SHARING INFORMATION TO IMPROVE DECISIONS

EXAMPLES OF BENEFITS AND COST AVOIDANCE

"...you cannot fix what you can not see."[1]

PREPARED FOR THE EXECUTIVE SUMMIT

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INTRODUCTION

This paper documents snapshots and case studies of information management projects and programs that quantify benefits from improved information collection, management and sharing or show how costs could have been avoided if different, yet known, information management practices had been followed.

The examples here have been put together to support a planned Northwest Region Executive Summit - focused on developing an understanding of changes needed to improve environmental information – from collection through analysis.

In planning for the workshop the primary sponsors: the Northwest Environmental Data Network (NED); the Pacific Northwest Aquatic Monitoring Partnership (PNAMP); and the Pacific Northwest Regional Geographic Information Council (PNW-RGIC), met in January 2007. At the meeting it was agreed that a business case showing benefits from regional information management should be developed, and that these groups needed to join together to bring their concerns to regional executives.

NED, PNAMP and PNW-RGIC Steering Committee members agreed to collaborate to advance this task.

What are the Information Management Challenges?

Environmental problems are significant and costly. Loss of habitat, loss of production from managed systems, increased frequency and severity of natural events, especially floods and fires, loss of naturally occurring diversity, increases in impacts from humans, reduced water quality, increased listings of threatened and endangered species, and disturbing climate change all challenge our organization, budget, and decision-making abilities.

They also expose many unmet information needs. What are the ecosystem consequences of these impacts and what are the best solutions? What regulatory or other responses are needed to satisfy legal mandates? What are the economic impacts of these changes and needed actions? What level of monitoring is needed to provide scientific and management certainty? How effective are the solutions?

These answers are far from trivial and are inherently difficult to answer because the causes and consequences cross organizational and administrative boundaries. Local, Tribal, State, National

and Public interests can all be affected across river-basins and larger regional scales. For the most part, the governmental and private entities have separate information systems, with different rules, standards, and operating procedures.

Improving our collective ability to share and exchange information at a regional scale will require a regional administrative and organizational solution – to address the technical and other issues. Unfortunately, a regional scale organizational and administrative solution is not in place.

For many needed decisions, just getting all the information so we can use it to take our best shot at fixing problems is daunting. Many problems involve multiple stakeholders who cannot see and share all the information. One example is the information needed to recover salmon populations, another is the information needed to manage and recover from natural disasters. Without more decision-making certainty, we are effectively mandated to operate conservatively, so the most promising solutions may be beyond our decision making grasp – at least without improved information when we need it.

Many have concluded through independent studies, workshops, or everyday reasoning, that we should all be able to do a better job of sharing the information that we already have and a better job of collaborating to collect the new information that we need. They have concluded that this would result in more efficient and better use of public and other resources.

This paper identifies many such efforts and regional scale studies within the Pacific Northwest that have returned similar findings.[2] In addition, there are other efforts not highlighted here, including international efforts. For example, in 2004 the United States signed a Global Earth Observation System Agreement to work on global data sharing across 47 Nations - "Dozens of observation systems are now generating reams of data that could be far more powerful if they were combined and widely disseminated".[3] The Northwest Environmental Data Network has summarized "Lessons Learned" from its efforts and the experiences. These lessons are summarized in the table below with some suggested solutions.

This paper provides examples of benefits that have been realized through investments in information system improvements. The authors completed this task by completing internet and other searches and by asking colleagues and others for documents that quantified costs and benefits from improved information sharing or related information management tasks.

