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Managing a whole economy: the contribution of GIS

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Most government bodies now have economic development strategies to enhance the wealth and the quality of life of their citizens. A number of them are basing these strategies – and the actions which arise from them – on the use of Information Technology (IT) to make data, information, and knowledge widely available in forms which foster learning, enhance public policy, facilitate business decisions, and enhance private/public sector collaboration.

A prime example of this type of action is that of North Carolina, which has had strong IT-based development policies for over 20 years and was the first government body in the world to have an operational asynchronous transfer mode-based (ATM-based) telecommunications infrastructure (in August 1994). The North Carolina Information Infrastructure policy is intertwined closely with the State's economic development policies; both involve public/private sector partnerships. Much of this policy development has a geographical dimension. For instance, a concern with equality of opportunity has led the State to attempt to provide equitable health care and education across both rural and urban areas: one manifestation of this is that users in both areas pay the same tariff on the ATM telephone network. GIS has played an important role in the development of strategies, the assessment of development options, and the implementation of the strategies: it is a widely used part of the central information infrastructure. Here it is argued that the success of these strategies is demonstrated by the substantial inflow of foreign investment into North Carolina, the low levels of unemployment, and the transformation of the economy from one based largely on primary industries (notably tobacco) to a much more diversified, thriving, and entrepreneurial one.

1 INTRODUCTION

The Information Age has changed the nature of commerce: it has provided the opportunity for all to become creators of goods and services, almost irrespective of location. In the Infomedia age, the concept of virtual presence is itself becoming a reality. As a result, those nations and states which are first to enable their businesses, educational institutions, and governments to operate online, to work together, and to operate in conjunction with the best people worldwide will become the leaders of the global economy for the first half of the 21st century. North Carolina has sought to do just that, notably through technology-focused economic development.

North Carolina is the tenth largest state in the United States. It has more than seven million people who live and work – from the mountains in the west, to the Piedmont, across the coastal plain, and to the Atlantic Ocean in the east. Over the last 35 years, the State has changed its economy from a reliance on textiles, agriculture, apparel, tobacco, and paper and allied products to one based on industrial machinery and equipment, chemicals and allied products, transportation equipment, and electronics and electric equipment. Table 1 compares the old and the current structure of the North Carolina economy and shows the improvements which have occurred. In late 1996 this economy was one of the four national 'hot spots' for high technology growth,

according to Cogentrix Consultants. It has an average unemployment rate of 4.2 per cent when the national average is 5.4 per cent. The gross state product is US$141 billion, ranking twelfth in the USA. In 1995, North Carolina exports were more than US$8.93 billion and imports were US$8.76 billion: thus the State had no current trade deficit with the rest of the world (North Carolina Department of Commerce statistics, as recorded in 1996). Moreover, North Carolina is the bearer of a triple-A bond rating for the effective management of its fiscal affairs. Only four other states have received this rating by all three national rating agencies. It has been rated the best place to live, raise a family, and work by magazines such as *Money*, *Fortune*, *Financial World*, *Forbes,* and *Plants, Sites and Parks Magazine*.

This success has not been achieved by accident. For instance, North Carolina has directed more state general fund dollars into technology than any of the other 50 states, and ranks fourth in per capita spending for technology. But more generally, technology-focused economic development has played a major role in this substantial economic change and fostering the technology remains central to all policy-making. In 1992, for instance, the Government Performance Audit Committee (GPAC) of the North Carolina General Assembly identified many economic and structural factors within the demographics of the State that might impact on its financial health, including three major trends: slower growth in revenues, increasing spending pressures (e.g. the costs of Medicaid, prison overcrowding, growth in number of school age children, investments in elementary and secondary education, needs of the university system, changing skill needs of the workforce, and the ageing of the state population) as well as constant change (Patterson and Smith 1994). GPAC made more than 350 recommendations to minimise the effects of these trends, a key group of which involved exploiting improved technology.

The Office of the State Controller in 1993 also noted a number of very disturbing trends that would affect the prospects for continued economic growth

Table 1 North Carolina's economic structure: measures of change.

