, state, and federal level by integrating a statewide geographical information system. This chapter provides a brief history of the Vermont Geographical Information System, describes the data layers developed to date, and discusses local resistance concerning data access, pricing, and privacy. The chapter concludes with a brief discussion of GIS integration in six rural Vermont towns.

Chapter Four presents an in-depth examination of Randolph, a rural town in Vermont, and provides a detailed investigation of integration issues and possibilities there. The chapter analyzes an attempt to integrate a GIS for use by a Randolph municipal board and discusses one-on-one training sessions with the town zoning administrator. It also discusses data coverages useful to rural areas.

Chapter Five reviews the previous chapters and reflects on whether in-house GIS makes sense for rural towns; what the relationship is of sophisticated data integration to town management and, if significant, what the likelihood is of fiscal and personnel resources being available; and what role the state and the regions should play. The chapter concludes with recommendations based on my experience in the town of Randolph.

CHAPTER ONE

RESEARCH METHODOLOGY

Chapter One delineates the objectives and expected significance of this research. It investigates various approaches to information and computer use, whether "geoprocessing" is possible in a rural town,* and how geographical information systems (GIS) can be embedded in its management. Huxhold's conceptual information pyramid is introduced and applied to the rural context, as are Dutton and Kraemer's conceptual model.

THESIS OBJECTIVE

The original objectives of this research were threefold: (1) to investigate applications of a geographical information system for automation and strategic use by a rural town community board; (2) to investigate the value of the impact of information and the extent to which the GIS reduces time required to perform routine operations in rural planning; and more broadly, (3) to make recommendations that encourage the use and maintenance of the GIS for rural community board meetings, town management, and planning. Detailed applications in a Vermont town were made to support the first two objectives and, in the end, provide insights for the third.

* For the purposes of this research I assume the US Census Bureau definition of rural as any county without a city greater than 50,000 inhabitants. I determine any town in such a county to be rural.

Research Method

The research was structured to include several steps: (1) review literature on rural towns and rural town GIS applications; (2) select a rural town (Randolph, Vermont) as a typical Vermont town; (3) select a municipal board (Randolph Capital Projects Board) as an example of a typical citizen board; (4) conduct technical facilitation and act as town staff through the board's decision-making process; (5) analyze field observations and make recommendations to Randolph and the state of Vermont.

The research was designed not only to observe a community at work, but to actively participate with municipal practitioners within that community. This type of methodology offered extraordinary learning opportunities and unique perspectives that should help to encourage a sustainable integration of a geographical information system. Throughout the research period, I sought to be sensitive to local concerns, work pace, and protocol. The study assumed the citizens (e.g. town staff, board members) to be of paramount importance, for it is they who will utilize, maintain, and sustain a geographical information system.

The research methodology emphasized tapping all resources available within the community, be they books, manuals, or people. A detailed schedule of research intervention can be found in Appendix A. It was extremely useful and important for me to participate in municipal activities other than board meetings. I learned an enormous amount by spending a day in the municipal hall with town officials. I attempted, to the greatest extent possible, to make myself available to the town. To insure project sustainability, the methodology required that I develop a counterpart relationship with the town planner to nurture a 'project champion.' I hoped this research would leave behind something greater and more dynamic than a static report.

SIGNIFICANCE

This section identifies the intention of my research to bridge three approaches to technically rigorous methodologies demanded by the Department of Urban Studies and Planning at the Massachusetts Institute of Technology.

My research took me from the technically rigorous methodologies demanded by MIT to the methods that are relevant to rural town planning practice. There is a gap in the academic perspective and the demands of real world practice. I attempt to integrate three approaches to "technical rigor" represented within the Department of Urban Studies and Planning by: 1) GIS technocrats, who develop the systems and encourage its use; 2) practicing planners, experts in rural community growth and land use planning; 3) organizational theorists, who are interested in organizational learning and systemic thinking. I hoped a case study would allow me to bring these approaches together to scrutinize what happens when the supposed hard analytical science of this department is applied to the soft intuitive thinking of practitioners in the field.

Dr. Donald A. Schön, Head of the MIT Department of Urban Studies and Planning and author of *The Reflective Practitioner*, stresses the importance of research functioning not as a distraction to practice, but as a development of it. However, the practicing world is different than the professional schools. Although the practitioner traditionally provides the researcher with cases to analyze there is a "complexity, instability, and uncertainty" of the real world that cannot be removed by applying scientific analysis. Schön cites the limitations of Technical Rationality, an epistemology that contends "professional activity consists in instrumental problem solving made rigorous by the application of scientific theory, " and searches for an alternative epistemology of practices that would merge the convergent analytical science of Technical Rationality with the "divergent thinking skills" found in professional practice. Schön introduces 'reflection-in-action,'

> ... the study of reflection-in-action is critically important. The dilemma of rigor or relevance may be dissolved if we can develop an epistemology of practice which places technical problem solving within a broader

> context of reflective inquiry, shows how reflection-in-action may be rigorous in its own right, and links the art of practice in uncertainty and uniqueness to the scientist's art of research. We may thereby increase the legitimacy of reflection-in-action and encourage its broader, deeper, and more rigorous use (Schön 1983).

The challenge for me, as a researcher representing a professional school and introducing the rigor of information technology, was to build maps and perform analysis with geographical information systems that are replicable and additional to the "mental images" Kevin Lynch refers to in *The Image of the City*. Tony Hiss refers to Lynch and writes that "the 'mental maps' of our home towns, which we all carry around with us, have a lot more precision and detail if we live in places that offer us richly detailed and well-defined experiences (Hiss 1990)." It is a challenge for GIS practitioners to encourage planners to use available tools that enable better planning, better understanding of place, and better living. My challenge was to use computers to encourage rural dwellers to visualize their world from a different perspective, without challenging their experience of place. To quote Lynch, "Every citizen has had long associations with some part of his [town], and his image is soaked in memories and meanings (Lynch 1960)." I do not wish to change his image, only to enhance it. When one works in or observes a rural town, one sees not only professional practitioners carrying on business in offices, but citizens conducting business after hours in the town hall or basements of municipal buildings. This research attempts to strengthen citizen-practitioners, counter professionalism, and foster local self-sufficiency. It is an attempt to establish spatial analysis tools and spatial analysis specialists in communities that have yet to word process or manage digital databases.

DEFINITION OF GEOGRAPHICAL INFORMATION SYSTEMS

Geographical Information Systems is a new information technology capable of multiple applications beneficial to local, regional, and state management. GIS is a set of hardware and software designed to collect, store, query and analyze spatially referenced data. Yet GIS is becoming far more than the hardware and software, it involves organizational change and personnel to use and maintain it. As geography itself is a common reference used by virtually every activity in local government, numerous operations in rural town government would benefit from GIS, (Huxhold 1991). The following list offers an extensive array of potential GIS applications useful to local government (PlanGraphics, Inc. 1989):

Table One: Potential GIS Applications

Natural Resources
Timber Stand Management
Land Cover Mapping
Water Discharge Tracking
Hazardous/Solid Waste Planning
Wetland Mapping
Sensitive Natural Resource Mapping
Flood Plain Mapping
Groundwater Modeling Support
Environmental Impact Analysis Support
Air Discharge Tracking
Water Well Drilling Inventory/Mapping
Soil Erosion Prediction
Continuing Forest Inventory
Wellhead Protection Area Mapping
Geologic Mapping

Land Use Planning/Zoning
Zoning Map Production
Land Use Map Production
Demographic Analysis
Historic/Archaeological Site Mapping
Rezoning Evaluations
Permit/Development Tracking
Support for Redistricting
Support for Comprehensive Planning
Support for Public Lands Acquisition

Public Works and Transportation
Special Road System Map Production
Pavement Management
Plat/Site Plan Review
Right-of Way Management
Traffic Volume/Accident Analysis
Route Analysis
Traffic Facilities Inventory and Mapping
Work Order Management
Support for Transportation Modeling
Route Log Maintenance

Parcel Mapping/Property Appraisal
Tax Neighborhood Analysis
Ownership Searches/Query
Identifying Parcels in Current Use
Property Map Update/Production
Field Appraisal Support
Special Property Map Production
Scheduling and Routing Appraisals

Water/Sewer Utilities
Mapping/Tracking Well and Septic Locations
Water/Sewer Map Update/Production
Support for Water Supply Permit Review
Pressure Analysis
Leak Tracking
Water Systems Isolation Identification
Work Order Management

Mining
Permit Preparation
Mapping Sand/Gravel Pits and Rock Quarries
Exploration Tracking
Property Rights Tracking
Mining Resource Mapping

Emergency Service
Support for Dispatch
Incident Mapping
Evacuation Planning
Contaminant Tracking

GIS is multidisciplinary and like the various disciplines in rural planning:

> all these disciplines are attempting the same sort of operation—namely to develop a powerful set of tools for collecting, sorting, retrieving at will, transforming, and displaying spatial data from the real world for a particular set of purposes (Burrough 1986).

GIS combines computer technology, cartography, and mathematical analysis to produce interactive electronic spatial topology and relational database managers. "GIS promises to transform cartography by changing what gets mapped, what form maps take, who makes and uses maps, and how maps are used (Muehrcke 1989)." GIS is a rapidly growing field, and GIS related hardware, software, and service sales growth have been projected to increase by thirty-five to forty percent in the 1990s ($590 million by 1994). In light of this growth, Huxhold predicted the emergence of a GIS profession (Huxhold 1991).

APPROACHES TO INFORMATION TECHNOLOGY AND USE

This section introduces various approaches to information technology and use and suggests some alternatives for a rural state.

GIS Technocrats

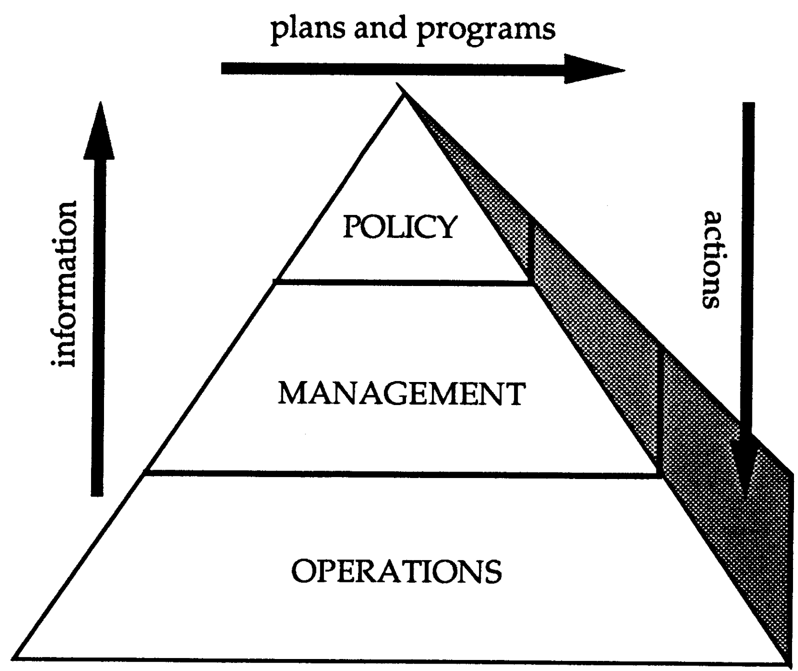
For GIS technocrats this research provided a rural town perspective not typically considered. Little can be found concerning rural town applications in GIS literature. State-wide geographical information systems have been developed without towns specifically in mind, but the focus has now changed; without local applications many statewide GISs have little hope of sustaining legislative support. Technology and automation are fine, but how, if at all, do GIS advocates propose for rural communities to use information technology? Many rural towns do not own computers, do not use spreadsheet or database manager applications, and do not have a professional planner. Technical training and competence are not mandatory for rural town practitioners. Developing technical competence in the practitioners who make decisions that affect the character and future form of America is a gargantuan task. What cost will the state incur if rural towns do not want or are unable to use

GIS? Who will do spatial analysis for them, and how will local information be aggregated for regional and state use? The field is far too new to determine if developing in-house GIS capacity in small places will be more cost-effective than relying on regional planning commissions, state agencies, or consultant services.

Huxhold's Typology

Huxhold's typology is of particular relevance to this thesis (Huxhold 1991). As illustrated in Figure 1, Huxhold's *Urban Information Pyramid* differentiates three functional uses of information in municipalities. **Operations** require the detailed information necessary for municipalities to provide services, such as sewer and water billing, tax billing, dog licence and zoning permit issuance. The operations function acts on the policy established at a higher level.

Figure 1



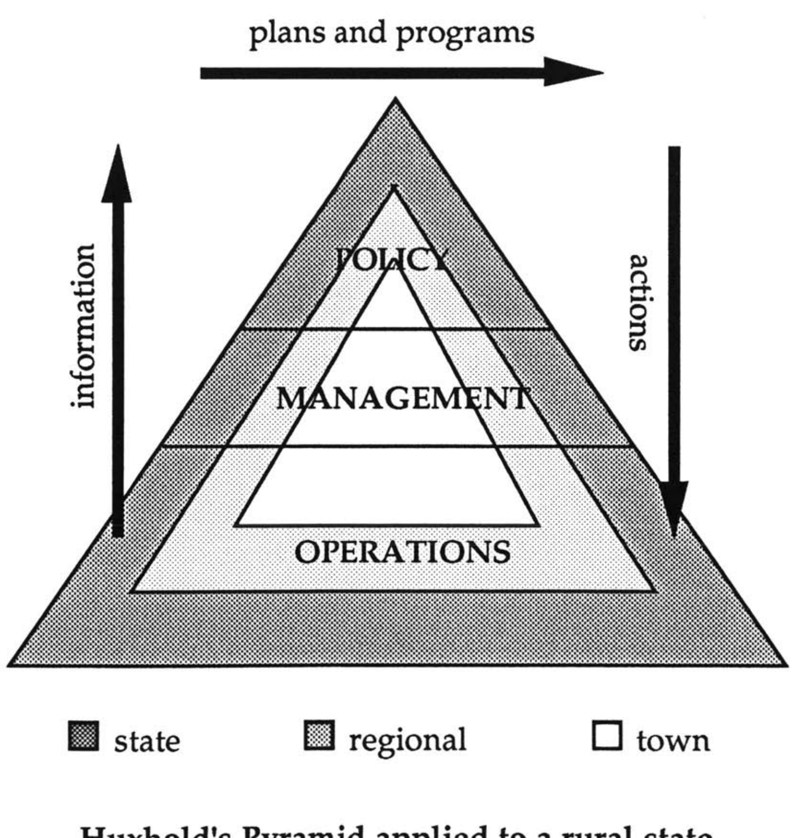
Huxhold's Municipal Information Pyramid

Management requires the base availability and analysis of operations data; management functions help towns control municipal resources by calculating budgets necessary for departments to carry out their day to day mission, such as infrastructure maintenance, service provision and fee assessment, and zoning studies. The management function demands policy decisions. **Policy** functions are at the peak of the pyramid. Policy is established for approving budgets, enacting laws and legislation, long range planning, and analysis of community and/or regional growth and its impacts. Information systems should be considered successful when information flows and is integrated within all three function levels. Information systems are ineffective when information does not flow easily among all functions.

