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Natural resource information from monopoly to competition

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Natural Resource Information

From Monopoly to Competition

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Abstract

Geographic information systems and remote sensing technologies have been rapidly adopted in many sectors of the natural resource field. Falling hardware prices and ever more powerful yet easier to use software have not only reduced the cost but have also broadened the accessibility of these technologies.

Technological advances are making the generation and use of resource information a competitive process. Whereas in the past public resource agencies alone had the data and analytical capability to prepare resource-management plans, today GIS technology can give a small group of knowledgeable and motivated users the power to replicate those analyses and to propose defensible and scientifically rigorous alternatives. Examples are given of forest management practices that were successfully challenged in this way.

The past decade has seen an explosive growth in GIS technology and a less dramatic but important acceptance of remote sensing technology. The rapid incorporation of these technologies into the natural resources field is due to a number of driving forces that have together made their adoption imperative.

During the past decade, the power and accessibility of computer software and hardware have increased by orders of magnitude while prices have steadily fallen. The $10,000 workstation, small enough to sit on your desktop, is more powerful than the million dollar minicomputers of 1980.

Software has become much easier to use. Developers of business software for the personal computer (PC) recognized early on that there was an enormous market for full-featured software that nonprogrammers could use. Fortunes have been made satisfying this demand, and in the process the man/machine interface has developed steadily in the direction of simplifying the control of ever more complex tasks. Today's spreadsheet programs, costing $300-$400, can do sensitivity analyses, optimize complex financial models, produce high-quality graphics dynamically linked to the data, and import and export data from external databases. They are easy to learn, and a novice can begin doing useful work in a matter of hours. The experience people gained with business software for the PC has led them to expect sophisticated software to be ever more user-friendly as well.

GIS and remote sensing software has followed suit. Though full-featured software may still require weeks of use for the novice to become proficient, these systems can be tailored with custom menus and routines so that standard tasks can be learned in a few hours. There are now dozens of inexpensive PC-based remote sensing and GIS software packages with user-friendly graphic interfaces. The past year has seen the introduction of GIS "viewing" software. These are inexpensive GIS packages offered as companion products to more complex full-featured systems. For example, Environmental Systems Research Institute (ESRI) has introduced ArcView to work with GIS databases produced by ARC/INFO, and Intera-Tydac introduced SPANS MAP to work with GIS databases produced by SPANS. These viewing products are designed to be very easy to use; and they offer sophisticated displays of map, image, and tabular data. They provide a wide range of query functions but limited analysis capability. Products such as these are a continuation of the trend toward GIS and remote sensing software becoming easier for the casual user to operate effectively and at lower cost.

During the past decade, society has become more concerned about the environmental consequences of development activities. There is growing concern for the scarcity of resources, such as clean air and water, prime agricultural land, and wildland areas. Headline-grabbing events, such as the explosion of the Chernobyl nuclear power plant in the Soviet Union, global warming, destruction of the Amazon rain forest, and the discovery of a hole in the ozone layer, have sensitized the public. The lifting of the Iron Curtain has revealed the severe pollution in Eastern Europe and the human health problems caused by industrial waste. Recognizing and understanding these issues and predicting their consequences require the compilation and analysis of large quantities of geographically referenced data. GIS and remote sensing technologies are now recognized as instrumental in identifying, monitoring, or analyzing these problems.

Western society has become more complex. Growing public concern over the widespread and diverse effects of development activities has led to more government regulation. Issues are now seen to be intertwined. For example, stricter regulations to protect endangered species may decrease employment in the logging industry, change procedures for road construction, affect tourism, and change import regulations. The application to build a new subdivision can involve agencies at the municipal, regional, provincial, and even federal levels of government. In addition, the increased public awareness of diverse and often subtle environmental interactions has made people feel that they are directly affected and have a stake in a wider range of issues. This perception has increased the number of stakeholders who are willing to take action to protect their interests. As a result, decisions involving land have become much more political. For example, forest harvest activities may be scrutinized by conservation groups, hunting and fishing interests, the local tourist industry, municipalities, native communities, and even citizens groups from outside the country, in addition to government regulatory agencies. Decision-making about land-related activities now requires more interaction with a more diverse group of organizations than before. In this complex political and regulatory environment, GIS and remote sensing technologies have proven to be cost-effective tools with which to develop and refine plans, to produce the documentation required by regulatory agencies, and to communicate with the public.

These forces have led to the adoption of computer technology on a broad scale. Once a luxury, computers have now become a necessity for managers, knowledge workers, and administrative staff. The technology has provided the tools with which to handle the volume and complexity of information they need to do the job. In so doing, decision-making capability (though not necessarily authority) has been driven lower down in the organizational hierarchy.

Among the benefits of GIS and remote sensing technology are the following:

1. Doing more in less time with fewer people.

2. Integrating large and diverse spatial data sets, enabling more factors to be considered in the planning and design of land-related activities. The technology makes a broader, more holistic scope financially feasible.