Measure	*North Carolina*	*US*
Per Capita Income (adjusted for inflation)		
1973	$13,926	$16,793
1995	$21,103	$23,208
Average annual change	1.9%	1.5%
Total Real Gross State/US Product		
Average annual change 1977 – 1992	3.3%	2.5%
High School attainment (% over 25 with diploma)		
1981	62.7%	69.7%
1995	76.3%	81.7%
College attainment (% over 25 with degree)		
1981	16.7%	17.1%
1995	20.6%	23.0%
Employment in agriculture		
1973	2.9%	1.5%
1995	0.9%	0.7%
Employment in textile manufacturing		
1973	36.9%	5.1%
1995	22.9%	3.6%
Employment in industrial/electronic equipment manufacturing		
1973	10.6%	20.5%
1995	15.0%	19.8%

in the State over the next decade. The impending demographic changes would require some significant commitment by the State in order to fulfil the resulting service demands. It was equally clear that the mix of state industries needed to change in order both to increase the revenue potential of the State as a whole and to change the funding cycle. Leaner government, coupled with enhanced economic growth from the high technology sectors, were clear targets for the state government policy-makers in the executive as well as the legislative branch.

2 THE STATE'S TRANSPORT INFRASTRUCTURE

The importance of the basic transport infrastructure has long been appreciated in North Carolina. For instance, the consequence of North Carolina's development of its paved roadway system in the 1930s and 1940s was the development of a trucking industry that carried the produce and manufacturing products of the South to market. An earlier example was the State's development of its own railroad in the 19th century.

For the past 20 years, North Carolina has focused particularly on the development of its wired infrastructure. The state government has set out to create and recreate whenever necessary the finest telecommunications infrastructure in the USA. This led to the deployment of the first statewide digital network in the USA in the early 1980s. A decade later, the state government entered into a technology partnership with private sector telecommunications companies to build the North Carolina Information Highway (NCIH: Patterson 1995). The state and chosen telephone companies in North Carolina developed the first wide-scale deployment in the world of an ATM-Sonet network (see below).

There were strong imperatives for this development. The Economic Strategy Institute has determined that growth can be greatly enhanced within an economy that deploys a dynamic information infrastructure. Cohen (1992) noted that investment in broadband communications 'could add as much as $321 billion . . . in net new output to the national economy over the next 16 years'. Similarly, Koelsch (1995) quoted European Community estimates that more than 3.5 million new jobs will be created by the deployment of an information superhighway. The potential to make delivery of government services more effective and efficient, as well as the prospect of increasing state revenues by boosting the local economy, was another strong factor in the North Carolina decision to encourage the private sector deployment of a broadband information highway.

3 INFORMATION TECHNOLOGY INFRASTRUCTURE

The North Carolina state government has declared that its information infrastructure must consist of an integrated statewide communications network with uniform technical features. It also insisted that all users of the infrastructure be able to share the information provided and that the facilities operate in a user friendly way and at a reasonable cost. Services must be integrated and operate to the highest levels of privacy and security. Thus to be effective, the technical infrastructure must offer a shared telecommunications network and allow the integration of processing across all computing platforms regardless of size.

In 1986, North Carolina was the first state in the USA to complete the conversion from analogue to digital networks. This has led to over one third of its current employment base being in industries which can be defined as telecommunications-intensive. The State's reliance upon such industries is expected to increase to over 50 per cent in the next few decades.

The next step was to create the NCIH. Prior to its development, selection criteria for the deployment of the first sites were developed. These criteria were: rural equity; institutional leadership; community leadership; curriculum development; fostering of a range of applications; facilitating teacher training; ample technical facilities; and availability of funding. From the outset, this was seen as a public/private sector partnership with the State acting as anchor tenant; the management structure of the NCIH is shown in Figure 1. Assessment of the financial aspects of the scheme included use of consultants Deloitte and Touche who were tasked with reviewing the price offerings by the telephone companies.