Alternative Typologies

Although Huxhold had in mind urban geographical information systems, it is relatively straight forward to apply his conceptual pyramid to a rural context.

Figure 2

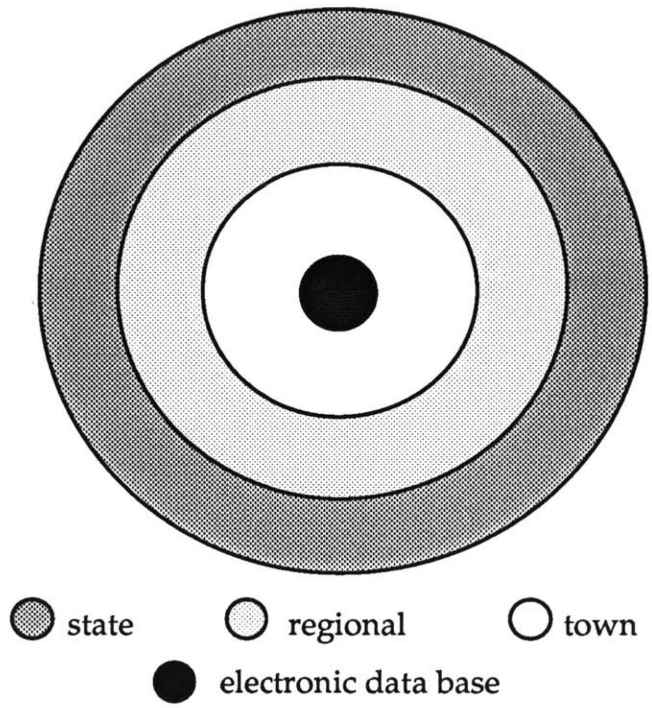


Huxhold's Pyramid applied to a rural state

His concept can be applied to rural municipalities, since policy is set at town meeting or council meetings and managers typically implement the policy while administrative assistants or staff conduct operations functions. Figure 2 illustrates my alternative conceptual diagram of information flows in an entire state. As applied to the entire state, it is important that *each* level of government, state, regional, and local, has a share in *each* function delineated in Huxhold's typology. For this research the Information Pyramid will be analyzed for information flows within an entire state. The hierarchy is often challenged by independent towns who are not willing to cooperate with state policy directives, particularly by GIS authorities who have limited power, or when policy set at the town conflicts with that of the state. State GIS offices can be seen as the policy head needing aggregate analysis based on operational information collected from actions performed at the local level. State GIS offices rely on management functions performed in-house or at regional authorities to establish the state policies. Statewide GIS initiatives are dependent on operational information maintenance. The GIS would be rendered useless if operational information were inaccessible.

Figure 3 illustrates Zuboff's conceptual diagram, similar in nature to Huxhold's: Users that rely on daily information will be closest to the database; those that need aggregate data will be located in a concentric circle farther away. Although this model might prove easier for towns already wary of the hierarchical structure of state and regional authority to accept, it magnifies the problem of towns, which are closest, to a cadastral database for example, being relegated to the operations of updating the data and not policy functions.

Figure 3



Operational Data Use based on Zuboff

Planning Academics

I sought to convince planning academics wary of sophisticated technology that GIS can provide tools to generate community participation, enthusiasm, and broad based planning. In the planning literature, little can be found concerning rural GIS applications. GIS is new, different, and excites even the casual observer. The novelty and excitement adds a dimension to planning that may instigate broad based participation in community growth planning that probably would not happen without the system.

Using GIS as a tool, I was interested in automating operational tasks and aiding analyses that support policy functions. Maps are an obvious product of geographical analysis systems, yet given low cost plotters and limited cartographic experience, the challenge for many rural planners will be to produce paper maps of equal, if not better, quality than those already in use, and to increase in-house map making capacity and reduce map contracting costs. Where maps are not in active use, I hope a GIS will stimulate increased spatial awareness and provide alternative perspectives that enhance the mental maps and make explicit the assumptions held by the legislative bodies and town staff.

To what extent are communities prepared to set policy based on computer generated analysis? Looking closely at Huxhold's conceptual structure one might ask whether rural communities can expect to contribute or indeed compete with state policy functions. I fear state policy analysts see GIS as an operational tool for rural municipalities, useful for automating map production. They do not expect local municipalities to use aggregate operational data to support policy analysis. It is easy to see GIS as a map maker, but policy setting is another realm not typically considered to be a rural town function by the region or the state.

There is an inherent danger in the assumptions of this thesis. The author is a true grass roots GIS aficionado. It was easy to assume that information technology had an obvious niche in rural planning. With that said, there is a certain magic in the inchoate process that occurs at community board meetings. Decisions are seemingly anachronistic: line graphs are produced by hand, zoning permit application maps are drawn by hand, and water consumption is calculated by hand. It is different, it is not urban. Yet, to the amazement of the technically sophisticated practitioner, the final decision is often rational; even without political or technical rationale. In sum, rural communities that have not experienced rapid growth may not need the technology to make good decisions.

Dutton and Kraemer present several perspectives of computer models, in *Modeling as Negotiation,* that should be kept in mind while examining GIS in Vermont. The **rational perspective** views models as "scientific aids to policy." Policy is set from a rational sequence: defining the problem, gathering information, and making a decision. Although technical experts play a strong role in the rational perspective and are given considerable leeway in establishing standards, the technocrat will not determine decisions. Incorporation of the model in the daily work of the organization is deemed crucial to this perspective for continued model-based analysis. The **technocratic perspective** views modeling as the domain of information technocrats. This perspective determines that models are far too complex for anybody but the technocrat to use, and if a legislator or body public wishes to use the model it must seek the elite few who are able. The **partisan perspective** contends that models are for propaganda purposes only and are not to be used if they do not support the proponents interest. Dutton and Kraemer then present the **consensual perspective** of models; models are to be used in policy functions for "negotiation, bargaining and interactive decision making." Modelers, not under the direction of any politicians, take into account all parties' "mental images", their desired outcome, and their criteria used to evaluate these outcomes (Dutton 1985).

Britton Harris wrote in the American Planning Journal,

> However, in defining the basis for a consensual decision, enormous difficulties arise in providing accurate measurements of many desirable goals, such as equity, amenity, flexibility, robustness, and implementability. More critically, such a definition may fail because bureaucrats, decision makers, and the public all have hidden or undeveloped criteria of choice, which may not become manifest until specific alternatives are being considered (Harris 1989).

Serious questions, however, must be asked by any rural town practitioner considering automation and information models: Do geographical information systems provide tools that will enable rural communities to envisage growth and its consequences? Will GIS help manage growth? What will/does GIS contribute to community growth planning that could not have been done without the system? Who can lay claims to good arguments and what constitutes proof in rural communities? Can GIS help?

Most town officials do not use electronic spreadsheets, but use maps for locating parcel abutters and are generally familiar with mapping principles. This common thread may be the link to successful GIS integration. Mapping workshops have been shown to be extremely powerful in integrating GIS at the local level (Edelstein 1990). In the multidisciplinary field of rural town planning, GIS, also multidisciplinary in nature, offers greater potential to share information and bring together several data layers (i.e., cadastral, soils, water lines) in a flexible system. As geography is common to most local government activities, so too might GIS be shared.

SUMMARY

This chapter presented the objectives of the research and various conceptual models of information and computer usage. The significance of the research is its' integrative methodology that brings together three approaches to technical rigor found at MIT and applies their methodologies to a rural town in practice. In so doing it was important to seek ways in which geographical information systems may replicate and enhance mental images held by the citizens. I introduce Huxhold's Information Pyramid and question whether the state expects rural towns to do more than provide operational information, deemed crucial to the state GIS. I also present my own diagram, where each level of government is equally represented in each information function Huxhold delineated. I examine GIS from the various perspectives of Dutton and Kraemer. Should one consider geographical information systems from the technical perspective, which is, like policy, outside the realm of local communities? Or should one consider GIS from the consensual perspective, where incorporation and adaptation is most important, and where rural towns will use GIS aggregated data for policy functions? It is feared that state policy is not molding the technology to the end user, and as a result, GIS, which is dependent on end user information may fail. Although GIS may not be for all rural towns, those that choose to use it may find significant the link to geography that is common to all local government activity.

CHAPTER TWO

RURAL TOWNS

> Planning in rural and small-town America is not difficult to justify. Rather it is a necessary ingredient in the fostering of sustainable communities, the development of greater self reliance, and the promotion of economic development and environmental protection (Lapping 1989).

INTRODUCTION

This Chapter defines the context of the thesis by examining rural towns and rural town planners. Although recent growth in rural areas is slowing, the rural town is still the predominant form of municipal government in the United States. Rural towns are woefully understudied and misunderstood, yet they, and the complex issues they are facing with limited staff, are vitally important to America's future.

The previous chapter discussed the use of GIS in rural towns. It will be important to understand exactly what is meant by a rural town, the issues it typically confronts, and what rural planning encompasses. Almost sixty million Americans live beyond metropolitan boundaries in the United States. Recent changes have made many rural areas harder to manage, and without solid planning skills many rural areas are vulnerable to being developed against the consensus of the citizens. An important balance will have to be reached as rural practitioners manage growth (or decline) in the 1990s.

The predominate form of local government in the United States is the rural town (Lapping 1989). While rural towns are little studied or understood, often face recession, and are unable to afford or support new growth (similar to metropolitan areas), surveys indicate the desirability of living in rural towns (Houston 1988). In 1970, urbanization slowed down and rural - urban migration was reversed. In 1980, for the first time since the census was taken in 1790, rural growth outstripped metropolitan growth; a record four million urbanites moved to rural areas. Since 1980, however, the short-term trend reversed itself again and urban areas grew at a faster rate than rural areas.

DEFINITION OF RURAL TOWN

The US Census Bureau defines "rural" two ways: a non-urbanized area of less than 2500, or a county without a city of greater than 50,000 people. In 1987 more than twenty five percent of all Americans were living in rural areas. Of the 3,137 counties in the United States only 798 are considered urban. Rural counties encompass eighty five percent of the land mass, contain thirty percent of all townships and seventy percent of all municipalities. According to the 1990 Municipal Yearbook, there are 7106 cities in the United States, of which 2024 have a population greater than 2500 and less than 5000. In New England there are 795 cities, of which 190 are between 2500 and 5000.

RURAL PLANNING & TRENDS

Rural planning is a multidisciplinary field requiring elements of agricultural economics, law, rural sociology, planning, community development, historic preservation, ecology, political science/public administration, negotiation, and bargaining. Rural town planners typically do all the work required of an entire urban planning staff. Lapping states: "Successful rural planning is not the adoption of traditional planning skills and task management to a smaller scale; the countrification of planning is not a workable model. Successful rural planning demands a generalist planner who can combine inventiveness, adaptation, and personality into useful practice." Table Two provides a list of generic municipal functions (Dangermond 1986):

Table Two: Generic Municipal Functions

1. Acquire & Dispose of Property
2. Process & Issue Parcel Related Permits
3. Perform Construction Inspections
4. Provide Legal Notification
5. Conduct Street Naming
6. Review Site Plans
7. Review Subdivisions
8. Create Street Addresses
9. Perform or Compile Event Reporting
10. Conduct Dispatching
11. Perform Vehicle Routing
12. Conduct Traffic Analysis
13. Conduct Facility Siting
14. Administer Area Districting
15. Administer Zoning By-Laws
16. Conduct Land Use Planning
17. Conduct Engineering Design
18. Conduct Drafting
19. Conduct Land Title Searches
20. Perform Tax/Fee Billing Collection
21. Create & Manage Mailing List
22. Allocate Human Resources
23. Perform Facilities Management
24. Perform Inventory Management
25. Perform Resource Management
26. Miscellaneous Management
27. Perform Map Management
28. Conduct Drawing Management
29. Perform Database Management
30. Conduct Development Tracking
31. Disseminate Public and/or Government Information
32. Respond to Public & Government Inquiries
33. Conduct Surveys
34. Maintain Library

The rural planner must be able to demonstrate the value of planning to a wary body public. Rural towns will have to become better organized in the future. Due to economic restructuring, traditional rural industries (agriculture, fisheries, forestry, and mining) now employ only twelve percent of total workforce: many rural towns in the Midwest are struggling to survive and jobs are not available for the youth. Due to rapid growth the environment is threatened and the supply of clean water and air quality is not guaranteed. Due to better transportation and telecommunications, traditional urban based industries are now locating in rural areas, causing an urban-rural migration. Lapping described a social crisis emerging from high unemployment, farming , poverty rates, and negative rural attitudes towards new comers. Due to declining federal support and more self-reliant rural areas Lapping saw a political crisis in leadership and direction .

The challenge facing rural planners is to balance economic development with environmental concerns; not only must new industry be brought to the area but it often must comply with stringent environmental laws. Trends in declining agriculture and changing land use challenge planners to develop innovative techniques that preserve the land without farming it and provide jobs for the existing population.