3. Using the modelling capabilities of GIS and high-speed processing to enable more alternatives to be considered (and iteratively refined) than were affordable using manual methods.

4. Utilizing GIS technology to empower an individual to work effectively with large quantities of diverse spatial data.

INFORMATION POWER TO THE INNOVATIVE AND THE COMMITTED

The growing adoption of GIS technology has been accompanied by the rapidly increasing availability of digital data. Government agencies in the United States offer elevation data, satellite imagery, street networks, electoral districts, land use and land cover, and many other data sets in digital form at nominal cost. Private firms, such as Etak, have entered the digital-data market to offer additional products or enhanced versions of government products. The availability of inexpensive data and inexpensive easy-to-use computer hardware and software has put the start-up and operating cost of a GIS and remote sensing facility within reach of small organizations.

Whereas in the past large organizations controlled the data and analyses because equipment was very expensive and a large staff was needed to perform analyses, now these data can be obtained in digital form and analyzed by a few dedicated individuals using inexpensive personal computer equipment. It is now feasible for a special-interest group to obtain the computer resources, data, and trained people to perform analyses with a level of scientific rigor and sophistication equal to those produced by the government agencies that administer natural resources. In addition, these small groups are not constrained by bureaucratic procedures, compartmentalizing of resources (e.g., remote sensing and GIS are done in different departments), restrictions on purchasing additional resources (e.g., not permitted to purchase additional software without approvals), and so on.

They can be as creative as they wish, obtaining data from the field or from other sources as needed and making data-sharing arrangements with outside organizations, free of bureaucratic constraints.

As a result, special-interest groups, citizen advocacy groups, and others are able to scrutinize the decision-making of government organizations in a much more comprehensive and rigorous manner. They are able to conduct their own research, field work, and analyses at a comparable or even superior level of quality and rigor. In so doing, they can not only ask whether alternative plans were considered, they can analyze those plans and develop alternatives using the same superior methods as the organization they challenge.

The responsibility to administer natural resources no longer grants an organization exclusive control and use of the information it generates. Analysis of the data is no longer dependent on prohibitively expensive equipment or on a large number of people. A small group of three or four talented individuals can evaluate land-use plans and develop defensible alternatives to challenge the administering agency. In effect, what had been the exclusive domain of natural resource agencies has now become a competitive process.

Where information generation and use become a competitive process, there is a significant premium to being creative, competent, and committed, especially in a rapidly changing political environment. Public decision-making that involves environmental issues takes place in the context of constantly changing political realities, scientific understanding of ecological processes, and financial and human-resource constraints. In 1990 Steve and Eric Beckwitt used their GIS and remote sensing analyses to appeal the U.S. Forest Service plan to log old growth in Tahoe National Forest. The quality of their data analysis and presentation of results were instrumental in the success of their appeal. Other West Coast citizen advocacy groups, such as the Greenbelt Alliance in San Francisco and the Wilderness Society in San Francisco, have also used this technology to support their causes.

In Canada, native communities are adopting GIS and remote sensing technology to assist them in developing land-claims proposals, in defending their land-related interests before and after land claims are settled, and in managing their lands. Recent land claims, such as the first James Bay Agreement and the Inuvialuit Claim, have given aboriginal people control of natural resources over large areas. These agreements stipulate specific management responsibilities, such as wildlife management (including the census of populations and setting of harvest quotas), the review of environmental and cultural effects of development activities (e.g., mining and forest harvesting), and the provision of community services (e.g., education and basic infrastructure, such as water and sewage).

Native communities are rapidly adopting GIS and remote sensing technology to gain control of the information about their current land holdings or the land they claim. Applications range from environmental assessments of mega-projects, such as the James Bay II hydroelectric project in Quebec, to local projects, such as the management of wild mushroom production.

In northern British Columbia, wild mushrooms are an important cash crop for native communities, such as the Nisga'a. Favorable mushroom sites can be identified by a combination of forest cover, elevation, and aspect. The Nisga'a have a PC-based GIS and remote sensing facility operated by two full-time staff. They analyze Landsat satellite data to develop a vegetation classification; and then within a GIS, they combine these data with elevation and cultural features. The results are used to define prime growing sites. These areas are then protected from forest harvesting and are used to plant and harvest mushrooms.

The Manitoba Keewatinowi Okimakanak (MKO) is an organization representing twenty-three native Indian bands in northern Manitoba. In 1988 the MKO established the Natural Resource Secretariat (NRS) to provide in-house research and information management for the natural resources upon which the MKO member bands have traditionally relied and upon which they will base their future economic initiatives. The acquisition of GIS and remote sensing technologies was central to the NRS facility, which has a staff of four and $65,000 of computer hardware and software. Start-up of the facility was financed with government funding to support MKO's participation in the environmental assessment for a proposed hydroelectric development. Instead of contracting out the work, the MKO used the project to set up a facility of its own and to develop the capability to collect and analyze resource information.