Lesson Learned	Suggested Solution
Data quality is compromised and the cost of management rises if it is created before a plan exists for how it will be maintained and shared	Require a data management plan before undertaking new data-creating projects
Data have value beyond their immediate use when they are integrated with other data sets	Each data-creating activity should follow a core set of standards to facilitate regional sharing and integration
Effective information management requires an ongoing effort and is not an episodic task	Provide services to maintain regional information management and sharing and assist local stakeholders
Consistent data management practices require policy-level support	Develop a basic MOA on information management practices essential for regional management and sharing
Data management practices have a direct effect on the usefulness of data collected and how it is shared	Adopt data standards and protocols for data collection and sharing of information
Scientist will generate data in formats that meet their needs	Data systems need to be flexible and accommodating; scientists need to adopt minimum data standards, study designs can be recommended that satisfy local needs as well as regional needs
Data needs to be shared and to do so is time consuming; data are often not compatible	Data exchange formats need to be designed collaboratively and standards employed when possible
Difficulty in understanding spatial and tabular data when transferred to others	Require mandatory metadata for spatial and tabular data
Technology will continue to evolve	Data systems should be reliable, well-maintained, dynamic and modular to permit future modifications
Data management schema need both distributed and warehouse approaches	Identify and support key data management projects: regional data warehouses or repositories and projects that provide data support services directly to providers
Scientists who want to publish data may delay its immediate use	Develop and adopt clear data reporting and sharing policies
Quality and reliability of the data are often unknown	Establish Quality Assurance/Quality Control protocols
Data management requires iterative improvements	To improve regional data management: evaluate and enhance existing projects and fill gaps with pilot or new projects

EXECUTIVE SUMMARY

Environmental problems are significant and costly. Loss of habitat, loss of production from managed systems, increased frequency and severity of natural events, especially floods and fires, loss of naturally occurring diversity, increases in impacts from and to humans, reduced water quality, increased listings of threatened and endangered species, and disturbing climate change all challenge our organization, budget, and decision-making abilities.

They also expose some unmet information needs. What are the ecosystem consequences of these impacts and what are the best solutions? What regulatory or other responses are needed to satisfy legal mandates? What are the economic impacts of these changes and needed actions? What level of monitoring is needed to provide scientific and management certainty? How effective are the solutions?

This paper shows that there are significant documented benefits from information management and technology sharing. For example:

- The EPA reported Return On Investment (ROI) from Exchange Network Projects ranging from 15 to 62% with payback periods from 1.6 to 6.9 years.
- The Upper Columbia Regional Technical Team identified direct cost savings of approximately $500K and improved return on existing and future investments through greater use of exiting data, a central data storage system, and common collection and quality control procedures.
- The Minnesota Department of Natural Resources Lake Survey Project saves thousands of work hours and over $216,000 annually, ensures better quality data, and allows easier sharing with the public.
- The National States Geographic Information Council estimated that applying uniform standards and applying other improvements to imagery acquisition and processing saved $160 million per three-year cycle, an ROI of 19%.
- The Federal Drug Administration reported savings of $10 million over a $200 million dollar IT budget using an enterprise solution.
- The state of Oregon predicts staff annual savings of more than $80 million for state agencies, at least $100 million savings for city and county governments throughout the state, and actual cost savings and revenue enhancement (increase) of well over $80 million over a 10-year period with a fully deployed GIS utility.

- The Department of Housing and Urban Development reported a $12 million dollar return from a $9 million dollar investment.
- An Illinois mapping consortium of local utilities, IMAGIS, in 1992-93 showed over $24 million in business benefits for city, county and utility participants including over $7 million in cash return or cost prevention.
- Six "*Snapshots*" showed benefits from various geographic information system collaborative efforts ranging from $50,000 per year to $4 million per year.

The studies also identified practices and actions (lessons learned) that contributed to these business successes. The chance of information management success is improved when:

- an enterprise or framework approach is adopted;
- planning prevents avoidable costs;
- there is a connection between these improvements and the business benefit;
- organizational and administrative arrangements are in place; and,
- there is strong executive support.

SNAPSHOTS

Benefits from Sharing Information or Cost Avoidance[4]

Cost Avoidance through Web Sharing

The County of Riverside, California, avoided staff costs of $4 million per year by providing developers, engineers, and consultants with development information via the web. For example, an environmental hazards map was provided.