Rural areas are typically less diverse than metropolitan areas, their resources less plentiful, their communications less frequent, and their politics typically less pluralistic. Rural people tend to be more conservative and view land as a resource for the production of goods, not as a commodity for housing and recreation. There is a distinct clash between the recently arrived, rich, educated urbanites and the native rural dwellers. Newcomers are looked at with disdain; not only do their vacation homes or subdivided lots drive up land prices, the cultural differences are vast. Urbanites expect and demand similar amenities found in urban centers. Psychologically, urbanites signal to the rural dwellers a change in lifestyle and the disappearance of the past.

Rural people may be considered set in their ways and not necessarily obliging of the regional, state, or federal government laws that infringe upon their freedom. They do not trust government, especially the federal government, and also distrust state and regional governments. On the other hand, they value and expect access to local government, and contact with officials can be quite frequent and personal. Rural planning usually occurs in board meetings after night-fall, where agendas are more flexible than urban agendas, town staff are generally more approachable than urban staff, and a social, story-telling type atmosphere prevails.

Private property rights are held in very high regard in rural areas and efforts to endorse land use legislation may meet great resistance. Lapping argues that the creation of the Department of Housing and Urban Development led to negative feelings by rural towns about planning. Although HUD enabled rural areas to receive grants, it generally treated rural areas as urban and as mere land repositories of the inevitably sprawling metropolitan centers.

This research risks describing the experience of one rural town, which may or may not be replicable in other towns. Swanson et al., in *Small towns and Small Towners,* are quick to point out that rural towns are not alike. Each town is clearly influenced by the distinct personalities of the handful of people most active within them (Swanson 1979). Harold Williams, President of the Institute of Man and Science, cautions that urban planners have been applying urban concepts to rural settings. Williams theorizes that rural towns are vitally important to America's future, have every right to take hold of their own future, establish goals and direction, and work hard to achieve them. Williams does not support the view that rural towns are subject to the larger forces (state, region) that surround it. In fact Williams warns that regionalistic activities (shopping centers, school districts, sewage treatment plants) threaten to destroy the rural town character.

FEDERAL INTERVENTION

Farm policy generally dominates federal rural policy. In 1980, when President Carter created the Rural Development Policy, he established that the United States Department of Agriculture would play a key role in the program. Key elements in Carter's policy were circuit rider planners, rural industrial development, local self sufficiency. Carter, Lapping felt, was trying, in his attempts to create an America "that never truly existed," to do something never done before. The Carter administration was "attempting to resurrect the image of rural communities and people as truly self reliant, independent, and fully capable of solving all their problems." However, rural development always featured federal intervention (Lapping 1988). Reagan and Bush, although reaffirming USDA's role in rural development, were generally disengaged from rural policy. Changes have resulted in the end of federal revenue sharing, cuts in fiscal support, and deregulation of trucking and banking industries.

RURAL PLANNING & GIS

Given the "complexity, instability, and uncertainty" of rural planning, the intuitive thinking skills of rural planning practitioners, and the enormous work load (Lapping would argue it is not a question of how much work rural planners do, it is a question of how useful rural planners are), it may seem difficult to justify the use of computers with their inherent additional layer of complexity. As rural planning is multidisciplinary in nature, so too is GIS. GIS might provide the impetus for planners to use planning information that is available. Britton Harris writes:

> The planner has to have an effective microcomputer-based planning system, which will provide scope and support for the exploration of diverse and imaginative approaches. A properly designed geographic information system with mapping and display capabilities must be at the heart of this system (Harris 1989).

However, Harris continues:

> This planning system must be fully integrated and user-friendly, but with many options available to the planner. Within a very free approach to planning, it should provide many checks on the accuracy, consistency, and completeness of the process.

The onus, Harris argues, is on the tool makers to design "flexible and well-designed" software packages that will not necessitate high-level computer skills in the user.

CHAPTER THREE

EXPERIENCE TO DATE OF THE VERMONT OFFICE OF GEOGRAPHIC SERVICES

INTRODUCTION

Chapter Three examines the experience of one rural state, Vermont, as it attempts to fulfill a land use planning act and comply with an executive order to facilitate data sharing at the local, regional, state, and federal level by integrating a statewide geographical information system. This chapter provides a brief history of the Vermont Geographical Information System, describes the data layers developed to date, and discusses the resistance it has met concerning data access, pricing, and privacy. The chapter concludes with a brief discussion of GIS integration in six rural Vermont towns.

Vermont is a rural state. Rural planning duties are quite similar to those discussed in the previous chapter. To better understand geographical information systems development in Vermont I have incorporated Vermont literature: legislation related to planning and GIS, papers, publications, and memos by the Office of Geographic Information Services, reports and publications of the Regional Planning Commissions, and newspaper articles. To better understand the state-of-the-art in GIS technology vis-a-vis rural towns and infrastructure planning I draw from URISA Conference Proceedings, URISA Exemplary Systems in Government Publication, GIS/LIS Proceedings, NCGIA bibliography, and theses.

In Vermont, there are 237 organized towns, five unorganized towns, four gores*, and nine cities. Fifty-four towns have a population less than 500. Almost half the towns (120) have a population less than 1000. There are 14 counties in Vermont, although the county government is essentially non-existent, and there are twelve, more powerful, Regional Planning Commissions. The preliminary 1990 census figures indicated an approximate Vermont population of 560,000 people. The number of parcels totaled 289,000. The most populous city was Burlington, with a population of 38,000. The least populous town was Victory, population 56.

Vermont prides itself on open space and unique land use legislation. Act 250, passed in 1970, requires large developments to meet ten criteria ranging from water quality to educational impacts. The 1988 Growth Management Act (Act 200) requires regions to develop plans and for towns to make plans in accordance with the regional plans.

Vermont is 157 1/2 miles long, is transversed by the Green Mountain range running north to south from Quebec to Massachusetts, and is bordered by New Hampshire to the east and New York to the west. It encompasses a land area of 9,278 square miles. Traditionally considered an agriculturally based state, agriculture in 1990 ranked third, following manufacturing and tourism. In 1953 there were 10,527 operating dairy farms producing 1.9 billion pounds of milk; in 1988 there were 2,592 operating farms producing 2.4 billion pounds of milk (52 percent of New England production). The state beverage is milk. Vermont is predominantly rural in character and quite mountainous.

GIS DEVELOPMENT IN NEW ENGLAND

Despite recent state budget deficits and economic recession in all New England states, GIS managers and directors at the 1991 New England Urban and Regional Information Systems Association (URISA) meeting indicated that GIS initiatives were progressing. Each New England state, to varying levels of scale and development, has acted on state-wide GIS initiatives.

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* As used in Vermont, a gore defines the smallest possible municipality.

Impressive applications were described at the meeting: Maine's $ 1 million oil spill response grant from the US Environmental Protection Agency, Rhode Island's legislation requiring municipalities to use Rhode Island GIS as a data source for updating town plans, Massachusetts' 80 projects in 24 months, and Vermont's parcel mapping and grant matching projects. All states spoke of the importance of local GIS initiatives.

GIS DEVELOPMENTS IN VERMONT

Amendments to Act 200 in 1989 required that the governor "develop a comprehensive strategy for the development and use of geographical information systems" and appropriated $ 4.75 million for a five year plan. All data relevant to GIS that was to be collected by local planning commissions, regional planning commissions, and state agencies was to *be compatible with, useful to, and shared with* the Vermont Geographical Information System. On 7 June 1989, Governor Madeleine Kunin signed Executive Order #75, which created the Office of Geographic Information Systems (OGIS) and a GIS advisory board. In 1991 however, after a $ 2.25 million investment, the Vermont General Assembly threatened to cut the OGIS budget by 95 percent. Despite this budget uncertainty and other obstacles, the Office of Geographic Information Services made fantastic headway in developing and making available electronic information to more than half the towns in Vermont. All 12 Regional Planning Commissions of Vermont have entered into agreements with the state to act as regional GIS service centers. All Vermont towns have access to GIS services.

The 1991 Annual Report described Vermont's Geographic Information System as consisting of *five major groups,*

- **Vermont GIS Advisory Board:** Fifteen members from local, regional, state government, and the private sector review policy, standards, and budgets.
- **Office of Geographic Information Services:** Professional staff of six development of data, standards, applications, and technology transfer.

- **Other State and Federal Agencies:** USDA, USGS, Vermont Agency of Natural Resources, Vermont Agency of Transportation, cooperate in data development.
- **Regional Service Centers:** twelve regional planning commissions that provide GIS services, trainings, support.
- **The VGIS Network:** an informal network that optimizes the access and exchange of information.

Although it appeared that local communities were conspicuously absent from the *five major groups*, there was room for local government involvement. The Vermont GIS Advisory Board, while seating two representatives from local government, was advised by a PlanGraphics Comprehensive GIS Strategy to form additional subcommittees, such as Regional and Local Subcommittees, to enable greater municipal participation. The Regional Service Centers, while serving as bridges between the communities and the state, are not a part of state government, and are, in fact, governed by member town representatives. The Regional Planning Commissions also encourage municipalities to become involved. Vermont communities may also participate in the VGIS Network.

In the 1991 Annual Report to the Vermont General Assembly, The Vermont Office of Geographic Information Services was proud to report that 146 Vermont communities have been engaged in GIS activities. Eighty-six towns were engaged in the Parcel Mapping Project, a "free" offer by the state to digitize any municipality's tax maps, and 17 communities matched Special Mapping Grants jointly awarded by OGIS and the Vermont Department of Housing and Community Affairs. Vermont GIS's data library was *scheduled* to include 58 percent state coverage of soils and surface waters in eight counties, 100 percent coverage of road centerlines, 51 percent of parcels (scheduled to be complete by 1991), 100 percent coverage of wetlands, 100 percent coverage of public water supply and well head protection areas, and 100 percent coverage of hazardous sites. Vermont has 100 percent orthophotography base maps at 1:5000 from which most coverages have been digitized, although scales range from 1:1250 to 1:250,000 (VGIS 1990). Vermont OGIS has developed accuracy standards, data interchange and dissemination policies, and is currently reviewing various organizational change scenarios.

OGIS activities offer local communities powerful tools to become an integral part of Act 200. The list of potential GIS applications (see Page 14) is extensive — spatial analysis offers planning assistance to planning commissioners and citizens. However, to date community boards or managers have not used the GIS in routine decision making. There were no examples in Vermont of a community board meeting taking advantage of the GIS. Problems remain: (a) towns mistrust the state of Vermont and the Regional Planning Commissions' intentions; (b) towns are unfamiliar with the technology, do not know what questions to ask, and are not aware of its potential as a planning tool; (c) towns resist the policy makers' goal of centralized data and electronic information; (d) town goals are different from those of the state; (e) towns cannot afford a professional planner, let alone a GIS specialist.

GIS PRIVACY AND COST RECOVERY ISSUES

State government computerization of municipal information has encountered resistance. What appears to be an excellent planning tool from the perspective of Act 200 may appear to be *Big Brother* to the municipalities. Issues of privacy couple with issues of access — what and whose information is being entered in the state data bank and who will have access to it? Fearful of the "conspiracy by the state and regional commission to get at town tax information," Rutland, the second largest city in Vermont, voted down anything to do with computerized mapping (Hoogland 1990). The Rutland Selectboard compared computerized mapping to giving your neighbor access to your bank account.

Executive Order #75 directed Vermont GIS to "establish fees for GIS services and data which are reasonably likely to permit the GIS to become self-supporting." The fees, according to the order, should be based upon public investment in the data used or sold, the expense of preparing the products sold, and the commercial value of those products or data. The directive raised some concern. Is public information to be sold? Vermont Secretary of State Jim Douglas argued against the directive:

> The government is not in the business of making money; government serves its constituents and the law is clear that the records it generates are available at cost.
> (Peek 1990)

It is also clear that neither the Governor nor the Director of OGIS expected a lawsuit on these issues to be filed. A lawsuit was filed. *Whitaker versus State of Vermont Agency of Administration Office of Geographic Information Services*, alleged that Mr. Stephen Whitaker, of Montpelier, Vermont, was denied electronic data he requested from OGIS and that he was excluded from Vermont GIS Access/Pricing Subcommittee meetings. Whitaker charged that the VGIS Advisory Board set policy when a quorum was not present, excluded important information from the minutes, and violated the Vermont Open Meeting Statute. Whitaker sought an injunction to halt the purchase of computer equipment ordered by OGIS, to require that minutes of meetings be complete and available as per the open meeting laws, and to ensure that he receive the electronic data he requested (Whitaker 1990). The American Civil Liberties Union of Vermont, Inc., who reviewed the case before it was filed, argued: "If the government says that as soon as information is stored electronically it is no longer a public record and not subject to the Public Records Act, there are serious civil liberties implications (ACLU 1990)." The suit was filed with the Washington County Superior Court on December 11, 1990, and action is pending at this time.

Nor did the governor or the director of OGIS expect a legislative response to a bill introduced in 1990 by the Committee on Natural Resources and Energy, exempting geographic data from the public records law. *An Act Relating to Public Access and Privacy*, sought to amend the current pubic records law to include computerized information. The bill proposed:

> to amend current access to public records statutes to include computerized information, and to create a state office of information to oversee collection, management, dissemination and protection of public records, clarify the protection of personal information in public records, and create a process of appeals regarding access to public records (VT General Assembly 1991).

Arguing that it is within the public interest to enable any person to review and criticize government officials, the legislation also sought to protect the right to privacy in personal and economic pursuits.

In response to the concerns, Bruce Westcott, Director of OGIS, was clear:

> No one has, or is considering, any policy under which individuals for their own private use, or government agencies, would pay anything more than the cost of reproduction. Period. And people need to understand that (Peek 1990).