The State determined in May 1993 that it would migrate its digital network to use the ATM-SONET technology. Single mode optical fibre is deployed to each site to provide a very high degree of environmental isolation, very high bandwidth capacity, and excellent bit-error-rate performance and reliability. At the outset, 155 Mb per second OC-3c rates were used between the customer site

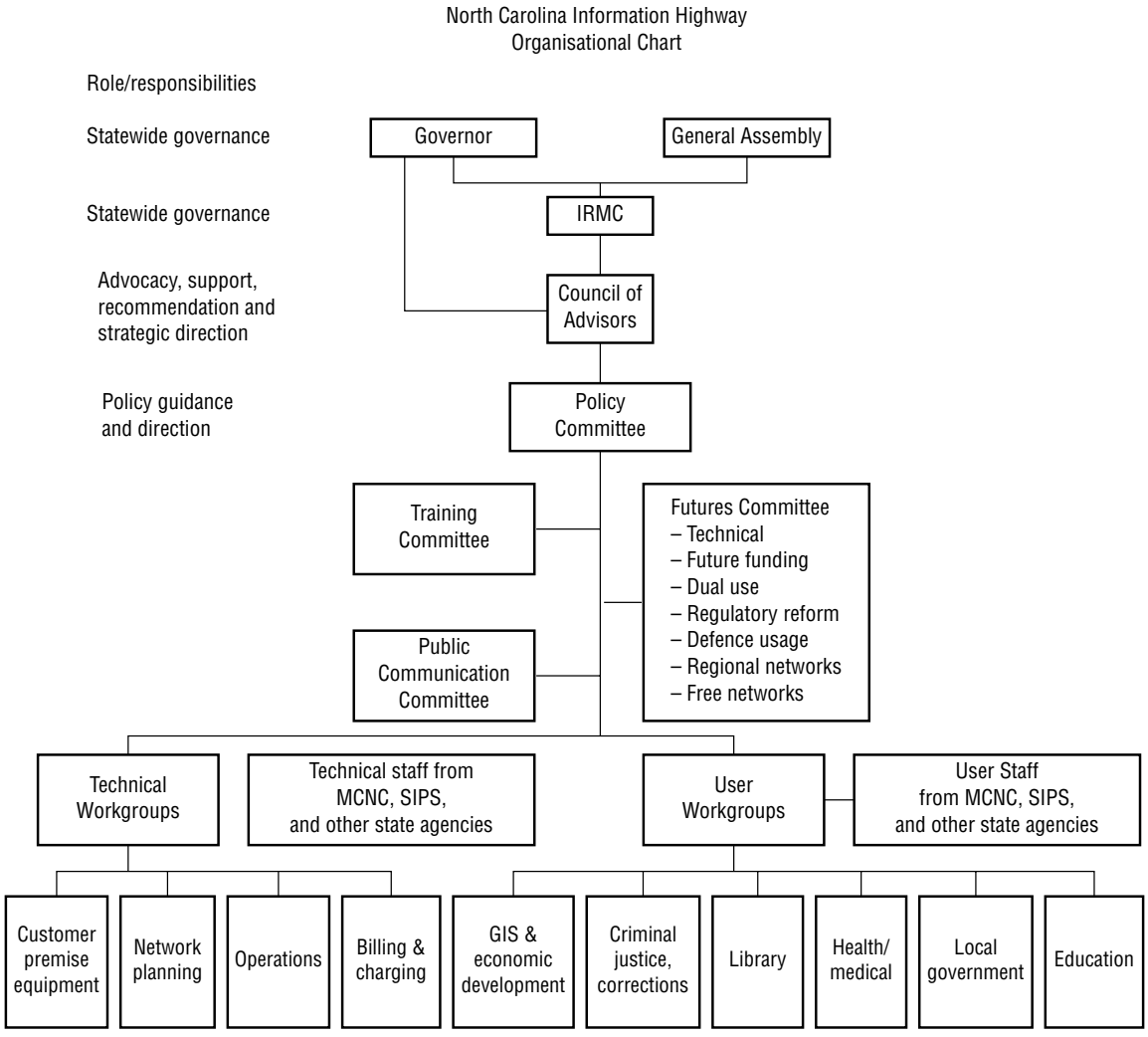

Fig 1. Management structure of the North Carolina Information Highway.

and the central office: enhancements to 622 Mb per second and 2.4 Gb per second or even higher access rates are planned. In late 1996, the NCIH was operating at 98.5 per cent reliability rate (based on the number of error free sessions), close to telephone reliability despite being deployed in many difficult and technologically challenged environments. By that date, the service provider companies had invested more than US$70 million in software and hardware equipment and hundreds of millions more in the fibre optic deployment necessary for the network.