Delivering Accurate Information on the Fly and Saving Money

Remote sensing data (LIDAR) saved Richland County, South Carolina, $140,000 by avoiding a field survey for elevation, slope and drainage.

Keystone to e-Government Strategy

The cost savings realized through this "build once, use many times" portal application is exactly the vision of the OMB's e-government initiatives. This was based on a federal mandate for improved efficiencies and cost savings.

Mapping Municipal Accountability

City of Baltimore introduced a real-time performance measurement and accountability system resulting in $70,000 in savings over 3 years. "Baltimore replaced a culture of delay and avoidance with a culture of accountability and results…".

County Monitors False Alarms, Raises Revenue and Reduces Costs

Charles County, Maryland, is saving more than $1.3 million per year with an automated alarm registration system. Revenue has also increased $250,000 per year.

Automated Addressing Saves Money

Automation of data feeds to a customer information system saves CenterPoint Energy, Houston, Texas, $50,000 per year.

CASE STUDIES

Lake Survey Project

Minnesota Department of Natural Resources

Minnesota's Department of Natural Resources (MN DNR) developed and implemented a robust mobile Fisheries Lake Survey system. This new system saves thousands of work hours and over $216,000 annually, ensures better quality data, and allows easier sharing with the public.

Documented accomplishments include:

- **Estimated cost benefits from implementing this application are $216,170 each year.** This was accomplished by eliminating redundant data entry from paper forms and eliminating data cleaning and consolidation; with additional savings in training, updated version distribution, and reporting.
- Eliminated 27 separate lake survey databases and weeks of data consolidation annually.
- Ensured better data quality by providing validation when the fish is still in-hand.
- Shortened data entry learning curve; eliminated need to memorize dozens of 3 digit codes.
- Improved research possibilities for their research biologists and other agencies as well.
- Added hardware flexibility; runs on any hardware device with a Java-compatible OS.
- Allows for meeting future business needs because of the modular data structure.

MN DNR now uses rugged tablets in its survey boats and validates data entry with fish in-hand to eliminate redundant data entry and reduce errors. The previous survey system required handwriting information onto paper forms and then typing the same information in offices across Minnesota. Dozens of Fisheries Area databases were methodically analyzed for errors and consolidated in a process that took months every year. The new data system now captures more valid data with less effort and provides quicker analysis reports and public information.

Additional innovative uses of technology with this system include: designing the application to work on any hardware platform that runs Java, using open source software on the tablet PCs to cut license costs, using the same data entry screens in the office and on the lake, automated delivery of updated drop-down menu lists, customizable short lists of drop-down menus, and reference links to geographic information allowing spatial mapping of fisheries data.

This Java client Lake Survey application is delivered to rugged tablets and desktop workstations over the Internet and provides statewide access to a single database and reports over the DNR intranet. Data captured, stored, and analyzed by this system includes current and historic physical, chemical, and biological information regarding habitat, water quality, and fish population characteristics. This information is used to manage Minnesota's fisheries.

The system components and capabilities include:

- Single state-of-the-art database accessed via the Internet.
- Entry validation on a rugged tablet PC in the boat.
- Intuitive screens with drop-down value selections.
- Rapid and flexible reporting once the data are uploaded.
- Integrated Age and Growth analysis and reporting.
- Improved connectivity with other databases enabled by common data formats.
- Automatic software updates deployed via the Internet.

Department of Housing and Urban Development

An article in Federal Computer Week, May 2, 2005[5], reported from Dick Burk, Office of Management and Budget's Chief Information architect,

> "Enterprise architects in the Department of Housing and Urban Development modernized systems underpinning the mortgage insurance line of business and reduced the number of systems by 80 percent. The effort cost $9 million in development, modernization and enhancement dollars but reduced the total cost of ownership by $12 million...Those systems increased the number of loans per day, identified faster mortgage lenders discriminating against customers or making bad loans, and made it easier to prevent fraud...Those were issues critical to the program office...Mission performance is the bottom line."

