Minnesota Department of Natural Resources

Strategic Information Resource Management Plan

November 13, 2000

Executive Summary

The mission of the Minnesota Department of Natural Resources (DNR) is to work with citizens to protect and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life. This plan defines how information resources and technology will be deployed to support the DNR mission.

Emphasized Business Strategies
Where can Information Technology (IT) have the greatest business impact?

The DNR has three resource management priorities: Conservation Connections, Smart Growth, and Sustainable Forests. Information technology can be employed fruitfully in the service of each of these strategies.

DNR's information technology architecture ensures timely access to current data and information, resulting in informed decision making, productive collaborations, excellent customer service, and effective natural resource management.

Information technology supports:

Natural resource management, through coordinated and distributed access to business and spatial data and applications;

Meaningful communication, both internally and with DNR customers; and

Reliable and convenient service delivery to citizens, community partners, regulated clients, department staff and others, so they can meet obligations, exercise rights, receive privileges, get quick answers, and make good choices.

IRM Vision
Guidelines for applying IT in the organization

The vision for information technology requires:

Policies, standards, and guidelines for application and information system development;

A dependable network infrastructure that supports DNR's geographically dispersed organization; and

Integrated and accessible data tailored to meet department and individual program needs;

Managed by DNR employees who have:

Expertise in information technology engineering;

Knowledge and training in the use of information technology commensurate with job responsibilities; and

Adequate funding for information technology projects that are directly linked to and support DNR's strategic business direction and program needs.

Successful implementation of this plan will require an ongoing effort to set priorities and to concentrate resources on these priorities.

IRM Strategies	**Realization** *How to get from the current to the future state*
Data Architecture *How data is organized, and how data stores are interrelated.*	P Continue using the Business Object Modeling approach to database development, and continue working with other agencies to share business object modeling fragments and expertise. P Continue to link database development projects to one another through use of the DNR Enterprise-Wide Framing Object Model. P Develop a department-wide metadata registry. P Revise the GIS Core Database structure.
Applications Portfolio *The organized collection of processes you have or need to run your business.*	P Maintain a dynamic ***Data and Applications Portfolio***. P Publicize the ***Portfolio***, both internally and externally. P Manage a strategic application development prioritization process. P Solicit strategic and tactical application development ideas. P Identify synergies and potential partnerships for data management and application development.
Applications Delivery and Support *How applications are created, including skills, methodologies, and tools.*	P Implement an Application Development Methodology. P Achieve Capability Maturity Model (CMM) Level 2 capability. P Select an Application Development Tools Suite. P Hire and retain an A-level application development team.
User Self-Service *What users can do for themselves, including skills and tools.*	P Continue to provide users with high-quality, interoperable desktop productivity software, updating both versions and standards as needed. P Continue to offer self-help options through the MIS Help Desk and the Virtual Help Desk. P Continue to provide employees with up-to-date information on human resources, policies, procedures, standards, and forms through the DNR Intranet. P Continue to provide GIS users, both internal and external, with current data sets, metadata, and other GIS information. P As new databases and application systems are developed, keep the principles of easy access and intuitive navigation in mind. Provide more Web delivery of databases and applications.

IRM Strategies	Realization *How to get from the current to the future state*
Technology Infrastructure *Computers, networks, and communications to enable and maintain the environment.*	**P** Continue to extend the DNR network to co-located field offices and larger state parks. **P** Put Central Office and regional network and GIS equipment on a replacement cycle. **P** Complete Central Office wiring upgrade to Ethernet. **P** Develop facilities to enable video conferencing among Regional and Central Offices. **P** Increase the security on the DNR network to prevent unauthorized access to restricted data, while freely sharing public information.
Socio-Political Organization *Policies and other factors governing behavior, organization, people, and culture.*	**P** Information Technology, and the data and information it serves, will be managed for the goals and objectives of the DNR as a whole. The needs of the individual business units will continue to be served, with the needs of the entire agency having the highest priority. **P** Data and information are DNR assets, not divisional, bureau, or personal assets. **P** At the Commissioner's Office level, all IT functions and activities will be the responsibility of the Assistant Commissioner for Administration. **P** Outside the Commissioner's Office, the Chief Information Officer (CIO) will be responsible for IT policy development and recommendations. **P** The CIO will review all IT project requests and make recommendations to the Commissioner's Management Team (CMT) about which projects should continue and which should not, based on a project's ability to meets the needs of the DNR and the business unit. **P** For reasons of efficiency and effectiveness, some functions will be centralized within the MIS Bureau. In some cases this will involve the reassignment of personnel and budget. **P** The CIO will be the lead Senior Manager for legislative issues and initiatives relative to IT. Divisions with IT projects will be responsible to represent programmatic issues to the legislature.

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Chapter I

Introduction:
DNR Strategic Information Resource Management Plan

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COMPONENTS OF THE PLAN

The Department of Natural Resources (DNR) Strategic Information Resource Management Plan (SIRMP) includes a review of existing information resources and technology, a vision of the future, and a plan to realize the vision. The SIRMP is driven by the mission and strategies of the department. This approach is in keeping with the principle that information resources and technologies should be deployed for maximum benefit to an organization's goals.

Information Resource Management (IRM) treats information as an organizational asset to be managed like other organizational assets (e.g. revenue, land, facilities, etc). IRM is concerned with managing the organizational resources involved in creating, storing, processing, transporting, accessing, presenting, managing, and disposing of information. IRM means conscious planning, organization, and oversight of the information resources.

All elements impacting the effectiveness of information resources must be planned. These are defined as follows:

IRM Element	Definition	Examples
Business Process; Application	Ordered series of activities that accomplish a business function.	P Payroll P E-mail
Applications Portfolio	The organized collection of processes you have or need to run your business.	P A collection of packaged software and in-house-written programs to track funding requests and project successes
Data	What you need to know to conduct and manage your business.	P For a person: address, telephone number P For a project: total budget, amount spent so far
Data Architecture	How data is organized; how data stores are interrelated.	P Payroll data in SQL server P Customer names linked to addresses P Data distribution to local sites
Information Resource Delivery and Support	IT services and products provided commonly; how applications are created; skills, methodologies, tools.	P Contract developers use structured analysis and design techniques to write programs using the C language P 24 hour help desk
User Self-Service	What users can do for themselves, including skills and tools.	P Spreadsheet P Database reporting program P Training class in Microsoft Word

Technology Infrastructure	Computers, networks, and communications to enable and maintain the technological environment.	P PC's connected to a server over a network P Communication line to a remote office
Socio-Political Organization	Policies and other factors governing behavior; organization, people, and culture	P Structure of the organization P Who creates and approves IT policies P User comfort level with computers

OBJECTIVES OF THE PLAN

The objective of the Strategic Information Resource Management Plan is to guide Information Technology (IT) efforts and investments in the Minnesota Department of Natural Resources over the next four to six years.

The plan is *strategic* in that it links information management activities to the business strategies of the department. It also sets a direction by documenting the current state and a desired future state of information resource and technology management in the department. Its focus on *information resources* includes all activities that impact business processes and enterprise information, from hardware and software to people and policies. It is a *management plan* in that it represents the best thinking of the organization at this time, and will evolve over time as business needs change and technology matures.

The SIRMP will guide the DNR's IT efforts and investments over the next four to six years. It also satisfies a legislative mandate, administered by the State Office of Technology, requiring every agency to develop a strategic direction in the management and deployment of information technology.

The SIRMP should become a living document, frequently reviewed and updated by DNR leadership.

APPROACH TO PRODUCING THE PLAN

The first step in the creation of this plan was a review of documents that define the department's strategic direction. These include the Ventura administration's Big Plan, the DNR Commissioner's Work Plan 2000, and DNR Directions 2000 (the agency's strategic plan). A future perspective was added by considering global technology trends and consulting each DNR division and bureau about their future IT needs.

The IT strategies were developed starting with applications and data to support the business strategies. To each application or data need was added an assessment of the current condition and the desired future state. Next, the methods for obtaining new applications and data were considered: professional development or user self-service. Then the foundations were added: the technology infrastructure and socio-political-organizational elements.

Once the strategies were identified, realization plans were added and prioritized. The near-term projects were defined in greater detail and planned at a high level to determine resource requirements and schedules.

The realization project list provides a starting point for the biennial Information Technology budget request.

PARTICIPANTS IN DEVELOPING THE PLAN

The primary authors of this plan were Bruce Abbott, Data Administrator, Colleen Mlecoch, Data and Applications Manager, and Henry May, Chief Information Officer. Input was also received from Jack Shea, Network Manager, and Les Maki, GIS Manager. The ***SIRMP*** could not have been written without the considerable contributions of DNR leadership and IT professionals in the department. We gratefully acknowledge your formal and informal support and advice, and look forward to a continued dialogue as we move forward to realize our vision.

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Chapter II

Business Strategy Model

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ABOUT THE BUSINESS STRATEGY MODEL

The Business Strategy Model is a way to encapsulate a complete definition of a business at a high level. The model is used to guide decisions about which IT projects to undertake.

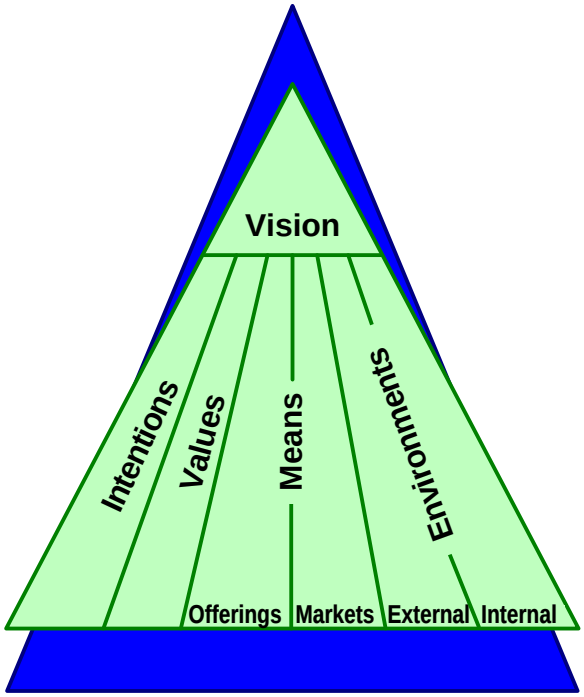
Intentions include both *aims* (what we intend to accomplish) and the *mission* (a summary of the aims).

To summarize the relationships:

We achieve our *intentions* by providing *offerings* to our *markets*. Our behavior is guided by our *values*. We track our *external environment,* and provide our *internal environment.*

The *vision* summarizes all of these elements.

As part of the planning effort, a business strategy model was created for the agency.



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THE BIG PLAN AND CITIZEN ACCESS

State agency strategic plans exist in the larger context of statewide strategic direction. In October 1999, Minnesota's Governor Ventura began releasing information relating to "The Big Plan – Strategic Directions of the Ventura Administration". (See www.mainserver.state.mn.us/governor/the_big_plan.html.) The Big Vision for Minnesota, as stated in The Big Plan, is:

> *We envision Minnesota as the best place to grow a business because of high-skilled workers and a supportive tax climate. The best place to retire because of affordable, accessible health care and living options; the best place to raise a family because of livable communities and excellent public education; the best place to immigrate because of economic and community opportunities; the best place to vacation and conference due to our hospitality and tourism industries; the best place to farm because of our commitment to competitive agriculture worldwide; and the best place to live because of our ethical, responsive, public non-profit and private sector leaders and involved citizens of all ages.*

The Big Plan outlines four major objectives for Minnesota government, in support of the Big Vision:

- *To create healthy, vital communities;*
- *To create self-sufficient people;*
- *To provide service, not systems; and*
- *To achieve world competitor status for Minnesota.*

According to the March 8, 2000 Report from the EGS Mini-Cabinet Work Group (see www.ot.state.mn.us/reports/index.html), "Meeting the objectives and achieving the expansive vision in The Big Plan involves many facets of our society, including the use of telecommunications and other types of technology to benefit Minnesota citizens and communities." The importance of electronic technology in providing *citizen access* to government services and information is underscored in two of the Big Plan's initiatives:

- ***Ensuring an information highway that leaves no community excluded:*** *...Electronic technology standards and guidelines adopted by all agencies and departments will increase their ability to work together, share information and leverage resources, while providing essential access to all citizens as well as local units of government. Electronic technologies utilized in government service will provide greater levels of access, ease and convenience for citizens using government services, as well as contributing to communities across the state. Our objective is to provide access to government services and commercial activity by means of electronic connectivity which is high speed, integrated and global.*

- ***Electronic Government Services Initiative:*** *...Government purchasing, inventory, and sales, from goods to real estate, must be transacted and advertised on a central file server. Electronic tax filing, and payroll communications, also will be conducted online. Such initiatives will increase government efficiency, provide for a comprehensive and coordinated information management system, and create avenues for citizen communication and participation with their government. Such initiatives also will be utilized to increase service levels, and speed up transactions across state government, while permitting both government and business to maintain a level playing field in commercial transactions.*

Citizen access to government services and information is also an underlying theme of the DNR's business strategy, which is described in the following section.

DNR BUSINESS STRATEGY

(Source: DNR Directions 2000, June 12, 2000 draft)

Vision

A high level summary of our intentions, values, means, and environments.

Minnesota's natural resource heritage defines the state's economy and lifestyle. The Minnesota DNR is a steward of that heritage. The mission of the DNR is to work with citizens to protect and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life.

The goal of sustainability guides our work with citizens to manage the state's natural resources. Sustainability depends on healthy ecosystems, a vibrant economy, and viable communities. Healthy ecosystems support natural resource industries, tourism, outdoor recreation, and lifestyles important to Minnesotans. DNR will continue to emphasize a healthy environment for managing natural resources in a sustainable manner. This implies protecting and restoring habitat, protecting fragile natural areas, and minimizing environmental impacts from development. There is no substitute for clean water, productive habitat, and healthy ecosystems.

We will continue to use good science and sound decisions and focus on long term basic responsibilities that have always been at the heart of resource management and that will continue to be foremost to all Minnesotans. This means a continuing focus on improving the way we manage resources for basic needs like recreation, hunting, fishing, tourism, resource industries, and preservation.

DNR will emphasize three resource management priorities:

Conservation Connections: DNR will partner with local citizen groups and local government to establish and maintain land and water connections throughout Minnesota. DNR will accomplished this through cooperative partnerships with interested people inside and outside of the DNR. DNR will strive to become a welcome partner in Minnesota growth using Conservation Connections as a resource to manage growth impacts on natural resources.

Smart Growth: DNR realizes that growth in Minnesota has a highly significant impact on natural resources. DNR will be guided by the Governor's Smart Growth Initiative as we strive to become a more active participant in growth issues at the local, county, and statewide levels. DNR will work with other government, non-profit, and for-profit organizations to sustain healthy ecosystems, a vibrant economy, and livable communities.

Sustainable Forests: DNR recognizes the critical importance of sustainable forest ecosystems and will continue cooperating with other agencies and organizations to accomplish that end.

Intentions

Why do we exist? What do we hope to achieve?

Mission

The mission of the Minnesota Department of Natural Resources (DNR) is to work with citizens to protect and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life. This plan defines how information resources and technology will be deployed to support the DNR mission.

The DNR mission is broad. It includes providing hunting and fishing opportunities for millions of Minnesotans, providing high quality recreation opportunities for park and trail users, providing economic opportunities for resource industries, and preserving important features of the state's natural heritage. DNR programs include fish and wildlife habitat improvement, fire management, mineral-potential research, management of public lands and waters, and many others – all designed to provide sustainable benefits to Minnesotans for the long term. The DNR mission requires sharing stewardship with citizens and partners.

Aims / Action Priorities

Directions 2000, as DNR's strategic plan, focuses on a five year time frame from the years 2000 through 2004. The goals and objectives of Directions 2000 are long range and most may not be reached during the plan's five year horizon. Most DNR goals can only be accomplished by working over the long term in broad coalitions with citizens and partners, such as the Conservation Connections approaches. DNR is committed to developing better ways of working with citizens and partners to accomplish sustainability goals. DNR is building better performance measures to track progress towards reaching long term goals. Performance measures will link DNR strategies to natural resource results and to public benefits.

DNR will review Directions 2000 in 2002 to ensure that strategies are still appropriate to challenges posed by longer term goals and objectives. DNR will continue to develop two year work plans to develop priorities for reaching long term goals. The DNR Commissioner's Work Plan 2000 emphasizes three resource management priorities. These priorities, described below, guide and inform the strategies developed in each of the key resource sections of Directions 2000.

1. Smart Growth: Creating healthy, vital communities is one of four major strategies in the Ventura administration Big Plan. A key component of this strategy is the Smart Growth Initiative. This statewide initiative includes six principles:

    - Economic Growth: Economic expansion is reflected by growth in employment, personal income, and private sector investment.

    - Stewardship: Environmental stewardship involves using land and natural resources wisely to sustain them in the future. Minnesota will protect the environment that supports outdoor recreation, tourism, and natural-resource-based industries.

    - Efficiency: Minnesota will coordinate and link investments and tax policies with Smart Growth principles.

    - Choice: Communities will have a range of choices regarding how they grow.

- Accountability: Growth, land use, and investment decisions will be consistent with Smart Growth principles.

- Fiscal Responsibility: Minnesota will maximize private and public good and minimize public investment.

DNR is a lead state agency in developing the administration's approach to managing growth. The project focus includes growth throughout Minnesota in urban, suburban, and rural land areas, including shorelands.

2. Conservation Connections: Minnesota Conservation Connections is a way for the DNR to connect with people where they live and where they work. It is a forward-looking way to protect and manage Minnesota's natural resources by working with people and their local governments. It builds on Minnesota's strong tradition of preserving its outdoor heritage for future generations. Relying on partnerships among public and private landowners, all levels of government, non-profit organizations, and concerned citizens, Conservation Connections respects individual property rights while providing a cost-effective approach to conservation.

   Conservation Connections is a statewide network of natural areas, wildlife habitat, working forests, and other open spaces connected by land and water corridors. Corridors provide many benefits. They help wildlife flourish by connecting fragmented habitat. They provide environmental services such as flood control and water purification at relatively low costs. They offer numerous recreation benefits that enhance the tourism industry.

   A statewide systems of corridors will provide a framework to coordinate resource preservation and sustainable land use planning. This is critical now as many areas of the state face increasing development pressures. Conservation Connections will help guide development in a way that balances environmental, economic, and social needs, thereby assuring the high quality of life expected by all Minnesotans.

3. Sustainable Forests: DNR is committed to sustaining healthy and productive forest ecosystems. Sustainable forests support a thriving timber industry, protect diverse habitats for plant and animal species, maintain water quality, and provide recreation opportunities. These benefits provide a foundation for Minnesota's economy and quality of life.

   Sustaining forest ecosystems requires a mix of strategies. DNR's Sustainable Forest Initiative gives focus to the following operational management activities to increase forest productivity:

   - Managing for older forests through DNR's Old Growth and Extended Rotation guidelines;

   - Implementing the Forest Resource Council's site-level guidelines;

   - Developing new tools to assess changes in the size, pattern, and connectivity of forest habitats and incorporating this information into operational management; and

   - Integrating timber production and biodiversity goals through landscape-level planning and coordination.

4. Additional Priorities: The DNR budget process may reveal additional priorities that merit funding support. As indicated in its twelve management principles (see below), DNR is seeking to better integrate the budget and Directions process.

Values
These principles or beliefs guide our behavior.

Twelve principles define how DNR fulfills its mission and provide an additional framework to shape the management strategies in this plan. These principles guide DNR decision-making at all levels of the organization.

- Basic Services: DNR believes that its long-term, basic work to sustain natural resources and serve citizens is the backbone of effective resource management. DNR will emphasize strong basic services that provide recreation opportunities, protect and improve habitat, and manage natural resources for sustainable use. This requires investments in core disciplines and finding new ways to improve interdisciplinary cooperation and partnerships with citizens to promote healthy and sustainable ecosystems.

- Partnerships: DNR believes that cooperation with other agencies, local units of government, citizens, and stakeholder groups is the best approach to managing natural resources effectively. DNR will expand its use of partnerships to develop cooperative resource management approaches. DNR will cooperate with county and local officials to mitigate the impacts of DNR land purchases on local tax revenues.

- Integrated Approaches: DNR believes that resources are part of large, interdependent systems and cannot be managed in isolation. DNR will emphasize a systems approach that seeks to coordinate and integrate the broad scope of management efforts.

- Science, Information, and Technology: DNR believes that the complex challenges of the future will require increased emphasis on good science, accurate information, and state of the art technology, especially information systems. DNR will accelerate the collection, interpretation, and dissemination of scientific information describing Minnesota's ecosystems and natural resources and will continue investing in the technology necessary to effectively manage the state's natural resources.

- Communication: DNR believes that good internal and external communication will be essential in managing future natural resource challenges. DNR will seek opportunities to improve communications with stakeholders and citizens, including legislators, local government, the media, stakeholder groups, the private sector, and other agencies.

- Technical Assistance: DNR believes that many resource and land use decisions should be made at the local level and that well-informed local decision makers will make good decisions. DNR will expand efforts to provide information and technical assistance to citizens and local government.

- Natural Resource Stewardship Education: DNR believes that informed citizens will be wise stewards of natural resources. Natural resource stewardship education will be a cornerstone for DNR efforts to develop an environmental stewardship ethic among all Minnesotans. DNR will implement recommendations of its Cornerstones 2000 report that defines priorities for delivering

natural resource stewardship education services more effectively.

- Performance Measurement: DNR believes that accurate assessment of its effectiveness and management must occur on a regular basis. During the year 2000, DNR will establish performance measures for the goals and objectives in Directions 2000. The DNR Performance Report 2001 will provide a more comprehensive assessment of the agency's success in managing natural resources for commercial use, recreation opportunities, and for the long-term sustainability of ecosystems.

- Sustainable Organization: DNR believes that its actions should model sustainable use of natural resources. Following a key recommendation from DNR Cornerstones, DNR will look for opportunities to manage its own programs, facilities, and workforce in a way that reflects sustainable use of natural resources. (Cornerstones 2000 recommended that DNR's commitment to sustainability should be reflected in its day-to-day practices and policies.)

- Planning & Budgeting: DNR believes that integrating planning and budgeting across area, regional, and state levels will strengthen the ability to accomplish its goals and objectives. DNR will integrate resource management priorities into existing departmental processes, discipline planning, budget development, regional resource plans, and spending plans, and will place more authority with area staff to manage budget and staffing priorities.

- Human Resources: DNR believes that sustaining natural resources requires an effective and skilled workforce to meet the changing needs of the human community. DNR will emphasize workforce planning that includes recruitment and retention of a diverse workforce, as well as employee development, training, and career paths to meet current and future community needs.

- Quality Services: DNR believes that the products and services it delivers to the public will be of the highest quality. DNR will look for further opportunities to continually enhance the quality of its products and services and will actively solicit suggestions for improvements.

Means

Offerings *What are our products or services?*	**Priority Ranking**	**Markets** *Whom do we serve?*
Protecting and restoring the natural environment while enhancing economic opportunity and community well-being	A	Minnesota citizens
Managing public lands and waters	A	Minnesota citizens
Managing natural resources for sustainable use	A	Minnesota citizens
Protecting and improving habitat	A	Minnesota citizens
Providing hunting and fishing opportunities	B	Hunters and anglers
Providing recreational park and trail opportunities	B	Park and trail users (campers, hikers, skiers, cyclists, etc.)
Providing economic opportunities	A	Resource industries (including timber and mining)
Preserving important features of the state's natural heritage	A	Minnesota citizens

Environments

External

What external entities should we track for changes in our environment?
What external conditions affect us?