By the end of 1996, more than 128 interactive two way audio-video sites had been sited across North Carolina. They are housed in schools, community colleges, universities, hospitals, prisons, senior citizen centres, health clinics, museums, and state and local government agencies. In addition, more than 50 000 computers and terminals are connected across the State's information infrastructure. Customers in both the public and private sectors connect across the NCIH backbone which is operated by private sector telephone companies. Representatives of more than 40 countries have visited the State to study the progress of the NCIH and the lessons learned.

4 MANAGING AND EXPLOITING THE NORTH CAROLINA INFORMATION RESOURCES

4.1 The Information Resources Management Commission

The State moved in the early 1980s to manage its information resources by creating the Information Technology Council, now named – with enhanced powers – the Information Resources Management Commission (IRMC). The IRMC has direct authority for information technology policy in state government. It works with all individuals and parties impacted by state information technology initiatives, including the federal government, local government, citizens, and private industry (North Carolina General Statutes 143B-426.21).

The IRMC has the following powers and duties:

- to develop, approve, and publish a statewide information technology strategy covering the current and following biennium. This is updated annually and must be submitted to the General Assembly on the first day of each regular session;
- to develop, approve, and sponsor statewide technology initiatives and to report on them annually;
- to review and approve biennially the information technology plans of the executive agencies, including their plans for the procurement and use of personal computers and workstations;
- to recommend to the Governor and the Office of State Budget and Management the relative priorities across executive agency information technology plans;
- to establish a quality assurance policy for all agency information technology projects, information systems training programmes, and documentation;
- to establish and enforce a quality review and expenditure review procedures for major agency information technology projects;
- to review and approve expenditures from appropriations made to the Office of State Budget and Management for the purpose of creating a Computer Reserve Fund;
- to develop and promote a policy and procedures for the fair and competitive procurement of information technology.

The IRMC thus has considerable responsibilities, influence, and power. It has enabled the state information infrastructure to develop on the basis of universally adopted standards in an interoperable open environment, resulting in less stranded investment of State information dollars.

4.2 Exploiting and developing the NCIH

It is obvious that providing a technology may be a necessary but is not a sufficient condition for economic success. North Carolina's government has taken various steps beyond ensuring existence of the basic infrastructure. For instance, it established the MCNC as a non-profit information technology research centre in 1985. This has provided network based support for collaboration in the research community within the state. MCNC owns and operates the North Carolina Research and Education Network (NC-REN), a video and data network with a user community that expects the very highest levels of service, reliability, interoperability, and performance for data and video communications. It provides modern telecommunications and computing technologies to create a world of 'virtual proximity' for the research and education communities to share their resources, knowledge, and materials without travelling. In effect, the information and expertise – rather than people – are mobile.

Aside from providing services to existing researchers, MCNC fosters the immigration of new industries attracted by its world-leading technologies, such as those for the testing of a wide range of networking technologies and services. In 1996, MCNC, in partnership with industry and the Research Triangle universities, established a high speed–high bandwidth test network – VITALnet – which allows manufacturers, vendors, and end-users a very economical real-world testing environment, thereby allowing them the opportunity to determine that their products operate as expected when running on one of the highest speed, highest bandwidth networks (2.4 gigabits/second). As a result, organisations like Seagate, Telelek, Ganymede, Hewlett Packard, and Radcom have used the test facilities and been attracted to North Carolina.

5 GIS AS A COMPONENT OF THE NORTH CAROLINA INFORMATION INFRASTRUCTURE

North Carolina has embraced GIS technology both as a major component of its information infrastructure

and as a tool to underpin its policy formulation and monitoring. The potential value of GIS technology was first recognised in the late 1970s when the North Carolina General Assembly enabled the creation of two new programmes. The early success of these programmes led to a close intertwining of GIS with the overall development and deployment of information infrastructure in the State. Measures of the current penetration of GIS throughout North Carolina include:

- *all* of the departments in state government either use GIS directly or obtain services through the Center for Geographic Information and Analysis (CGIA: see below);
- the North Carolina Association of County Commissioners estimates that 60 out of 100 counties are using GIS technology to support a diversity of programmes. A further 30 counties are developing geographical databases for impending use in GIS;
- North Carolina is a State of small cities and towns: only 54 out of 524 municipalities have a population greater than 10 000 people. Despite this, about 50 of these large municipal governments have installed GIS, in addition to many of the smaller cities and towns;
- over one half of the State's 18 lead regional organisations have GIS installations;
- every federal department with an office in North Carolina uses GIS in at least one programme area;
- there are dozens of businesses in North Carolina using GIS to support their operations including manufacturers, utilities, engineering firms, newspapers, and banks. At least 20 companies in North Carolina offer GIS-related products or services;
- five GIS sites are beginning operations on the NCIH.