National Institutes of Health

The National Institutes of Health (NIH) identified 6 benefits from the use of enterprise architecture approaches:

- Links information technology (IT) to the mission of NIH,
- Improves interoperability and integration (including making information available whenever and wherever needed),
- Enables agility,
- Reduces costs,
- Improves security, and
- Reduces technical risks.

Food and Drug Administration

The Food and Drug Administration was able to realize direct IT savings of $10 million from an IT Budget of $200 million by adopting an enterprise planning approach.

Across Federal Agencies

The Results of FY 2007 Federal Enterprise Architecture Assessment shows that:

> "…the majority of agencies (19 out of 24) were also able to demonstrate they are realizing IT cost savings, cost avoidance, and/or satisfactory program performance…"

INFORMATION TECHNOLOGY INVESTMENTS BASED ON ENTERPRISE ARCHITECTURE *EFFECTIVE AND BETTER INVESTMENTS*

National Association of State Chief Information Officers

Information investment decisions are not easy to make and many seem like lose/lose decisions

For example, executives or managers may want to solve a business problem by collecting more information in the hope that the problem will be solved with the latest data, or perhaps by investing in new IT, to access existing data faster. What is the right decision? The use of Enterprise Architecture can help to inform these decisions.

In their Research Brief[6], the National Association of State Chief Information Officers reported that state and local governments were expected to invest an estimated $48 billion dollars in information technology (IT) in 2005. It is the biggest information management cost and spending was anticipated to increase by 48.5% to $70 billion by fiscal year 2010.

The brief also recommended the benefits of Enterprise Architecture (EA) to "blue print" information investment decisions. The brief shows how Enterprise Architecture can be used to improve state IT procurement. Through a closer alignment of IT procurement and EA it would be possible to:

- Enhance the role of government as a steward and wise-investor of taxpayer dollars
- Increase the efficiency and effectiveness of IT service delivery, and
- Simplify and streamline the IT investment and contracting process.

IT procurement is just one part of information management, albeit the most expensive. The authors concluded that increased value from IT investments can be realized by using Enterprise Architecture to guide IT decisions which translates into more efficient government processes and services which ultimately improve the ability of government to serve its citizens.

DATA MANAGEMENT PLANNING IMPROVES USE OF COLLECTED DATA

USDA Forest Service

The USDA Forest Service was involved in coordinating the collection of significant data sets for the Northwest Forest Plan across multiple agencies and programs. The service spent (internally) around $130,000 to aggregate one needed information component - an estimate of the extent of road construction and decommissioning where the data existed but was not already organized. This estimate did not include the cost of aggregating vegetation, intermittent streams, land use, culverts, ground disturbing activities and many other data sets. The lack of a comprehensive interagency plan prevented many data sets from being collected.[7]
The task of estimating costs and benefits is not easy, and it is difficult to even estimate potential efficiencies with seven resource analysis topics across eight federal agencies with 25 million acres of land in three states. The burden for inter-operability is substantial. Information for the Forest Plan came from 19 Forest Service and six Bureau of Land Management units (each with an average of three sub-units), the states of Oregon, Washington, and California (each with a total of a dozen or so counties), and 76 Tribes. The Regional Ecosystem Office GIS shop had three people working for 10 years at about $100,000 per person, per year – about $3 million, a total cost that did not include the other agencies and units.

Data aggregation for "ground disturbing activities" is an example of where all (approx. 75) units in the plan area had between two and five people creating the relevant data. However, it was not created in a standard format and could not be compiled.

Considerable investments in data collection from the effort were not usable because it couldn't be compiled due to integration barriers. The data could have been used if the issue or integration barrier was solved ahead of collection efforts. The barriers, in order of importance are data: Existence; Accessibility; Consistency (standardization); Compilation; Maintenance; and Documentation.