- hunting and fishing organizations
- outdoor recreation enthusiasts
- environmental organizations
- resource industries
- Minnesota Forest Resource Council
- Sustainable Forest Resources Act
- information technology trends

Internal

What kind of internal environment do we create to enable all of the above?
What internal conditions are key?

- Executive and senior management support
- Trust and collaboration between MIS and business units

Chapter III

Information Technology Overview: Vision and IT Architecture

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INFORMATION TECHNOLOGY ARCHITECTURE . . . . . Page III-2

INFORMATION TECHNOLOGY VISION

The DNR has three resource management priorities: Conservation Connections, Smart Growth, and Sustainable Forests. Information technology can be employed fruitfully in the service of each of these strategies.

DNR's information technology architecture ensures timely access to current data and information, resulting in informed decision making, productive collaborations, excellent customer service, and effective natural resource management.

Information technology supports:

Natural resource management, through coordinated and distributed access to business and spatial data and applications;

Meaningful communication, both internally and with DNR customers; and

Reliable and convenient service delivery to citizens, community partners, regulated clients, department staff and others, so they can meet obligations, exercise rights, receive privileges, get quick answers, and make good choices. Because an increasing percentage of the DNR's service delivery recipients have access to the Internet, we will support the Big Plan's Electronic Government Services initiative (see page II-3) by continuing to increase the Internet availability of DNR services and information.

The vision for information technology requires:

Policies, standards, and guidelines for application and information system development;

A dependable network infrastructure that supports DNR's geographically dispersed organization; and

Integrated and accessible data tailored to meet department and individual program needs;

Managed by DNR employees who have:

Expertise in information technology engineering;

Knowledge and training in the use of information technology commensurate with job responsibilities; and

Adequate funding for information technology projects that are directly linked to and support DNR's strategic business direction and program needs.

INFORMATION TECHNOLOGY ARCHITECTURE

An architecture can be defined as the orderly arrangement of interconnected parts that produce an intended functionality. An architecture describes how parts go together, and what they should do when they work together. In the realm of information resource management, IT architecture describes the orderly arrangement of information resources that produce an intended functionality – support of the

mission and strategies of the business (DNR).

The major strategic elements of the SIRMP can be viewed as sub-assemblies of the overall IT architecture. *Data Architecture* describes how data is organized, and how data stores are interrelated. The *Applications Portfolio* is an organized listing of the automated processes needed to run a business, including brief descriptions, statuses, and contacts for further information. The *Applications Delivery and Support* component describes the development environment for the creation of applications, including skills, methodology, and tools. The *User Self-Service* component describes the support, documentation, and tools available to help users take personal advantage of the information technology available to them. The *Technology Infrastructure* describes the hardware, software, network, and communication architectures. Finally, the *Socio-Political Organization* component describes the policies, staff structure, and other factors that govern behavior, organization, people, and culture as they relate to information technology.

All six of these "component assemblies" must fit together and function in concert, in order that the overall IT architecture can work effectively and efficiently in support of the business. These components are detailed in the next six chapters of the SIRMP.

Chapter IV

IT Architecture: Data Architecture

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BUSINESS OBJECT MODELING

For the last two biennia, the DNR has been adopting the approach to data architecture promoted by the Office of Technology. This approach centers on the concept of "business object modeling" as a critical first step in the analysis of business users' information needs.

The following paragraphs, excerpted from a white paper entitled "An Analysis of Business Object Modeling," are included here to provide a conceptual understanding of the benefits of this approach[1]:

> Advanced Strategies, Inc. of Atlanta, GA (www.advancedstrategiesinc.com) developed the Business Object Modeling approach to user-centric conceptual data modeling. This approach is clearly focused on business users, or Subject Matter Experts (SMEs). Data modelers help SMEs to represent real-world facts about important entities and the relationships among them, for a specific business domain / project scope / universe of discourse. SMEs are pre-selected to be business, not data, experts, and are asked to describe the *real world* of their business, *without* filtering it through any knowledge of existing legacy data structures. The modeler guides the SMEs through a set of exercises to produce a Business Object Model, which consists of an entity/relationship diagram (ERD) with accompanying (off-diagram) textual descriptions. This model lays out, in a highly readable format, essential facts about their business objects and the associations among them. Facts related to business policies (which change more quickly and unpredictably than essential facts), and facts of implementation related to technology constraints (which change even more rapidly!) are kept out of the Business Object Model, and saved for later modeling steps. The result is a very clear representation of the essential nature of a business area, easily readable (and therefore verifiable) by the business experts who built it. Because this model is based on real-world facts, it remains stable over a fairly long time frame (as long as the essential nature of that area of the business remains stable).
>
> Note that the term "Business Object Modeling" refers to business objects, as understood by business experts. It has nothing to with UML or other object-oriented modeling approaches.
>
> ...
>
> The primary goal of Business Object Modeling is to clearly portray the Subject Matter Experts' view of the real-world facts about the business area under study. All of the notational conventions used in Business Object Modeling are intended to support that clarity and that perspective. In fact, Business Object Modeling sessions often result in a clearer understanding among SMEs of the essential nature of their business. The fact that the notation is fairly simple and intuitive allows SMEs to build the model themselves, in real time, with the *assistance* of the data modeler. This gives the SMEs ownership of the model. Some non-IT-oriented SMEs have been known to hang Business Object Model entity/relationship diagrams in their offices, not because the models represent innovative IT methodology, but because they clearly show "what the business is all about".
>
> ...

[1]This paper was written in March, 2000 by Bruce Abbott, DNR Data Administrator. The full paper can be found by doing the following: Go to the DIG-IT Web site at www.data.state.mn.us. Click on "Data WareHouse". Click on "Data Modeling Notations". Follow the instructions on the screen.

> "Just the facts, Ma'am…" This statement characterizes the rigorous search for model elements that describe, succinctly and in plain English, the real world of the business area being modeled, in terms provided by the SMEs themselves. Modelers in Business Object Modeling sessions repeatedly address two simple questions to the SMEs, regarding a specific fact under discussion. First, is it true? Second, do we care? In other words, the model is validated by making sure that it only depicts statements about the subject area that are both true and relevant (given the focus of the project). This rigor, coupled with the full participation of the SMEs in building the models in real time, results in models that reflect the essential truths about the business area under analysis.
>
> The user-centric nature of Business Object Modeling benefits everyone – the business experts, the business unit under study, the modelers, and the downstream data analysts. The SMEs often come away from Business Object Modeling sessions with a better understanding of their own business, because of the care with which they defined their terms and characterized the associations among the important elements of their business. They nearly always come away from these sessions with the sense that they have been heard, that the model is *their* model. They are also confident that the data modelers who helped them build the model have a clear picture of their business. And when the modelers and downstream data analysts, via a well-established set of techniques beyond the scope of this paper, convert this model of their world into a physical database, the business unit is left with an elegant, robust database structure. This structure is based on a complete understanding of the business area under study, not just the current data requirements. As a result, the database will be able to answer standard user queries, as well as questions that the SMEs didn't know they wanted to ask at the time the model was being developed. This really extends the useful life of data structures built from Business Object Models.

The "later modeling steps" mentioned in the above paragraphs involve three steps. First, the business object model is first transformed into a *conceptual data model* – a straightforward translation of business objects into logical records and fields. Next, business experts are again consulted, in order to add policy-related information to the model. This will result in a *logical data model*. Finally, information systems experts are consulted, in order to add hardware/software technology constraints to the model. This will result in a *physical data model*, which is the jumping-off point for actual construction and population of a physical database.

Now, if this approach were simply applied to individual database development efforts within an agency, the resulting databases would be elegant, robust, and reflective of the business users' views of the information they need to do their jobs. However, the problem of data silos would still remain – information structures scattered across the landscape, which, while internally consistent and well organized, would not be able to share information with other structures. The Office of Technology and Advanced Strategies, Inc. recommend the creation of an "enterprise *framing* business object model" to overcome this isolation. This approach involves the building of a high-level business object model that attempts to portray the major entities and relationships important to the business as a whole. ("Business" in this case refers to agency or data community.)

This framing object model is not intended to be refined and developed into a single, enterprise-wide database. Rather, it is used as a guide to determine what subsets of entities and of business experts should be involved in the creation of detailed business object models. These detailed models *are* intended to lead to databases. It is important to note that the impetus for starting a detailed business object modeling project must come from *business* drivers, not technical drivers. As the needs of the business require new or re-engineered database and application development projects, the framing object model is consulted to

determine who should be involved in the creation of the detailed models. In this way, models and databases created in year X are much more likely to have logical hooks to models created in year X+Y, even though the two projects may not be directly connected or even in the same unit within the organization.

Given this context and approach to data architecture, here is what the DNR has accomplished in this area:

- In 1997, the DNR developed an *enterprise-wide framing business object model*. This model is being used in the manner described above.

- In early 1998, the DNR MIS Bureau created and filled the new position of *data administrator* for the department. The purpose of this position is "to manage the design, development, and maintenance of an integrated information architecture for the Department of Natural Resources in support of Ecosystem-Based Management of Minnesota's natural resources. Specifically, it will produce and maintain a business object model for an overall DNR corporate information framework, manage DNR data definitions and related business rules, and work with DNR project teams to produce object models and conceptual data models for DNR databases and applications."

- In 1999 and 2000, several database development efforts within the DNR took advantage of the business object modeling approach. Notable among them is the Customer Database Project, an effort to develop a single source of information about the customers of DNR's varied products and services. This project (still underway) took as its starting point a portion of the DNR framing business object model.

We intend to continue using this approach to database development, and to continue working with other agencies to share object modeling fragments and expertise.

METADATA REGISTRY

The DNR is in the process of developing a metadata registry that will be conformant with ISO/IEC 11179: Specification and Standardization of Data Elements. The following project definition and initial project plan (pages IV-5 to IV-9) were developed by Bruce Abbott, DNR Data Administrator, as a candidate project during the Data Summit meetings in the spring of 2000. (These meetings were sponsored by the Data Issues Group – Information Technology (DIG-IT), the Information Policy Council (IPC), and the Office of Technology (OT).) Given the interagency uncertainties surrounding the Data Summit, the DNR is planning to implement this registry at the agency level.

Project Definition: Develop and Implement a Metadata Management Facility

Intentions (What are the business purposes, goals, objectives for this project? What business results are expected? Why is this effort worth doing?)

Expected Business Results	Effort Contribution of This Project to Support these Results
1. Improve the quality of and accessibility to state data	P Build a metadata registry with strong quality control standards and an emphasis on user access and accessibility
2. Enable professionals (including the legislature and executive branch) to make better decisions	P Facilitate cross agency comparisons, analysis, and sharing of data. P Help ensure data is accurately interpreted and appropriately used
3. Increase the ability to more quickly respond to public and other (legal, press, etc.) misrepresentations of data	P Make the context of data known so a response can be made quickly
4. Increase self-reliance for users of state agency data	P Enable users to create their own reports and appropriately interpret the data
5. Enhance the ability to maintain and extend contractor-built work products after contract programmers leave	P Use metadata registry to hold contractors to data element and metadata standards

Values (What beliefs, trade-offs, and judgement guidelines govern the results and the methods of achieving them?)

- P Collaborate among agencies
- P Be driven by a wide variety of participants, not a single school of thought
- P Seek practical uses, not academic ones
- P Utilize our collective strengths
- P Be realistic
- P Research and evaluate the appropriateness of existing standards and solutions

Stakeholders (Who can impact or be impacted by this project?)

Direct:

- For users of state agency data (within and across agencies, as well as citizens, the Legislature, the governor's staff, etc.), a data element metadata registry specifies a basic set of data element characteristics necessary to share data. It places special emphasis on important data element characteristics such as identifiers, definitions, and classification categories. A data element registry will lead users of shared data to a common understanding of a data element's meaning, representation, and identification.
- For systems analysts and data stewards, a data element metadata registry provides a way to reuse a data element that meets a need, or to design a new data element if one does not already exist. Even before the user accesses data elements in a database, data stewards and systems analysts must have a way to identify and describe data logically so that they do not inadvertently introduce inconsistent values of data.
- For software developers, a data element metadata registry provides means to assure data coherence. A registry can serve software developers by enabling the consistent use of data throughout the Software Development Life Cycle (SDLC). A registry will provide the mechanisms for managing data elements and for ensuring their traceability between SDLC phases.
- For developers of a data dictionary, data element registry, CASE tool, and other data management software, the specifications for a standard data element metadata registry provide the basis for designing a metamodel necessary to enable the capture, storage, management, and exchange of the data element metadata.

Indirect:

- Minnesota citizens who are recipients of state agency services will benefit from the increased efficiency and effectiveness with which data and information are collected, stored, accessed, and archived.
- Agencies that do not directly participate in this project will have both a standard and a software implementation tool available if and when they are appropriately positioned to take advantage of this approach to data standardization.

Focus Statement

Breadth (What portion of the business processes, activities, functions, and/or organizational units are covered by this project?)

Including:

- Development or adoption of data element metadata standards
- Registration of as-is legacy data elements (perhaps within a certain data community or other workable subset of state agency data)

same data community), to be kept in a separate section of the registry

Portion of the Data Pool to be Initially Addressed

Two thoughts:

- Some subset of the environmental data community, because of the potential synergy with the U.S. Environmental Protection Agency's Environmental Data Registry, a working implementation of a metadata registry
- Some data community that would tie in with Electronic Government Services, because it will get Executive and maybe Legislative branch attention in Minnesota

Depth (How much detail of the business must be explored to produce the appropriate deliverables)

- Existing data element metadata from such sources as operational data dictionaries will be collected first
- This project should provide cost estimates for converting existing metadata to the new standards

Universality (How generic a solution is required?)

Problem set:

- This metadata registry is intended to handle metadata about conceptual entities, attributes, and relationships, as well as physical data elements (including representational information such as data type and format). Some ability to handle classification information, such as keywords and taxonomies, will be included.

Deployment:

- This registry will be deployed as a descriptive registry (or perhaps set of registries, each managed by its own agency) across participating data sets in participating agencies. A follow-on project will analyze portions of this descriptive information to develop a prescriptive registry of standard data elements, to be used in new data set development.

Time frames:

Stable: 3-5 years

Extensible: 10+ years. The ISO/IEC 11179 standard is on a five-year review cycle. Given the openness evidenced by the standard and implementation developers at a January 2000 Open Forum on Metadata Registries, metamodels and working data structures reflecting the latest standard will likely continue to be made available.

Scope of Integration

- Minnesota Geographic Metadata Guidelines

Context (In what context can the solution be sought?)

Assumptions

- Documentation and sharing of metadata will enhance use and sharing of state data resources.

Risks

- Non-participating agencies may ignore this effort.
- Non-participating (or even participating) agencies may actively block this effort either in favor of another approach or keeping things the way they are now.

Obstacles

- There are not enough bodies to do everything we want to do
- There is a short organizational attention span at the state for this type of work – need short time-frame deliverables.
- There is nothing to compel the owners of the data to utilize DIG-IT's work.
- The connection between data management and supporting state mandates is not known by the legislature and others.
- There is a perception that improved data management and data sharing will reduce privacy.

Opportunities

- There is enthusiasm and commitment to data sharing and resolving data issues.
- An international standard for the content of metadata registries, ISO/IEC 11179: Specification and Standardization of Data Elements, has been developed over the last decade. Several national-level government agencies (including the U.S. Environmental Protection Agency, the U.S. Health Care Financing Organization, the U.S. Bureau of the Census, the U.S. Department of Veteran Affairs, the U.S. National Institute of Standards and Technology, and the Australian Institute of Health and Welfare) have been involved in the development of the standard and/or the development of working implementations of this standard.
- The U.S. Environmental Protection Agency, which already has in its online Environmental Data Registry (www.epa.gov/edr/) a working implementation of an earlier version of the 11179 standard, is developing a full implementation of the metamodel presented in the newly-revised Part 3 of the standard. They are doing the development in Oracle, and will port it to MS-Access. They will then make this MS-Access version, complete with extensive online help, available as freeware, in order to help promulgate the standard. The EPA will also, by arrangement, either make the Oracle structure available, or, for agencies with a large overlap in data interest with the EPA, may actually host metadata registries for other organizations (or perhaps add other agencies' data elements to the EDR). The MS-Access version is scheduled to be available in May 2000, with a beta version out a month or so earlier. Bruce Abbott has already made arrangements with the developers to be a beta tester.
- The openness and willingness to share mentioned in the Universality section of the Focus Statement above are more likely to continue if Minnesota state agencies continue to participate in ISO/IEC 11179-related forums, and perhaps even become involved in the standards development and refinement process. (Bruce Abbott first participated in the Open Forum on Metadata Registries in January 2000. This was the 3rd annual Open Forum. Bruce is also planning to become involved with the 11179 Metadata Registry Implementation Coalition.)

Initial Draft Project Plan

ID	Process Tasks	Size (in Days)	Precedence	Resource
1	Review ISO 11179 standard, and evaluate MetaPro, the EPA freeware implementation of ISO 11179	10		Bruce Abbott & other agency reps
2	Determine target databases for metadata registration	3		Bruce Abbott & other agency reps
3	Register as-is data element metadata from target databases	5	After 2	Bruce Abbott & other agency reps
4	Determine dissemination mechanism for registry	3		Bruce Abbott & other agency reps
5	Determine and conduct demonstration of benefits of collected metadata	5	After 3,4	Bruce Abbott & other agency reps
6	Publicize results	3	After 5	Bruce Abbott & other agency reps

GIS CORE DATABASE

Because so much of the business of the DNR centers around land- and water-based resources, Geographic Information Systems data sets play a prominent role in the data architecture of the department. The following *draft* paper (pages IV-10 to IV-20), written in March 2000 by Robert Maki, DNR GIS Database Coordinator, describes the GIS Core Architecture.

GIS Core Database Revision: Revised Core Database General Architecture Design

Introduction

This system design discussion describes a comprehensive Geographic Information System (GIS) database architecture for the Minnesota Department of Natural Resources (DNR). The Revised Core Architecture includes the administrative components of data maintenance, access, cataloging, and description. Technically, business application development and database design efforts exist apart from the architecture. The database architecture exists to standardize information storage and access, streamline end-user access to information, reduce the costs associated with new database and application development, and set the stage for information systems integration at the database level.

Although the effort is being driven principally by changes in DNR Geographic Information System (GIS) requirements, it is expected that some components will support the full domain of corporate information technology resources within the organization. In fact, the integration of GIS and traditional databases, resulting in new information resources, is a principle objective of the effort.

This discussion is preceded by two other documents that describe various aspects of the system and its implementation. These include a general white paper on the subject, "GIS Core Database Architecture Revision" (Robert Maki, 1999), and a project plan, "Revised Core Database Architecture Project Plan" (Robert Maki, 2000).

This discussion is oriented around the primary data storage structures and supporting processes that comprise the proposed system. The Principal System Components section (page IV-12) provides an overview of these. Most of the descriptions rely on Data Flow Diagrams (DFD's) to describe the various subsystems, and are supported by textual descriptions that describe preferred approaches, detailed design considerations, and standards requirements. The remainder of the discussion describes key data stores and processes in separate sections, as follows:

Section Title	Section Description
Design Principles	Assumptions underlying the effort
Principle System Components	An overview discussion of the various components which comprise the Revised Core Database environment
Core Database	A discussion on the range of data resources and storage constraints of the integrated Core Database environment
Access Site – Central and Remote	Characteristics and description of an Application Data Store, including both central and remote incarnations
Extended Data Dictionary	A discussion of the general parameters of an extended data dictionary to support the system, and serve as the basis for database integration in new efforts, and legacy conversions

Section Title	Section Description
Mirror	A description of the subsystem that copies data out to remote Core Access Sites
Product Generation	A description of the processes that are used to generate Application Data from Core Data
Access Support	A description of the processes that facilitate access to Core Access Site data and link remote sites to the Data Dictionary
Wrap-up and Next Steps	Additional considerations plus last thoughts and comments on the project

Design Principles

The Revised Core Architecture builds on our experiences with the original GIS Core Database by extending the existing design concepts to new types of source data, new technologies, and greater flexibility in end user applications. The approach outlined here is intended to improve access to the technology.

Technology is in a constant state of change – a condition which threatens to continually destabilize information systems. The Revised Core Architecture should serve to insulate users from structural changes in technology (data migration, new database environments, hardware/software revisions) to the greatest extent possible.

All efforts of this type rest on a set of underlying assumptions. The following list was developed from our current experiences with database architecture development and operation within DNR:

1. The DNR is a distributed application environment where staff in remote locations require localized information products to overcome technological limits in network bandwidth for acceptable performance. Although this is probably not the case for traditional, non-graphic intensive applications, it is certainly true for GIS applications. This condition will persist over at least a five year time horizon, even as sub-regional network connectivity becomes more common. Optimally, remote sites will have access to local, as well as centralized data resources.
2. DNR staff desire information products that are tailored to their requirements and which can function effectively in responsive desktop applications. These products should be rich in long-name descriptions, rather than obtuse attribute codes.
3. DNR corporate data resources should and will experience a continuing process of consolidation and integration. Users should be insulated from major structural changes in Core data.
4. Managed data resources within the organization exist in a diversity of administrative environments (hardware, software) and will continue to do so over the next five years, although on-going standardization in this area is desirable and will be an investment priority through this period.
5. End-user applications will be centered on the personal computer, either as desktop application clients or as intranet browser clients. Users desire a data access environment where they need not know the particulars of where and how data are stored on the system.
6. The department has a significant number of general access users (typically, ArcView-based) that need ad hoc access to a wide variety of data and productivity tools.
7. Data resources should be documented to the fullest practical extent. DNR users rely on documentation to determine fitness of use for their applications.

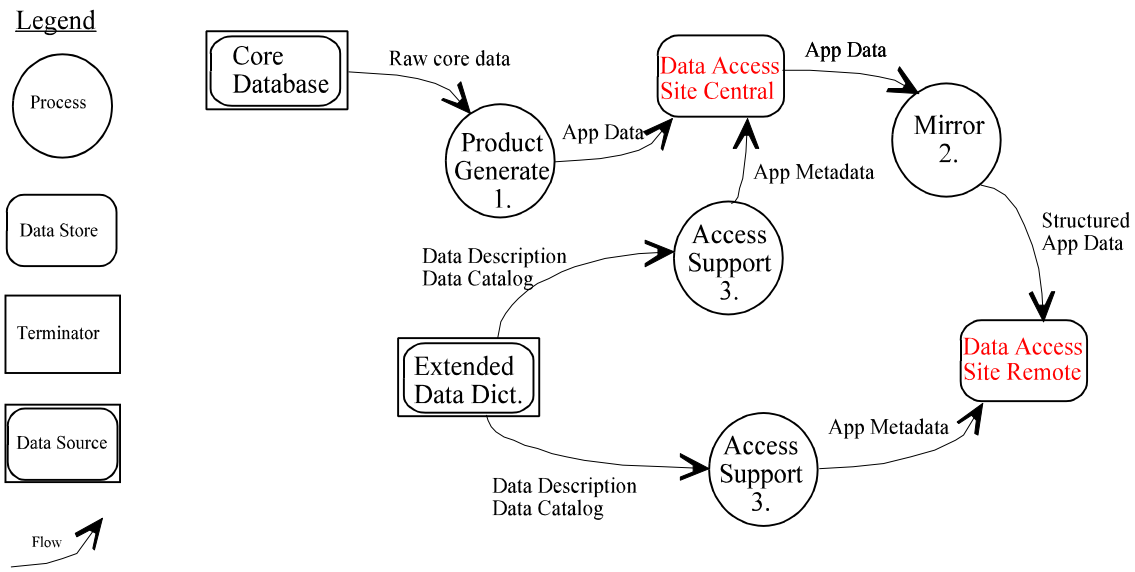
8. All efforts in database infrastructure development should be built around our current hardware and software computing resources, avoiding major capital investments when possible. We should seek to leverage our existing investments.