VERMONTERS FACING CHANGE

Recent high technology advances, rapid development and growth, increased environmental concerns, deteriorating infrastructure, limited revenues, and solid waste management issues pressure legislative bodies and town managers in rural Vermont towns to plan appropriately and systemically to insure equitable allocation of town resources. On Annual Town Meeting Day and at weekly municipal board meetings, participants are forced to deal with complex issues as change occurs more rapidly than ever before. Not only must the institutions change to meet the development challenge, but the mental attitudes of the legislators and managers must also change.

Towns, however, may or may not choose geographical information systems to help manage this change (Rosenfeld 1990). Planners were not being trained in advanced computer applications (Wiggins 1990). But as user-friendly computers slowly win over managers and planners, it becomes more possible for managers, and better still, citizens, to design their own model on which to base decisions rather than to rely on outside consultants and academics. Citizens will be able to use their models to demonstrate potential alternatives before reaching decisions. Once managers become familiar with, and reflect upon, the "virtual world" in the planning office, they might take that knowledge to the "real world" and employ it there (Schön, 1983).

Of course, while information is required for planning and model building to take place, and GIS might be the ultimate source, it alone does not guarantee a good decision will be made. Once people gather enough information and make a decision they tend to get on the band wagon and stop accepting new information (O'Hare 1983). Work at the Department of Extension Service, Wageningen Agricultural University, The Netherlands, embraced knowledge ("occurs between the ears, a property of the mind") and information ("sensory input that maintains the goodness-of-fit between knowledge and the real world") to develop what they call a Knowledge Information Systems (Röling and Engel 1990). Although Röling and Engel research agricultural extension, I draw parallels with the work of this research and technical facilitation. Röling and Engel found that research, extension, clients, and actors must act synergically in order to effective. Röling, specifying the benefit, wrote,

> The persons, networks and institutions, and the interfaces and linkages between them, which engage in, or manage, the generation, transformation, transmission, storage, retrieval, integration, diffusion, and utilization of knowledge and information, and which potentially work synergically to improve the goodness of fit between knowledge and environment, and the technology used, in a specific domain of human activity (Röling 1988).

On the importance of synergy, The Vermont Geographic Information System Policy #1, *Regional Planning Commission and Local Government Roles,* stated:

> The Vermont GIS cannot operate without the support local, regional and state officials. Each is an INDISPENSABLE source of data for the other two, and *each gains* from the cooperation of others (VGIS 1989).

The state and regional agencies have devoted little attention to date to the logistics of change — if a town chooses to develop in-house GIS, who will maintain the database? Why are towns like Weston, Vermont, with a complete set of coverages , not using GIS (Price 1990)? Why do the selectmen of Calais, Vermont, with complete GIS coverages at their disposal, insist on using traditional tax assessor maps (Healy 1990)? The perception of Ed Claudefelter, town lister of Calais, may be held by others: GIS is a "dog and pony show" producing fancy maps yet not doing the hard core number crunching required of tax assessors (Claudefelter 1991).

USE OF GIS IN RURAL TOWNS

Despite the concerns raised above, I am arguing in this thesis that citizens who use information technology will be better prepared for policy functions located at the top of Huxhold's conceptual pyramid. Any citizen who becomes facile in the use of geographical information systems will be exposed to information, that in Röling's words, "maintains a goodness of fit" with their knowledge and the rest of the world (i.e., the community). If citizens are to be able legislators they need to visualize their community. GIS may offer a quality of information that never before existed. Citizens should know what needs to be done, ask the right questions, and determine whether GIS is the best interface for their knowledge. Developing an end-user interface is not easy. Regional Planning Commissions and the Office of Geographic Information Services in Vermont have been busy developing a geographical information data library for the state. Workshops have been held, technical notes made available, yet a GIS administrator's prescription reflects the reality of many projects: design and develop the system and then incorporate the people (Edelstein, 1990). I believe the best outcome of a state GIS will be obtained from the earliest possible citizen involvement. The Vermont GIS must be molded for the end-user; I would reverse the prescription: incorporate the people and then design the system.

As the Vermont GIS is clarified, understood, and accessed by local government, state and regional officials will be held more accountable for their decisions and policies affecting the growth and development of rural towns. "Computers in the hands of local people will blunt the coercion that centralists have always used to take away local control (Bryan 1990)." In her book, *In the Age of Smart Machines,* Shoshana Zuboff notes that "management introduced new technologies that made old hierarchies unnecessary — and regularly did everything in its power to maintain those hierarchies. The habits of the obsolete past dominate the possibility of a radically humane future (Zuboff 1988)."

The Need For Training is Real (In Fact its the Law)

> A municipality may have a plan. Any plan for a municipality shall be prepared by the planning commission of that municipality ... planning commissioners shall solicit the participation of local citizens and organizations by holding informal working sessions that suit the needs of local people (ACT 200, Chapter 117, Subchapter 6. Municipal Development Plan, Section 4384).

As Act 200 mandates informal working sessions so too should working sessions be held for GIS. It is clear that training citizens in the use of geographical information systems will dispel many fears of invasion of privacy and limited access. One example of training efforts was found in an April 6, 1990 Request for Proposal issued by the Southern Windsor County Regional Planning and Development Commission (Hatling 1990). At the end of a list of technical mapping tasks were the following:

> ***Task #7:*** Conduct a series of informational meetings to assist the region and member towns in understanding the costs and benefits of a geographic information system.
>
> ***Task #8:*** Work with the Regional Commission in conducting a feasibility study for establishing a regional geographic information system that will address the needs of its member towns.

The importance of Task #7 should not be de-emphasized. It is precisely because *informational meetings* were not provided at early stages that there is little understanding of computerized mapping and planning applications. Efforts to conduct informational meetings were described in the February 1990 GIS Pilot Project Quarterly Report of the Two Rivers-Ottauquechee Regional Commission:

> Citizen training in the form of simple introductions to GIS and the products it can produce is very helpful to both the people and the Arc/Info (GIS software) manager/technician. It reveals the questions and concepts citizens hold about mapping and the use of maps and information in their activities. We plan to offer three basic types of training for the town official and interested citizens:

- •Short Introduction to GIS and its Products
(planning commission meetings are typical forums for this (1/2 hour max.))

- •Introduction to Mapping Workshop
(typical two hour session with intro to maps, scale, accuracy, etc.)

- •How to Prepare Your Own GIS Overlay Workshop
(probably a 2 hour session, using actual orthos and overlays for a town or towns, to teach people how to align the overlays, trace features, and code them with attributes) (Edelstein, 1990).

GIS provides a tool with which to plan, yet like most tools, time is required to become skilled in its use. It will require more than five hours of commitment on the part of both the trainers and the trainees. Short training sessions, as described above, may foster an interest in GIS, but will not develop local expertise; rather, they may develop local dependence on outside experts. The tip of Huxhold's pyramid will never be reached. Municipalities will flounder in operational mire, while the Regional Planning Commissions do the long-range, regionwide policy analysis. Edelstein's "mapping workshops" (or as David Healy refers to them, "mapping parties") are proved mechanisms to incorporate citizens, contributing to perceptions of local empowerment. Little attention, however, focuses on the tool beyond the map making level; or its use as a geoprocessor for instance, to automate municipal tasks and aid policy functions at the local level.

THE ROLE OF GIS IN RURAL TOWNS

Local governments in Vermont will play a key role in the development of GIS. According to Vermont's Comprehensive GIS Strategy Study, done by PlanGraphics:

> Local governments will need to take the lead for preparing and maintaining several layers of the GIS database, either because they are the source or the major user of the layer in GIS applications. Local governments will need to be involved in both the initial creation and most of the maintenance of data layers for property lines, political/administrative boundaries, zoning, detailed land use/cover, detailed soils, water, sanitary sewer,

stormwater, and other infrastructure facilities; and septic systems (PlanGraphics 1989).

Bruce Westcott, Director of the Vermont Office of Geographic Information Services (OGIS), however, felt the capacity for town planners and managers to engage in spatial analysis and policy functions is limited. He contended that towns have always relied on outside consultants in the past and will continue to rely on them in the future (Westcott 1991). David Healy, Operations Administrator of OGIS, disagrees, yet, in reaction to a proposal for this thesis, questioned the time and energy a town would devote towards automated mapping A prerequisite for geographical analysis and software use, Healy felt, would have to be intensive technical training and/or a technical facilitator such as myself. He also foresaw the need for an information management specialist and noted some smaller towns may not want to use GIS.

OGIS, however, cannot operate without local support and is dependent on local operations information. PlanGraphics, while expecting the local government role in creating and maintaining data to be significant, predicted that town and city "GIS requirements will be relatively unsophisticated" if their populations are under 10,000. The smaller communities needs will be for "standard map products and tabular reports," and only the larger municipalities "may justify the need for complex geographic query, analysis, and mapping (PlanGraphics 1989)." Despite this seemingly technocratic perspective, several municipalities have proved PlanGraphics wrong. Towns with far fewer than 10,000 residents are developing in-house GIS capacity and have justified the need for sophisticated applications, a contingency for which Vermont OGIS might not have planned.

The Vermont Office of Geographic Information Services hired consultants, (Associates in Rural Development) to write *GIS for Vermont Communities: Applications and Concepts* (Budd 1990). The workbook provided a good overview of mapping concepts and spatial analysis specific to Vermont communities. It was to be used in training sessions conducted around the state. According to Budd there were three options for a community considering geographical information systems:

- Develop in-house
- Use Regional Planning Commission GIS service centers or the University of Vermont
- Contract to consultants

Budd stipulated that although local planning needs are the primary focus of OGIS, few localities will have both the financial and personnel capacity to warrant development of an in house GIS.

Budd predicted that the bulk of requests will come from users needing paper products, "but not interested in analysis or interactive GIS access." For the few towns that choose in-house GIS, the study recommended hiring a minimum of one person, trained in GIS, to manage the system. In 1990, this position, according to Budd, commanded a $30,000 salary, a figure that may make towns hesitate. In 1991 hardware costs ranged from $3500 to $7000 and from $2000 - $5000 for modules of the standard software (Arc/Info) in use in Vermont.

VERMONT RURAL TOWN EXAMPLES

In this section I present six Vermont towns that are planning to use the Vermont Geographical Information System.

Brandon

(population: 4,194, area: 25,152 acres, grand list* : $704,819)

Data availability: none
Applications: none
Hardware: none
Personnel: Pamela S. Jones Caskie, Town Manager
Familiarity with GIS: novice

Town Manager Pamela Jones Caskie foresaw many applications for GIS once it was integrated in rural town government. Before integration, however, she saw barriers: staff to be trained, limited staff capacity to manage databases,

* As used in Vermont denotes a percentage of appraised property value from which tax rates are based.

potential staff turnover, system sustainability issues, and insufficient financial resources. She was depending on training from the University of Vermont's extension service and technical support from the Regional Planning Commission to get Brandon's GIS started. Eventually she wanted in-house GIS capacity (a personal computer and small plotter) for use by herself, the zoning administrator, the public works director, and other town officials. She planned for the town to do data base entry and maintenance. Jones Caskie has requested a series of natural resources maps from the Rutland Regional Planning Commission. She expected to take advantage of data layers being developed by Vermont GIS and envisioned several applications for Brandon's GIS: resolving boundary disputes, mapping road conditions, determining road classes, planning school bus and snow routes, analyzing road and utility network, and integrating the grand list with the parcel map. Brandon did not have current in-house GIS capacity and unfortunately, due to budget cuts all planning grants were on hold.

Burke
(population: 1,385; area: 18,496 acres; grand list: $367,581)

Data availability: parcels, land transportation
Applications: tagging parcel attributes, fire dispatch
Hardware/Software: 486 Everex, pcArc/Info Starter Kit, Arcplot
Personnel: Bruce Heinrich, Chairman, Burke Planning Board
Familiarity with GIS: extensive

Without the expertise of Bruce Heinrich, president of microData Technologies, chairman of the planning board, and a lister* somewhat fluent in applications, the planning board would not have allocated $8000 for hardware and software purchase or a contract to digitize the parcels (conveniently done at microData). "They needed a computer anyway," rationalized Heinrich. It had been five years since Burke purchased its last computer. Heinrich was also instrumental in helping Burke be the first community to link the grand list attributes (dBase file) to the parcel polygon attribute table; a useful exercise in itself, the linkage reveals parcels not on the tax list. Heinrich brings great GIS expertise to the planning board. "It is clear," he

* tax assessor

noted, "that without me the town would be lost." As it stands at this writing, ten volunteers are being trained in using light tables to interpret land use from orthophotos. Coverages under development include point coverage of all buildings, recreation trails (hiking, cycling, and snow mobiling), and land use. Reflecting on the prospects for maintenance of the data, Heinrich was not clear: "I'll let you know in a year." The town recently purchased two modules of pc Arc/Info (Starter Kit and ArcPlot) and hopes to use a laser printer emulating HPGL to print plots; bigger plots will be done at Heinrich's office. It was evident that Burke would become the active regional service center well in advance of the Northeastern Vermont Development Association, the Regional Planning Commission (Heinrich, 1991).

Plainfield
(population: 1249; area: 14, 912 acres; grand list: $209, 508)

Data availability: scenic road corridor, floodplains, wetlands, and wildlife habitat.
Applications: build out analysis, prototyping parcel mapping
Hardware/software: none
Personnel: Betsy Ziegler, planning board member
Familiarity with GIS: novice

Claiming to be a pioneer of Vermont's geographical information services, Plainfield has worked with the University of Vermont's GIS laboratory and the Central Vermont Regional Planning Commission in maintaining its "ongoing effort to completely map the town and to tailor its GIS database to serve an innovative planning process." At the second annual Vermont GIS Conference held in February 1991, planning board member Betsy Ziegler presented examples of how their GIS provided citizens with the opportunity to participate in community planning (Ziegler, 1991). Citizens attended local hearings and planning workshops to examine the maps closely and make corrections. The importance of experience of place is highlighted when errors are present: "Hey, this is not on my property," or "Hey, my property extends to the brook." Local expertise provided essential feedback on the quality, integrity, and reliability of the system. Plainfield, however, does not have in-house GIS capacity and relied on regional GIS service and a private contractor to produce maps.