Thus GIS technology is extensively and deeply embedded in a multiplicity of broad initiatives, all of which are designed to improve the quality of life and foster a vibrant state economy. The sustainability of this GIS contribution has been engineered through the creation of an organisational structure to integrate the disparate efforts into a cohesive whole. The key components of this structure are described briefly below.

5.1 Center for Geographic Information and Analysis (CGIA)

The first programme created to deal specifically with GIS technology in North Carolina was set up after the Land Policy Act noted a lack of 'systematic collection, classification, and utilisation' of geographical information and authorised the 'definition, preparation, and maintenance of an information service to provide local governments, state agencies, and private citizens and businesses with information for making decisions'. The predecessor to CGIA was established in response to this enabling legislation. Since its inception, CGIA has been a technology resource for the entire state, performing services for numerous organisations and supporting decision-making related to the major issues which have impacted on the economy of the state during the past two decades.

5.2 Land Records Management Programme

Also in the late 1970s, the Land Records Management Programme was begun in the Department of Administration. The primary purpose of this initiative was to establish minimum standards and to provide advice and technical assistance to local governments in implementing and maintaining these minimum standards, with regard to the following aspects of land records management:

- uniform indexing of land records;
- uniform recording and indexing procedures;
- security and reproduction of land records.

Adoption of indexing procedures and specification standards has improved the quality of services, reduced costs, and/or improved the efficiency of land records operations in the State's register of deeds offices. The standards involved include formats for indexing land records, for security and reproduction of land records, and use of computer and micrographic technologies (for a general discussion of data standards, see Salgé, Chapter 50).

5.3 Geographic Information Coordinating Council (GICC)

The North Carolina Geographic Information Coordinating Council (GICC) was established in July 1991 by Executive Order and was subsequently reaffirmed with an expanded membership by Governor James B Hunt Jr, in Executive Order #16, in May 1993. The GICC is the policy body charged with fostering cooperation among state, federal, and local government agencies, academic institutions and the private sector 'to improve the quality, access, cost effectiveness, and utility of North

Carolina's geographic information and to promote geographic information as a strategic resource for the State'. It functions as a standing committee of the IRMC (see above).

The GICC was established and works through several standing committees: the State Government Geographic Information Users Committee, the Affiliated GIS Users Group, the State Mapping Advisory Committee, the GIS Technical Advisory Committee, and the Federal Inter-agency Committee. Each of these committees is represented in the GICC membership which includes executives from the departments of Administration; Agriculture; Commerce; Environment, Health, and Natural Resources; Public Instruction; State; Transportation; other executive officers; and representatives from local government, the federal government, and lead regional organisations as well as the non-governmental sector. The Council is chaired by the Governor's Advisor on Policy, Budget, and Technology and is staffed by the CGIA.

One of the major undertakings of the GICC is oversight of the Corporate Geographic Database, an organised collection of geographical datasets supported and shared by both state government and non-government organisations. More than 60 layers of data comprise the centrally coordinated but physically distributed Corporate Geographic Database. Datasets conform to standards set by the GICC, contain metadata describing their contents, and are maintained according to negotiated schedules and procedures (see Goodchild and Longley, Chapter 40; Guptill, Chapter 49). Large parts of the database currently are online and plans are to have the entire database accessible over the NCIH.

6 THE GIS UNDERPINNING OF NORTH CAROLINA'S ECONOMIC AND GOVERNMENTAL DECISIONS

Some specific examples of how GIS has been and is being used to buttress the economy now follow. Given its successful evolution in North Carolina over the past two decades, the continued use of GIS over the next two decades to support the newly defined activities in these key policy areas seems assured.

6.1 Building the information infrastructure

From the onset of the NCIH initiative in 1993, GIS was viewed as a key technology – not only to provide content and traffic but also to assess geographical alternatives for deployment of the ATM network, to assist in determination of equipment in local premises that supports a wide range of demanding uses of the ATM, and to promote the NCIH through compelling, visual demonstrations.