Principle System Components

The Revised Core Database Infrastructure has seven primary database and subsystem components. These are listed in the following table, and presented in a data flow diagram (DFD) on page IV-13. Each component is discussed in separate sections below.

Primary Architecture Component Descriptions	
Component	**Description**
Core Database	The suite of managed data stores, optimized for administrative processes, including maintenance and integration. These will include the range of formats in which strategic data resources are stored.
Data Access Site-Central	The principal location where application data products are stored. This will include the range of formats in which data resources are accessed. It serves as both a point of access for Central Office applications, and the staging area for data distribution to remote data access sites.
Data Access Site-Remote	The suite of locations that provide access to application data products at remote-networked sites (which are part of the wide area network), including regional offices and (potentially) sub-regional sites (which have been incorporated into the wide area network). These will include the range of formats in which strategic data resources are accessed. Data are mirrored from the central to the remote application data sites. It should be noted that standalone environments could also be centered on Data Access Site structures, with local data stores and system level metadata.
Extended Data Dictionary	A centralized database serving as the repository for data element definition, narrative metadata, and core and application product registries.
Mirror	A set of automated processes which keep Remote Application Data Sites in sync with the Central version.
Product Generate	A set of automated processes which generate application data products that reside on the central Application Data Site.
Access Support	A set of automated processes which generate system metafiles that support standardized access and application interface to the various Data Access Sites.

Principal System Components Data Flow Diagram



Note: Access Support Processes (3.) are identical but separate instances.

Core Database

The Core Database is the collective environment where digital enterprise data resources are stored and maintained. The Core Database is optimized for database administration processes and aspires to high levels of content integration. The Core Database is comprised of multiple sources, including traditional enterprise databases in AS/400 and Oracle environments, GIS databases in ARC/INFO data formats, and (potentially) Novell-based MS-Access databases. Source types are listed in the following table. Some data standards will be globally applicable, while others will be specific to a particular environment. The DNR has a long-term objective to consolidate data resources into a common Oracle-based environment, although this will take years to accomplish.

Core Database Environment Types	
Data Type	**Description**
ARC/INFO filesystem-based	Includes Shapefiles and/or ARC/INFO 7.X coverage formats at some level
Oracle-ARC/INFO DBMS	ARC/INFO 8.X Geodatabase
Oracle DBMS	Traditional relational database administrative environment
AS/400 UDB2	Traditional relational database administrative environment

Core Database Environment Types	
Data Type	**Description**
MS-Access	MS-Access support is uncertain. It would be desirable to capitalize on some of the data resident in this environment, but a number of technical issues present themselves, particularly interfacing with these databases through automated processes.

Core Database Elements are subsidiary databases. It would be desirable for this body of data to conform to a particular suite of database, table, and field naming standards, but in reality, this is not realistic. Large volumes of legacy data will be entering the system, bringing with it a variety of conventions that must be supported for the foreseeable future.

Some Core Database element types will conform to file-system-level structural standards. Clearly ARC/INFO coverages and ARC Shapefiles will require structured organization at this level. These structural standards may be borrowed directly from the current Core Database architecture.

The Core Database will be administered by multiple persons, including representatives from, potentially, every business unit within the DNR. Some maintenance processes will be highly structured and distributed (e.g. customer database), while others will be centralized and much less structured. Some maintenance processes will conducted via web-based technologies. Structural database standards could assist in the development of standardized maintenance applications.

The Core Database should include some provision for data versioning. Categorizing changes as to type is useful when considering the requirements for version tracking. Error correction as a category of change probably does not need to be tracked, while temporal changes probably should be logged in some fashion. The latter case is one of the principle features of a so-called data warehouse, where legacy information is maintained and made accessible. If the source data are stored in an Oracle environment, then some provision for versioning at that level could presumably be made, which could find its way into the derived products. Data managed on file servers will have to have some other mechanism for tracking change, and perhaps some business-specific applications for presenting data changes within desktop applications.

Although most data need not include a lineage in its maintenance environment, others will require it. Business data with legal implications, such as land records and the Protected Waters Inventory (PWI), may require roll-back capabilities to illustrate the state of the data at some particular point in time. Certain types of land imagery are available to users (e.g. LandSat TM data) with multiple dates for any given area. The temporal aspects of the data are extremely valuable for land planners, ecologists, and policy makers.

Core Database Elements will be linked using both client-server TCP/IP and mounted file system protocols.

Access Site – Central and Remote

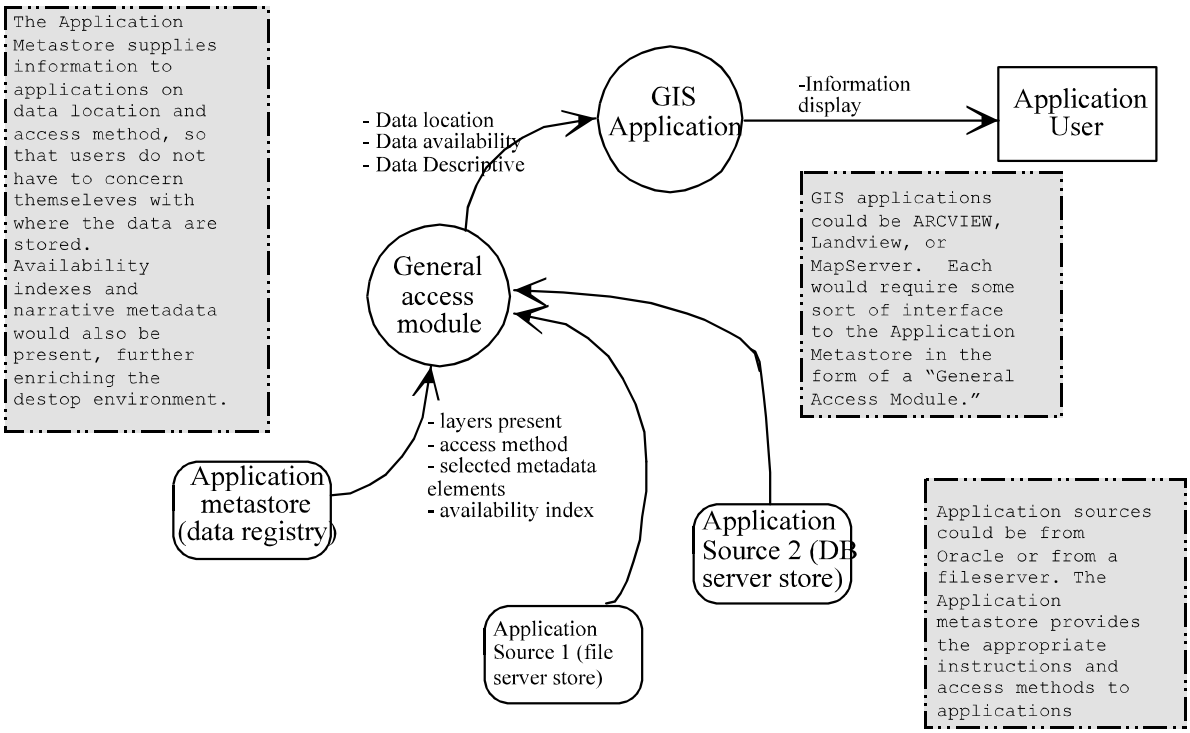
The Central Office Access Site is where derived ("application") products are placed upon creation. Access Sites are centered around a suite of system-level metadata which provide a registry of data

available on a site. From the Access Site perspective, data will be available in a variety of schemes. Some data will exist on a local file server within a standardized directory structure using standardized file names. Some data will reside on database servers, and will be accessible through client-server applications. Data may exist as actual derived data sets, or as "logical" or "virtual layers" that are the result of a query process against an application server. Data may be truly "local," or reside remotely while appearing local. The various storage schemes are listed in the following table.

Access Site Data Types			
Data Type	**Local Storage Option**	**Remote Storage Option**	**Description**
File server	yes	no	File-server-based access to ARC/INFO data. From the application perspective, these data would be locally resident on the Access Site, regardless of type (Central or Remote).
Database server – derived	yes	yes	Derived data resident within a DBMS environment. These data would always be stored at the Central Data Access Site, while being accessed throughout the wide area network.
Database server – logical	yes	yes	Logical data view within a DBMS environment or in the case of SDE for Coverages, traditional ARC/INFO data presented by a database technology. These data would likely be stored at the Central Data Access Site, while being accessed throughout the wide area network.

All data types will exist within the local registry (which is provided via a file server), along with their specific access method. The registry would likely be file-server-based, for reasons that are discussed in the Access Support section (page IV-19). In some future world when network capacity increases, the entire Access Site concept may collapse into a single DNR-wide access site that is referenced from all locations. The concept of an Access Site with an associated data registry and an application interface is shown in the following figure.

Data Access Site-Application Interface



Remote Access Sites are identical to the Central Access Site, except that they are more distant from the Data Dictionary subsystem, which serves as the master registry of data sources and participating sites. The data content of the remote sites will vary somewhat, because resource management, land ownership, land use patterns, and associated data requirements vary considerably between regions.

This same schema could form the basis for field-based applications in standalone (non-networked) environments. In this configuration, the Application Metastore reflects the structured data environment on the user's workstation. Application environments such as ArcView and LandView could interface to the Metastore using the same techniques as are used in Networked locations. This particular implementation would probably require the development of some basic utilities to keep the user's data stores in sync with their Application Metastore, in contrast to the wide area network implementation, which features a centralized environment for keeping the Metastores up to date.

Extended Data Dictionary

The Data Dictionary subsystem consists of a wide array of metadata resources, ranging from classic entity-level data definition, to detailed attribute-level descriptions of data products, to product catalogs and narrative metadata descriptions (e.g. supporting standard GIS data reporting). The subsystem also would support the generation of narrative user products (e.g. web-based DNR GIS data resource pages) and data discovery tools (search engines) as the array of available data resources increases in complexity and volume. A listing of required data elements is provided in the following table. This list is not exhaustive. Other elements may necessarily be added to support other DNR business functions.

Required Data Dictionary Elements	
Element	**Comments**
Data Element Definition	Physical Entity Definition (possibly the same as Table Registry).
Attribute Field Registry	A master registry of attribute fields that can be cross-referenced against Entity Definition and Table Registry entries
Attribute Field Domains	Domains of each Attribute Field. Conceptually (and perhaps physically) embedded in Field Registry.
Table Registry	A master registry of both physical and virtual attribute tables, cross-referenced to Attribute Field Domains. Spatial feature classes are registered as tables.
Core "Layer" Registry	A master list of Core Data Products. There are difficulties associated with defining Core "layers." The term may not be meaningful for some suites of highly integrated data. On the other hand, some spatial core products (e.g., image products) cannot be integrated and, therefore, do exist as discrete "layers." These may be registered as application data without a Core Data source. This category of data may not exist within the traditional database domain.
Application Data Registry	A master list of derived products. This is less ambiguous than the Core Data Registry concept. Application products are by definition discrete. This registry needs to be affiliated with the local registries for each Data Access Site.
Core Relationships	Mechanisms for describing relationships amongst some core elements, particularly relational tables. At this point we wander into some of the native capabilities present in the RDBMS environment. Still, some relational data will exist outside of, for example, Oracle, and cannot be effectively described using native Oracle.
Application Data Parent-Child Relationships	We need to know where Application Data products come from (i.e., their lineage from the Core Database).
Narrative Metadata	Descriptive metadata is an important part of the GIS documentation environment. This would include the FGDC and MGMG data elements
Product Generation Process Registry	Registry of the process name, type, and specification used to generate derived products

The Data Dictionary subsystem has two crucial points of integration within the Revised Core environment. The first of these is with the Application Support subsystem, where the Data Dictionary describes Application Data Product availability for each site. Certain descriptive metadata elements need to be accessible at the Application Data Site level, perhaps through a daily download-update process from the Central Office to the remote sites.

The second point of integration is with the Product Generation processes. Products and associated methods are identified in the Data Dictionary, and may help drive the set of processes which generate the Application Data Products. It may not be necessary to integrate these two subsystems. Product Generate could function independently.

At the time of this writing, the Data Dictionary is envisioned as an Oracle 8 database, perhaps conforming to the ISO Data Dictionary standard being studied in the MIS Bureau. The Data Dictionary would be maintained through a client application with a graphic interface. On-line metadata products will almost certainly exist as XML documents with associated style sheets.

Mirror

The Mirror subsystem pushes data from the Central Office Data Access Site to the Remote Data Access Sites. Only file-server-based products will be affected by this process (Oracle database products are assumed to be available via remote access.) Mirror will operate wholly from filesystem-based change detection processes, much like the techniques that are used in the current Core Database environment. The difference here will be the physical standards that shape the Revised Core Access Sites. The processes will almost certainly be written in PERL and scheduled for nightly execution. They may either be resident as a Central Office process which pushes data out to the regions, or as a regional process which pulls data from the Central Office. Security considerations may guide the decision as to which configuration is implemented.

Product Generate

The Product Generate subsystem creates Application Data Products resident on the Central Office Data Access Site from the Core Database. This subsystem will be one of the most difficult to fully realize. Three different data dimensions are at work in the subsystem: 1) source data type(s), 2) target data types, and 3) update schedule.

Product-generation processes will likely be written in Structured Query Language (SQL) for Oracle database queries, and ARC Macro Language (AML) for processing ARC/INFO-based products. PERL should be used when possible to optimize text-based processing, especially those processes which feature some form of data import/export through the filesystem.

Some products will have simple data sources, simple target data types, and simple scheduling scenarios (e.g., “Weekly” or “Static”). This type of product-generation process will be simple to support. An example might be “PLS Sections” derived from the “Control-Point Generated PLS” Core layer executed on a weekly schedule using AML. Other product-generation processes could be considerably more complex. Consider, for example, “DNR Conservation Officer Contact by Enforcement Area” derived from a combination of GIS base data in ARC/INFO format, and an Oracle-based employee database (a change in either of which might trigger the generation of a new product) using a mixture of AML and SQL through Database Integrator processes. This would require change detection in multiple environments. It may be prudent to abandon change detection triggers from the Product Generate subsystem and move wholly to scheduled updates, except when dealing with both sources and derived products that exist wholly within the Oracle environment, which is better equipped to handle change detection-based processes.

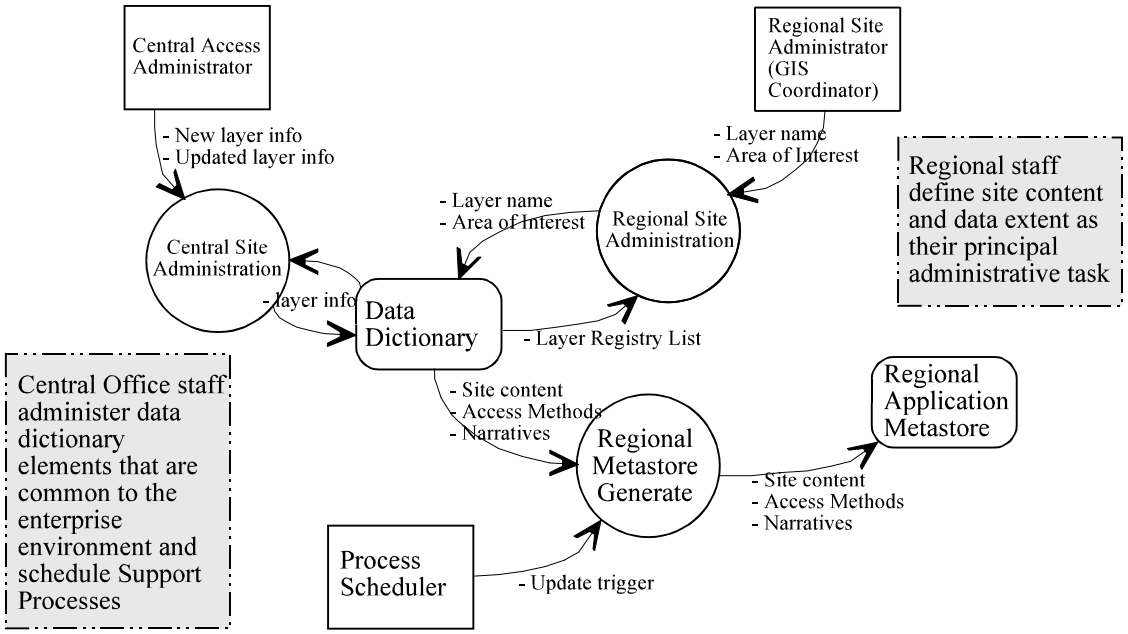
Access Support

The Access Support subsystem exists to populate and maintain the Application Metastore (data store) introduced under "Access Site – Central and Remote" (page IV-14). There are a variety of options available for accomplishing this. They include:

1. Keep the Application Metastore (for each access site) in the Data Dictionary. In this scenario, all applications that use the metastore would query the Data Dictionary at startup to establish its access environment. The Access Support subsystem would exist wholly within Oracle.
2. Compose each site-based Application Metastore in the Data Dictionary, and then write out a system file (or series of files) that serve as the Metastore for each site. These might be updated daily, or triggered on demand. Under this scenario, maintenance of all sites would be administered through an Oracle application.
3. Maintain the Application Metastore as an encapsulated environment at the remote site, with system processes that read local data registries, browse data sites, and generate availability information based on what it sees. Under this scenario, maintenance would be centered at the remote site. This would be an extension of the current approach, which includes processes that peruse the filesystem looking for registered data and record data availability information, which are then used by applications (e.g., Core Access Tools, Roadmap).

Of these, Option 2 has some distinct advantages. One of the objectives of the Revised Core Architecture is to reduce the burden of Access Site administration on the Regional GIS Coordinators. Option 2 provides for centralized administration of all sites within Oracle. At the same time, there are advantages to providing local storage (at the remote sites) of the Application Metastore, including 1) stable access that is unaffected by variations in network throughput, 2) application development that can be implemented in standalone environments, as well as networked ones, and 3) potential for three-tier architecture-based site administrative applications, facilitating maintenance of the administrative environment. Option 1 has the disadvantage of not working for non-networked locations, although it probably would work for regional ones (over the wide-area network). Option 3 is unnecessarily distributed, and probably has a higher overhead associated with its maintenance than the other options. Option 2 is depicted graphically in the following figure.

Application Metastore Generation and Associated System Administration



Wrap-up and Next Steps

This general design discussion provides the framework for proceeding with the detailed design, prototyping, development, and integration of the various infrastructure components. Subsequent investigation may serve to invalidate some of the conclusions and directions suggested here, and take individual components into somewhat different implementation scenarios. Still, this discussion stands as the initial framework for the effort.

It is expected that technical teams will be assembled around the various subsystems with staff contributed from various DNR units in addition to MIS Bureau staff. MIS Bureau staff will have principle responsibility for system implementation, integration, and operation.

Chapter V

IT Architecture: Applications Portfolio

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INTRODUCTION

The DNR Enterprise Applications Portfolio is a dynamic inventory of databases, applications, and information systems developed for and used by department managers and professionals in support of natural resource management, public outreach, and administrative activities. This release of the Portfolio documents 89 databases, applications, and information systems. These are listed alphabetically in four tables, representing the customary phases an information system moves through in the course of its life-cycle:

1. Operational: Maintain / Evolve (46)
2. Development / Testing (12)
3. Proposed New Applications (26)
4. Phase Out / Replace (5)

Following these tables is a scatter diagram showing the fitness, from both business and technical perspectives, of 25 major DNR applications.

CONDITION OF THE INVENTORY

The DNR, like most large public and private enterprises, relies heavily on computer applications to support its business operations. Because business processes change dynamically in response to legislation and new demands from citizens, it is important that computer applications also be able to change rapidly. Most current applications, however, are either monolithic or two-tier client/server applications. The inventory of "legacy" applications reflects not only the tools available at the time the applications were developed, but also how system development projects were funded and managed. Many applications were originally designed and funded to perform a specific operation, for a specific unit, on a specific hardware platform. They were typically developed independently using different languages and tools. The ability of these applications to communicate with each other, or to adapt to changes in business strategy, was generally not a design requirement. The existing situation adversely impacts DNR business in four key ways:

1. The cost and time to modify existing applications to support new business requirements;
2. The cost and time to enable existing applications to take advantage of technologies such as the Internet and Geographic Information Systems;
3. The difficulty of integrating applications to share common services and data; and
4. The expense of developing and maintaining applications because there is little reuse of code.

Recommended best practices to remedy this situation and improve approaches to application design and development will be discussed in Chapter VI.

The Portfolio is being expanded to include a more complete inventory of GIS and Internet-based applications. This is in keeping with the department's strategy to more tightly integrate the management of administrative and spatial data, and to deliver as much data as possible via the Internet. GIS has not been successful in business application integration. The current approach inadvertently re-enforces the separation of GIS from business applications by: 1) requiring significant purchases of proprietary software (ArcView) for access, and 2) not including provisions for integration with traditional database resources. Both of these issues relate strongly to the immaturity of DNR's traditional IS environment in

the sense that there are no current database or application standards on which to base integration. The migration of traditional databases into a unified environment is going to be an incremental process.

OPERATIONAL: MAINTAIN / EVOLVE

Operational: Maintain / Evolve	
Application	**Description**
ArcView Extensions (GIS Tools) Contact: Tim Loesch, GIS Applications Analyst Tim.Loesch@state.mn.us	ArcView - EPPL7 Extension (Version 2.04 - 5/7/99) Integrates ArcView with the raster GIS EPPL7 and works with GeoTiff files. Gives the user some raster analysis capabilities including image rectification, clipping and rotation.
	ArcView Tools Extension (Version 1.3) Contains a number of utility tools: Clipping, Mosaic, Buffer, etc.
	DOQ/DRG Tools Extension (Version 1.3 - 12/21/98) Variety of tools for viewing DOQ's and DRG's. Allows the user to create DOQ Themes straight from a USGS County based DOQ CDROM without having to uncompress.
	Roadway Symbology Extension (Version 1.4) Creates roadway symbols in ArcView. Supports the automatic generation of four types of road symbols and works off a roads database.
	Stream Mode Digitizing Extension (Version 1.05 - 8/15/2000) Provides the functionality to do on-screen stream digitizing of lines and polygons.
	Garmin GPS Utilities (Version 1.4 - 08/3/2000) Allows users to upload and download Waypoints and Tracks from a Garmin GPS receiver and ArcView GIS.
	DNR Forestry CSA Utilities (Version 1.0 - 07/12/2000) Written for DNR staff using Cooperative Stand Assessment (CSA) data.
	DataAccessTools Developed for GIS users who need access to spatial data. The software allows users to select a subset of information they need to do the task at hand without knowledge of where the data is and in what format it is stored. Platform: ESRI Arc/Info Arc Macro Language (AML).