Randolph
(population: 4689; area: 30,592 acres; grand list: $1,243,247)

Data availability: parcels, soils, road centerlines, surface water, zoning, wells, well head protection areas, natural heritage, hazardous wastes, political boundaries
Applications: industrial site suitability, slope analysis, parcel attributes, road maintenance
Hardware: 386 with 387 coprocessor, 25 megahertz clock, 200 megabytes
Software: pc Arc/Info ver 3.4D
Personnel: Ed King, part-time planning and zoning administrator
Familiarity with GIS: novice

The town of Randolph purchased pcArc/Info in September, 1990 (one of 21 licences in the state). It was initially housed at the Vermont Technical College, located in Randolph. The town was given unlimited access to VTC facilities including a Zenith 386, Numonics 2000 digitizer, and Calcomp 1040 plotter. Randolph was the first town in Vermont to have extensive data coverage. All hardware and software costs were provided by funding from Act 200 planning grants. I was employed by the Vermont Office of Geographic Services to act as technical facilitator for Randolph. I performed several tasks: prototype mapping (sml development), prototype abutter notification (sml development), data preparation (soils, parcels attribute tagging, and minor digitizing (zoning), workshop on GIS, soil suitability analysis, development suitability, and one on one training sessions. This town was selected as a case study and will be discussed in detail in subsequent chapters.

Shelburne
(population: 5,008; area: 28, 864 acres; grand list: $2,023,962)

Data availability: road centerline, soils, land use, wetlands, recreation facilities
Applications: water and sewer service areas, current and projected land use,
Hardware: none
Personnel: Joyce Ohlson, Town Planner
Familiarity with GIS: novice

Joyce Ohlson was contemplating whether the town should designate a GIS technical staff person to develop in-house GIS with pcArc/Info, or go with a lower end, and presumably easier to use, system. She assumed there would be a need for a GIS technician. In the meantime, the board of selectmen, who were sympathetic and readily issued contracts for mapping projects, allocated $6,000 in mapping contracts. Extensive GIS mapping was done, including visual and natural resource inventories, water and sewer service areas, and parks and recreation needs assessment. The objective was use GIS to help rewrite the town plan. Shelburne's model, however, leaves little promise of sustaining in-house GIS capability, since the paper maps that hang in town offices are the products of consultants.

Weston
(population: 627, area: 22, 848 acres, grand list: $523, 846)

Data availability: land use, tax parcels, roads, surface waters, zoning districts, house footprints, soils, zoning, selected contours
Applications: build out, permit tracking, on site septic limitations, solid classifications, future housing, productive resource lands, LESA
Hardware: none
Personnel: Noel Fritzinger, Weston Land Trust
Familiarity with GIS: extensive

Taking advantage of Act 200 monies and investing $11,500 in data gathering, data entry, analysis, interpretation, reports, and administration, Weston completed an ambitious mapping project. Town volunteers, town officials and professionals overcame several rural data collection obstacles to organize data for a mapping contract with the University of Vermont. Fritzinger felt very much on the edge of technology in rural area applications. Like Shelburne, however, the ability to maintain the data for their maps is noticeably absent. As with the Plainfield model, Fritzinger noticed the importance of "personal experience with the geographic location covered by the map." Weston opted to use service centers for map production and has yet to discuss automation of operations. The developers of Weston's mapping project believed they failed because they did not incorporate the town officials into the project from the beginning (Fritzinger, 1990). The maps were deemed too valuable to use and are locked in the town vault. Lessons could be learned from the Weston experience.

GIS LITERATURE VIS-A-VIS RURAL TOWNS

This section briefly examines the literature of state-of-the-art rural GIS applications outside Vermont.

Although numerous textbooks related to GIS have been published in the past two years (Aronoff 1989; Burrough 1986; Goodchild 1990; Huxhold 1991; Star 1990; Tomlin 1990), little regarding rural towns and community planning is included in these texts. The Urban and Regional Information Systems Association (URISA) Proceedings and Exemplary Systems in Government Publication offer a richer set, albeit a cursory review, of cases applicable to infrastructure issues facing many rural towns. Among them, deterioration and traditional "band-aid" approaches (Roe 1989), infrastructure capacity and intensity zoning (Kingma 1989; Kingma 1990; Kramer 1989), impact analysis of land use on city finances (Tomaselli 1988; Tomaselli 1990). Other authors related industrial site selection to infrastructure needs at the state level (Cowen 1989), and describe at the national level urban expansion alternatives and building site selection for non-specialists (Geertman 1990).

Three entries in the GIS/LIS 1990 Proceedings give an indication that rural communities are finding uses and value in GIS. Two articles provide implementation guidelines, but give limited attention to applications and uses (Bentley 1990; McFarland 1990). One article provides a nice survey of Missouri cities with fewer than 10,000 people (McCrary 1990). Although the response rate was low (33 percent), they do indicate that the communities sought a better management system than the one currently used. Other literature addressed organizational issues: organizational structures best suited for the implementation and development of GIS (Campbell 1990); the changes organizations should plan for in the integration of GIS (Somers 1989). Although the National Center for Geographical Information Analysis has one research initiative (out of 13) devoted to Use and Value of Geographic Information, to date little attention has been devoted to this question.

After a lengthy study of GIS applications in Boston's South End, Chen's Master's Thesis: *Visual Display of Spatial Information: A Case Study of the South End Development Policy Plan,* recommended continuing efforts to learn how people respond to spatial information and its representation (Chen 1990). Chen cites the theoretical framework of computer modeling established by Dutton and Kraemer (similar to Schön's technical rigor versus professional relevance), which claims the gap between professional experts and lay policy officials may bring conflicts between technology and democracy. Unfortunately Chen provided little discussion of the planning group and how if at all, this conflict was manifested.

CONCLUSION

Vignette #1:

It's annual Town Meeting Day 1992. A debate on whether the highway budget should be amended was taking place on the floor. People are skeptical of the towns road maintenance record — the roads are in poor repair and seem to get worse each year. The town manager, sitting behind his workstation, runs a macro to demonstrate for the assembly road maintenance history and future road work plans. Lively colors illustrating each year's maintenance program awe the assembly.

Vignette #2(Bryan, 1990):

A debate is taking place at Town Meeting concerning the public funding of kindergarten transportation. A young woman in the middle of the crowd has been punching in a series of instructions on a miniterminal in her hand. "Mr Moderator," she calls, and stands while her husband holds the baby.
She is recognized to speak.
"You're wrong," she says turning in the direction of the earlier speaker. "The average cost for transportation to kindergarten is not above the statewide average. May I?" She looks at the moderator.
"You have the floor and the computer."
She presses a final button on her terminal, and on the huge screen perched on the basketball backboard there appears a map of Vermont highlighting the array of transportation costs and Starksboro's position relative to the rest of the state.
"There!" she says and sits down.

Vignette #3:

Its 10:00 p.m., Tuesday night. The Planning and Zoning Board are reviewing the first site plan ever to be considered for a new mixed development zone. The zoning administrator sits behind his pc. He has called up the site in question, rendering it in a three dimensional wire frame. He drapes the surface waters and hydroponic soils over the wire frame, calls up annotation identifying each abutter; roads are mapped. The digital site plan is then called up, georeferenced to the state plane grid, the buildings and roadways are placed, indicating cuts and fills over the original site. Norway maples the developer proposes to plant are then plotted giving view shed analysis impacts from the state highway five, ten, and fifty years in the future.

One of the greatest advantages of information technology, Bryan asserts, is that it allows the people to do the work of government in the local community itself. Bryan's vision of a town meeting day may be realized, but, he cautions, new information technologies are needed for democratic structures that feature face to face politics (Bryan 1990b). The state of the art in rural town GIS applications is in its infancy, but the race is on. More and more communities in Vermont, while not yet having in-house capacity, are engaged in GIS activities. While 1991 budget cuts are currently threatening the entire region's GIS development, Vermont GIS was off to an ambitious start during 1989-1990. Problems, however, remain: funding is uncertain and service fees and access to the digital database have met resistance. Rapid change in technology and rural communities will influence the way governments conduct business. GIS might provide a solution but it does not guarantee good decisions will be made. Nonetheless it may hold state and regional authorities more accountable. Training will be necessary for molding the technology for the end-user to create a truly consensual and integrated state GIS.

CHAPTER FOUR

EXPERIENCE TO DATE IN RANDOLPH VERMONT

"If we wish to manage we must be able to measure"
Mr Simpson, Randolph Town Meeting Day, 4 March 1991.

INTRODUCTION

In the first three chapters of this thesis I attempted to set the stage for this case study. Chapter One described the proposed research methodology and some of the overarching principles and objectives of the methodology. Chapter Two described rural towns and how they are different from the larger municipalities commonly considered and discussed in the geographical information systems literature. Chapter Three discussed the Vermont Office of Geographic Information Services development and how it is progressing towards local implementation. This chapter provides an in-depth examination of Randolph, a rural town in Vermont, and investigates integration issues and possibilities. An attempt to integrate a GIS for use by a municipal board is then analyzed, and one-on-one training sessions with the zoning administrator are discussed. My reasons for working with only one community were several: to develop a keen understanding of a rural town at work, to develop a close relationship with town officials, and to develop a prototype for use by others from the rural perspective.

Before selecting Randolph for this research I interviewed planning officials in Shelburne, Brattleboro, and Randolph, Vermont. I appreciated the commitment and enthusiasm that was evident during my interview with Don Rich, the zoning administrator of Randolph at the time. After his presentation of

Randolph's Capital Projects Board, several economic development projects, and how GIS might be used, it was clear to me that Randolph was the best client for my thesis. I was particularly interested in the fact that Randolph purchased pcArc/Info and, in a cooperative arrangement with Vermont Technical College, had access to a Zenith PC 386 with 150 megabytes, a CalComp 1040 plotter, and Numonics 2000 digitizer. The town subsequently purchased its own personal computer to host Arc/Info.

THE GEOGRAPHIC CENTER OF VERMONT

Settled in 1776, and chartered in 1791, the town of Randolph, with a present population of 4764,* is medium-sized by Vermont standards. Situated in the Connecticut River Valley watershed, the town is in the approximate geographic center of Vermont. It is the largest town in Orange County and the largest within the Two Rivers Ottauquechee Regional Planning Commission's jurisdiction. Randolph's land area of 30,562 acres is characterized by rolling hills and forest and is divided by Randolph Hill, upon which rests Randolph Center. To the east is the residential area of East Randolph. To the west is Randolph Village, the commercial center and most densely settled part of Randolph. Other populated areas are North and South Randolph. The population of Randoph jumped twenty percent from 1970 to 1980, to 4689 inhabitants. In 1990, growth did not result in as promising a figure as the planners and writers of the 1990 Randolph Municipal Plan had hoped. Preliminary census figures indicate the population has stagnated, growing less than two percent to 4764, far less than the anticipated total of 5861.

Agricultural and manufacturing operations, the latter producing furniture, plastics, and grey iron, and educational and health care institutions provide employment for the residents of Randolph. Detached single family homes are the most common form of housing in Randolph. Owner-occupied units represent 68 percent of total housing. About seven percent of all housing units are vacation homes, considerably less than the 27 percent vacation

* The Vermont Municipal and Regional Planning and Development Act, defines "'Rural town' as a town having a population of less than 2500 persons, or a town having 2500 or more but less than 5000 persons which has voted by Australian ballot to be considered a rural town. "

homes in neighboring towns of Brookfield and Braintree (both are closer to ski areas). Housing needs were estimated at 1,691 units in 1980 and at 1,961 units in 1990.

The town is bisected by Interstate 89, which provides direct access to the largest city in Vermont, Burlington (one hour drive), and the capital of Vermont, Montpelier (one half hour). Major metropolitan centers are not far: Boston is a two and one half hour drive south, Montreal a two and one half hour drive north, and even New York City is only four and one half hours away. Numerous large ski areas are nearby. Killington and Pico are visible on a clear day, but not close enough for the town to experience any ski industry related growth.

The town maintains a police force within the village area only, but three volunteer fire companies service the entire town. Public water is available to the village and the town center only. Public sewer serves the village area and selected areas of the center (primarily Vermont Technical College). In 1990, the town maintained 88 1/2 miles of class 2 and class 3 roads. There is currently only one river crossing into the village, often causing congestion. A second bridge and village bypass was recommended in the 1990 Randolph Municipal Plan. The railroad arrived in Randolph in 1848. In 1991, despite considering restoration of service, Amtrak was not providing passenger or freight service to the town.

In 1991, Randolph is facing pressures similar to those enumerated in Chapter Two. The decline in federal revenue sharing and the 1991 recession have forced capital improvements to be put on hold. The roads are in disrepair, the water is impotable, the sewer treatment plant is obsolete, the bridge deteriorating, the school needs replacement, the commercial center needs revitalization, and the town staff (manager and zoning administrator) is unstable.

Town Staff, Governing Boards & Budgets

In the 1990 Municipal Yearbook Randolph's government is classified as a ` council-manager type of government. There are twenty-one elected officials, consisting of town officers, selectmen, listers, auditors, school directors, trustees of public funds, library trustees, budget committeemen, and constables; nine appointees including assistant town clerk and treasurer, town manager, superintendent of cemeteries, director of civil defence, tree warden (town manager), zoning administrator, and fire warden, town service officer (town manager), fire advisory service councilman; and various appointed committees such as a nine-member planning and zoning board; a nine-member capital projects board, a fire advisory committee, a twelve-member solid waste committee, fence viewers, pound keepers, an 'inspector of lumber etc.', a town forest committee, the trustees of Chandler Music Hall, a town recreation committee, a town history committee, and justices of the peace.

In 1991 the following budgets were reported: Highway Department: $897,733; Sanitation Department: $239,386; Police Department: $242,017; general government: $819,541. Computer related hardware, contract services, depreciation and supplies totaled: $28,678.