SHARING PROVIDES COST SAVINGS AND IMPROVES PRODUCTS

Indianapolis Mapping and Geographic Infrastructure System Consortium

In the mid 1980's, 28 agencies across three Indianapolis Counties were spending nearly $9 million per year in map related activities. These groups formed the Indianapolis Mapping and Geographic Infrastructure System (IMAGIS) consortium to share the costs and benefits of shared GIS resources. A City-County Council consortium was formed, with the highest executive of each organization as the directorate and with a technical committee to make recommendations to the Board. Both meet monthly.

The cost for hardware, software conversion and staff was $7.2 million for the first 4 years. Ongoing costs averaged about $400,000 for day to day operations, data integrity, hardware and software maintenance, data updates and coordination between participants. The data sharing arrangements have been working for 20 years and include a "Participants' Service Agreement".

"A good GIS is an error finding machine…..for example comparing billing systems to geography always finds unbilled customers".

In 2004, IndyGIS compared solid waste customers to the IMAGIS aerial photos, and found over $300,000 in uncollected annual fees for Department of Public Works. Ten years ago, a study of the sewer billing system found over $1,000,000 per year in unpaid bills to Department of Public Works.

A study done for IMAGIS in 1992-93 showed over $24 million in business benefits for city, county, and utility participants, including over $7 million in cash return or cost prevention. IMAGIS considers that similar benefits continue to this day.[8]

SUB-BASIN PLANNING - AVOID COSTS WITH UPFRONT DATA MANAGEMENT PLANNING

Northwest Power and Conservation Council

The Northwest Power and Conservation Council (NPCC) provided local watershed groups with approximately $15 million to collect and manage information for subbasin planning and develop plans. When the funding was made available a data management plan to require standard reporting or to maintain each data set was not in place to maintain the data across all subbasins.

An after-the-event effort to collect and archive the fish and aquatic habitat data was completed to try to protect the value of the $15 million data collection investment. Contracts and in-kind efforts to collect and archive the data cost $251,000. Even with this effort, not all data was able to be recovered. About 90% was recovered where local planners used Ecosystem Diagnosis and Treatment or QHA tools . In other areas recovery was probably less than 50%.

Information recovery difficulty was compounded by basic problems with data documentation. For example, plans did not always reference the data sets they relied on so it was not possible to work backwards. In other cases, data were no longer accessible or were stored in such a way that they could not be separated.

Terrestrial data sets had similar problems and challenges. It is estimated that of 56 Sub-basins, information is available only for approximately 25. In practice this means that only about 35-40% of wildlife information is currently available and useful.

The main lesson is that planning for data capture and management should have been completed before information collection. Data management planning saves time and money and the data can be used for other purposes once it has been collected and carefully documented.

DATA MANAGEMENT PLANNING AVOIDS COSTS

National Biological Information Infrastructure

Sain Roan Mountain: this study[9] carefully documents the challenge of bringing together collected priority legacy data sets for a critical natural resource area. The study includes quantitative measures of the time and effort spent to compile the information. Besides describing problems associated with data management the cost information shows the importance of proper planning and data management from the outset of an initiative.

For this project, researchers spent 3,564 hours and incurred direct costs of $68,392 (plus in-kind costs) to assemble the legacy data sets. These costs were avoidable if standard yet basic data collection and management practices had been followed – in particular the creation of metadata records and the placement of data within viable data repositories.

SIGNIFICANT CROSS AGENCY AND REGIONAL COST SAVINGS WITH NATIONAL IMAGERY

National States Geographic Information Council

The National States Geographic Information Council (NSGIC) Imagery for the Nation (IFTN) program would offer all levels of government a first-ever, large-scale imagery program completely funded by the federal government. It has been adopted as a line item for consideration in the 2008 U.S. Geological Survey (USGS) federal budget.