Operational: Maintain / Evolve	
Application	**Description**
Boat and Water Safety Records Contact: Kim Elverum, Boat & Water Safety Coordinator Kim.Elverum@state.mn.us	Data associated with watercraft accidents. Developed by MIS in 1995. Platform: AS/400. Need migration plan.
Capital Budget System Contact: Mark Wallace, Facility Manager Mark.Wallace@state.mn.us	System used to produce biennial Capital Budget. Developed by Vision Technologies in 1997 at a cost of $63,000. Platform: Access; Visual Basic 4.0. Need to integrate with facilities management system.
Commercial Game & Fish Licensing Contact: Ron Kullmann, Fish and Wildlife Consultant Ron.Kullmann@state.mn.us	Tracks commercial game and fish licenses issued. Developed by CCSI in 1986. Platform: AS/400. Need migration plan.
Conservation Officer Training Contact: Roger Teitz, Training Officer Roger.Tietz@state.mn.us	Tracks Conservation Officer training. Developed by CCSI in 1985. Platform: AS/400. Need migration plan.
Division of Enforcement Activity Reporting System (DEARS) Contact: Diane Moe, Enforcement Business Manager Diane.Moe@state.mn.us	Manages Conservation Officer activity, time, expense, and budget reports. Developed by Vision Technologies 1997-2000. Platform: AS/400; Visual Basic 4.0 client. $125,000 investment. Enhancements and Oracle 8i migration planned for FY01.
DNR Web Site (www.dnr.state.mn.us) Contact: Steve Lime, Web Applications Analyst Steve.Lime@state.mn.us	An informative, educational and entertaining web site whose purpose is to facilitate citizen access to natural resource and recreation information. Popular applications are the lake survey reports and maps, river level reports, state parks, community forums, and the GameFinder. Platform: SUN E250; Apache Web Server; MYSQL databases; Perl, Java, Javascript.
DNRnet Contact: Steve Lime, Web Applications Analyst Steve.Lime@state.mn.us	DNRnet is the department's Intranet, introduced in November 1998. The DNR Web Team designed an overall architecture, and business units are contributing content. Site is growing, but needs additional staff support if it is to continue to grow.
Electronic Licensing System (ELS) Contact: Tom Keefe, ELS Coordinator Tom.Keefe@state.mn.us	Point of Sale system manages the sale of hunting and fishing licenses. Developed and operated by Central Bank, Jefferson City, MO. System operational in 1700 locations as of March 2000. See also under "Development / Testing", this chapter. FY00/01 budget is $2.7 million.

Operational: Maintain / Evolve	
Application	**Description**
Enforcement Violations, Arrests, and Confiscations System Contact: Pat Watts, Enforcement Management Analyst Patricia.Watts@state.mn.us	Mission critical system maintains records of DNR-issued warrants pertaining to fish, game, and recreational vehicle law violations. Developed by CCSI 1985. Platform: AS/400. Major modifications by MIS in 1995 to accept transfer of data from the Total Court Information System (TCIS). Minor fixes by Born Consulting in July 1999. FY00 maintenance: $25,000. Need migration plan.
Engineering Project Management Contact: Judy Winiecki, Principal Land Surveyor Judy.Winiecki@state.mn.us	Provides status of survey and design projects, both in-house and under contract. Platform: Access 2000. Need network access to database. Contracted with Wendy Nelson in July 1999 to upgrade functionality and reporting options.
Environmental Review Database Contact: Steve Colvin, ER Program Supervisor Steve.Colvin@state.mn.us	Consolidated database of environmental review information and a common application for accessing that database by parties involved in the receipt, review, and response to environmental review documents. Developed by Vision Technologies in 1999. Y2K investment was $42,400. Total investment to date is $125,000. Platform: Oracle 8i; Visual Basic 5.0 client.
Field Services Consolidated Database (CODA) Contact: Mark Wallace, Facilities Manager Mark.Wallace@state.mn.us	Project initiated Fall 1996 to integrate four databases and applications: Facilities Management, Fleet Management, Fixed Asset Inventory, and Safety Programs. Application continuing to be developed by Vision Technologies. Platform: AS/400 with VB6.0 client. Y2K investment of $405,000. Total invested to date is $785,000. Annual maintenance estimated to be $80,000. Need migration plan.
Fisheries Creel Survey Database Contact: Al Stevens, Program Coordinator Allen.Stevens@state.mn.us	Application estimates fishing pressure: hours of fishing per time period; catch per unit effort (CPUE = number of fish caught per unit of fishing effort); total catch as identified by anglers surveyed. Developed by Division of Fisheries. Data maintained in fisheries area offices. Platform: dBase IV.
Fisheries Data Mart Contact: Karen Schroeder, Fisheries Programmer Analyst Karen.Schroeder@state.mn.us	Database contains detailed and summary statewide data from Creel, Lake Survey, and Stocking databases. Users connect to the database via LAN, WAN, or dial-in, and use SQL-compliant software (e.g. Microsoft Access, ArcView, Crystal Reports, Quattro Pro) to access the data. Platform: Oracle 8i.
Fisheries Lake Management System Contact: Maggie Gorsuch, Office and Administrative Specialist Maggie.Gorsuch@state.mn.us	Application to help Fisheries managers reach decisions regarding the best management of lakes, prepare and implement plans, and evaluate results. Platform: dBASE IV; plan to replace the program with a web-based application in 2001. See also under “Development / Testing” in this chapter.

Operational: Maintain / Evolve	
Application	**Description**
Fisheries Lake Survey Database Contact: Karen Schroeder, Fisheries Programmer Analyst Karen.Schroeder@state.mn.us	Application organizes physical, chemical, and biological data concerning habitat, water quality, and fish populations in Minnesota lakes. Allows Fisheries to develop management plans, evaluate management techniques, and monitor long term changes or trends in aquatic environments. Lake reports generated by the system are very popular with the public and are available in printed form or on the DNR Web Site. Data is maintained at area offices, and combined at Central Office into a statewide database. Platform: dBase IV; will be replaced by a web-based application (interface written in PHP) in 2002.
Fisheries MinnAqua Database Contact: Linda Erickson-Eastwood, MinnAqua Program Manager Linda.Erickson-Eastwood@state.mn.us	Application maintains data for the aquatic education program. Goal of the program is to inform the public about life history, habitat requirements, and management of the aquatic species of the state, and to promote understanding of the issues related to balancing social, environmental, and economic demands. Database contains information about the activities of the program, volunteer time, and donations, and is stored in the Central Office. Platform: Visual dBase.
Fisheries Stocking Database Contact: Maggie Gorsuch, Office and Administrative Specialist Maggie.Gorsuch@state.mn.us	Application tracks the stocking of public lakes. Data, including the species, strain, size, and number of fish stocked, is entered and maintained in the Central Office. Platform: dBase IV; release of new web-based application scheduled for January 2001.
Fisheries Work Planning & Budgeting Contact: Linda Erickson-Eastwood, MinnAqua Program Manager Linda.Erickson-Eastwood@state.mn.us	Application used to develop annual work plans and budgets. Process starts at area offices and rolls up to division work plan and budget. Uses data from Fleet Management System and SEMA4 to calculate equipment costs, staff costs, and resources. Application developed by Rick Nelson, Fisheries Biologist. Potential for use throughout DNR. Modification underway to include Capitol Budget Program (Linda Erickson-Eastwood). Platform: Visual dBase. Projected completion date is July 2001.
Forest Campgrounds Administrative Database Contact: Steve Simmer, Program Coordinator Steve.Simmer@state.mn.us	Information on forest campgrounds for management purposes. Platform: Access ‘97.

Operational: Maintain / Evolve	
Application	**Description**
GIS Core Database Contact: Robert Maki, Database Administrator Robert.Maki@state.mn.us	The GIS Core Database is an outgrowth of a traditional ARC/INFO database architecture that relies on remotely mounted file systems to access data across various portions of the network. Data are organized in tile-based extent, and are generally only accessible through proprietary software. Spatially continuous data access is provided through ARC LIBRARIAN data structures. Data are redundantly stored at separate key access sites to improve performance of GIS applications, and better support user requirements. Data may also exist in different file formats, particularly in ARC/INFO coverages and Shape files. Data are accessed extensively through both desktop (Windows) and UNIX-based environments. File systems are shared through Samba server processes to desktop clients (the "v" drive), or through the use of NFS networking protocols between UNIX workstations. Portions of the Core Database have found their way into web-based applications, although the data has typically required additional pre-processing.
GIS Data Deli Contact: Steve Lime, Internet Applications Analyst Steve.Lime@state.mn.us	An internet-based spatial data acquisition site that allows users to download raw computer-readable data for use in their Geographic Information System, image processing system, or database. The site includes links to extensive and summary level data descriptions (metadata). The web search interface is written in Javascript and Java with system support functions provided by Perl scripts. The spatial display, query, and reporting functions are provided by the University of Minnesota's MapServer software. A variety of integrated data processing support functions are written in Perl and Arc Macro Language (AML). The site is an integrated system of data storage, access, maintenance, documentation, and distribution. The site contains data that is assembled from the DNR GIS Core Database. An update process is executed on a weekly schedule.
HEAT: HelpDesk Expert Automation Tool Contact: Leah Kemp or Jeff Pauly, Help Desk Specialists Leah.Kemp@state.mn.us Jeffrey.Pauly@state.mn.us	HEAT: HelpDesk Expert Automation Tool (GoldMine Software Corp.)is PC/LAN-based help desk automation software for help desks and call centers providing internal and external customer support. HEAT features a complete suite of call logging and tracking tools, management and analysis reporting, knowledge-based problem solving assistance and add-on knowledge bases, automatic call escalation and messaging, call record import, and easy DOS-to-Windows data conversion. HEAT's help desk automation features streamline internal efficiency and improve customer service.

Operational: Maintain / Evolve	
Application	**Description**
Land Ownership System **Mineral Rights Information System** Contact: Mike Jordan, Data Systems Specialist Mike.Jordan@state.mn.us	System to manage all DNR-owned surface land and mineral rights. Developed by CCSI 1983-85. Accounts receivable, and billings for land sales, gravel, and professional services added 1988-1992. System has been cobbled together over the last ten years and is seriously out-of-date. A Project Definition JDA[SM] was held in March 1999 to begin defining needs for a new system. The FY00/01 budget initiative was not funded. LCMR Proposal FY02/03: $2,875,000. DNR should set a highest priority on developing an integrated land information system. Platform: AS/400.
LandView Contact: Craig Perreault, GIS Specialist Craig.Perreault@state.mn.us	LandView is a program designed for non-GIS users to view a suite of geographic data that would otherwise require learning complex data storage techniques. Basemaps such as Digital Orthophoto Quads (DOQs), Scanned USGS Quadrangle Maps (DRGs), National Wetland Inventory (NWI), Digital Plats Books, and DNR Land Ownership are tiled (stored in many pieces) because of their large size. This program will foster GIS knowledge. Users will become familiar with information available and will be empowered to use spatial data in their work. Some users will want more and will move on to more complex software such as EPIC and ArcView. This software is not a replacement for ArcView or EPIC, but is designed to fill a gap in our information access technologies. Platform: Visual Basic 6.0.
LandView Contact: Steve Lime, Internet Applications Analyst Steve.Lime@state.mn.us	This is an Internet version of the LandView system described above. Both applications are needed due to limited high-speed access to the Internet.
License Point of Sale System Contact: Suellen Rau, Registrations Program Manager Suellen.Rau@state.mn.us	System manages sale of hunting and fishing licenses, park permits, and cross-country ski passes at the License Bureau counter. Interface to LRDI, Registrations, Lotteries, and Titling systems. Platform: Visual Basic 6.0.
Map & Brochure Distribution System Contact: Robin Persons, Info Center Supervisor Robin.Persons@state.mn.us	Maintains information associated with mailing DNR publications. Developed by MIS 1995. Platform: AS/400. Need migration plan.

Operational: Maintain / Evolve	
Application	**Description**
MapServer Contact: Steve Lime, Internet Applications Analyst Steve.Lime@state.mn.us	An OpenSource development environment for building spatially-enabled Internet applications. The software builds on other freeware systems like Shapelib, FreeType, Proj.4, libTIFF, Perl, and others. MapServer will run on Linux/Apache platforms, is known to compile on most UNIXes, and will run under Windows NT/98/95. MapServer supports MapScript, which allows scripting languages such as Perl, Python, Tk/Tcl, Guile, and Java to access its C API. MapScript provides a rich environment for developing applications that integrate disparate data. If the data has a spatial component and you can get to it via a scripting environment, then you can map it. Originally developed by the University of Minnesota ForNet project (Steve Lime) in cooperation with NASA and the Minnesota DNR. Enhancements made by DNR and the Minnesota Land Management Information Center. Current development is funded by the TerraSIP project, a NASA sponsored project between the University and a consortium of land management interests.
Minerals Work Planning Database Contact: Perry Canton, Minerals Senior Engineer Perry.Canton@state.mn.us	Database manages annual work plan proposals and budgets, generates annual spending plans, staff time allocations, and tracks work plan accomplishments for performance reporting. Vision Technologies conducted JAD session March 1999. Perry Canton, Minerals engineer, developed conceptual, logical, and physical data models, and implemented the system in Access '97.
Natural Heritage Information System (NHIS) Contact: Carmen Converse, MCBS Supervisor Carmen.Converse@state.mn.us	NHIS provides information on Minnesota's rare plants, animals, native plant communities, and other rare features. The database is continually updated as new information becomes available, and is the most complete source of data on rare or otherwise significant species, natural communities, and other natural features. The most commonly-used component of NHIS is the Rare Features Database. It began as a compilation of historical records from museum collections and published information. This has been supplemented with data from years of field work on rare features. Platform: DataFlex / PC-UNIX. System needs to be upgraded. Meetings with Natural Heritage staff May-July 2000 to explore delivery of NHIS data over the web. See also under "Proposed New Applications" in this chapter.

Operational: Maintain / Evolve	
Application	**Description**
Observation Well Records (OBWELL) Contact: Tom Gullett, Observation Well Hydrologist Tom.Gullett@state.mn.us Jim Zandlo, State Climatologist James.Zandlo@state.mn.us	DNR Waters has managed a statewide network of water level observation wells since 1944. About 700 observation wells are monitored currently. Data from these wells are used to assess ground water resources, determine trends, interpret impacts of pumping and climate, plan for water conservation, evaluate water conflicts, and otherwise manage the water resource. Soil and Water Conservation Districts under contract with DNR Waters measure the wells monthly and report the readings. The U.S. Geological Survey also monitors some wells using continuous recorders. Readings are also obtained from volunteers at other locations. Platform: NT network server; FoxPro 2.6; web-enabled access: ASP and Visual Basic.
Parks Campground Management Contact: Suzanne Jenkins, Parks MIS Supervisor Suzanne.Jenkins@state.mn.us	"Campground Manager," a packaged application developed by Mission Management Information Systems Inc., Ontario, Canada is being implemented. Functions include: camp site reservations, customer tracking, revenue tracking, and various accounting functions and reports. Implemented in 19 state parks in 1999, 15 more in 2000. Parks allocated operating funds to implement after FY00/01 initiative failed. Estimated investment to date is $500,000.
Pathology Lab Management Contact: Joe Marcino, Pathologist Joe.Marcino@state.mn.us	Database stores casework the laboratory has handled since 1992, including all testing, recommendations, and reports. Developed by Pathology Lab staff. Application meets user needs at this time. Platform: Access '97.
PlatViewer Contact: Tim Loesch, GIS Applications Analyst Tim.Loesch@state.mn.us	The PlatViewer program allows users to interactively browse Rockford Plat maps that are stored in digital format. The plat information is created by township and the users can select a township of interest by specifying either a Public Land Survey (PLS) section or by browsing through the townships organized in county folders. The application allows users to view the plat information and create printouts that they can take into the field. Platform: Visual Basic with ESRI MapObjects Light add-ons.

Operational: Maintain / Evolve	
Application	**Description**
Revenue Management System (REVSYS) Contact: Linda Notch, Management Reporting Finance Specialist Linda.Notch@state.mn.us	Processes revenues of over $100 million per year and makes deposits to 400 distinct account distributions. Majority of transactions and revenues grouped in nine business areas: mining rents and royalties; water permits and pumping fees; timber sales; park permits and merchandise sales; vehicle and boat registrations; arrests and confiscations; real estate sales and leases; and fleet usage. Originally developed by Born Consulting; rewritten by CCSI for MAPS. REVSYS is seriously out-of-date. Advanced Strategies, Inc. facilitated four JDA^{SM} sessions and completed 1) a Project Definition (11/21/96), 2) a Business Process Model (12/14/96), 3) a Business Object Model (1/10/97), and 4) four Event Models (1/22/97). Additional meetings were held in February 1997 to approximate costs to develop and fully implement the Revenue System project. Advanced Strategies, Inc. prepared a Phase I Final Report dated May 7, 1997. Budget initiative submitted for FY98/99 was unsuccessful; project was included in failed FY00/01 IT Budget Initiative at $425,000 plus ongoing cost of $80,000 annually for one position. See also under "Proposed New Applications" in this chapter.
Scientific and Natural Areas Database Contact: Bob Djupstrom, SNA Program Manager Bob.Djupstrom@state.mn.us	DOS-based system developed by The Nature Conservancy for managing SNA biological and conservation data. SNA program budget data is maintained in Lotus. Goal is to integrate components. Met with Carol Pearson 11/24/98 to discuss options for system upgrade. Met with Terry Johns (volunteer) 12/3/98. Platform: Advanced Revelation. Need migration plan.
State Parks Facility Database Contact: Suzanne Jenkins, Parks MIS Supervisor Suzanne.Jenkins@state.mn.us	Database used by staff for planning, reservation data, and public brochures about park facilities. Contains everything about park facilities from miles of trails to counties that the parks are in. Primary database for the web team to extract data from and to share with others in DNR. Platform: Access '97.
Watercraft Titling System Contact: Suellen Rau, Registrations Program Manager Suellen.Rau@state.mn.us	Manages watercraft titling transactions. Developed by CCSI 1991. Platform: AS/400. Need migration plan.

DEVELOPMENT / TESTING

Development / Testing	
Application	**Description**
Aquatic Plant Management Contact: Dave Wright, APM Program Supervisor David.I.Wright@state.mn.us	System to maintain and report information associated with issuing permits for the control of vegetation and organisms in public waters using chemical or mechanical means. Supports permit issuing process as well as post-season reporting and management activities. Application under development by Vision Technologies 1999 abandoned after $70,000 investment. Database developed by Paul Radomski, Brainerd fisheries biologist, for year 2000 permit season. Platform: FoxPro. Micah Garber and Joe Pugh, MIS programmer analysts, will review specification documentation and user requirements, and plan to continue development Fall 2000. Platform: Oracle 8i, Java.
DNR Customer Database Contact: Tom Felton, Database Administrator Tom.Felton@state.mn.us	Over the years, many DNR programs have developed customer databases to meet their unique needs. From permit, lease, and license holders, to *Volunteer Magazine* subscribers, state park visitors, hunters, anglers, and special interest groups, each program has its own interests concerning customers, and its own way of recording that information. Many of these databases contain duplicative, incomplete, or incorrect information. This database will establish a core, up-to-date repository of data about DNR customers. Developed by MIS Data and Applications/GIS team. Object model, logical, and physical database complete. Populating database for the Volunteer Magazine application. Platform: Oracle 8i.
Electronic Licensing System (ELS) Contact: Tom Keefe, ELS Coordinator Tom.Keefe@state.mn.us	Phase II of ELS under development by Central Bank. New functionality for registration of recreational vehicles. Expected implementation date is May 2001. See also under "Operational: Maintain/Evolve" in this chapter.
Fish Distribution Application Contact: Tim McGuire, Fisheries Programmer Analyst Timothy.Mcguire@state.mn.us	Web-based application to collect, edit and report data for DNR fish distribution. Stores fish stocking, harvest, transfer and stocking proposal data. Provides both standardized reports and supports user-defined queries which can be modified, stored, and re-used by other users. Users enter and edit data in a browser environment from remote locations. Application will also update Fisheries data mart periodically. Developed by Fisheries staff. Platform: SUN E250; Apache Web Server; Oracle 8i database; PHP server side web scripting; and client side JavaScript - HTML. Expected release date: January 2001.

Development / Testing	
Application	**Description**
Fisheries Lake Management System Contact: Karen Schroeder, Fisheries Programmer Analyst Karen.Schroeder@state.mn.us	Web-based application to help Fisheries managers reach decisions regarding the best management of the lakes, prepare and implement plans, and evaluate results. Data stored centrally. Platform: SUN E250; Apache Web Server; Oracle 8i database. See also under "Operational: Maintain / Evolve" in this chapter.
Forest Information System (FORIST) Contact: Tom Eiber, Forestry Administrative Supervisor Tom.Eiber@state.mn.us	Integrates Forest Inventory and Timber Sales System. Forestry engaged Vision Technologies to work on a Timber Sales accounts receivable system in 1997. Project abandoned; $19,000 investment. Norstan Consulting developed inventory database. Now customizing Linnett Geomatics's *Woodlands The System* application, which includes components for forest development, forest inventory, and planning. Components funded for FY00/01: Timber Sales, Forest Protection, and Private Forest Management modules. Estimated investment to date is $1,000,000. FY02/03 investment estimate = $800,000. Platform: Oracle 8.04.
GIS Extended Data Dictionary Contact: Sandra Paddock, GIS Database Specialist Sandra.Paddock@state.mn.us	The data dictionary is a common, department-wide source for data description, including entity definition, field definition/object properties, valid attribute value domain, descriptive metadata, long data names, unique data layer identification, and other information. The system also supports registration of data product generation processes and data resource site data storage definitions. Platform: Oracle 8i. Internet front end for data registry and discovery. XML documents and database products (GIS / "traditional") will be auto-triggered from database stores. A subset of the ISO/IEC 11179 metamodel (see **Metadata Registry** below) is being used in the development of this project.
Hunting Lotteries Contact: Rick Nordby, BIEL IT Project Manager Richard.Nordby@state.mn.us	System manages selection of applicants for hunting lotteries (doe, moose, bear, and turkey). Originally developed by CCSI in 1985. Platform: AS/400. Application re-written by Born Consulting, Summer 2000. Testing of Fall Turkey lottery successful. Fingers crossed for the Doe Lottery in October 2000. Platform: Oracle 8i; Visual Basic 6.0 client. Estimated investment is $120,000.
Media Reservation System Contact: Robin Persons, Info Center Supervisor Robin.Persons@state.mn.us	Manages the lending of films, videos, and other media to DNR customers. Application originally developed by Jim Smith in Rbase. Vision Technologies engaged to upgrade; project abandoned. Y2K investment of $32,000. Joe Pugh, MIS programmer analyst, is continuing development. Platform: Oracle 8i, Visual Basic 6.0.