Randolph Computer Environment

In 1991, the municipal office had five personal computers. They were not networked. One was located in the zoning administrator's office, two were with support staff (primary function: water and sewer billing), one was with the town clerk, and one was with the lister. The support staff was just beginning to use word processing (Wordperfect 5.1) and worked with a dedicated sewer and water billing application (based on dBase III+). The lister's office recently acquired an IBM pc 55sx to host a dedicated tax assessment package (Sigma Computer Assisted Property Tax Administration Program). The Zoning administrator recently received a 386 (150 megabytes of disk space, eight megabytes of RAM, 25 megahertz clock) to host pcArc/Info, a geographical information systems software. Software inventory of the town included: Lotus 1-2-3, dBase III+, Wordperfect 5.1, Sigma CAPTAP, pcArc/Info ver 3.4D.

CAPITAL PROJECTS BOARD

One of my primary objectives was to investigate applications of geographical information systems for use by a rural town community board. I selected

Randolph as a case study because of a recently established board there called the Capital Projects Board. I thought it would be appropriate to observe this board and try to integrate GIS as a planning support system into their activities. The original intent was to observe a rural town board at work before, during, and after the installation of a geographical information system. I proposed to do this by attending all Capital Project Board meetings, interviewing board members, conducting workshops and individual training sessions. I felt it was important to establish close links to the Capital Projects Board. By sharing in the development experience of the system I came to understand the perspective of the town staff and the staff came to understand technical aspects of geographical information systems. This contributed, perhaps, to the perceptions by the board members of the importance we placed on the intervention. We wanted to live and feel the town. It was my desire to be as much like a citizen of Randolph as possible.

The Capital Projects Board (CPB) is made up of three members of the general public and two representatives each from the School Board, the Planning and Zoning Board, and the Board of Selectmen. In accordance with Vermont Statute Annotate Chapter 117 capital budgeting and programming serves two purposes: (1) to provide a business plan for the community and (2) to provide a legal framework for the Selectmen to adopt ordinances to establish "impact fees." The board was formed in 1990 to aid in the planning of Randolph's capital infrastructure. In charge of preparing a *Capital Budget and Program Document*, the CPB was to evaluate and prioritize capital budget projects (proposed by departments and committees of Randolph) by looking at their financial impact, transportation impact, and water and sewer costs with financial impact being the most important criterion. In practice, priorities (Figure Four) were set by using each board member's perception of project necessity and then by project cost. The document was reviewed in February, 1991 by the Budget Committee and the Planning and Zoning Board. The Board of Selectmen convened a public hearing 14 February 1991 to adopt the Capital Budget and Program. On Town Meeting Day, 4 March 1991, citizens approved the 1991 Capital Budget.

In the 1991 Town Report Chairman Linda Stover reported that the board completed its first year very successfully and had developed a "prudent" business plan for the community. The two top priorities, however, storm and sewer separation and new water sources, were not considered for funding in 1991, due to on-going studies by a local engineering firm (Randolph, 1991).

Table Three

1	Gen Govt:	Storm Water and Sewer Separation	?
2	Water:	New Water Source	?
3	Recreation:	Electric repairs and Pump Hook up	$1,950.00
4	Water:	Pipe Replacement	$15,000.00
5	Recreation:	Pool Pump Replacement	$4,860.00
6	School:	Bus Replacement Program	$31,950.00
7	Gen Govt:	Appraisal Hardware & Software	$7,000.00
8	School:	Land Purchase	$400,000.00
9	Sewer:	Plant Upgrade	?
10	Recreation:	2 Pool Ladders	$700.00
11	Gen Govt:	Appraisal Fees	$100,000.00
12	Water:	New Bucket Loader	$5,000.00
13	Highway:	Front End Loader	$90,000.00
14	Library:	Wiring & Window Rehab.	$7,500.00
15	Gen. Govt.:	Ext. Water and Sewer Services	?
16	School:	New School	$3,670,000.00
17	Recreation:	Wash &Paint Pool	$3,770.10
18	Recreation:	Replace Piping & Repave	$22,543.00
19	Library:	Shelving Upgrade	$30,000.00
20	Gen. Govt.:	New River Crossing	?
21	Fire:	20' x 60' Addition	$17,500.00
22	Recreation:	Tennis Lights	?
23	Library:	Painting	$2,400.00
24	Recreation:	Skateboard Area	?

Prioritized List of Capital Projects Requested 1991
(? indicates cost unknown)

INTERVENTION TECHNIQUES

The board held eleven meetings from 12 September 1990 to 21 January 1991 (see complete schedule in Appendix A) and I attended nine of them. On Wednesday, 3 October 1990 and Wednesday, 17 October 1990 I discussed my purpose and presented updates. The board meetings were taped and minutes were taken. Verbatim minutes were essential, and were treated as data to analyze the growth and technical maturation of the board. A learning curve could be constructed by comparing questions that the board members asked at the beginning of the sessions like: "What is GIS (Richburg 1990)?", with those asked towards the end: "What is Arcedit (King 1991)?" It was important to analyze the types of questions asked, when they were asked, and how questions changed over time. I hoped to plot the board members' expectations over the course of the project. The board members developed an understanding of basic GIS concepts during the project: I sent a letter to each board member enclosed with a glossy Vermont GIS promotional flier and a report, GIS Applications in Weston, Vermont (Price 1990). One board member enthusiastically thanked me for sending the report, saying that he now saw the way GIS could be applied in Randolph

I was encouraged from the beginning of my involvement with the town to hear board members and town officials speak of a new sort of management that would be necessary in coming years. The new town manager was flabbergasted to find budgets in utter disarray. Town officials were tired of running the town on an ad hoc basis. Randolph could no longer afford to disregard capital deterioration. The board members cautioned against raising taxes, yet on the other hand they did not want to ignore the capital improvement needs of their town. The board wanted to start off right — no more petty politics and band aid approach to capital improvements. There was a sense that the town was only handling mundane things and not going ahead, being reactive rather than proactive, and not deciding on any major capital improvements in the past 15 to 20 years. Stover felt past management practices proved expensive and that in the long run, the lowest bidder mentality doesn't pay off. The town manager and the board members repeatedly likened the capital program and budget to a business plan.

IF COMPUTER APPLICATIONS MAKE A DIFFERENCE

Historically, rural communities have not analyzed decision-making (Herr 1991). The instance of rural towns using computer applications to model planning scenarios is rare. The instance of rural towns setting policy based on a model is even rarer. One might have assumed the same to be true of Randolph.

It was my intent to have a GIS running during CPB deliberations. Unfortunately the system was not developed in time for the 1990 -1991 board (see Appendix B). Nonetheless, my observation of the process proved useful for understanding the potential uses of the system for next year. Due to the weighty recession, 1990-91 was a poor year to test GIS integration for strategic use by community boards. The deliberations of the board were not contentious. Although Chairman Stover reported that major projects were not being considered for funding due to on-going study, it was clear that money for capital projects was not available. The economic climate stopped implementation of major capital projects. The board had few manual operations to perform during their deliberations, thus any GIS applications would have been of little use. The town has not experienced fast growing sprawl (less than two percent). These events could be considered fortunate; nothing was decided upon without the GIS, therefore when the GIS and the economy are more robust, the board will have a decision support system in place for big capital projects, such as a new river crossing or a new water treatment plant.

The board members did not use spatial information representation on a daily basis, nor do they particularly recall using maps to assist them in past decision making activities. Randolph is rural, readily perceived, and knowable, particularly by native residents; decisions were made through consultations with friends, other board members, and gut feelings — "somehow deep down in my heart I knew what was right (Stover 1990)." Spatial references were made frequently during the meetings, yet during the 1990-91 Capital Projects Board tenure a paper map was consulted only once (21 January 1991) to define school site options and a proposed new river crossing. It was obvious that board members have a relatively keen mental understanding (Lynch's *mental images*) of Randolph's topology without referring to maps. However, with a proposal for a large or controversial project, this might quickly change.

TECHNOLOGY TRANSFER — A GIS FOR WHOM?

I intended to observe a rural town community board at work and investigate automated analysis and mapping for the board. It became apparent that a staff person would be the logical carrier of the system to the board. I spent the first half of the project observing the board; the second half I developed a rapport with the zoning administrator and held one-on-one workshops with him to transfer the technology. In my workshops with Ed King, Randolph Zoning Administrator, several questions concerning the flexibility of the software arose and together we investigated the software to accomplish necessary tasks. We shared in the development of Randolph's GIS and learned together — an important first step, I believe, in developing sustainability of the project.

The town of Randolph, however, did not see paper products (even those in draft) until late March. To be fair, I did not produce a map as quickly as would have been ideal for the CPB process. Numerous accounts in the literature point to the importance of getting maps out early to make things visible. However, there was a wealth of maps (blueprints from the regional planning commission) already available to the town, and although maps produced by the GIS would be nice, initially it was not entirely necessary. I was hoping to get the zoning administrator involved in map making and spatial analysis; in that sense it would truly be his work product, his investment in the learning curve and time, and his local perspective and not mine. At the time of this writing, the zoning administrator was neither making maps nor using Arc/Info. Although I worked with the town since September, 1990, and this thesis is being written eight months later, the zoning administer still did not have an adequate amount of training to use Arc/Info. The transfer of Arc/Info skills necessary to do sophisticated spatial analyses did not occur.

Despite on-going training sessions, Randolph is the only town in the state to have an impressive array of hardware and software at the town planner's disposal. "That's the way it should be," exclaimed Town Manager Don Rich. Randolph also had the most complete data coverage in the state of Vermont, developed virtually outside of the town: parcels, soils, road centerlines, surface water, zoning, wells, well head protection areas, natural heritage, hazardous wastes, political boundaries. The town's purchase of pc Arc/Info and a 386 pc contributes, I thought, to the desire to learn about and understand the potential of the GIS — $9100 is a substantial sum that instigates more than just a passing interest. Data was provided by the state at no cost to the town. Most digitizing went out to contractors: parcel line work promised by December arrived in April — that should be expected. Geographic Data Technologies, Inc. did the road line work and surface waters (received September, 1990) , Smartscan did the parcels (received March 1990), The School of Natural Resources at the University of Vermont did the soils and natural heritage (received December, 1990).

Interviews of Board Members

Pursuant to Robert Yin's methods on early networking, I interviewed six of the eight board members individually on 26 and 30 October 1990 (Yin 1984). I selected three or four individuals to interview twice during the project. It was clear from my initial interviews that without Town Manager Don Rich, a GIS aficionado, the board members felt the GIS project could not have survived. His commitment and knowledge of GIS had a significant impact. All board members interviewed found the concept of GIS intriguing. They envisioned several analyses and applications that could have been of great assistance to the board. The initial questionnaire followed (a semi-structured interview format) the one provided in Appendix C. I made it clear that I was there to serve the board and I sought their input. I expressed my concern that Randolph's geographical information system might not be strategically used in the deliberations of the board due to incomplete data development and the type of activities the board undertook.

One of the most pertinent interview comments was board member Steven Springer's suggestion that my role would be ancillary if the Capital Projects Board were not to play a long-range planning role (Springer 1990). He felt that only when the CPB starts planning in a long term capacity will there be any use for GIS.

Upon hearing my explanation of GIS and its capabilities and potentialities in Randolph, Chairman Linda Stover exclaimed, "This is totally awesome (Stover 1990)." However, she cautioned that if Randolph is not the model of success it may be the example of failure. Linda Stover felt that a lot of people in Randolph have no idea what their town looks like. She expressed the view that the provision of services will dictate what the town will look like. In the 1991 Town Report Mrs Stover wrote "[GIS] far exceeds the realm of capital projects."

Board member Ed King felt that even though the citizens drive the roads day in and day out, nobody volunteers to do anything about their condition. He hopes to make a difference. He stated, "I really think [GIS] is going to be great, especially if individuals can get directly involved in it and be able to see results. When they see what they can do with it I think they will get more excited about it (King, 1990)."

I presented examples of GIS applications in New England. Board members expressed concern for the invasion of privacy. They thought that GIS applications in Newton, Massachusetts were going to far when parcel polygon attribute tables had information on whether pets were spayed. This application Ed King likened to "buying the Rolls Royce when all we need is the Chevy."

Geographical Information System Presentation

After my introduction of basic GIS principles at the board meetings, I organized a workshop on GIS concepts and applications on January 7, 1991 at Vermont Technical College. My objective was to demonstrate real-time analyses and provide hands-on experience to the members of the board using Randolph coverages. Demonstrating a high level of interest, 15 people attended the workshop: all eight members of the Capital Projects Board; three members of the Planning and Zoning Board; four members of the Board of Selectmen; the Regional Planing Commissioner; the director and staff of the Vermont Office of Geographic Information Services (OGIS); the town manager and planning and zoning administrator, plus one person from the planning board of the neighboring town of Bethel. The director of OGIS was impressed with the large turnout. Conversations with the town manager following the workshop indicated the desire of the town manager and, in fact, the necessity for other town staff to use the Randolph GIS.

The workshop lasted two and one half hours. I started the workshop by showing a 15 minute video titled *GIS ARC/INFO: The Total Geographic Information System,* produced by the developers of Arc/Info, Environmental Systems Research Institute, in 1989. The video illustrates several applications of GIS in real world situations and the numerous advantages of having digital data. The video fails to represent adequately, however, the complexities of digital databases and mapping. Nonetheless, it was a good introduction to GIS terminology and use in municipal government. After the video, I introduced the participants to Randolph's existing digital coverages (roads, soils, water, zoning, natural heritage, and wells) and displayed seven different mapping scenarios on the computer monitor. This demonstrated to the participants what is entailed in preforming some of the analyses demonstrated in the video. Some scenarios were simple; for example, a map of Randolph road centerlines delineating the classes, or a map of Randolph surface water. Others were quite useful; for example, mapping Randolph's road maintenance history for the past five years. I then conducted a detailed development suitability analysis for the town's new mixed use development (MXD) zone. I based development suitability on three simple criteria: distance from roads, distance from surface waters, and slope.