USGS and U.S. Department of Agriculture (USDA) agreed to fund an in-depth cost benefit analysis for IFTN, a critical step to having it seriously considered for federal funds and a strong indicator that federal agencies see great value in the program

The USDA's existing National Agricultural Imagery Program will be responsible for annually providing 1-meter orthophoto imagery over all states except Alaska. The USGS will administer a companion program for Alaska that will provide 1-meter orthos every five years. The agency will also make 1-foot imagery available once every three years for all states east of the Mississippi River, and for all counties west of the Mississippi River with population densities greater than 25 people per square mile. (1-foot imagery is also being considered for the remaining areas of the Western states.)

IFTN is seen as a sustainable, consistent, and flexible spatial program that will provide the needed resources to help mobilize local and state governments to better coordinate their own countywide — or ideally, statewide — imagery programs.

Under the proposed IFTN, users will have access to 1-foot imagery such as this. Produced by EarthData and provided by the Maryland Department of Natural Resources, this image was taken shortly after an F4 tornado struck Charles County in Southern Maryland.

Using "buy-up" options in the IFTN, government agencies can fund the cost of acquiring and producing 6-inch-resolution imagery. This false-color infrared image of Miami, Florida, was produced by Sanborn..

At present, the NSGIC and National Digital Orthophotography Program estimate that the IFTN will cost $111 million a year, which covers imagery acquisition and processing costs, contract management, quality control, quality assurance, data distribution, and archiving. Nationally, that equates to an estimated $160 million savings per three-year cycle, a benefit largely attributed to IFTN's ability to contract for larger areas, reduce duplicate programs, eliminate certain overhead costs, and provide a return on investment of approximately 19 percent by applying uniform standards. The NSGIC expects the results of the USGS and USDA's cost-benefit analysis, which is due in June 2007, to refine the current cost estimates.

SOME JUNK DATA IS ANOTHER RESEARCHER'S TREASURE

National Aeronautics and Space Administration

Gavin Schmidt[10] is a climate researcher at the NASA Goddard Institute for Space Studies, a regular contributor to *RealClimate*, and an expert in gathering information about *isotope ratios* from all sources. He offers this view on the importance of data sharing:

"All over the world, data gathered by environmental researchers is gathering dust on 8 inch computer tapes, on 5 inch floppies and in decaying notebooks forgotten at the back of never-again-to-be-opened cabinets. These data, most often paid for by taxpayers, didn't necessarily make it into the publication, was perhaps thought uninteresting or was simply left behind when the investigator moved to a better-paid job in finance.

In my experience there are vast treasure stores of data sitting around laboratories that haven't ever been collated because it just didn't seem important, or it was something that one might eventually "get round to doing".

Environmental research today is complex and deals with a vast number of intertwined problems. It's so intertwined that data collected for one purpose may end up playing a key role in some quite unrelated field. Add to that the need for global data sets to compare with global models or remote-sensing information and it's clear that rescuing these individual pieces of information is more important than ever."

Gavin quietly points out what might ordinarily be obvious, that we are not wise enough or have enough vision to be able to predict how useful our data will be to others, when or for what reason. It is important then to make our data available beyond the initial purpose for which is was collected.

OREGON BUSINESS CASE – BENEFITS FOR THE STATE AND LOCAL GOVERNMENTS

State of Oregon

Public agencies and non-governmental organizations in Oregon depend on maps and geographical referenced information to support day-to-day operations and longer-term planning and decision-making.[11] But users experience limited access to important GIS information or the technology to use it. At least 80 percent of the information collected and managed by governmental bodies is geographic in nature—referencing location.
Some benefits of multi-jurisdictional geographic information management are:

- Information management can be more efficient and better coordinated;
- Organizations can more fully capitalize on past and current investments in GIS;
- Considerable redundancy and duplication in data collection, data maintenance, data storage, and system resources across and within organizations can be reduced;
- High-quality GIS data coverage that is incomplete and data quality that will not allow all broad-based user needs and citizen expectations to be met could be completed;
- Procedures, standards, and stewardship practices for effective maintenance of regional and local geographic data can be improved;
- Access to data and technology can be more consistent, with less regional disparity; and
- Opportunities for leveraging outside funds can be more fully explored and realized.