Development / Testing	
Application	**Description**
Metadata Registry Contact: Bruce Abbott, Data Administrator Bruce.Abbott@state.mn.us	Implements a department-wide metadata registry based on the ISO/IEC 11179 standard "Specification and Standardization of Data Elements." ISO/IEC 11179 describes the standardizing and registering of data elements to make data understandable and shareable. Data element standardization and registration as described in ISO/IEC 11179 allow the creation of a shared data environment in much less time and with much less effort than it takes for conventional data management methodologies. The purpose of ISO/IEC 11179 is to give concrete guidance on the formulation and maintenance of discrete data element descriptions and semantic content (metadata) that shall be used to formulate data elements in a consistent, standard manner. It also provides guidance for establishing a data element registry. A subset of the 11179 metamodel is being used in the **GIS Extended Data Dictionary** project above.
***Minnesota Conservation Volunteer* Magazine System** Contact: Kathleen Weflen, *Minnesota Conservation Volunteer* Magazine Editor Kathleen.Weflen@state.mn.us	Application manages a subscriptions database for the *Minnesota Conservation Volunteer* magazine and tracks donations. Original application platform AS/400. Application upgrade by Vision Technologies abandoned. Y2K investment of $75,000. Joe Pugh, MIS programmer analyst, is continuing development. Platform: Oracle 8i, Visual Basic 6.0.
Protected Waters Inventory Contact: Glenn Radde, Wetlands GIS Manager Glenn.Radde@state.mn.us	The purpose of this project is to create a seamless, statewide GIS data set to replace the current Protected Waters Inventory paper maps. Ultimately these data will delineate all public waters basins and watercourses, as called for by Chapter 382, Laws of Minnesota 2000 (SF83). Platform: Arc/Info on SUN UNIX workstations. The overall project will take another year or so to complete, and will ultimately require some statute and rule changes.

PROPOSED NEW APPLICATIONS

Proposed New Applications	
Application	**Description**
1-800-TREES Contact: Tom Eiber, Forestry Administrative Supervisor Tom.Eiber@state.mn.us	Develop a central clearing house/web page/ordering station where people can get current sales and inventory information on low-cost Minnesota-grown native seedlings with MCIA certification for statewide cost-share programs. See also **Electronic Commerce** below.
Aerial Photographs and Satellite Images Online Contact: Bill Befort, Forest Resource Assessment Bill.Befort@state.mn.us	With increasing regularity we get queries from DNR people and the public about this, saying "When are you guys going to enter the 21st Century?" or words to that effect. And they're right; it's hard to name a commodity better suited to Web distribution than digital images. It would be possible to go "outside" to one of the numerous e-commerce firms and set something up. We've resisted this notion, chiefly on the grounds that 1) the state was supposed to be developing its own mechanisms if we'd wait a while, and 2) we'd probably get into some fiscal or legal (You Can't Do That) difficulty by going off on our own. But this is getting old. Web entrepreneurs by the thousand are selling (or not selling) goods far less well adapted to e-commerce than ours, and the whole business of secure servers, transaction handling etc. is now less mysterious than it used to be. We'd much prefer to avoid duplicating any effort that the state is making; but is the state any closer to getting its act together on this? See also **Electronic Commerce** below.
Affirmative Action Reporting Contact: Trancey Williams, Affirmative Action/Diversity Director Trancey.Williams@state.mn.us	Application will track and report on protected class status of all applicants for DNR jobs. Met with Oracle Consulting 06/03/99, and received estimate for system 06/09/99. On hold; estimate exceeded budget available.
Archibus/FM™ Contact: Mark Wallace, Facilities Manager Mark.Wallace@state.mn.us	Archibus/FM™ is an asset maintenance and facilities management software solution integrated with AutoCAD. The MN Department of Administration and Veteran's Homes Board are using this software for facilities management. Met with Mark Wallace and Bill Olson 08/31/00 to explore possibility of replacing CODA with this COTS (commercial-off-the-shelf software) package.

Proposed New Applications	
Application	**Description**
Community Based Management Contact: Kathleen Wallace, Region 6 Director Kathleen.Wallace@state.mn.us	Database will serve as a tracking system for community contacts – a customer service log for the communities with which DNR collaborates. Examples of items that could be included are: meetings, technical assistance, and grants. Intent is to provide employees with information about the entire scope of activity in a local area. Would facilitate internal DNR coordination and improve service to the community. Included in failed FY00/01 IT Budget Initiative $400,000.
Electronic Commerce Contact: Colleen Mlecoch, Data & Applications Manager Colleen.Mlecoch@state.mn.us	Partner with the Office of Technology and state-wide Electronic Government Services (EGS) group to develop e-commerce capability. See also **1-800-TREES** and **Aerial Photographs** above.
Electronic Document Management Contact: Eileen Quam, Document System Manager Eileen.Quam@state.mn.us	Project to develop common tools for electronic document management and increase records availability throughout the department. System may utilize the document library function in GroupWise 5.5, but will also explore other web-enabled document management systems. Included in failed FY00/01 IT Budget Initiative $150,000 capital and $40,000 operational costs. MIS position dedicated to system in July 2000. Funding will be needed for web-based IDMS software and ongoing software maintenance.
Electronic Engineering Records Contact: Judy Winiecki, Principal Land Surveyor Judy.Winiecki@state.mn.us	System will provide access to facility and infrastructure records, digital map library, and historic air photos. It will make use of the tools and standards developed by the Electronic Document Management project to convert millions of dollars of historic air photos and detailed plans of the department's facility infrastructure from hard copy to digital products available electronically at any location. Included in failed FY00/01 IT Budget Initiative $900,000.

Proposed New Applications	
Application	**Description**
Enforcement Records Management Contact: Diane Moe, Enforcement Business Manager Diane.Moe@state.mn.us	Enforcement wants laws, rules, and directives available as a reference library on a shared drive on a server so all officers could see these on their laptops (via a Shiva modem session). Wants a smaller subset of this information available on CD-ROM, along with a search mechanism. Enforcement also wants a system where officer generates report, unique ID gets assigned, then all follow-up documentation gets cross-referenced. Ability to search, print, etc. There is case management software available – a Canadian company that managed the Atlanta Olympics used a case / documentation management package. We want officers to be able to 1) record report over the phone via voice mail, and get it typed and e-mailed back; 2) record to digital tape with large buffer and voice recognition, with a secretary cleaning it up and e-mailing it back; or 3) do something similar, but field-based.
Floodplain GIS Data Layers Contact: Joe Gibson, Waters Information Services Manager Joe.Gibson@state.mn.us	Digitize floodplain GIS data layers; data collected via a Waters legislative initiative.
Grants Tracking System Contact: Sharon Pfeifer, Regional Planner (Metro Region) Sharon.Pfeifer@state.mn.us	System proposed to track community grant projects. From 1996 to 1998, Metro Region recommended over 100 project grants for LCMR approval, totaling approximately $800,000. There is no system to track the effectiveness of these project activities, such as habitat restoration, protection, and active management practices. The region needs to track project information such as acreage, type of habitat restored or protected, geographic locations, and adjacent land uses. Met with Sharon Pfeifer 11/23/98 and 11/30/98 to explore options. Conducted Project Definition session 04/12/99. Met with Kent Myers 06/03/99. Project proposal submitted 06/07/99. Project dropped due to difficulty in defining scope and resources.
Human Resources Position Audits Contact: Pat Burt, HR Assistant Director Pat.Burt@state.mn.us	Internal performance measurement system to track the process and progress of position audits. Met with Oracle Consulting 06/03/99 and received estimate for system 06/09/99. On hold; estimate exceeded budget available.

Proposed New Applications	
Application	**Description**
Human Resources Vacancy Postings Contact: Pat Burt, HR Assistant Director Pat.Burt@state.mn.us	Application will make internal job vacancy postings and bid application forms available via DNRnet. Met with Oracle Consulting 06/03/99, and received estimate for system 06/09/99. On hold; estimate exceeded budget available.
Media Contacts and Mail Distribution Contact: Denis Stauffer, Communications Director Dennis.Stauffer@state.mn.us	Integrated system to manage media contacts and send press releases via fax and e-mail. Proposed by Scott Pengelly, News Editor, and Dennis Stauffer, Communications Director. Bruce Abbott facilitated JDA™ session 02/08/00 to define user requirements. Zentropy Partners consulted re: application development. Investigating use of GroupLinks's *ContactWise*, a Customer Relationship Management (CRM) application that is tightly integrated with GroupWise.
Migratory Bird Harvest Information Program (HIP) Contact: Roger Lake, Assistant Wildlife Research Supervisor Roger.Lake@state.mn.us	Survey of hunter success for waterfowl species, reported to USFWS. Data collected by ELS. System platform: AS/400. Met with Roger Lake and Margaret Dexter to define needs for new system 07/25/00. Wildlife managers considering requirements.
Natural Heritage Information System Data Distribution Online Contact: Karen Cieminski, Data Manager / Ecologist Karen.Cieminski@state.mn.us	Natural Heritage staff would like to explore delivery of NHIS data over the web. Meetings held May-July 2000. Steve Lime, Internet Applications Analyst, is developing a prototype using MapServer© interface.
Oracle Financials Contact: Linda Notch, Management Reporting Finance Specialist Linda.Notch@state.mn.us	Oracle Financials was selected to replace REVSYS. Software was purchased with Y2K funds $135,000. System integration consulting firm SIS, Inc. selected to complete Phase 1: Requirements Analysis. Funds identified to move forward with Phase 1 in January 2000. Responses to May 2000 RFP exceeded budget. Executive sponsors Jerry Rose, Forestry, and Peggy Adelmann, OMBS, considering alternatives. See **Revenue Management System** under "Operational: Maintain / Evolve" in this chapter.
Photo Database Contact: Carol Hall, MCBS Zoologist Carol.Hall@state.mn.us	Photo database for DNR Wildlife division and Natural Heritage program. This would be like the one the MN Historical Society has. It would be published on both the Internet and the Intranet.

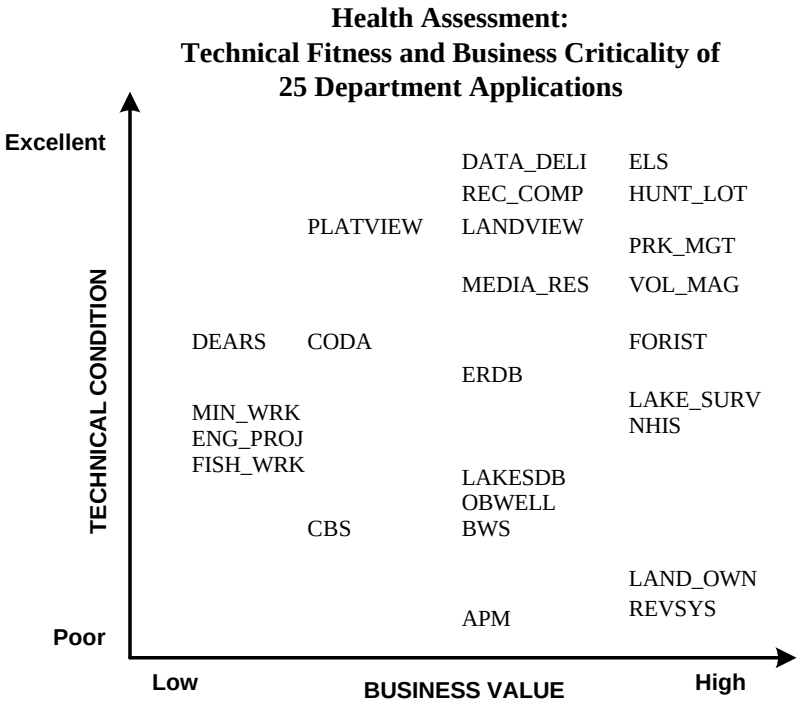
Proposed New Applications	
Application	**Description**
Public Land Survey Notes Contact: Gretel Kiefer, Natural Resources Specialist Gretel.Kiefer@state.mn.us	Transfer of ecological and cultural information from the handwritten Public Land Survey field notes to digital format. Public access to resulting natural and cultural covers, associated databases via DNR web site. LCMR Proposal FY02/03: $400,000.
Publications Database Contact: Sheila Gebhard, Communications Project Manager Sheila.Gebhard@state.mn.us	Database will provide an inventory all DNR publications. Proposed by Regional Information Officers and Sheila Gebhard, BIEL.
Waters Information System Contact: Joe Gibson, Waters Information Services Manager Joe.Gibson@state.mn.us	New system will integrate PERMITDB, LAKESDB, SWUDS, OBWELL, and Dam Safety applications.
Wildlife GIS System Contact: Hal Watson, Wildlife GIS Manager Harry.Watson@state.mn.us	Project to digitize Wildlife Management Area (WMA) boundaries, collect and enter cover type information within WMAs, and develop wildlife facilities layer (docks, roads, etc.).
Wildlife Land Acquisition System Contact: Kim Hennings, Land Acquisitions Program Coordinator Kim.Hennings@state.mn.us	Land acquisition database managed by Kim Hennings; "piecemeal." Details he needs are different from Lands and Minerals. It would be good to tie into the State Land Records System, and keep both up to date. The Federal Aid parcel database and the land acquisition tract database and the Land Records PLS database are inconsistent. Once GIS WMA boundaries are done, will want to digitize tract boundaries (tracts are tied to landowner and acquisition history, same as Federal Aid database parcels.) Wildlife needs land acquisition data back to 1951; the Land system starts in the early 1970s. For Federal Aid land in particular, need to track all licenses, easements, sales, and trades. There is an opportunity for $1.5 million from reimbursement for in-lieu-of-taxes, but the Federal Aid program requires data since 1951. The biggest problem is reconciling Federal Aid, Lands, and Wildlife databases. The U.S. Fish and Wildlife Service has begun a project to convert paper records to ArcView GIS. They are using a different data structure than we are, but we'll be able to use their data with some programming.

Proposed New Applications	
Application	**Description**
Wildlife Management Area Recreation and Management Information Contact: Steve Benson, Research Analyst-GIS - Region 2 Steve.Benson@state.mn.us	Create Internet and management applications and companion data for the public to locate and view Wildlife Management Area information, maps, and recreation opportunities, and improve wildlife work planning and reporting. LCMR Proposal FY02/03: $942,000
Wildlife Resource Information System and MN-GAP Project Contact: Gary Drotts, Area Wildlife Manager - Region 3 Gary.Drotts@state.mn.us	Create a statewide wildlife resource information system for the 557 species of wildlife in Minnesota. Also, provide funding necessary to complete the Minnesota Gap Analysis Program (MN-GAP) project. LCMR Proposal FY02/03: $290,000.
Wildlife Work Planning and Accomplishment Reporting System Contact: Dennis Simon, Wildlife Management System Coordinator Dennis.Simon@state.mn.us	Develop a planning and accomplishment reporting system. Multi-unit modeling session with Vision Technologies in March 1999 showed that participating units had such differing needs it would be too cumbersome to design a single system. Wildlife considered developing a system in-house (MS Access), but has no programmers. Also considered developing in ArcView because they have these skills, but this really is a database application. Complex application – hard to get a handle on scope. Stakeholders and legislators expect Wildlife to predict work needed, estimate costs, and report on accomplishments. Wildlife has 32 separate funding sources and 900 spending plans. The system envisioned must be defendable, predictable, repeatable, and require minimal field staff involvement. It should be built in a modular, staged way, with in-house support. *Using outside contractors is unworkable.*

PHASE OUT / REPLACE

Phase Out / Replace	
Application	**Description**
Boat and Recreational Vehicle Registration Contact: Suellen Rau, Registrations Program Manager Suellen.Rau@state.mn.us	Application tracks boat and recreational vehicle registrations. Developed by CCSI 1985. Platform: AS/400. Electronic Licensing System (ELS) will replace system in May 2001.
License Refund System Contact: Suellen Rau, Registrations Program Manager Suellen.Rau@state.mn.us	System maintains information on issued refunds. Interfaces with MAPS. Developed by License Bureau staff in 1988 and re-written in 1995. Platform: AS/400. Function will become part of Oracle Financials implementation.
License, Registration, and Decal Inventory (LRDI) Contact: Suellen Rau, Registrations Program Manager Suellen.Rau@state.mn.us	Tracks inventory of fishing, hunting, and x-country ski licenses that are sold by DNR and license agents. Interface to REVSYS for receipts. Developed by Born Consulting 1995; technology upgrade complete December 1999 at a cost of $100,000. Current platform is Access 2000 and Visual Basic 6.0 client. ELS will eliminate need for system.
Real Estate Management Decision Support System	Graphical interface designed to facilitate access to the Land Information System for viewing project information and status. DSS also tracks employee workload and skill sets. Application developed by Vision Technologies, 1999. Platform: AS/400; Visual Basic 5.0 client. Not currently in use. Estimated investment $92,000.
Timber Sales System and Scale Report Contact: Doug Ford Forest Economist Doug.Ford@state.mn.us	Systems will be replaced by FORIST, described under "Development / Testing" in this chapter. Y2K compliance investment of $189,000 for the two systems.

APPLICATIONS ASSESSMENT SCATTER DIAGRAM



KEY

APM	Aquatic Plant Management
BWS	Boat and Water Safety Records
CBS	Capital Budget System
CODA	Consolidated Database (Inventory)
DEARS	Enforcement Activity Reporting System
ELS	Electronic Licensing System
ENG_PROJ	Engineering Project Management
ERDB	Environmental Review Database
FORIST	Forest Information System
FISH_WRK	Fisheries Work Planning and Budgeting
DATA_DELI	GIS Data Deli
HUNT_LOT	Hunting Lottery Application
LAKE_SURV	Lake Survey Database
LAKESDB	Lake Hydrology Program
LAND_OWN	Land Ownership System
LANDVIEW	LandView
MEDIA_RES	Media Reservation System
MIN_WRK	Minerals Work Planning Database
NHIS	Natural Heritage Information System
OBWELL	Observation Well Records
PLATVIEW	Plat Map Viewer
PRK_MGT	Parks Campground Manager
REC_COMP	Recreation Compass (MapServer)
REVSYS	Revenue Management System
VOL_MAG	Volunteer Magazine Circulation & Donations

Chapter VI

IT Architecture: Applications Delivery and Support

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APPLICATION DEVELOPMENT: PROCESS, PROJECT MANAGEMENT, AND METHODOLOGY

Current Conditions

As detailed in the DNR Applications Portfolio (Chapter V), the DNR manages a large number of information systems, varying widely in size, complexity, and criticality. The department spends over $5.5 million annually on application development, enhancement, and support. Of this, $2.5 million (46%) is spent on consultant contracts, $1.5 million (27%) on business unit staff, and $1.5 million (27%) on MIS staff.

Application development (AD) priorities and approaches are determined primarily within the bounds of business-unit-specific needs. AD processes are often improvised by programmers and project managers during the course of a project; schedules and budgets are often exceeded because they are not based on realistic estimates; there is no objective basis for judging product quality, nor for resolving product or process problems; activities to enhance quality such as reviews and testing are routinely curtailed or eliminated; documentation and user manuals are rarely finished. In spite of this ad hoc process, many projects do succeed and high quality applications are produced. Success depends on the competence of individuals, rather than on repeating the proven methods of a mature organizational AD process. Capability is a characteristic of individuals, not the organization. This is a risky position to be in today, considering the shortage of IT skills and the fluidity of the IT labor market. The lack of a coordinated approach to AD also has resulted in a fragmented information systems environment that is difficult to support, nearly impossible to integrate, and expensive to maintain. We recognize the challenges we face in improving our AD processes and methodology.

Software Process Improvement: The Capability Maturity Model (CMM) [2]

In 1993, the Software Engineering Institute (SEI) published the Capability Maturity Model (CMM), a framework for assessing AD processes in an organization, and a foundation for systematically improving those processes. The CMM describes an evolutionary path from ad hoc, chaotic processes to a culture of software engineering and management excellence.

The SEI defines a *software process* as a set of activities, methods, practices, and transformations that people use to develop and maintain software and associated products (e.g., architectures, project plans, object models, design documents, code, test cases, user manuals). *Software process capability* describes the range of expected results that can be achieved by following a software process; *software process performance* represents the actual results achieved.

Software process maturity is the extent to which a process is explicitly defined, managed, measured, controlled, and effective. Maturity implies a potential for growth in capability and indicates both the richness of an organization's software process and the consistency with which it is applied in projects throughout the organization. The software process is well-understood throughout a mature organization, through documentation and training, and the process is continually monitored and improved by its users. A *maturity level* is an evolutionary plateau toward achieving a mature software process. Each of the five maturity levels contains a set of goals that, when satisfied, stabilize an important component of the

[2] Paulk, M., B. Curtis, M. Chrissis, C.Weber, "Capability Maturity Model[SM] for Software, Version 1.1." Technical Report, CMU/SEI-93-TR-024 (February 1993).

software process. Achieving each level of the maturity framework results in an increase in the process capability of the organization.

The CMM is a *descriptive* model; it describes key attributes that characterize an organization at a particular maturity level. It is also a *normative* model; it details the practices that characterize the normal types of behavior that would be expected in an organization at a particular maturity level. The CMM is not a *prescriptive* model; it does not tell an organization how to improve. It is intended to be at a level of abstraction that does not constrain how the software process is implemented by an organization. An organization applying the CMM should make a reasonable interpretation of the practices in the context of its unique business environment.

CMM Level 2

The DNR today is at maturity Level 1 and wishes to move to Level 2. At Level 1, as described above, the AD process is ad hoc – few processes are defined, and success depends on individual efforts. At Level 2, policies, procedures, standards, and disciplined project management techniques for effective management of AD projects are implemented. An effective process is defined as practiced, documented, enforced, trained, measured, and able to improve.

Projects in Level 2 organizations have established basic software management controls. Realistic project commitments are based on the results observed on previous projects and on the requirements of the current project. Project managers track software costs, schedules, and functionality; problems in meeting commitments are identified when they arise. Software requirements and the work products developed to satisfy them are base-lined, and their integrity is controlled. Software project standards are defined, and the organization ensures they are faithfully followed. The development team works with its customers to establish a strong working relationship.

CMM Initiative in the DNR

The success of an AD process improvement initiative in the DNR will require an organizational culture supportive of the methods, practices, and procedures needed to achieve this evolution. Improvement activities must compliment the DNR's strategic plans and business objectives, its organizational structure, technology infrastructure, AD culture, and social culture. The journey begins with an honest assessment of where we are today. CMM offers the tools to help us do this assessment. The journey will be long; it can take several years to move from Level 1 to Level 2, and moving between the other levels usually takes on the order of two years. The end will make the journey well worth the time and effort.

Following is a list of goals we would like to achieve in six *key process areas* defined by CMM Level 2.

Key Process Areas for Level 2
The *key process area* for each level identifies a cluster of related activities that, when performed collectively, achieve a set of goals considered important for enhancing process capability. Key process areas at Level 2 focus on concerns related to establishing basic project management controls.

<u>Requirements Management</u>

Goal 1 System requirements are controlled to establish a baseline for application development and management use.

Goal 2 Software plans, products, and activities are kept consistent with the system requirements.

Software Project Planning

Goal 1 Software estimates are documented for use in planning and tracking the software project.
Goal 2 Software project activities and commitments are planned and documented.
Goal 3 Affected groups and individuals agree to their commitments related to the project.

Software Project Tracking and Oversight

Goal 1 Actual results and performances are tracked against the software plans.
Goal 2 Corrective actions are taken and managed to closure when actual results and performance deviate significantly from the plans.
Goal 3 Changes to software commitments are agreed to by the affected groups and individuals.