The participants were excited by the presentation. It helped catalyze and instigate discussion about the quality of water as a result of certain developments, the spatial patterns of surface waters as a result of previous development, the location of public well heads and aquifers relative to preexisting or future development; concerns for development occurring outside the town but which affects Randolph's aquifers. Many members of the board expressed interest in getting their hands on the machine to play around with the coverages.

GIS Applications Envisioned

Even before the GIS workshop, the board members and town manager envisioned many applications. Ideally Randolph would have electronic information and applications readily accessible. Board members were quick to visualize several applications that illustrated a high level of sophistication on their part. The following is a list, classified by Huxhold's functions, I compiled from the interviews, the workshop, and the board meetings since September:

• **Operations**
track the history of road maintenance; link sewer, water, and tax receipts to location; map new construction; map fire hydrants; send notices to parcel abutters; map water and sewer lines; map house footprints, map storm drains and road culverts.

• **Management**
locate land available for development; identify septic and water system for each home; identify aquifers for purchase; locate cluster housing sites; determine emergency response times; propose scenarios for new sewer system; locate new sewer plant sites; traffic assignments; rank road conditions on a scale of one to five.

• **Policy**
track growth patterns; plan sewer and water services; encourage preservation of open land; analyze buildout; plan emergencies (fire protection, ambulance services); plan new river crossing; film roadside views and signage (viewshed analysis).

It was easy for the board members' initial expectations of the GIS to exceed the software's capability or the present state of development of the data layers. Randolph was a long way from performing many of the analyses identified by the members of the board, or from producing the maps they had come to expect. Ed King and Don Rich both challenged the power of current software to segment the road network to identify culvert, fire hydrant, and sign locations. Ed King questioned his ability and the capability of the software to perform accurate subdivision upgrades. Pat French, town lister and member of the Board of Selectmen and Capital Projects Board, raised questions about whether the system could produce tax maps with which he was familiar (cadastral line work laid on top of orthophotos). In several instances during the course of the 1990-91 Capital Projects Board meetings, members raised questions concerning the integration of GIS in planning other municipal projects such as the engineering study on water, or in the study on assisting emergency response systems. It was easier for board members to visualize the GIS as fully operational than to imagine the complexities of data development and maintenance, map making, and technology transfer. As can be seen in Appendix B, the board was not prepared to base decisions and set policy on computer generated spatial analysis — coverages were not ready.

AUTOMATION?

The Town of Randolph is currently not automated. Graphs are still produced by hand, databases still queried manually, zoning permits still tracked by hand, and map upgrades still done by outside consultants. Although spreadsheet applications and database managers have been available to the zoning administrators office since 1989, they are not used. There is a psychological perception of computers, systems, and technology and its inherent complexity that makes the matter of computing seem dreadfully difficult. Printing a Word Perfect document leads to shouts of disgust about the new computer system and how the typewriter would have been easier to use. There is a distrust of new systems. The new sewer billing system wreaks havoc with administrative assistants who find themselves on the telephone line ad nauseam with the tool providers. In my view the project, i.e., the geographical information system, is not implemented if the town continues to be reliant upon outside consultants to do the greater bulk of their work. It is clear that a technical facilitator, information manager, or technical staff, will be indispensable in sustaining the geographic information system of a rural town.

Organizing Data Sharing and Use of the System

It will be important for the Town of Randolph to take advantage of their data status and hardware and software configurations. The task of integrating and coordinating the data are enormous. Randolph will have to plan how it proposes to achieve the applications it has envisioned. Significant change in the town of Randolph will, by necessity, originate within the town. Connectivity and transferability of consultant studies and other information will be important. Digital data compatible to the Randolph GIS should be explicitly required of all contracts with consultants, and the town should specifically retain the digital data as its property. The mistrust by townspeople and town staff of state and regional planning officials, or for that matter, of any outsiders negates some of the potential of these outside groups. Local experts, and there are many, will determine the acceptability of spatial information analysis. Using and taking advantage of the Randolph GIS coverages will not occur overnight, yet the town should know the data standards and formats that are necessary. Even at the time of this writing numerous applications could be applied; a consultant, for example, did an industrial park study that could have used the soils coverages yet did not.

SUMMARY

While the Capital Projects Board did not use geographical information systems this past year, my experience proved interesting and highlighted several issues that should be addressed. Randolph currently has the most robust data coverage in the state of Vermont, yet no one will be able to access the data without further training. Ironically, Randolph is one of the only towns in Vermont that is close to using a GIS. The easy stages of GIS have already been accomplished — the Board of Selectman has already purchased the hardware and software, the state has provided the coverages. The harder task now facing the town is assigning someone to be responsible for the maintenance and support of the Randolph GIS.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

It is difficult to evaluate Randolph's GIS when it is just beginning. My objectives to go "on-line" with GIS at community board meetings to analyze the effects and value of digital information and representation went unfulfilled. Digital spatial analyses never supported decisions at a board meeting. Perhaps next year's board meetings will use GIS, but this year's did not. Several things went wrong in the town: the board did not have extraordinary, or contentious choices facing it; the current recession slowed capital projects; and the town did not experience rapid growth — and several things went wrong with the GIS — digital coverages were not complete; town staffing for the GIS was uncertain; and hardware was purchased late. Despite these factors, Randolph's GIS was started and the town is the current leader in Vermont data coverages. Randolph's work, however has just begun and it must take advantage of its data status and maintain its system.

This chapter briefly reviews earlier chapters and then reflects on whether in-house GIS makes sense for rural towns; what the relationship of sophisticated data integration is to town management and, if significant, what the likelihood of fiscal and personnel resources being available is; and what role the state and the regions should play. The chapter concludes with recommendations based on my experience in the town of Randolph.

REVIEW

Chapter One: Research Methodology

It was important for me to investigate the use of information and computers in planning. Chapter One reviewed several conceptual frameworks of information and computer model usage and concluded that the challenge for geographical information systems is to inform and enhance, but not replace, local residents' image of place. I was concerned that the information compiled by the state GIS would be of policy use only by the state and not the localities. I offered an alternative to Huxhold's Municipal Information Pyramid for use by a rural state, where each level of government — state, regional, and local — has a share in policy decisions affecting the state GIS (Figure Two). Chapter One also discussed usage of computers as decision support systems. Dutton and Kraemer provide several approaches to model use. I hoped to follow Dutton and Kraemer's consensual approach, and use GIS for hands-on modeling and shared decision-making in rural towns.

Chapter Two: Rural Towns

Chapter Two discussed rural towns and the multidisciplinary approach of rural town planning. There is difficulty in applying information technology to the already complex environment of rural planning. Britton Harris provides encouraging words for computer based planning and recommends that a geographical information system be placed at the heart of a planning system. However, he cautions that consensual decision-making may not provide accurate measurements of goals. Training and staff turnover make GIS integration difficult and information demands are far greater for a transient staff than stable staff.

Chapter Three: Vermont GIS

The Vermont Office of Geographic Information Service has made spectacular headway in developing the nation's first truly multi-organizational, multi-governmental parcel-based geographical information system. Data coverage efforts have been coupled with technical training sessions and conferences. The Vermont Office of Geographical Information Service maintains an excellent library and makes pertinent articles available to the general public. Books, manuals, conference proceedings, and reports are also available on a sign-out basis. OGIS is developing a handbook on data standards, access, pricing, and policies. Technical notes are also being produced in collaboration with some of the Regional Planning Commissions and draft copies are available. These resources offer excellent assistance to municipalities or other interested users. Technical assistance is also available. Vermont's GIS developers made a wise decision to develop data at scales large enough for the municipalities to use.

Despite these advances, Chapter Three concludes that Vermont GIS maintains a relatively rigid technocratic perspective that fails to take into account the rural town as an *active* end-user. In partial response to this, a lawsuit has been filed and legislation has been introduced to provide greater access to electronic databases. Ironically, OGIS is dependent on localities support to maintain data and without a more consensual approach any efforts to date may have been for naught. Röling stresses the importance of technology in enhancing the "goodness of fit" between the information represented by the technology and the user's knowledge of place and of the synergistic effects when state, regional, and local practitioners work together. OGIS did not consider towns fewer than 2,000 people would plan to develop in-house GIS; nonetheless, as the examples in Chapter Three attest, rural towns *are* planning to use GIS and *do* display a high level of sophistication in the analyses they intend to perform.

Chapter Four: Randolph

Chapter Four discussed Randolph, Vermont. The town may be considered an atypical case study. It is bigger than most towns in Vermont and was undergoing administrative changes at the time of study, making the town management relatively unstable (three managers in one year). The person that was being trained in Arc/Info is no longer working for the town. However, much like many other towns in Vermont, Randolph is experiencing difficulty in maintaining its infrastructure. Randolph's roads are in disrepair, the sewer treatment plant is obsolete, and the water is impotable. Despite this, *planning* grants were made available with which Randolph purchased the state-of-the-art in hardware to house a GIS software package. To date, Randolph has the most complete set of electronic data coverages in the entire state, but no one on the town staff has yet been able to access the data and use it as a decision support tool. Randolph GIS developed without anyone prepared to run it. Nonetheless, the members of the Capital Projects Board envisioned several sophisticated GIS applications for policy, management, and operation functions of the town (see page 60).

REFLECTIONS

Assuming that GIS plays a role in rural town planning, what is the relationship of sophisticated data integration and town management? What is the likelihood that fiscal and personnel resources will be available? and what role should the state and regional authorities play?

Does GIS make sense for rural towns ?

I have assumed from the beginning of this research that GIS applications will be useful to rural towns. GIS may offer both a quality of information that did not exist before and provide a fresh perspective on mental images that have been long held. GIS should not only replicate a person's mental image of place but also uncover hidden forms often glazed over and encourage new understandings about place. While I avoided investigating the effects computers had on organizations and people, studies indicate that computers do save time and provide for a more efficient work force (Zuboff 1989; Dutton 1986). "There is little question that microcomputers are having a significant impact on the planning profession (Klosterman 1987)." The state of Vermont has made a significant investment of time and money to develop data layers at a scale large enough for municipal functions. OGIS was eager to encourage the use of its system to sustain it in economic hard times and to generally proselytize its use: GIS applications, they say, are *good* tools for planning and management of Vermont communities. Unfortunately, most rural town practitioners are not trained in advanced computer applications.

What is the relationship of sophisticated data integration and town management?

There is a great difference between traditional planning techniques and computer based planning systems using GIS. Even though most rural town officials do not use electronic spreadsheets they do use maps, especially cadastral maps and tend to use them daily. Geography itself is a common reference used by virtually every activity in local government (Huxhold 1990). GIS might offer real intrigue and usefulness to the rural town planner by bringing together more than one map at a time (cadastral, soils, and zoning for example) in a flexible format. Never before has such disaggregate data been available. As mapping workshops have been shown to be extremely powerful in integrating GIS concepts at the local level, the common thread between traditional planning techniques and automated techniques might be geography and spatial reference. As readily perceivable and needed, this commonality might provide the incentive to use and maintain a GIS.

The list of generic municipal tasks (Table Two) and the list of potential GIS applications (Table One) indicate a significant relationship between the tasks on the one hand and the applications on the other. The Capital Projects Board in Randolph provided sophisticated analyses they wanted the town to perform. Given the complexity of GIS one might assume, however, that towns will only use GIS for making maps (see page 38) and will not obtain the sophisticated, and more significant to town management, policy analyses found on page 60. While the question of the relationship between GIS and town management may be easily answered, it is not clear that sophisticated data integration produces better town government — better information may produce better government.

Is it Likely that Fiscal and Personnel Resources will be Available?

If the state or the regional planning commissions believe that rural towns are capable of and should develop an in-house GIS, then they will have to convince rural towns that it is worth their investment of time and personnel. The previous section delineated incentives to use GIS, yet most rural towns in Vermont still do not have what David Healy refers to as the critical mass in finances and personnel As OGIS has made clear, the Vermont GIS will have to be developed from an initially large cash infusion to the towns (OGIS was originally allocated $ 4.75 million). Without the financial support from the state, it is doubtful any rural towns would have digital coverages. Randolph provides a good example however, despite state grants, that several problems might occur, like staff turnover and late data development (Appendix B), GIS has yet to be used, and no personnel can run it. The likelihood that resources will be available in the future regardless of complete coverages, stable staff, and incentives is difficult to ascertain. Given impact fee assessments might provide the fiscal resources it may still be difficult for a town to justify a GIS professional, when a planner or manager might be more cost effective. The stronger the relationship between sophisticated data integration and town management the better the likelihood.

The greatest obstacle facing rural towns is locating or training personnel to maintain the system and update the parcel coverages. My one-on-one training sessions in Randolph were insufficient to insure sustainability of the project. Despite my presence for almost eight months, more will have to be done. Staff turnover may threaten the sustainability of the Randolph GIS. GIS may have a role in the "complexity, instability, and uncertainty" of rural planning, yet it will not be assumed overnight. The challenge, once the system is installed, will be data maintenance and upgrades, and this will only be facilitated by incentives and the "goodness of fit" of sophisticated data integration and town management. Randolph must plan for the management and maintenance of the system.

One of the greatest obstacles facing the Vermont GIS is funding. At the time of this writing, funding for the 1991 fiscal year was uncertain. The Vermont General Assembly was considering budgets ranging from $55,000 to $280,000. (The General Assembly initially allocated one million dollars in 1988). Other obstacles, such as towns mistrust of state and regional authorities, updating the data, particularly cadastral data, access to data, and fee structures, may prohibit a truly multi-organizational GIS to occur.

What is the role of the State and Regional Planning Commissions?

Given the advances of Vermont GIS to date, and despite budgetary constraints, one may delineate some levels of progression OGIS and the Regional Planning Commissions may pursue vis-a-vis rural towns in the 1990s. As mentioned above, towns have little hope for using GIS without tremendous assistance by the state and other strong incentives. The minimum level for OGIS and the regionals might be to maintain the status quo and continue to provide annual or biannual intensive technical training sessions and conferences, to keep GIS Service Center contracts with the Regional Planning Commission, and to continue allocating grants, in conjunction with other state agencies to municipalities. The next level might be to develop even greater rural community outreach (assuming GIS makes sense in rural towns) and assign a state or regional circuit rider or technical facilitator for rural town extension. Vermont GIS Advisory Board might designate local subcommittees and broader municipal representation on its board. The third level might be to actively encourage rural town participation and local in-house capacity. OGIS might offer cash incentives and/or extensive software compatibilities for towns to update and use the GIS. OGIS might also sign a contract with municipalities who do have the "critical mass" to become regional service centers and municipalities might assign local GIS committees.