Among the first work groups formed for the Information Highway was the GIS, Economic Development, and Local Government Committee. This illustrates the widespread acceptance in North Carolina that GIS technology is a boon to the State's economic development and that its successful implementation is an inter-governmental endeavour. The committee has resulted in five out of 125 initial NCIH sites being installed specifically to support GIS whilst many of the other sites (most notably high schools and community colleges) are planning to use GIS over the ATM in their routine affairs.

6.2 Improving the transportation infrastructure

The North Carolina Transportation Improvement Programme is the State's ongoing comprehensive, coordinated transit programme which includes aviation, highways, public transportation, rail, and bicycle transport. In 1989, the North Carolina Legislature established the Highway Trust Fund, a $9 billion effort to improve highways across the State over a 13-year period. The Highway Trust Fund was the single largest appropriation in North Carolina history, effectively raising the Transportation Improvement Programme from US$450 million to US$1.2 billion annually. Upon completion, there will be a four-lane highway within 10 miles of 96 per cent of the State's citizens.

At the time the Highway Trust Fund was established, the highway planning process typically began with a feasibility study which focused upon engineering and economic considerations and, to a lesser extent, on social and environmental concerns. Typically, an environmental and cultural review occurred late in the process after a significant portion of the project's funds were expended (see Bernhardsen, Chapter 41, and Maguire, Chapter 25, for discussion of the incidence of costs over the GIS project life-cycle). Problems discovered at that stage often resulted in design changes and delays in

completion of a highway project. It was clear that the accelerated Transportation Improvement Programme would place an added burden on the highway planning and review process, not only within the Department of Transportation but also on other agencies responsible for the environmental and cultural review of highway projects.

Within one month of creation of the Highway Trust Fund, the Secretaries of the Departments of Transportation; Cultural Resources; and Environment and Natural Resources agreed that GIS technology would be an essential tool for approaching the accelerated programme of highway construction. They formed a joint working group whose task it was to recommend a specific process using GIS and a shared, common database to increase the efficiency and timeliness of highway planning and review, and to balance highway construction with protection of valuable natural and cultural resources. The process included means of early identification of problem areas, automated environmental and cultural review, and identification and evaluation of alternative highway corridors (see Eastman, Chapter 35, for an overview of multi-criteria evaluation). The process put in place remains in use today and has enabled satisfactory progress towards the goals of the Highway Trust Fund.

The data now used by highway planners and staff of the environmental and cultural resource agencies include political boundaries, the existing transportation system, locations and status of all proposed highway projects, land use and land cover, soils, wetlands, hydrography coded with the state's water quality classifications, flood zones, Superfund sites, hazardous waste sites, historic sites, point source dischargers, leaking underground storage tanks, archaeological sites, solid waste facilities, Natural Heritage Inventory (endangered and threatened species), parcel boundaries (with owner and assessed value of parcel, etc.), and digital orthophotography. The common, shared database organised for this effort has evolved into the Corporate Geographic Database (see above) and access to the data is provided through use of NCIH in combination with other lower bandwidth components of the state's information infrastructure.

6.3 Water and sewer infrastructure

In many North Carolina communities, economic growth is hampered by insufficient water and sewer facilities and currently numerous communities have imposed development moratoriums. Estimates of needed improvements approach US$4 billion for sewer systems and US$2 billion for water systems. Yet, like most states, North Carolina has not had an effective strategy for determining where existing water and sewer systems are, what condition they are in, exactly what are the needs for the future, and how to repair and build needed facilities. Through a cooperative effort of the Governor's Office and the US Department of Agriculture, an inventory and needs assessment of water and sewer infrastructure is being conducted by the Rural Economic Development Council. This work will be the blueprint for future development and maintenance of the State's water and sewer infrastructure. The GICC agreed to become the oversight partner of the data created from this study to ensure future updates and access by users.

From the beginning, GIS technology has been integral to this project. The inventory of existing infrastructure and perceived needs was developed as GIS data layers. GIS will be used to validate needs for water and sewerage, to prepare capital improvement plans for water and sewerage, and to provide information for economic planning and development.

The locations of the State's water distribution and sanitary sewer systems are stored in a GIS, including system boundaries, water lines, sewer lines, water storage tanks, pumping stations, treatment plants, water intakes, master meters, discharge sites, and land application areas. Attributes include system ownership, construction dates, renovation dates, average and maximum daily usage, and costs by user type, pipe size, and tank capacities. The data are available as a part of the Corporate Geographic Database and accessible via the NCIH.