Software Contract Management

Goal 1 The project manager selects qualified software contractors.
Goal 2 The project manager and contractor agree to their commitments to each other.
Goal 3 The project manager and contractor maintain ongoing communications.
Goal 4 The project manager tracks contractor's actual results and performance against commitments.

Software Quality Assurance

Goal 1 Software quality assurance activities are planned.
Goal 2 Adherence of software products and activities to the applicable standards, procedures, and requirements is verified objectively.
Goal 3 Affected groups and individuals are informed of quality assurance activities and results.
Goal 4 Noncompliance issues that cannot be resolved within the software project are addressed by senior management.

Software Configuration Management

Goal 1 Software configuration management activities are planned.
Goal 2 Selected software work products are identified, controlled, and available.
Goal 3 Changes to identified software work products are controlled.
Goal 4 Affected groups and individuals are informed of the status and content of software baselines.

Project Management

While *process management* specifies the management of project functions, *project management* details the activities of managing a project (e.g., budgeting, resource scheduling, status tracking, and reporting). By improving our project management capabilities, we perfect our ability to consistently achieve targets for cost, schedule, functionality, and customer satisfaction. A practical approach to project planning and management is the IEEE Standard for Software Project Management Plans (IEEE/EIA 12207 1998). Implementing a structured AD project management plan will help us realize the following goals:

1. Leadership and Management
   - The goals of AD project management are understood and supported throughout the department.
   - AD project teams establish effective relationships with their customers; there is frequent and unfettered flow of communication and information among all parties involved in a project.
   - Management is "in-the-loop" and focused on project success.
   - There is clear responsibility and accountability for all AD project tasks.
   - AD project management is a valued skill and core competency; standard training is required.

2. Project Management and Control
   - Project scope is comprehensively and continuously defined, and rigorously managed.
   - Project estimating techniques produce accurate cost and schedule estimates.
   - Project plans identify potential risks and mitigation plans; there is a continuous emphasis on mitigating risks before they become serious problems.
   - Budgets reflect project scope, resource requirements, and schedule objectives.
   - Schedules incorporate all project tasks, dependencies, and resource requirements.
   - Skilled AD staff are available for every project as necessary to meet requirements.
   - Contractors are managed as project team members; the same project disciplines apply to them.
   - Project cost, schedule, and technical performance are measured against a consistent baseline.
   - Changes to all baselines are controlled in a systematic fashion, and agreed to in advance by all parties with a clear understanding of the impact on the project.
   - Projects are routinely monitored using timely, objective, and discrete indicators of performance; deviation from performance is analyzed for potential impacts; corrective action is taken.
   - AD project management tools are standardized, well understood, and used in all projects.

3. Policies and Procedures - "How Things Get Done Around Here"
   - Software quality is a very high priority; quality is built into products from the start.
   - Standard, customizable templates are used to develop and manage AD projects.
   - AD project management processes are thoroughly documented and effectively communicated.
   - A post mortem is conducted on significant projects; lessons learned are systematically retained.
   - Historical cost, schedule, and technical data are used as references in validating project plans.

Application Development Methodology

An application development methodology is the body of knowledge that provides the "how to" with respect to building a software application. An AD methodology, or "Software Development Life-Cycle," is the series of steps that an application undergoes from concept exploration through product retirement. The goal is to produce high quality software applications, where "quality" means that the application satisfies explicit customer requirements, is well documented from both a technical and user perspective, has an elegant graphical user interface and clear navigation, contains minimal residual errors, performs as intended with little downtime, and is easy to modify and upgrade when requirements change.

There are a number of well-known AD methodologies, such as the Waterfall Model, Rapid Prototyping, the Incremental Model, the Spiral Model, and the Object-Oriented Model. There is no one best model; rather, each is best-suited to a particular type of AD project, and each has advantages and disadvantages. Activities common to all are:

- Requirements Definition

  Gather user requirements using tools like project definitions, interviews, JAD sessions, prototyping. The goal is to determine the feasibility of the proposed system, explore alternatives, and define the system in terms of scope (what we are trying to do), boundaries (what we are not trying to do), interfaces (how it looks outside), and subsystems (how it looks inside).

- Specification / Analysis

Analysis produces a functional specification of precisely what the product must do, and identifies constraints such as network infrastructure and performance requirements. The goal is to produce a structured specification, focused on what the system is to do.

- Design
  Three aspects of design are: external (specifies links to other systems, graphical user interface, etc.); architectural (specifies the product in terms of modules); and detailed (describes each module, algorithms, etc.). The goal is to produce a design specification to achieve customer requirements.

- Construction
  Construction produces an implementation and test of the design. The goal is to produce the system.

- Acceptance Test Generation
  Acceptance testing uses structured specifications to generate a definition of an "acceptable system." This is best done in parallel with other development. The goal is to produce test strategies and cases.

- Installation / Transition
  Integration of the new system in the organization. The goal is to make system available to its users.

- Operations / Maintenance / Retirement
  Any changes made after client acceptance. This is an integral part of software production that should be planned for from the beginning. Product reaches end of useful life and is decommissioned.

The DNR will explore a formal AD methodology as part of a comprehensive AD improvement initiative.

Application Development Tools

A DNR work group has started to explore AD tools available to support all phases of the software life-cycle.
Consensus is forming around the tools listed below, some of which are already in use and constitute a significant part of the department's AD infrastructure. Any new tools selected must at a minimum be compatible with our network and database infrastructure.

Key AD Infrastructure: Servers, Databases, Programming Languages, Clients

- IBM AS400 / DB2 / RPG
- IBM AS400 / DB2 / Client Access (ODBC) / Microsoft Visual Basic
- GIS: SUN Solaris / ESRI ArcInfo Arc Macro Language (AML)
- Internet: SUN Solaris / Apache Server / MYSQL / Oracle 8i / HTML, Perl, Java, JavaScript
- Client-Server: SUN Solaris / Oracle 8.04 / Microsoft Visual Basic / COTS applications
- WindowsNT / Microsoft Access

AD Tool Category	Tools	
Project and Process Management	P IEEE Standard for Software Project Management Plans (IEEE/EIA 12207 1998) P Capability Maturity Model (Software Engineering Institute) P Microsoft Project	
Requirements, Analysis, Design, and Modeling	P Business Object Modeling (Advanced Strategies, Inc.) P UML (Together) P Visio	
Programming Languages	P ASP P Java P Javascript P PERL	P PHP P PYTHON P RPG IV P Visual Basic
Integrated Development Environments	P JBuilder (Borland) P JDeveloper Suite (Oracle) P Forté	
Graphic Design and Layout	P Adobe Photoshop P MacroMedia Dreamweaver (HTML, XML, JavaScript)	
Reporting	P Microsoft Access P Crystal Reports	
Configuration Management	P Concurrent Version System (CVS - freeware) P Visual Source Safe (Microsoft)	
Content Management	P Zope	
Document Management	P GroupWise Document Management System	

Application Development Staff: Current Skills and Competencies

The majority of DNR business units contract with IT consultants to deliver needed applications; some rely on staff who have programming skills but were hired to do other work; five units employ one or two programmers. Staff in the Data and Applications Section in the MIS Bureau include: a data administrator, a database administrator, four Internet developers, three programmers, and a metadata specialist. (GIS skills are detailed in a separate white paper.)

We know that this group of DNR employees, talented and dedicated though each member is, is neither large nor skilled enough to deliver and support all of the applications in the DNR Applications Portfolio (Chapter V). The matrix following this discussion identifies the skills needed to improve our AD process. For each key function, we will assess current skills and levels of skills needed. If we are not now performing at an acceptable level, we will determine whether we should fill the gap by training or reassigning current staff, hiring new staff, contracting for services, or dropping the function.

Core Internal AD Staff or IT Consultants?

A pivotal strategic decision is whether it is better in the long-run to continue reliance on IT consultants, or to build a core internal AD team. As is the case in many organizations, the idea of a centralized AD unit has been under siege since the coming of the personal computer. A centralized unit is viewed as too expensive, too out of touch with user needs, and too slow to respond to requests. On the other hand, recent experience in the DNR warns that decentralized AD, either by business unit staff or consultants, will result in architectural chaos, inappropriate use of professional resources, and dependence on increasingly high-priced consultants. Even when we agree in principle that we could achieve greater economies of scale, lower cost of ownership, tighter systems integration, and better customer service by centralizing, we resist taking the step for political reasons. Some of the advantages, disadvantages, and relevant management questions associated with each alternative are presented below.

Core Internal AD	External Consultant AD
Advantages	
P Retain knowledge and skills P Increase employee satisfaction P Staff familiar with business and culture P Opportunity for cross-training	P Access to unique skills P Consultant assumes staff risks P Hiring flexibility P Manage fluctuating demands
Disadvantages	
P Substantial HR investment P Technology may outpace skills P Employees may feel confined P Retention is not guaranteed	P Strategic skills learned at DNR expense P Consultants prone to turnover P Compensation disparity issues P May not jibe with DNR culture
Management Questions	
P What skills do we need? P Are we investing appropriately ? P How can we fill skills and training gaps?	P Can we manage contracts effectively? P Can we provide ongoing application support?

Cost-Benefit Analysis: Internal vs. External Application Development

An analysis of expenditures on consultants for 12 AD projects over an 18 month period was completed in December 1999. During the period sampled, the DNR spent $740,350 for 11,390 hours of consultant time billed at $65/hour. (This hourly rate is at the low-end of IT consulting fees, which range up to $325/hour on the current state contract.) In comparison, the average salary and benefits expense for an Information Technology Specialist in the State's classified service is about $100,000 per year. This means that for the same 18 month period, we could have employed five programmer analysts for $750,000, and quite conceivably have accomplished more. Of the 12 projects, three were dropped in the requirements phase; one was implemented but has never been used; one was developed by business unit staff following the requirements phase; three were dropped in the user testing and acceptance phase, and are now being developed by internal MIS staff; and four are in use today. By industry standards, this record is not

unusual. An estimated one-to-two thirds of all software projects exceed their schedule and budget targets before they are delivered; about half of all large projects so far exceed their targets that they are canceled, and many others are quietly abandoned.[3]

Proposed Application Development Strategy

It may seem contrary, at a time when the IT industry is fostering a shift from centralized to decentralized management and decision making, and when the global trend seems to be toward more and more AD outsourcing, to propose a centralized AD strategy in the DNR. There is, of course, no single correct organizational model, and each has its strengths and weaknesses. GartnerGroup[4] defines a hybrid organizational model in which business units control AD planning, budgeting, and project management, and the IS unit manages a core development team. The DNR actually uses this model in two areas of application development today – both GIS and the DNR web site operate from a core of expertise in MIS, and are among the most successful long-term IT projects in the department.

This strategy will help us best manage AD projects by establishing an internal consulting group – a core of talented information technology professionals who understand natural resource management *and* systems engineering, who will establish close relationships with the business units and customers they support, and who will not walk away with the intellectual capital they have gained at the department's expense when their projects are finished. It also calls for a new approach to budgeting for and funding AD projects over the total application life-cycle.

AD costs are on a continuing upward spiral, driven by the high demand for IT skills and a critical shortage of qualified workers. Contracting for AD is expensive, and IT consulting firms face the same constraints as internal IS shops. Those that have skilled resources are charging premium prices for them, often three to four times the cost of internal AD staff. This trend is likely to continue. In estimating AD costs, these factors must be considered, because developer skill levels have a direct and expensive effect on the overall project result, time lines, and deliverables.

The Application Development Team

The proposed AD strategy has at its core a team of software engineers – systems analysts, project managers, data modelers, database administrators, and programmers – with a level of expertise and brainpower sufficient to build and maintain 75 percent of the department's software applications. The team will be organized in "centers of excellence," patterned after DNR's natural resource management responsibilities and strategic objectives. The make-up of each team will be based on an analysis of the Application Portfolio (Chapter V) and the results of the skills assessment. Business units will establish priorities for the teams, and contribute business process intelligence to the application development process.

To better define expectations and responsibilities for both customers and application developers, and to ensure customer satisfaction, AD projects in the DNR will be guided by a ***Bill of Rights***. This document creates a collaborative environment essential to project success, and can be used at the close of a project to elicit feedback and evaluate performance.

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[3] Capers Jones, Patterns of Software Systems Failure and Success. Boston: Int'l Thompson Computer Press, 1996.

[4] F. Magee, "Shared Service Hybrid Organizations: Balancing Extremes," GartnerGroup Top VIEW (September 1996).

DNR Bill of Rights for Application Development Projects[5]

Customer Rights

1. To set objectives for the project and to have them followed.
2. To know how long the project will take and how much it will cost.
3. To make reasonable changes to the application requirements throughout the course of the project, and to know the time and cost impacts of making those changes.
4. To know the project's status clearly at all times, to be informed of risks that might affect cost, schedule, or quality, and to be provided with options for addressing the risks.
5. To have ready access to project deliverables throughout the project.

AD Team Rights

1. To know in detail the project objectives and priorities, and the customer's expectations for the application.
2. To have ready access to the customer, manager, or other person responsible for making decisions about the application's functionality.
3. To approve effort and schedule estimates for all work the team is asked to do. This includes the right to provide only the kinds of cost and schedule estimates that are theoretically possible at each stage of a project, to take the time needed to create meaningful estimates, and to revise estimates whenever project requirements change.
4. To have the team's project status accurately reported to customers and management.
5. To work in a productive environment free from frequent interruptions and distractions.

[5]Inspired by Steve McConnell's, Software Project Survival Guide. Redmond: Microsoft Press1998.

APPLICATION DEVELOPMENT FUNCTIONS AND SKILLS ASSESSMENT MATRIX

Application Development Function	Doing this now at acceptable skill level.	Not doing this now at acceptable skill level.	Not doing this now. Get new skills to do.*				Phase out function and reassign staff.
			TS	RS	HS	HC	
Leadership and Customer Relations							
Manage a dynamic portfolio of DNR information systems							
Engage senior management in developing an AD vision, and secure support from operations managers and IS professionals							
Develop and manage a process to prioritize project development							
Manage a process for developing and adopting data standards, AD methodologies, and project management processes							
Adopt, publicize, and enforce an AD "Bill of Rights"							
Facilitate development and produce the final version of an integrated strategic IRM plan and biennial IT budget initiative							
Standards and Methodologies							
Documentation Standards for:							
Project proposals and project definition documents							
Functional specification and design documents							
Risk management documents							
IT project plans							
Business object and technical data models							

Application Development Function	Doing this now at acceptable skill level.	Not doing this now at acceptable skill level.	Not doing this now. Get new skills to do.*				Phase out function and reassign staff.
			TS	RS	HS	HC	
Architectural and detailed design documents							
User manuals and technical documentation							
Unit, integration, and system testing							
Customer testing and acceptance documents							
Metadata standards for business and spatial data holdings							
Data Management Standards							
Develop a suite of specifications for the collection, organization, naming, integration, security of, and access to enterprise data							
Develop naming standards for field names, variable names, data objects (tables, indexes, databases, triggers, stored procedures), etc.							
Develop field content standards, specifying value domains, definitions, and codes							
Document data holdings using DNR metadata standard							
Develop and keep current an integrated Metadata Repository							
Keep current the “Enterprise-wide Framing Business Object Model”							
Develop standards for the physical storage of data and data objects							
Develop standard methods for accessing data in a multi-tier environment (e.g., SQL, remote procedure calls)							

Application Development Function	Doing this now at acceptable skill level.	Not doing this now at acceptable skill level.	Not doing this now. Get new skills to do.*				Phase out function and reassign staff.
			TS	RS	HS	HC	
Database Administration							
Manage database creation, back up, recovery, access, and security							
Manage data conversion and data migration activities							
Monitor database performance and conduct capacity planning							
Design and manage spatial and business data stores and warehouses							
Application Programming							
Develop application programming / coding standards							
Develop reusable component libraries							
Generate code, test it, modify it, and regenerate it using standard AD techniques and tools such as Visual Basic, Perl, Java, etc.							
Use human factors best practices in designing user interfaces							
Project Execution and Management							
Application Development							
Develop project specific data models using standard methodology							
Ensure that new applications are integrated when appropriate with existing information systems							
Ensure compliance with approved data and AD standards							
Ensure all project participants understand the “Bill of Rights”							

Application Development Function	Doing this now at acceptable skill level.	Not doing this now at acceptable skill level.	Not doing this now. Get new skills to do.*				Phase out function and reassign staff.
			TS	RS	HS	HC	
Facilitate development of project definitions using JDA**K** and other techniques							
Conduct cost benefit analysis and feasibility studies							
Use formal techniques such as COCOMO to establish initial project cost estimates							
Develop project plans using project management tools such as Microsoft Project							
Define and sequence project activities and document activity interdependencies using PERT or GANTT charts							
Identify and secure project resources							
Track project status and ensure milestones are met on-time and in-budget using project management tools such as Microsoft Project							
Manage requirements change control process							
Communicate frequently with customers as to project status – informally and formally, verbally and in writing							
Establish relationships with IT consultants and select consultants for specific projects							
Manage application development contracts							
System Analysis and Design							
Conduct business process analysis							
Specify high level system requirements							

Application Development Function	Doing this now at acceptable skill level.	Not doing this now at acceptable skill level.	Not doing this now. Get new skills to do.*				Phase out function and reassign staff.
			TS	RS	HS	HC	
Develop detailed functional design documents							
Develop detailed technical design documents							
Documentation Development							
Develop and implement technical documentation standards for online and print documentation							
Develop and implement end-user documentation standards for online and print documentation							
Customer Testing and Acceptance							
Develop and implement rigorous user application testing and acceptance requirements							
Develop and implement quality assurance criteria							
AD Staff and End-User Training							
Equip employees with the knowledge and skills they need to perform their jobs to the best of their abilities by implementing a comprehensive training plan							
Deliver GIS end-user training to DNR employees							
Coordinate training for DNR project managers, data managers, modelers, database administrators, and software engineers							
* KEY: TS: Train Staff HS: Hire Staff RS: Reassign Staff HC: Hire Consultant							

Chapter VII

IT Architecture:
User Self-Service

DESKTOP PRODUCTIVITY SOFTWARE . . . . . Page VII-2
DNR HELP DESK . . . . . Page VII-2
DNRNET, THE DNR INTRANET . . . . . Page VII-2
DNR INTRANET FOR GIS USERS . . . . . Page VII-3
DNR GIS DATA DELI . . . . . Page VII-3
BRIDGES: MINNESOTA'S GATEWAY TO ENVIRONMENTAL INFORMATION . . . . . Page VII-3

The DNR Information Technology environment is quite rich and diverse in the area of user self-service. We provide a standard set of desktop productivity software, a help desk reachable by phone and e-mail during business hours, an Intranet site with a plethora of self-help sources, a specialized GIS Intranet serving all sorts of information and assistance, a public Web site that provides GIS data sets, and a public Web site that provides metadata searching for environmental information among Minnesota state agency Web sites. These diverse services are catalogued below.

DESKTOP PRODUCTIVITY SOFTWARE

- Word processing: WordPerfect
- Spreadsheet: Quattro Pro
- Presentations: Corel Presentations
- E-mail and calendaring: GroupWise
- Internet browser: Netscape Navigator
- Desktop database: MS Access

DNR HELP DESK

Available by phone and e-mail during business hours, helps users with:

- Logging into networks
- GroupWise
- AS/400
- Corel applications
- Windows NT or 95
- MAPS, SEMA4, IA
- Printing problems
- Other problems or questions regarding DNR-standard hardware or software

DNRNET, THE DNR INTRANET

Delivers information in the following topic areas:

- Bulletin Board
- Human Resources
- Policies, Procedures, Standards
- Forms
- Virtual Help Desk:
  - Daily system status messages on DNR and statewide systems (MAPS, SEMA4, IA)
  - Virus protection updates (also available automatically at network login)
  - On-line job aids / self-study guides for:
    - Corel Presentations
    - GroupWise
    - Internet
    - MS Access
    - MS Windows
    - Quattro Pro
    - WordPerfect
    - PC skills
  - Tips'N'Techniques
  - Web Authoring Resources:
    - Web site project proposal form
    - Link request form
    - Links policy
    - Community Forums guidelines and proposal form
    - Web site priorities

- DNR web site style guide
- WebReady Class notes
- Basic HTML
- HTML Step by Step
- DNR Template
- Web Glossary

R Upcoming computer training

R Contact information for desktop and network support personnel

DNR INTRANET FOR GIS USERS

Provides information on the following topics:

P GIS Human Resources
P What's New
P Data Resources
P ArcView Resources
P GIS Help
P Events and Training
P GIS Links
P GPS Info
P Common Map Plots

DNR GIS DATA DELI

A public Web site (**http://deli.dnr.state.mn.us**)

P The GIS Data Deli is an internet-based spatial data acquisition site that allows users to download raw computer-readable data for use in their Geographic Information System, image processing system, or traditional database environment. The site includes links to extensive and summary level data descriptions (metadata) to support our users.

BRIDGES: MINNESOTA'S GATEWAY TO ENVIRONMENTAL INFORMATION

A public Web site (**http://www.bridges.state.mn.us**)

P Bridges provides users with a controlled vocabulary and a specialized search engine, enabling them to search several environmental state agency web sites simultaneously for information. Bridges is developed with the collaboration of Minnesota state government environmental agencies to facilitate access to the rich and diverse environmental information available in electronic format in Minnesota.