The MKO facility uses SPOT and Landsat satellite data, existing digital map data, and aerial photography to monitor and challenge forest harvest activities and road construction in the lands they claim. The GIS is being used to map the lands occupied and used by member bands in support of future land claims. With the support of the band council, the staff of the GIS facility interviewed every member of the community who harvested resources from the land through hunting, fishing, or trapping. Staff members also inventoried culturally significant places such as burial sites. These data formed the core database of information about the community's land-resource base. When organized within a GIS, it provided an effective means with which to defend its interests. The MKO has found that through its creative use of remotely sensed data and GIS methods it is able to generate more current and accurate information than the provincial resource agencies with which it negotiates. It has been able to successfully challenge forestry operations by analyzing such features as the location and number of roads built, size and number of cut-blocks, and location and timing of harvest operations.

In 1989 extensive forest fires raged through northern Manitoba. One fire burned to the edge of an MKO community. Claiming that the Manitoba Forest Service had been negligent in controlling the fire, the MKO sought compensation for the loss of facilities in the vicinity of the settlement as well as for the many widely scattered trapping cabins. In a matter of a few weeks, the GIS facility produced maps from satellite imagery, showing the extent of burned areas. It also identified by aircraft overflights which cabins had been destroyed, and it produced individual claims for each trapper who had lost property.

A small group can successfully advance its cause with high-quality information products generated by talented and committed individuals using low-cost equipment and data. The advantage over a large bureaucracy lies in the people who power these facilities and who are dedicated to their cause. In the case of native people, they see the defense of the lands they claim as a matter of survival. These facilities are staffed by small groups of individuals directly involved in the group's success or failure. There is little bureaucracy to constrain unorthodox but promising approaches. Creativity can be easily accommodated. The objectives of these groups are clearly defined; they know their mission and are fully committed to it.

CAN GOVERNMENT RESOURCE AGENCIES LEARN FROM THE CITIZENS' GROUPS WHO CHALLENGE THEM?

Techniques to raise morale and to generate commitment within large organizations have been extensively discussed in the business literature. Of particular note are the following observations.

There are many operational GIS activities that require a strictly prescribed series of tasks. Transaction processing, for example, demands that data be entered in a rigorously controlled manner. However, when the unusual or unexpected occurs, it is the creative and competent individuals familiar with the capabilities of the organization's information systems who can quickly develop new information products to respond to the challenge. In order to develop these systems, organizations must give individuals the time and the freedom to experiment, to try different analysis approaches, and to work with a variety of software products. Organizations need to stimulate and reward goal-directed experimentation and creativity.

An organization's data is the foundation of its operation. If it is not standardized, the organization's effectiveness is compromised. However, standardization should not be religiously extended to the tools the organization uses to work with its data. By allowing some experimentation with alternative data analysis tools (e.g., GIS software), the organization promotes the infusion of new ideas and develops alternative analysis approaches and capabilities. In so doing, in-house users develop a diversity of skills that can be invaluable when a quick response to a new situation is needed.

Diversity is further enhanced if users can be organized into small groups with diverse expertise, i.e., remote sensing specialists should not be isolated from GIS specialists. In assigning different specialists to work together as a team, there is an opportunity to develop a working knowledge of related specialties and to find new ways of optimizing the combined use of their expertise and technology.

There is an important role for creative individuals with a talent for GIS and remote sensing analysis. They are demoralized by constraints on their inquisitiveness and are easily frustrated by weak managers unwilling to try the new and unproven. Yet it is these individuals who provide the talent to keep pace with unexpected and rapid changes. Organizations must learn to channel the energy of these individuals into productive activities instead of reining them in. The mavericks have the energy and imagination to handle the unpredictable. In order to compete successfully with small, committed special-interest groups equipped with GIS and remote sensing information technology, large organizations need the same kind of creative talent, initiative, and competence that these small groups naturally attract.

CONCLUSION

Rapid advances in GIS and remote sensing technologies have made it less expensive for a committed group to defend its interests successfully and more expensive and difficult for a large organization to keep up with these groups. Rapid changes in the political arena, in the technology, and in the availability of information have created a situation in which a small group can outmaneuver a large organization by working more quickly and by being more creative. As the pace of change increases, a small resourceful group is increasingly favored. In order to keep up, large organizations need to create the dynamic and productive work environments that small groups provide. The recent management literature has reported extensively on the merits of this type of approach, i.e., intrapreneurship, and has encouraged champions to push new ideas through the corporate bureaucracy. Encouraging individual initiative is critical to maintaining the competitiveness of the corporation.

Government agencies responsible for natural resources have traditionally not seen their role as an administrative, research, and regulatory function in the public trust. GIS and remote sensing technologies have fundamentally changed this role. By enabling small groups to challenge the information and resource plans generated by these agencies, they serve, in effect, as competitive sources of information and plans for the use of resources.

In the corporate world, the first place to look for successful ideas is at successful competitors. In the same way, when resource agencies find themselves outmaneuvered by small special-interest groups that generate more accurate or more current information, the agencies would do well to learn how these small groups acquire and maintain their talent, resources, and commitment to success—then emulate them.