6.4 Environment and natural resources

One of the pervasive application areas of GIS in North Carolina is management of the environment and natural resources. One example only of this will be given: the management of waste.

In the mid 1980s, the US Department of Energy (DOE) conducted a search for two repository sites across the country to store the nation's high level nuclear waste. It identified two areas in North Carolina, out of 12 such sites in the eastern USA, as potentially acceptable repositories. GIS was used by the State to analyse these areas independently, to identify their shortcomings as repository sites, to

develop a formal response to the DOE and eventually to refute the siting process. GIS has also been instrumental in the State's own efforts to locate waste management sites within its borders. In 1989–90, the North Carolina Hazardous Waste Management Commission used GIS extensively to screen the State for suitable locations and to convey the results of the screening analysis graphically at public meetings.

One of the most controversial environmental issues to face North Carolina in many years is the management of waste associated with large scale animal operations, especially 'high tech', high density pork production. The State is now the nation's second largest pork producer, generating more than US$1 billion annually in revenue. More than 4000 large farms and four million animals are dispersed across a region of 25 counties in the Piedmont and the coastal plain, among the State's most environmentally sensitive and vulnerable areas. Most of the animal waste is contained in wastewater lagoons or applied to the surface of the land, reportedly causing problems with odour, groundwater contamination, and pollution of nearby surface waters. A rash of lagoon failures prompted the Governor and the General Assembly to impose restrictions on the siting of lagoons and spray fields. Both the Governor and a Blue Ribbon Commission of the General Assembly on Animal Waste used information and maps generated by GIS to assess the possible impacts of certain buffer requirements around streams, residences, property boundaries, and features such as schools, hospitals, and churches before agreeing to legislation.

6.5 Education

The State spends more than 60 cents of every dollar on education and considers this to be a prudent and essential investment in the long term economic wellbeing of its citizens. GIS technology has been employed to provide content to the public (State) school curriculum, by supporting different education initiatives and by assisting peripheral operations of the schools.

The Office of Environmental Education was created to coordinate between schools, colleges, government agencies, citizen groups, and the business/industry community, in promoting environmental education. Preparing the educational community to utilise current environmental data is a primary objective of the North Carolina Environmental Education Plan. As stated in that Plan, '[the] overall goal of environmental education is to have a citizenry with the knowledge, understanding, and skills necessary to nurture this "goodliest land under the cope of heaven" through sound decision-making and responsible stewardship of North Carolina's environment.' The Office of Environmental Education initiated a collaborative effort of state and private organisations in a model programme bringing GIS into schools and classrooms. The ability to manipulate research-quality environmental data specific to their own community is seen to be a motivating factor for students.

The use of GIS to enhance peripheral operations of the public school systems is shown by the Transportation Information Management System (TIMS), an initiative of the Department of Public Instruction. In each of North Carolina's 117 public school districts, school buses are routed and scheduled through TIMS, a GIS in which students and bus stops are spatially identified in order to determine optimal bus routing sequences. Initially funded by the North Carolina Energy Division because of its potential for saving fuel, TIMS is provided free of charge to local school districts by the State. School districts regularly examine alternative routing strategies generated through the shortest path capabilities of TIMS. Some districts rely on mileage and times calculated by the system to determine bus driver wages. In addition, using the student residence and school locations, school district planners are able quickly to assess the impact of opening new schools, closing old schools, or changing school attendance lines. At a higher level, the Department of Public Instruction uses data from TIMS to help 'level the playing field' for districts across the State. Geographical data, including the connectivity of the street network, the distance of students from school, and the dispersion of students around each school, are compared for all districts to ensure that equitable funding is provided which takes account of the geography of the district. Church (Chapter 20) provides a general overview of location–allocation modelling and GIS.

6.6 Recruitment of industry

The economic development community in North Carolina includes local developers (the counties), seven multicounty regional partnerships created and funded by the General Assembly, the development staff in the state Department of Commerce, and

economic development allies (e.g. utilities). Their activities include creating detailed proposals for site consultants, presenting targeted information to business representatives evaluating a particular facility location, gathering data for an existing industry considering expansion, and coordinating communication and information gathering among the economic development community.