Chapter VIII

IT Architecture: Technology Infrastructure

HARDWARE INVENTORY BY TYPE . . . . . Page VIII-2
INFRASTRUCTURE SOFTWARE INVENTORY BY TYPE . . . . . Page VIII-3
NETWORK DIAGRAMS . . . . . Page VIII-4

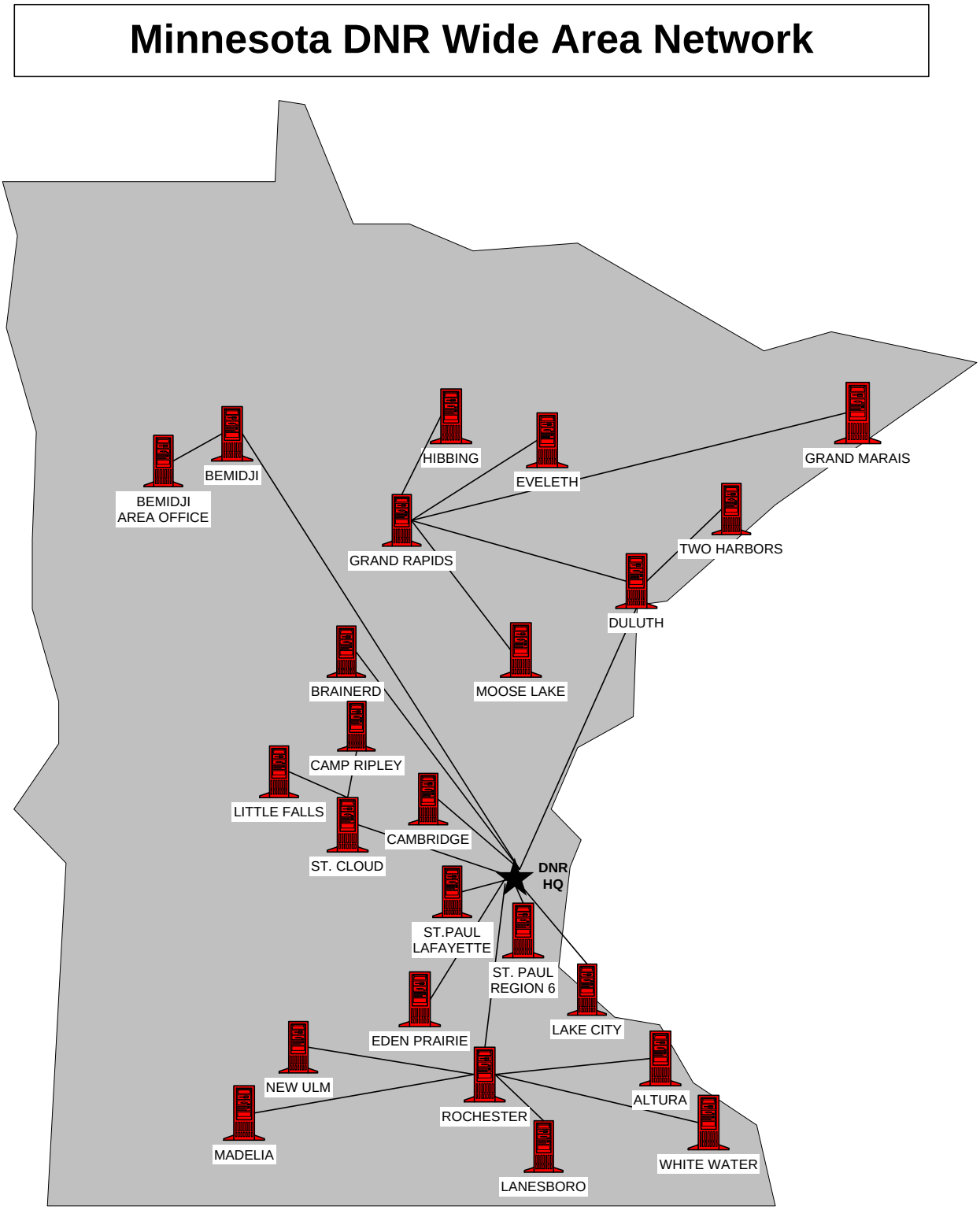
HARDWARE INVENTORY BY TYPE

MN DNR Statewide Computer Hardware Inventory Summer 2000		
Hardware Category	**Processor/Model**	**Count**
Desktop		
	386	3
	486	32
	Pentium	565
	Pentium II	637
	Pentium III	313
	Pentium Pro	194
	Celeron	11
	Non-Intel	12
Total		1767
Intel-based Servers		
	Compaq 1600	15
	Compaq 3000	8
	Compaq 5000	1
	Compaq 6500	5
	Compaq 7000	1
Total		30
Unix Servers		
	Data General AV3000	1
	Sun E250	6
	Sun Netra1	1
	Sun Sparc 20	4
	Sun Ultra 2	13
	Sun Ultra 10	3
Total		27
IBM Midrange	AS400 B510	1

INFRASTRUCTURE SOFTWARE INVENTORY BY TYPE

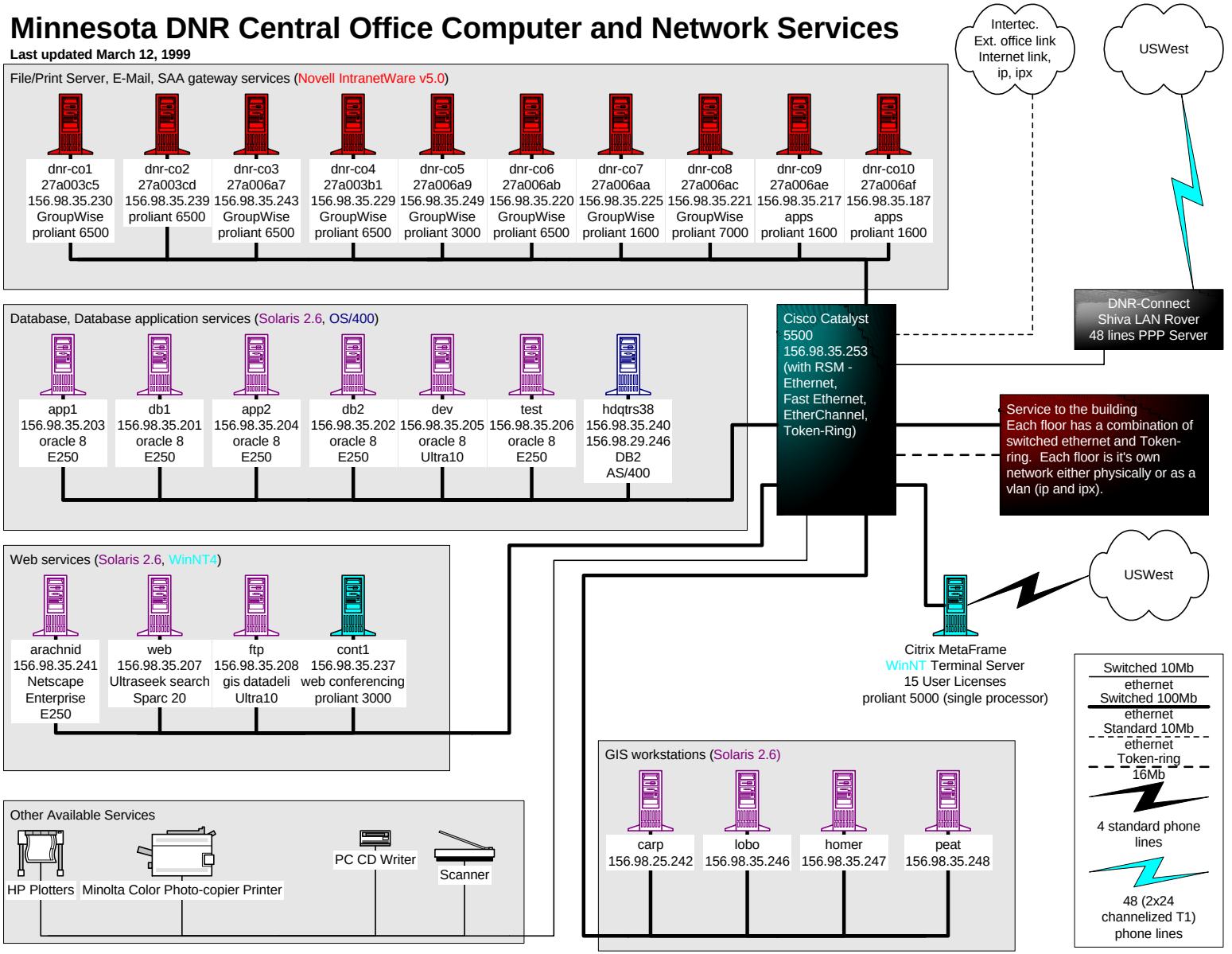
MN DNR Statewide Personal Computer Software Inventory Summer 2000		
Software Category	**Program**	**Count**
Asset Management	Tally Systems NetCensus	1826
CAD	Autodesk AutoCAD	76
Internet Browser	Netscape	
	Internet Explorer	
Database	Access version 2	220
	Access 97	495
Report Writer	Crystal Reports	265
Geographic Information Systems	ESRI ArcView	400
Presentation Graphics	Corel Presentations	1105
	Microsoft PowerPoint	243
Network	Novel GroupWise	1202
Operating System	Windows 3.1	28
	Windows 95/98	299
	Windows NT	1428
	Windows 2000	9
Spreadsheet	Quattro Pro	1169
	Lotus	370
	Excel	366
Anti-Virus	InnocuLAN	1375
	McAfee Virus Scan	93
Word Processor	WordPerfect	1506
	Word	37

NETWORK DIAGRAMS



Minnesota DNR Central Office Computer and Network Services

Last updated March 12, 1999



Chapter IX

IT Architecture: Socio-Political-Organizational Issues

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RECOMMENDATIONS FOR IT POLICY DEVELOPMENT . . . . . Page IX-4
RECOMMENDATIONS FOR NETWORK MANAGEMENT AND END USER SUPPORT . . . . . Page IX-5
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RECOMMENDATIONS FOR INTEGRATED TELEPHONE SUPPORT WITHIN THE AGENCY . . Page IX-6
RECOMMENDATIONS FOR DNR APPLICATION DEVELOPMENT . . . . . Page IX-7
RECOMMENDATIONS FOR DNR GEOGRAPHIC INFORMATION SYSTEMS (GIS) . . . . . Page IX-8

INTRODUCTION

The socio-political-organizational situation with regard to Information Technology in the DNR is summarized in an August 22, 2000 DNR internal memo (pages IX-3 to IX-8) from the Assistant Commissioner for Administration and the Chief Information Officer to DNR unit managers. (The format of the memo has been slightly altered for stylistic continuity with the current document. Also, names of staff members have been replaced by italicized position names in parentheses.)

For clarification and context-setting, please first read the following October 23 letter from the DNR's Chief Information Officer to the Office of Technology. (The Chapter 8 referred to in the October 23 letter is actually Chapter IX in the current document.)

10/23/2000

Reggie David, Assistant Commissioner
Department of Administration
Office of Technology
332 Minnesota Street, Suite E1100St. Paul, Minnesota 55101-1322

Greg Peterson
Planning Director, Technology Management Division
332 Minnesota Street, Suite E1100St. Paul, Minnesota 55101-1322

Dear Reggie and Greg:

I am sending this letter to provide additional information regarding our Strategic Information Resource Management Plan (SIRMP). Chapter 8 contains the full text of an internal DNR working document that is a plan to realign important information resource management tasks within the agency. The information in this document is premature in that it implies the DNR is currently taking specific actions to improve the management of our information systems. While this document is accurate in terms of the stated goals and objectives, the specific tactical solutions called for are only proposed solutions at this time. We are continuing to have internal meetings to work out specific tactical solutions that will work within the DNR.

I would like to emphasize that the document in chapter 8, like the SIRMP itself is a "living document" and will be updated as appropriate. It is our intention to have the specifics of our MIS reorganization well documented over the next 6 months. As that plan matures and we move forward with our implementation we will update the SIRMP with the most current information.

Sincerely,

Henry B. May
Chief Information Officer
Minnesota Department of Natural Resources

August 22, 2000

Internal Memo

To: Division Directors
Bureau Administrators
Regional Directors

From: Kurt Ulrich, Assistant Commissioner for Administration
Henry May, CIO

Re: MIS management plan

In recent years, Information Technology (IT) has played an increasingly important role in how the DNR performs its work. In recognition of this, the Commissioner's Office has requested the development of a process for improving the management of the DNR Information Technology resources. Several Divisions and Bureaus have made significant investments in Information Systems Technology, and for these Divisions and Bureaus IT has become a cornerstone asset. Notably, combined spending within the DNR for IT reaches $12 million to $15 million annually. Our goal is to create a uniform high level of capability for the entire Department. To achieve that goal we are recommending changes that will draw from the strengths of the business units and from the MIS Bureau. We are asking for your assistance in achieving this goal.

The changes we recommend are outlined in this document and come in the areas of IT policy development, networks, personal computer and equipment procurement, telephony, applications development, and geographic information systems (GIS).

The Commissioner has asked us to use the following criteria as a basis for recommending and implementing changes to the management of IT for the DNR.

- Information Technology, and the data and information it serves, will be managed for the goals and objectives of the DNR as a whole. The needs of the individual business units will continue to be served, with the needs of the entire agency having the highest priority.
- Data and information are DNR assets, not divisional, bureau, or personal assets.
- At the Commissioner's Office level, all IT functions and activities will be the responsibility of the Assistant Commissioner for Administration.
- Outside the Commissioner's Office, the Chief Information Officer (CIO) will be responsible for IT policy development and recommendations.
- The CIO will review all IT project requests and make recommendations to the Commissioner's Management Team (CMT) about which projects should continue and which should not based on a projects ability to meets the needs of the DNR and the business unit.
- For reasons of efficiency and effectiveness some functions will be centralized within the MIS Bureau. In some cases this will involve the reassignment of personnel and budget.
- The CIO will be the lead Senior Manager for legislative issues and initiatives relative to IT. Divisions with IT projects will be responsible to represent programmatic issues to the legislature.

The anticipated benefits for the DNR and its business units include:

- Business units can focus on their areas of responsibility and not dilute their resources by having to maintain base level IT services.
- Data and IT infrastructure will be integrated at the Department level resulting in more shared information and less systems redundancy.
- Total IT costs for the Department are not expected to go down, however we expect to be able to provide a higher level of service for the same amount of time and money.
- IT development projects will be more successful at meeting end user requirements, budget targets, and development timelines.
- Information management will be improved at the Department level.
- The DNR will meet legislative reporting requirements for IT activities.
- Communication about IT activities will improve throughout the agency.
- IT professionals will have a more clearly defined role and career path within the agency.
- The MIS Bureau and MIS functions will be more responsive to customer needs within the Department.

The timeline to implement these changes is expected to start immediately with all recommendations being implemented within 18 months. The specific timelines are contained within the individual recommendations that follow.

RECOMMENDATIONS FOR IT POLICY DEVELOPMENT

The following changes in IT policy development are contemplated:

- The Information Management Team (IMT) will become a technical advisory board for the exchange of technical direction and information. Membership will be extended to all IT professionals (current membership is limited to appointments made by the Commissioner's Office.) The September 1997 DNR Operation Order #92 (Subject: Developing, implementing and managing department wide Information systems (IS) through the Information Management Team and IS working Committees) will be rescinded. An IT policy advisory board will be appointed by the Commissioner and coordinated by the Chief Information Officer. This body will be the IT policy steering Committee for the CIO and for the DNR.
- The CIO will be responsible for IT policy development and recommendations.
- The Commissioner's Office will give primary consideration to policy recommendations made by the CIO in making IT policy decisions.
- At the Commissioner's Office level, all IT functions and activities will be the responsibility of the Assistant Commissioner for Administration.

RECOMMENDATIONS FOR NETWORK MANAGEMENT AND END USER SUPPORT

The following four recommendations permanently move funding from the business units to cover support costs already being paid by the business units for services provided by MIS. Our recommendation is that these changes be made immediately.

- Reprogram $ from HR, OMBS, Field Services and Commissioner's Office to MIS to permanently fund *(sixth floor desktop support person's)* salary.
- Reprogram $ from Lands and Minerals and Engineering to MIS to permanently fund *(fourth floor desktop support person's)* salary.
- Reprogram $ from BIEL and Enforcement to MIS to permanently fund *(first floor desktop support person's)* salary.
- Reprogram $ from Forestry and BIEL to cover cost of 5th floor support position.

The following six recommendations are designed to improve the consistency of network services offered, lower the overall costs, and provide backup to the business units served by these people. Each employee would continue to support the business unit they currently work for but may have additional support duties. Our recommendation is that these changes occur over the next 2 – 6 months.

- Move *(Fisheries and Wildlife ITS support person)* to MIS with salary to support Fisheries, Wildlife, and Ecological Services on 2nd floor.
- Move *(Hibbing Minerals ITS support person)* and salary from Lands and Minerals (Hibbing) to MIS.
- Move *(Enforcement ITS support person)* and salary from Enforcement to MIS.
- Move *(Parks ITS support person)* and salary from Parks to MIS.
- Move *(Forestry ITS support person)* and salary from Forestry to MIS.
- Evaluate needs for desktop support in Waters, Trails and Waterways, and Parks. Move resources (personnel and $) as necessary to provide adequate service levels.

The following two recommendations are being suggested in order to provide service to the large number of current DNR employees along the north shore and in the northwest section of the state. These recommendations also recognize that with the area office connectivity project(s) we are adding 50 locations and over 250 employees to the network without additional end user and technical support. Our recommendation is that these two positions will be added within the next 12 – 18 months. There is currently a significant need for end user support in these areas now; however, funding for these positions is not readily available.

- Recommend adding end user computer support person in Two Harbors to provide support in R2 along North Shore. Ask legislature for $ to cover salary; reprogram $ if unsuccessful at the legislature.
- Recommend adding support person in Fergus Falls to cover field support issues in the southern and western part of R1. Ask legislature for $ to cover salary; reprogram $ if unsuccessful at the legislature.

RECOMMENDATIONS FOR CENTRALIZED PERSONAL COMPUTER (PC) AND HARDWARE PROCUREMENT

Continue process of centralized acquisition of PCs and related hardware and software. Enforce hardware and software standards for department via centralized acquisition process. To facilitate this centralized purchasing and vendor management we will need to:

- Establish an account structure to support the centralized purchasing so that purchases can be tied to the business unit making the purchases.
- Improve reporting of expenditures.
- Implement leasing and other "pay as you go" financing to improve cash-flow management for business units ordering PCs.
- Establish fixed asset life cycles and replacement schedules for all PC and related hardware purchases using established tax code and or established industry wide standards.

We are recommending that these suggestions be implemented immediately. We have already begun the process and the changes suggested above will have little effect on the business units.

RECOMMENDATIONS FOR INTEGRATED TELEPHONE SUPPORT WITHIN THE AGENCY

Move phone systems responsibilities to MIS. Currently telephone system planning, procurement, installation, and maintenance is split between field services, the business units, and regional business managers. There are 4 specific tasks that will need to be performed. They are:

- Develop a plan for integrated telephone technologies for the DNR based on current usage and the opportunity to increase capabilities and lower overall operating costs.
- Develop a plan for video conferencing capabilities for the DNR.
- Develop a plan for the integration of video, voice, and data services.
- Add 1 – 2 professional staff to implement and maintain this integrated system for the DNR.

We are recommending that these responsibilities transfer to the MIS Bureau over the next fiscal year to allow the bureau adequate time to develop an integrated plan for telephony and acquire the staff resources to adequately manage the telephone systems.

RECOMMENDATIONS FOR DNR APPLICATION DEVELOPMENT

- All application development (AD) projects must first be approved by CIO / CMT.
- All application development projects will follow a structured project management and development methodology established by MIS and will be engineered to be consistent with overall DNR systems architecture.
- Business units will be responsible for defining needs, supplying executive sponsors, and providing project management, funding and data management.
- MIS will be responsible for all AD activities including systems analysis and design, software acquisition, programming, testing, integration, systems and software maintenance, and application retirement. Application development activities for Forestry and Fisheries will be delegated back to those divisions at this time.
- MIS will manage all AD contracts and supervise MIS staff programmers.
- Formal training will be required for all project managers in key areas of software engineering: 1) development methodologies; 2) systems analysis and business process engineering; 3) technical communications; 4) software project management; 5) requirements specification, testing, and software quality assurance; 6) data and database management; 7) designing for Internet access; and 8) software process maturity assessment (SEI CMM).
- The MIS Bureau will coordinate the AD project management training described above. Training should be completed prior to the launch of any new AD project. Training should be complete in one year. Estimated cost is about $10,000 per employee. Potential training participants are: *(NHNRP supervisor)*, Eco Services; *(engineering specialist)*, Engineering; *(program analyst)*, Fisheries; *(Forestry Information Systems supervisor, forest economist and Timber Sales supervisor, computer user support coordinator)*, Forestry; *(program analyst)*, BIEL; *(senior engineer, data systems specialist)*, Lands and Minerals; *(management reporting finance specialist)*, OMBS; *(MIS Supervisor)*, Parks; *(GIS coordinator)*, Trails and Waterways; *(Information Services Manager, LAN administrator)*, Waters; *(Management System Coordinator)*, Wildlife.
- Succession planning should be done for *(staff members)* with application development responsibilities who are retirement eligible within the next two years.

We are recommending that the changes outlined above be made immediately. The defined education would begin immediately, with completion within 18 months.

The following table is an excerpt from the June presentation made to CMT outlining which responsibilities the business unit should have and which responsibilities the MIS Bureau should have. This table and the presentation are the basis for the recommendations made above.

Business Unit Responsibilities	MIS Bureau Responsibilities

P Executive Sponsorship
P Business Process Engineering
P Funding
  R Design and build
  R Data migration
  R Maintenance
  R Data integrity
	P Systems Analysis and Design
	P Programming
	P Maintenance of Standards
	P Training and Development

RECOMMENDATIONS FOR DNR GEOGRAPHIC INFORMATION SYSTEMS (GIS)

The demand for GIS continues to grow. Currently approximately 10 percent of the DNR employees use GIS tools in their daily work. At the same time, we are seeing demand grow for GIS tools, data, and output to enhance our ability to communicate with the public, the legislature, and our constituency groups. The development of GIS viewers and support tools such as LandView is generating an accelerated demand for GIS information. We will need to expand the GIS capabilities of the DNR to meet the needs within the Department and from the public, and we will need to integrate GIS and application development activities to develop spatially enhanced applications. To meet these demands, we are recommending the following:

- Add additional GIS staff in the regions. It will be necessary to add 1 – 2 FTE to each region to meet the demand for GIS services in the field and by the public. At this time Wildlife has a proposal to add 1 FTE to each region. We recommend adding the staff to the MIS Bureau regional staff roster in order to meet the significant demands, keeping the primary short-term priority on the needs of Wildlife with additional projects as required.

- Add 1 GIS professional to the MIS Bureau for support to the Commissioner's Office, Conservation Connections project, and OMBS support.

- Add 1 planner with GIS skills to OMBS to interpret and present GIS data to the public, the legislature, and others.

- Add 1 GIS professional to support Emergency Management to provide, maintain, and keep ready a state-of-the-art, mobile GIS facility to assist DNR response to statewide emergencies (fire, flood, tornado).

We are recommending that these changes be implemented as soon as possible based on the availability of funding.

End of August 22, 2000 Internal Memo

Chapter X

Realization Projects

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ABOUT REALIZATION PROJECTS

Recognizing that IT resources are limited, realization projects must be ranked for their potential to impact business strategies, considering the importance of the strategies and the leverage information resources and technology can provide. This step is an initial attempt at triage; with limited resources, you may want to avoid detailed planning for projects that do not fall in your planning horizon.

ELECTRONIC GOVERNMENT SERVICES

The Governor's Office has placed heavy emphasis on Electronic Government Services (EGS). These are (state) government services delivered electronically, using methods such as interactive or automated voice response, electronic data interchange, electronic funds transfer, or web-enabled applications delivered via the Internet. The Governor is eager to make significant progress on EGS. His staff has asked that agencies provide information on electronic delivery initiatives for the period of his term – January 1999 through January 2003. In the following sections, realization projects containing an Electronic Government Services component are highlighted with an "***(EGS)***" indicator.

PROJECTS COMPLETED JANUARY - JUNE, 1999

Network Services

- ***(EGS)*** Purchased and installed Web servers
- Began regional network upgrades
- Conducted field office network pilot
- Upgraded DNR e-mail system

Data and Applications

- ***(EGS)*** Managed development of Electronic Licensing System
- ***(EGS)*** Developed Bridges web site
- ***(EGS)*** Developed Game Finder Web application
- Managed development of DEARS (Division of Enforcement Activity Reporting System)
- Managed development of CODA (Field Services Consolidated Database)

Geographic Information Systems

- ***(EGS)*** Implemented DNR Data Deli, a website that provides nearly 50 layers of GIS data at no cost to public and private sectors.
- Complete cooperative project with University of Minnesota and Association of Minnesota Counties to produce and publish statewide land cover census map.
- Developed automated process to routinely download land record information from the AS400 to a GIS core library coverage giving GIS users access to most current departmental land record information.
- Led efforts to improve GIS metadata on state and DNR levels.
- ***(EGS)*** As key member of the Governor's GIS Council Standards Committee led the effort to establish statewide standard for transferring GIS information between state agencies.
- Working with Governor's GIS Council and the DNR Division of Waters led efforts to design a consistent hydrographic GIS database.
- Worked with emergency management professionals to develop initial "GIS Kit" for wildfire response teams and assisted on fire response teams at state and national levels.
- Provided complete DNR GIS data library to Minnesota Science Museum and assisted them with development of their showcase Minnesota Lakes and Watersheds interactive display.