RECOMMENDATIONS

This section provides recommendations to the Town of Randolph, the Vermont Office of Geographical Information Services, and other towns considering GIS.

Recommendations to Vermont GIS

Vermont GIS, dependent as it is on the end-user for the maintenance of local data, must institutionalize the GIS in a way that takes into account, and involves and encourages rural town participation in formulating policy and technology dissemination activities of GIS to the greatest extent possible. Incorporating rural towns in such a manner will insure the availability of up-to-date cadastral information. If GIS is to be successfully institutionalized, if it is to help Vermonters visualize choice, the technology must be molded for the end user.

Without a doubt, OGIS is in an unenvious position in 1991, facing wary towns and 95 percent budget cuts. Nevertheless, if OGIS wants rural towns to develop in-house GIS capacity, it should assume a more consensual perspective, as Dutton and Kraemer delineate, on geographical information systems.

Although some subcommittees have been established by the Vermont GIS Advisory Board, I highly recommend the establishment of the Regional and Local Subcommittee, as PlanGraphics outlined, to assist with both regional and local needs. Also a subcommittee on education and outreach should be formed in order to encourage technology transfer to regional and local governments.

OGIS or Regional Planning Commissions should carefully consider full time professional circuit riders to troubleshoot and provide technical support and outreach to towns that develop in-house GIS capacity.

Since budgets are tight, OGIS should do everything possible to alleviate its burden by supporting the development of municipal GIS. OGIS should encourage each town with a GIS interest to assign a municipal GIS coordinator to act as liaison with the Regional Planning Commissions or other towns. OGIS's current model of 12 Regional Planning Commission acting as GIS service centers is commendable and results to date make it seem effective. Towns, however, that do develop in-house GIS should also be considered as GIS service centers for several reasons: towns are closer to each other, towns trust municipal government more than the regional government; and towns face familiar issues and similar agendas. The Regional Planning Commissions' role should not be diminished nor discouraged. They should continue to design training programs and provide services for municipal users.

OGIS should continue and encourage reviews on alternative software and hardware that will make GIS more accessible to communities. OGIS Technical Paper #3, Desktop Mapping/GIS Software Review, offers a good survey of four commercially available software packages that are considerably less expensive than the OGIS standard. Unfortunately, the Vermont GIS handbook, *GIS System Hardware & Software Specifications,* Part 3 - Guidelines (VGIS 1991), gives little indication that any software other than pcArc/Info is available or acceptable. Data conversion to other software is not be trivial matter and OGIS should make a greater effort in this regard.

OGIS, while behaving graciously in its one-time Special Parcel Mapping project, should realize that maintenance of local governments' data will determine the success of Vermont GIS. VGIS should not expect to be accountable for every locality's information. Cash incentives, potentially funded by a GIS impact fee, should be considered to encourage local data maintenance.

OGIS should continue to support graduate/undergraduate thesis students who work with municipalities, state, or regional agencies as technical facilitators. The students may provide VGIS with an interim GIS circuit rider, one who is continually on the road troubleshooting for towns, or the "visiting GIS assistance units" described in the PlanGraphics report. Currently there are only two or three GIS related theses written each year from the School of Natural Resources at the University of Vermont. Other state schools have yet to graduate any GIS specialists, but efforts are underway to incorporate GIS into the curriculum.

Recommendations to Randolph

Randolph's efforts to create the most complete set of data coverages to date in the state of Vermont should be commended. It will be important to take advantage of this status to sustain GIS use and maintenance in the town of Randolph. Randolph must develop a strategy in order to accomplish the applications envisioned on page 60. Interest in Randolph GIS is currently high (see page 58). Efforts should be made to incorporate the activities of all town boards in its use. Applications are numerous for the Selectboard, the Planning and Zoning Board, and still significant, even though less numerous, for the Capital Projects Board. Many decisions by the Board of Selectmen might be supported by the Randolph GIS, as can those of the school board and the solid waste committee. The deliberations at public hearings, not to mention town meeting, might all potentially benefit.

Randolph should consider becoming a service center for neighboring towns, with the aim of recouping some of its costs. Coverages developed by the state in Bethel, Braintree, and Tunbridge will require service, yet these towns may not want to use the Regional Planning Commission. If neighboring towns do decide to use the Randolph GIS, it may provide a great opportunity for inter-town planning.

Randolph should not ignore, and may rely on, the Two-Rivers Ottauquechee Regional Planning Commission, consultants, or extension services provided by the University of Vermont for technical support. Randolph might also rely on a circuit rider assuming that one will be assigned, as described earlier, to trouble shoot any system problems that may occur.

The most important decision facing Randolph will be whether or not to hire a person with GIS experience or to train in-house personnel. There are several personnel options for a town like Randolph: It may hire a professional staff to run it — a $30,000 average salary may seem excessive and beyond the reach of most towns (however, Randolph's zoning administrator's salary was $33,000 and the town manager's close to $40,000) — or it may choose instead to train in-house personnel. More than one person might be considered for training to insure against the loss of system memory and information in case of staff turnover. People not part of the town staff, like board members, might consider training in GIS in order to use the information available for deliberations of their board. My experience proved that even though the person I was training no longer had a job with the town, he still wanted, as a member of the Capital Projects Board, to continue his training sessions. Despite staff turnovers there still may be a capacity for board members and/or citizens to use the system. Even so, Randolph should be prepared to devote at least a half-time worker to GIS maintenance and use.

Cost recovery may be the second most pressing issue for maintaining the Randolph GIS. Impact fees might be assessed to new development to cover the cost of parcel updates and any road, sewer or water line work.

Integrating Randolph GIS with current contract work (sewer and water), which is currently being done by an engineering firm, and all future contract work should be given high priority — all contracts with the town of Randolph should explicitly require digital copies of line work and attributes in a format compatible to pcArc/Info.

As growth occurs, maintenance will be a serious chore in Randolph's GIS. Subdivisions should be edited in the parcel coverage, assessor's data from the Computer Assisted Program and Tax Assessment Package will have to be periodically downloaded and brought into the Randolph GIS. PlanGraphics recommended, and Randolph might consider, that towns establish a GIS committee to facilitate data integration, sharing, accessing, and pricing and a GIS liaison, as mentioned above, to work with the state and regional authority.

Recommendations to Vermont Towns considering GIS

It is difficult to envision a town using computer technology for geoprocessing when it has yet to use it for word processing. Towns face enormous obstacles in using GIS actively and sustainably: towns cannot afford GIS personnel to run the system; towns cannot afford the hardware and software to run the system; towns cannot afford to develop and maintain data layers that will be necessary for a robust GIS; towns do not have the capacity to to understand GIS; town staff turnovers may occur far too frequently to permit an established GIS; town legislative bodies have difficulty ascertaining the marginal value of a GIS: for example, is it worth a half time professional, who may be far more effective as a full time manager or planner?

Towns must determine how much they are willing to spend on GIS services performed outside the town by the Regional Planning Commissions or private consultants. By analyzing their mapping budgets, Regional Planning Commission fees, and private consultant fees, towns may seriously consider what economic resources are available to hire or train an in-house GIS. How much does, or will, a town spend on maintaining and using out-of-town GIS services, and how much will it cost for them to develop their own in-house capacity? Although the field is far too new to tell, I doubt that in the long run contracting out GIS work can be cost-effective to the town. I would like to see all towns develop in-house GIS capacity. It does not take a technocratic wizard to run Arc/Info, just patience, time, documentation and some technical support.

For towns that do choose to develop an in-house GIS, in-depth training sessions will be necessary for the town staff or a professional hired so that the town is capable to prepare, maintain, and use a digital database. Once towns are facile with GIS then the state and regional planning commissions will be held more accountable for their actions.

Towns should be certain to coordinate automation activities and request digital copies of all contract work done, hard copies don't go far when the database is electronic. GIS must be integrated across all the town boards and the Regional Planning Commission.

Towns should become a *"node"* on the Vermont GIS network and receive their mailings, use the Vermont Office of Geographical Information Services located on Main Street, in Montpelier, and peruse their library and pick up the latest articles of interest, OGIS technical notes and other publications. Towns should take advantage of Regional Planning Commissions and get the latest macros, legends, and tips.

If a town plans to use pcArc/Info, it should be certain to join the Vermont Arc/Info user group. There are several publications, available free to municipal officials, that should be subscribed to, such as GeoInfo Systems, Government Technology, and Arc News.

SUMMARY

This thesis probably will not dispel any fears practicing planners have concerning GIS integration in rural towns. It may bolster greater fears. Although I was unable to chart the effectiveness of the technology on the deliberations of the board, my experience confirmed that rural town GIS integration is a very complex and long term venture. Training sessions accordingly should be multiple and reiterative. Someone will have to run and maintain the system and incentives, such as cash or easy to use front ends, will have to be in place. The value of the impact of information and the extent to which GIS reduces time required will have to be determined at a later date. This thesis was intended foremost for rural Vermont towns. By serving as a progress report on one town which is becoming automated, I hope it will guide the development of the GIS in other rural towns. If Vermont GIS is to truly excel as a multi-governmental GIS it will be important for the Office of Geographical Service not to underestimate or forget the capacity of the people at the local government to govern themselves, or take an even greater responsibility in the future than at present for the development and maintenance of the data they find most useful.

APPENDIX A

Intervention Schedule

Date	Person/Purpose	Comments
6/20/90	David Healy	project discussion
6/23/90	David Healy Bruce Westcott	VGIS Workshop at Vermont Technical College
8/07/90	Don Rich	Project Interview
9/12/90	Capital Projects Board Meeting	Introduction
9/20/90	Ken Stevens,VTC	Use Computer Laboratory
10/03/90	Capital Projects Board Meeting	What is GIS and what does it do?
10/09/90	Don Rich, Eric Edelstein, Don Bourdon	Regional Planning Commission, GIS
	David Healy	Interview
10/17/90	Capital Projects Board Meeting	GIS Review, Sewer CIP
10/26/90	Stephen Springer	Interview
	Linda Stover	Interview
10/30/90	Patrick French	Interview
	Virginia Richburg	Interview
	Ed King	Interview
	Jim Maloney	Interview
	Don Rich	Interview
	Capital Projects Board Meeting	Library CIP,Listers, GIS update, Fire Dept CIP
11/07/90	Capital Projects Board Meeting	Water CIP,Highway CIP, Recreation
11/08/90	Ken Stephens	VTC, plots
11/19/90	Capital Projects Board Meeting	School CIP,Listers CIP
11/20/90	Ed King	At VTC, GIS training
12/03/90	Capital Projects Board Meeting	Prioritization Workshop
12/06/90	David Healy Bruce Westcott	GIS Conference Woodstock Vermont
12/10/90	Capital Projects Board Meeting	did not attend
12/17/90	Capital Projects Board Meeting	did not attend
1/07/91	GIS workshop	15 town officials attended high interest
1/08/91	Bruce Westcott David Healy	Project champion vs consultant, six days of technical training necessary
	Ed King	GIS training
1/14/91	Capital Projects Board Meeting	
1/21/91	Capital Project Board Meeting	Final Discussion of Prioritized List/ preparation for public hearing, first time map consulted
2/14-15/91	VGIS Conference	parcel abutter notification demo by ESRI Danvers
2/18/91	VTC	Randolph Data Demo
3/04/91	Town Meeting	"If we wish to manage we must be able to measure"

	Don Rich	Status Report quote "Rome wasn't built overnight"
	Ed King	
	pc CAPTAP	download parcel attribute records
3/14/91	Pat French	pc CAPTAP; download records
	Linda Ferris	
	Wendy & Sandy	copying WP5.1 files
3/21/91	David Healy	data status, Vermont boundary files picked up
	Ed King	daily chores; GIS applications, cost of training, water routes decline consumption
	Linda Ferris	dbase, word perfect printing, automation planning, police word processor
	Pat French	total parcels, mobile homes
	Don Rich	data status
	Meeting	Planning and Zoning Industrial Park Study
	pc CAPTAP	download records

APPENDIX B

Time Schedule

1990-91	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Board Activities CIP Requests	Intro Arc/Info Purchased	Sewer Library Listers Fire	Water Highway Recreation School	Prioritize Decisions	GIS Demo Final Board Mtg	Public Hearing	Town Meeting	Hardware Purchased
Data Coverages								
Road								
Surface Waters								
Soil								
Zoning								
Well Heads								
Parcels								

APPENDIX C

Interview Questionnaire

Randolph

What are the most pressing issues facing your town in the next five years?

What does planning mean to you? What role, if any, should the town play? The state?

GIS

Had you heard about geographical information systems before? What was/is your initial reaction?

Knowing what you do about GIS, do you foresee any strategic uses of the GIS in the deliberations of the board?

What effect(s), if any, do you think the GIS will have on the board? On you?

Do you think suitability analysis, site selections, infrastructure line analysis, or buffering of sensitive areas appropriate analyses for the board to consider?

CPB

What would you like to see the board accomplish?
What do you perceive as your particular role on the board?

In your view, what would make your role easier? What would make your role most effective? What would get in your way?

Some people think that organizations learn. Do you think that is true? If so, what do you think the organizations with which you have worked learned? What have you learned?

What is the extent of your experience in municipal government? How many boards have you served on?

Have you ever run for political office? If so, which one?

In your experience, how do boards make planning decisions?

How often have maps been consulted in the deliberations of the board meetings?

Do you find maps useful in the deliberations of the board? What other data/models have you found useful?

What was/is your initial reaction to my presence on the board?

Please summarize what I propose to do in Randolph.

What was/is your initial reaction to what I propose to do?

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