Ironically, the area where GIS – and indeed information technology in general – has achieved the least penetration is in the day-to-day activities associated with the recruitment of industry, the prototypical activity of economic development. To redress this shortcoming, the economic development community in the State has collaborated on the design of a statewide Economic Development Information System (EDIS). In 1995, the Department of Commerce and the regional economic development partnerships assembled a statewide steering committee of economic development organisations to participate in a feasibility and design study and to develop a design specification. The result of this effort is a plan for creating a unified system with common interfaces, standards, and databases which also permits customisation by individual developers to meet their unique needs. The plan relies fundamentally on the NCIH, GIS technology, and the Corporate Geographic Database.

6.7 Disaster recovery and mitigation

On September 5–6, 1996, Hurricane Fran hit the coast of North Carolina, turned inland, and eventually dissipated into heavy rains – but not before affecting more than half of the State's 100 counties and generally wreaking the State's 'worst disaster in this century'. In the aftermath of Hurricane Fran, eastern North Carolina also experienced severe and prolonged flooding. As a consequence of both the hurricane and floods, communities faced mud contamination of drinking water, three quarters of the homes in one barrier island community were destroyed, farm damage totalled US$179 million, acres of woodland were damaged, major fish kills resulted from low levels of oxygen caused by runoff and debris, community services were strained by round-the-clock removal of downed trees and other debris, mosquito hordes threatened an outbreak of encephalitis, and insurance losses are expected eventually to reach as much as US$1 billion. Plates 46 and 47 illustrate the damage caused by Hurricane Fran in the coastal region of the State. GIS technology was employed throughout the region during the emergency to respond to virtually all of these impacts to the economy, environment, and health of North Carolina. Cova (Chapter 60) provides an overview of emergency management applications for GIS.

In addition, there is now anticipated use of GIS in long term disaster mitigation. The process involves keeping homes and communities away from floodplains, re-engineering bridges and roads, relocating or elevating structures, and creating and enforcing effective building codes. In October 1996, Governor Hunt signed an executive order creating the Disaster Recovery Task Force, chaired by the Lieutenant Governor and with a membership comprised of 23 elected officials, appointed cabinet secretaries and advisors, and representatives of local government. The responsibility of the Task Force is to recommend comprehensive actions to ensure North Carolina's long-term recovery from recent natural disasters and thence to help to mitigate future disasters. The initial efforts of the group suggest that GIS technology and GIS will be used to assess the need and consequences of major mitigation efforts such as relocation of communities, roads, and sewage treatment facilities.

7 LESSONS LEARNED IN MANAGING THE STATE ECONOMY WITH THE SUPPORT OF GIS

Leadership in the government of North Carolina has been strongly exercised for over two decades through the creation of high technology infrastructures to centrally defined standards. A focus on 'leading edge' IT has demonstrably transformed the economy of the State. This has not been achieved easily: a singleminded focus on preparing for the future rather than dealing with the symptoms of past malaise has been necessary. Risks have been taken and close working relationships with the private sector have been forged. All of this has been made to work within a democratic framework where promising long-term benefits does not always produce electoral rewards.

Though the leadership has been strong and has come from the very top – the Governor – a key feature of the North Carolina approach has been the

Plate 46 Property damage caused by Hurricane Fran.

Plate 47 Flooding caused by Hurricane Fran.

plethora of consultation mechanisms and the way in which many different players have had some role to play in improving the wealth and quality of life of the State's citizens.

The role of the Corporate Geographic Database described earlier now underpins many of the planning and operational activities of the state and of its partners. In this alone, GIS has made a major contribution to the management and development of North Carolina in the last twenty years. But its success has rested on more than the technological aspects of maintaining and using the State's core data framework. The institutional networking of organisations like the CGIA has fostered acceptability of and familiarity with GIS so that a multiplicity of organisations now regard GIS as a part of the 'taken for granted' world.

That said, the evolution of GIS in North Carolina has been an extended one. It therefore seems clear that the success of economic development strategies and the contribution of GIS to them are only sensibly judged over a period extending over five years or more – the effort and cost of developing databases, the complexities of public and private sector institutional arrangements, the variety of circumstances which can arise, and the role of senior leaders all have great effects on what can be achieved. Like economic development or environmental protection, the success of GIS is never permanent. This has many implications for how GIS is best funded, organised, and led.

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