PROJECTS COMPLETED IN FY 2000

Network Services

- ***(EGS)*** Installed 17 Field Office Network Connections
- ***(EGS)*** Upgraded network servers in six Regional Offices
- Installed HEAT call tracking software for Help Desk and computer support staff

Data and Applications

- Compiled first release of the DNR Enterprise Application Portfolio
- Researched and wrote a white paper, "Application Development Strategy," which included a cost-benefit analysis of outsourcing application development
- Researched and wrote a white paper comparing data modeling techniques: "An Analysis of Business Object Modeling: Intended as an Addendum to David C. Hay's October 1999 Paper, 'A Comparison of Data Modeling Techniques'"
- Developed a Physical Data Model for the DNR Metadata Repository, and worked with GIS unit to integrate the GIS Extended Data Dictionary and the enterprise metadata repository
- ***(EGS)*** Designed and implemented Data Warehouse for Electronic Licensing System (ELS) data, and managed data practices issues involving media and academic requests for copies of the data
- ***(EGS)*** Managed development and delivery (on time and within budget) of the Hunting Lotteries application in partnership with Born Consulting
- Implemented Consolidated Database (CODA) in partnership with Vision Technologies
- Implemented Environmental Review Database (ERDB) in partnership with Vision Technologies
- ***(EGS)*** Developed Forest Service Teacher's On-line Catalog ($15,000 revenue)
- ***(EGS)*** Worked with The Connection to post camping and lodging reservations on the DNR Web site
- Developed second RFP for Oracle Financials implementation and reviewed responses
- ***(EGS)*** Completed LCMR Project, Foundations for Integrated Access to Environmental Information; published report, "Best Practice Guidelines for Web Metadata," and two related research reports: "Usability Study for Dublin Core Metadata & Controlled Vocabulary," and "Bridges User Interface Study"

Geographic Information Systems

- ***(EGS)*** Continued work to make DNR GIS Data Deli the major Minnesota GIS data server
- Continued to grow GIS Core Database library by adding important new layers
- Began design of revised GIS Core Database library and development of DNR Extended Data Dictionary
- ***(EGS)*** Designed and deployed LandView GIS data viewer on desktop and Internet platforms
- Developed the ease-of-use Quick Themes extension for ArcView users
- Built new tools for interfacing GPS tools with ArcView GIS software
- Trained numerous DNR employees on use of basic and more advanced GIS capabilities
- Provided GIS assistance to Consolidated Conservation lands project
- Developed Vegetative Cover classification in Metro Region with eye on department-wide usage
- Produced statewide Wildlife Management Unit map
- Prepared numerous products for Off-Highway Vehicle project in Region 3
- ***(EGS)*** Developed Region 5 prototype for presenting Wildlife Management Area data on the Internet
- Assisted Waters and Fisheries on design of hydrography layer (stream, lakesheds, Protected Waters Inventory)
- Provided extensive GIS support for BWCA blowdown and for several wildfire incidents
- Developed CD data set to distribute DNR GIS data; several hundred copies distributed

CURRENT PROJECTS, FY 2001 (current status shown as percent completed)

Network Services

- ***(EGS)*** Install 15 Field Office Network Connections (50%)
- ***(EGS)*** Upgrade Central Office network servers (0%)
- Complete network security impact analysis and improvements, November 2000 (0%)
- Begin phone system upgrades (0%)
- Plan video conferencing pilot project (10%)
- Plan SEMA4 upgrade (25%)
- Place ARC/Info 8 into NT environment (90%)
- Test Solaris on Intel (85%)

Data and Applications

- ***(EGS)*** Complete development of a web application to deliver Natural Heritage Information System data (50%)
- Minnesota Conservation Volunteer Magazine application – complete development and testing; implement (100%)
- Media Reservations application – complete development and testing; implement (90%)
- Media Tracking System – evaluate potential of ContactWise™ (GroupWise add-on) (10%)
- Aquatic Plant Management application – complete development and testing; implement (0%)
- DNR Customer Database – continue database development (0%)
- DNR Metadata Repository – continue database development (10%)
- Division of Enforcement Activity Reporting System – move database from AS/400 to Oracle (Vision Technologies?) (10%)
- Consolidated Database – transfer support from Vision Technologies to DNR (75%)
- Archibus/FM™ – evaluate product as potential Field Services consolidated Database replacement (10%)
- Integrated Records and Document Management System – research options (10%)
- DNRnet – continue development (10%)
- ***(EGS)*** B2B application for Field Services warehouse operations – develop prototype (0%)

Geographic Information Systems

- Begin migration to ARC/Info 8 and ArcView 8 technology (15%)
- Install and test SDE 8 for Oracle and begin development of integrated systems (15%)
- Continue development of revised GIS core that will reside in eventual DNR system architecture (40%)
- Improve internal GIS data access tools with completion of Quick Themes functionality (90%)
- Work with MIS Bureau Data and Applications staff to implement one high visibility "traditional business application" with a spatial component, that is, spatially enable a traditional application (0%)
- ***(EGS)*** Continue LandView development on desktop and Internet platforms (90%)
- Enhance GIS ability for emergency response (10%)
- Begin conversion of ArcView from 3.x to 8.x line (10%)

MAJOR DNR REALIZATION PROJECTS AND COSTS FOR THE CURRENT AND NEXT THREE BUDGET CYCLES

This table contains IT realization projects in the areas of Network / Hardware Infrastructure, Software Tools Infrastructure, and IT Staff. These projects have required or will require budget initiative funding or internal reallocation. Application development projects are discussed in Chapter V: Applications Portfolio.

Major DNR Realization Projects and Costs for the Current and Next Three Budget Cycles					
Project Name	**Description**	**Costs by Biennium ($000's)**			
		2000-2001	**2002-2003**	**2004-2005**	**2006-2007**
Network / Hardware Infrastructure					
Sub-Regional Connectivity (FY 2000 Initiative) ***(EGS)***	**P** Extend the DNR network to collocated offices and larger state parks	$402	$282	$282	$282
Sub-Regional Connectivity (FY 2002 Reallocation) ***(EGS)***	**P** Extend the DNR network to additional collocated offices and larger state parks		$390	$280	$280
Regional Network Upgrade ***(EGS)***	**P** Upgrade the DNR computer network to offer more capacity for data communications **P** transfer management of the DNR network to the MIS Bureau so that cost discrepancies between regions will be spread evenly over the entire department			$325	$300
Network Repair and Betterment	**P** Put Central Office and regional network equipment (servers, communications, test and diagnostic equipment) on a replacement cycle **P** Put Central Office and regional GIS equipment (servers, workstations) on a replacement cycle **P** Complete Central Office wiring upgrade to Ethernet			$940	$900
Regional Office Technology Upgrade	**P** Update office electronics (fax machines, scanners, copier/printers, etc.) with new, more cost effective technologies			$300	$300
Security and Firewall	**P** Increase the security on the DNR network to prevent unauthorized access to restricted data, while freely sharing public information			$280	$220

Major DNR Realization Projects and Costs for the Current and Next Three Budget Cycles					
Project Name	**Description**	**Costs by Biennium ($000's)**			
		2000-2001	**2002-2003**	**2004-2005**	**2006-2007**
Insurance for Computer Hardware	**P** Purchase insurance policy for computer equipment at DNR (valued at $4 million in network equipment and $2.5 million in PCs) to cover casualty loss against fire, flood, theft, etc.			$80	$80
Disaster Recovery	**P** Develop off-site backup storage, mirrored disk arrays, emergency hardware facilities			$250	$250
Emergency Management and Assistance	**P** A basic set of GIS tools is already available through the multi-agency emergency cooperative, MNICS (Minnesota Incident Command System), and its MIFC (Minnesota Interagency Fire Center) facility. This initiative would build upon the existing tool-set by: **R** improving and expanding its on-line data resources **R** providing more and higher power computers with larger data storage capability **R** providing GPS capabilities **R** establishing Internet tools **R** providing additional tools for producing maps and related products			$90	
Regional / Central Office Phone System	**P** Install an integrated DNR telephone system for Central Office and regions using up-to-date technology and industry standard equipment that can integrate voice, data, and, potentially, video communications			$650	
Prototype Labs	**P** Establish a facility where DNR staff can test and debug new hardware, software, and network tools in an environment that is separate from the active network where DNR's day-to-day work takes place			$300	$200
Smart Conference Rooms	**P** Develop facilities to enable video conferencing among Regional and Central Offices			$550	$150
Subtotals, Network / Hardware Infrastructure		$402	$672	$4,327	$2,962

Major DNR Realization Projects and Costs for the Current and Next Three Budget Cycles					
Project Name	**Description**	**Costs by Biennium ($000's)**			
		2000-2001	**2002-2003**	**2004-2005**	**2006-2007**
Software Tools Infrastructure					
Oracle 8 Implementa-tion (FY 2000 Initiative)	**P** The department has chosen to adopt a single standard for database engine and platform to increase accessibility of the information we have, reduce operating costs, reduce implementation costs, develop an integrated information system environment. This provides two Oracle FTEs plus $50,000 for development tools. (Oracle licenses, beyond the 55 already purchased, to be purchased by development projects as needed.)	$374	$162	$162	$162
Oracle 8i – Infrastructure Support	**P** Renew end user licenses **P** Provide software upgrades and technical support		$100	$100	$100
Spatial Database Engine (FY 2000 Initiative)	**P** Improves access and storage of existing and new GIS information. This is the current standard used by LMIC and MNDOT. Is also being adopted as state standard by other state agencies. Links GIS and non-GIS information systems. Makes GIS information and tools more accessible to a wider group of users in the department.	$100	$20	$20	$20
GIS Software and License Management	**P** Bring order and organization into the way DNR manages (purchases, maintains, upgrades, and distributes) its GIS licenses for software products such as ARC/Info, ArcView, EPPL7 and EPIC, and for UNIX workstation and other shared hardware products			$240	$240
Subtotals, Software Tools Infrastructure		$474	$282	$522	$522

Major DNR Realization Projects and Costs for the Current and Next Three Budget Cycles					
Project Name	**Description**	**Costs by Biennium ($000's)**			
		2000-2001	**2002-2003**	**2004-2005**	**2006-2007**
IT Staff					
Software Engineering Services – Phase 1 (FY 2002 Reallocation)	**P** **F.Y. 2002:** **R** **New Staff (4 FTEs):** – 1 Systems Analyst – 1 Software Engineer – 1 Oracle Financials Developer – 1 Database Administrator **R** **Projects:** – Design and begin development of the Revenue Management system ***(EGS)*** – Reserve $400,000 for existing consultants to accelerate the completion of the FORIST system **P** **F.Y. 2003:** **R** **Projects:** – Complete development and implementation of the Revenue Management system ***(EGS)*** – Design and develop the Revenue Management system's interfaces to the FORIST and Parks Campground Management systems ***(EGS)*** – Reserve $400,000 for existing consultants to complete the FORIST system **P** **F.Y. 2004-2005** **R** **New Staff (4 FTEs):** – 1 Senior Project Manager – 3 Software Engineers **R** **Projects:** – Design, develop, and implement the State Land Records system – Have capability within DNR to develop and maintain additional systems as they are prioritized		$950	$950	$950

Major DNR Realization Projects and Costs for the Current and Next Three Budget Cycles					
Project Name	**Description**	**Costs by Biennium ($000's)**			
		2000-2001	**2002-2003**	**2004-2005**	**2006-2007**
Software Engineering Services – Phase 2	**P** New staff (10 FTEs): **R** 1 Systems Engineering Supervisor **R** 1 Project Manager **R** 2 Systems Analysts **R** 2 Software Engineers **R** 1 E-Commerce Analyst **R** 1 Database Administrator **R** 1 Technical Writer **R** 1 Records Management Specialist				$2,000
GIS Services	**P** New Staff (9 FTEs): **R** 1 Special Project Support **R** 1 Emergency Management GIS Specialist **R** 1 Data Acquisition Specialist **R** 6 Regional GIS Technicians, or 6 * 2 students			$1,800	$1,800
Network Services (FY 2000 Initiative)	**P** New Staff (2 FTEs): **R** Regional LAN Supervisor **R** Regional LAN Administrator, Grand Rapids	$324	$324	$324	$324
Network Services	**P** New Staff (5 FTEs): **R** 2 Network Support - Area Offices (North Shore and Bemidji) **R** 1 Backroom Support (WAN and GroupWise) **R** 2 Telephony (1 video/voice/data, 1 Central Office phone system)			$1,000	$1,000
Project Management Training	**P** Provide project management and systems engineering training for MIS and business unit project managers and systems analysts	$9,000	$8,000	$2,225	$2,150
Subtotals, IT Staff		$9,324	$9,274	$6,299	$8,224
GRAND TOTALS		$10,200	$10,228	$11,148	$11,708

PROJECT PRIORITIZATION FRAMEWORK[6]

As the department moves to create a core software engineering capability, a decision-making framework will be implemented to establish application development priorities. While most will agree that project priorities should be decided based on "business value", there is a challenge in defining business value because it often differs among business units. Within this decision making-framework, projects will be prioritized from a department perspective by comparing costs, benefits, and risks in a consistent way with clear criteria defined by the Commissioner's Office, the CIO, and senior managers, following these steps:

1. ***Gather information***. Use tools such as a cost benefit analysis to define project value in business terms. Identify risks – business, resource, and technical risks – as inhibitors to proceeding with the project.

2. ***Apply weighted criteria***. Define specific weights for specific benefits, costs, and risks. Weights of criteria will change as business goals shift. Top management creates a scorecard comparison of decision criteria so that project priority derives from a consistent formula understood by all involved. After the results of the scoring are known, competing project sponsors will have a clear understanding of why projects have been approved, denied, delayed, partially funded, or canceled.

3. ***Compare the project with others competing for resources***. Be aware that adding new top priority projects that draw from existing resources and force re-prioritization of projects in flight often causes the projects put on hold to fail. Use a triage matrix such as this to compare:

	URGENT	NOT AS URGENT
IMPORTANT	1 do all of these	2 do most of these
NOT AS IMPORTANT	3 do some of these	4 probably not done

1 - If not done now, will never do

2 - If not done now, critical later

3 - We can muddle through

4 - If never done, no one will notice

4. ***Schedule the project***. Project scheduling may be constrained by a necessary sequencing of projects, and will depend on the availability of key resources.

5. ***Continuously validate the portfolio***. Continuous evaluation of projects against one another and against strategic business goals is imperative. Become comfortable with canceling likely failures well before they consume resources to a degree beyond their likely return.

There is a high probability that a list of priority projects resulting from the use of this decision-making framework will be endorsed by the department. The list will be invaluable in managing customer expectations and essential in determining resource allocation.

[6] Gartner Research Note (11 July 2000) C. Natale, M. Light, " Prioritize Projects Strategically or Suffer the Consequences."

REALIZATION PROJECTS FY 2002-2003

Project 1: Sub-Regional Connectivity

Information Resource Realization Plan	
Agency	Dept. of Natural Resources
Project Name	**Sub-Regional Connectivity**
Date of plan	June 1999; revised September 2000
Project description	Collocated offices and larger state parks need to share computer resources and information within the offices. They also need to access DNR information and systems located at other locations as well as access non-DNR systems. This initiative intends to accomplish these goals by extending the DNR network to these offices and providing local area networks within these offices. Extending the network to these field offices will be done in collaboration with counties, local communities, and other state agencies. Funding in this biennium will complete the installation of the DNR network and provide funding for ongoing operation of the DNR network in field offices.
Benefit description	This project will speed information dissemination, improve data sharing within DNR, and increase customer service by providing access to information about DNR programs and the resources of the state.
Start	July 1, 2001 (continuation of project funded in FY 2000)
End	Purchase and installation, June 30, 2002. Operational costs of $140,000 will continue into future years.

Financials					
Biennium	**2002-03**	**+2**	**+4**	**+6**	**Total**
Cost ($)	390	280	280	280	1230
Benefit ($)					0
Net ($)	0	0	0	0	0

Mini Project Definition	
Intentions	**P** Develop infrastructure to support collaboration, coordination, communication, information sharing **P** Provide ready access to information and communication channels for field employees **P** Provide for sharing of computer resources and information within field offices
Values	**P** Better to plan for needed technology changes, rather than letting them happen to us **P** The DNR values people over technology **P** Better to share than to duplicate (provides greater effectiveness and efficiency) **P** Work with communities for sustainable development

Focus	Breadth P Including co-located field offices and larger state parks P Including WAN connections to offices and LAN servers and connections within offices Perspectives P Field office staff P Regional managers Depth P Great detail – sufficient to implement a solution Universality Problem set: P Organization-wide, not division-centric P Industry and state agency accepted tools and methods Deployment: P Statewide Time Frame P Stable: 3-5 years P Extensible: 5-10 years Scope of Integration P Connecting Minnesota project – MN Depts. of Administration and Transportation P County Collaboration project
Context	Assumptions P Continued growth of the Internet Risks P Availability and retention of staff P Willingness of legislature to give dollars to technology, not directly to resources Obstacles P Contention for bandwidth Opportunities P Potential for sharing of bandwidth with other agencies and units of government

Mini Project Plan, 2002-2003 Biennium						
		Costs ($)			Dates	
Task	**Resource**	**Time**	**Rate**	**Fixed**	**Start**	**End**
Select site	Regional staff				7/1999	1/2000
Purchase equipment	MIS staff Vendors			150,000	7/2001	12/2001
Install data lines	Vendor			15,000	10/2001	5/2002
Install equipment	MIS staff			20,000	10/2001	6/2002
Train users	MIS staff			5,000	10/2001	6/2002
Production operation of completed sites during installation period				60,000	10/2001	6/2002
Production operation, ongoing	DNR staff			140,000 per year	7/2002	ongoing
Totals		**0**	**0**	**390,000**		

Project 2: Software Engineering Services

Information Resource Realization Plan	
Agency	Dept. of Natural Resources
Project Name	**Software Engineering Services**
Date of plan	September 2000
Project description	P The DNR will hire four full-time Information Technology Specialists – one systems analyst, one software engineer, one Oracle Financials developer, and one database administrator – in F.Y. 2002. P $400,000 in capital funds will be provided in each of the fiscals years 2002 and 2003 in order to allow existing consultants to accelerate the completion of FORIST, an integrated forest management system. P The DNR will hire four additional full-time Information Technology Specialists – one senior project manager and three software engineers – in F.Y. 2004.
Benefit description	During F.Y. 2002 and 2003, these personnel resources will be used to accomplish the following: P The in-house Information Technology Specialists will design, develop, and implement a single, department-wide, integrated Revenue Management system to streamline the collection and tracking of revenues for the large variety of DNR sales transactions. They will also develop interfaces between this system and 1) a Forest Management system under development, as well as 2) a Campground Management system now being deployed to State Parks. P The IT consultants now developing the first (Forest Inventory) module of an integrated Forest Management system will accelerate the completion of the system by developing and deploying the second (Timber Sales) and third (Forest Protection) modules. During F.Y. 2004 and 2005, the four newly-hired Information Technology Specialists, along with the four hired in F.Y. 2002, will P design, develop, and deploy an integrated State Land Records system; and P begin to work on additional database and application development projects, identified in the DNR Strategic Information Resource Management Plan, as they are prioritized.
Start	July 1, 2001
End	June 30, 2005 Annual operational costs of $950,000 will continue into future years.

Financials					
Biennium	2002-03	+2	+4	+6	Total
Cost ($)	1,900,000	1,900,000	1,900,000	1,900,000	7,600,000
Benefit ($)					0
Net ($)	0	0	0	0	0

Mini Project Definition	
Intentions	**P** Integrated data **P** Integration of tabular and geographic information **P** Aimed at developing integrated information system to replace older standalone systems **P** Integrated approaches to managing resources **P** Accelerated collection, interpretation, and dissemination of scientific information **P** Query ability for making management decisions **P** Efficient and effective operation of business **P** Elimination of manual systems **P** Better customer service **P** Improved cash management **P** Improved document and forms management **P** Improved employee computer skills
Values	**P** Better to have Department-level integrated information systems than standalone expert data systems **P** Better to share than to duplicate (provides greater effectiveness and efficiency)

Focus	Breadth Including P Integrated applications P Applications that benefit multiple units (e.g., Land Ownership Database) P Applications that tie units together (e.g., DNR Revenue System) P Resource and administrative systems Excluding P Standalone application P Single-unit applications P Individual or unit-specific expert systems Perspective P Senior Managers P Operations Managers P Information Management Team P Chief Information Officer P The entire DNR, through the above representatives Depth P Great detail – sufficient to implement a solution Universality Problem set P Organization-wide, not Division-centric Deployment P Statewide Time frames P Stable: 5 years P Extensible: 10 years Scope of Integration P Intertechnologies Group P Dept. of Public Safety (Drivers License database) P Dept. of Human Services (delinquent child support data) P Office of Technology P Dept. of Finance P State Treasurer P MAPS, SEMA4, IA Data Warehouse P Dept. of Revenue (Tax Refunds) P County Auditors P Statewide data standards

Context	Assumptions P Continued growth of the Internet Risks P Availability and retention of staff P Willingness of legislature to give dollars to technology, not directly to resources P Operating system environment – NT vs. Unix P Development environment – 32- vs. 64-bit Obstacles P Organizational trust in the central IS unit P Competition for dollars with resource projects P Lack of knowledge in Senior Managers about technology P Perception that technology costs too much P Contention for bandwidth Opportunities P Commissioner's Office support for consolidated IT staffing and efforts

Mini Project Plan, F.Y. 2002-2005						
Task	**Resource**	**Costs ($)**			**Dates**	
		Time	**Rate**	**Fixed**	**Start**	**End**
Hire 4, support 4 for one year	Data & Apps Mgr.			400,000	7/2001	6/2002
Purchase development tools	Data & Apps Mgr.			150,000	7/2001	
Design and begin development of Revenue Management system	4 MIS staff				7/2001	6/2002
Design, develop, and implement FORIST Timber Sales module	consultants			400,000	7/2001	6/2002
Support 4 for one year	Data & Apps Mgr.			400,000	7/2002	6/2003
Purchase development tools	Data & Apps Mgr.			150,000	7/2002	
Complete Revenue Management system development and implement	4 MIS staff				7/2002	6/2003
Design, develop, and implement FORIST Forest Protection module	consultants			400,000	7/2002	6/2003
Hire 4, support 8 for two years	Data & Apps Mgr.			1,600,000	7/2003	6/2005
Purchase development tools	Data & Apps Mgr.			150,000	7/2003	
Design, develop, and implement State Land Records system, work on other development projects	8 MIS staff				7/2003	6/2005
Purchase development tools	Data & Apps Mgr.			150,000	7/2004	
Totals		**0**	**0**	**3,800,000**		