For a wide range of programs and projects, staff and program managers spend a considerable amount of time just gathering or pulling together information from a wide range of sources. Geographic information is hard to find, access, and integrate in a manner that makes it useful to those who need it, when they need it.

The problem is rooted largely in policy and organizational procedure and not, as commonly assumed, in technical hurdles. Administrative barriers, poorly defined management authority, problems in allocating and using available funding, and inadequate management controls have resulted in missed opportunities, duplication of resources and effort, and inconsistencies in data format and quality, which inhibit the use of valuable geographic data and complicate ongoing data maintenance processes.

Proposed Solution

The Oregon Geographic Information Council (OGIC) and the Information Resources Management Division (IRMD) propose the development of the Oregon Statewide GIS Utility to help solve these problems. The GIS Utility initiative will establish and maintain an administrative and operational structure to support effective creation, maintenance, sharing, and access to geographic information and it will do so in a way that supports the program needs of state agencies and the wider governmental and non-governmental communities throughout Oregon.

Its overall impact will be to reduce the cost and duplication of geographic information management while delivering tangible benefits to a large community of users statewide. The results of the analysis presented in this report confirm the short-term and long-term benefits of the GIS Utility and justify the investment in time and resources to initiate the program and bring the GIS Utility to a full operational status.

Benefits and Outcomes in Oregon

The proposed GIS Utility development case shows substantial, ongoing benefits for public agencies, private companies, and the general public. It documents a clear, long-term return on investment, as well as significant non-financial benefits that will improve operations, delivery of services, and the effectiveness of public agency programs at the state, regional, and local level.

- Staff efficiency/productivity increases which, when measured in monetary terms, can result in annual savings of more than $80 million for state agencies and at least $100 million for city and county governments throughout the state when the GIS Utility is fully deployed.
- Opportunities for actual cost savings and revenue enhancement (increase) of well over $80 million over a 10-year period.
- Greatly increased opportunities for securing outside funds for GIS development and related technology projects statewide.
- Tangible, non-financial benefits resulting in robust information security, improved quality of service, enhanced emergency preparedness and public safety, responsiveness to needs of Oregon citizens and businesses, and better management of the state's environment and infrastructure.

- Support for state-regional-local collaboration and the extension of information technology capabilities to currently underserved jurisdictions.
- Stimulus for economic and business development and public-private partnerships.

ENVIRONMENTAL INFORMATION EXCHANGE NETWORK RETURN ON INVESTMENT

US Environmental Protection Agency

The Exchange Network Return on Investment (ROI) and Business Process Analysis Project[12] was conducted to better understand the effects Exchange Network Technologies have on the quality and efficiency of environmental data exchanges for states, tribes and local agencies. A Return on Investment Model quantified the savings associated with the implementation of Exchange Network projects.

The Project Team selected five data flows to include in the ROI analysis. These flows are:

- Air Quality System (AQS)
- Resource Conservation and Recovery Act (RCRA)
- Safe Drinking Water Information System (SDWIS)
- Toxics Release Inventory (TRI)
- Electronic Discharge Monitoring Report (eDMR)

Four state agencies participated in the development of this study: the Michigan Department of Environmental Quality, the New Jersey Department of Environmental Protection, the Pennsylvania Department of Environmental Protection, and the Washington Department of Ecology. Each agency selected three to four data flows to be analyzed out of five total flows that were included in the ROI analysis. In the table below are the total results for multiple flows found at each state:

	Michigan	New Jersey	Pennsylvania	Washington
Data Flows Examined	**AQS eDMR SDWIS TRI**	**AQS RCRA SDWIS**	**AQS eDMR RCRA SDWIS**	**AQS RCRA TRI**
Total Annual Operational Cost Pre-EN ($/year)	$1,622,120	$1,266,519	$1,352,807	$311,560
Total Annual Operational Cost Post-EN ($/year)[1]	$834,407	$672,789	$710,181	$272,294
Initial Capital Investment ($)[2]	$1,095,940	$845,233	$1,002,390	$139,422
Post-EN Annual Maintenance Cost ($/yr)	$107,983	$75,831	$105,609	$19,014
Post-EN Annual State Savings ($/year)[3]	$679,730	$535,192	$537,017	$20,252
ROI Summary				
Average ROI (5 year basis)	62%	61%	54%	15%
Payback period (years)	1.6	1.6	1.9	6.9

"This table shows the total cost to operate all of the data flows implemented by each state (of the five that were included in this study) both before and after the implementation of Exchange Network technologies.

By dividing the net savings of the project by the initial investment, a Return on Investment percentage was determined. All states participating experienced a positive return on their investment in Exchange Network technologies to flow data. Implementation of additional data flows would likely improve these individual state ROI values."

EXPECTED BENEFITS OF INFORMATION SHARING AND EXCHANGE

Northwest Environmental Data Network

The Pacific Northwest's natural resource and environmental management agencies and inter-agency organizations recognize the value of information technology (IT) and information exchange.[13] However, environment and natural resources do not conveniently align with political and jurisdictional boundaries. Cross-boundary work requires ready access to information across those boundaries, systems and jurisdictions.

State and tribal departments, inter-governmental organizations, non-governmental organizations and federal agencies all broadly agree that the use of common data standards, data dictionaries and cross-walk tables and read/copy access to databases… information paid for almost entirely by public funding, can, would and does improve our control and protection of the environment and our management of natural resources.

How would this be accomplished?

Many of these departments, agencies and organizations have committed to advance the exchange of environmental information across the region. Commitment to information exchange is found in the Pacific Northwest's natural resource and environmental management program reviews and some interagency charters.[14] [15]

The Northwest Environmental Data network has completed assessments, strategies and plans showing the need for and value of an enterprise-level environmental information network including standards and protocols to support interoperability and distributed interconnected databases.[16]

The primary issues and challenges to expanding the information or data exchange network are institutional in nature rather than technological. Current information technology has proven its ability to locate access, transfer and present data with common data and IT vocabularies, languages, standards and procedures for the location, access, and transfer of data.

Our challenge is to move past our insular views and investments and to embrace changes in IT, information management, and local work flows that promote a greater good at system and enterprise levels. Case studies show that these approaches are cost effective.

Business Impacts and Benefits

Save Money/ Avoid Costs

Save Time

Increase Efficiency

Increase Accuracy

Increase Productivity

Increase Communication and Collaboration

Support Decision-making

Automate and Improve Work Flow

Expand and Enhance Information Bases

E-GOVERNMENT CASE STUDY[17]

State of Washington

A Business Portal Project Team in the State of Washington developed a case study for an information system portal. Approximately 85 businesses attended roundtable discussions over eight months. They told the Team they wanted:

- One place to go to understand all the requirements for state and local government.
- A consistent screen layout when they complete any type of transaction with any level of government.
- Online processes to apply for and renew their licenses and environmental permits.

Without a consolidated permitting process each environmental permit must be applied for separately. Three of the common environmental permits required much the same information during the application process. Complicated permit applications often caused errors and delays in processing. For example, 20 percent of the 6,400 Forest Practices Applications processed annually for the past two years were returned to the applicant at least once for additional information. Businesses wanted one efficient, consolidated process that is easy to understand in order to apply for all the permits needed to operate in cities, counties, and the state.

A major purpose of the Portal was to provide businesses with relevant requirements and services in one place to help them "get it right the first time". Higher accuracy up front would reduce wasted time and effort for businesses and government agencies. In addition, the Portal would reduce the need to access or understand multiple systems by delivering government information and processes to businesses through a single location.

This investment would build on the efforts initiated during the 2005-07 Biennium by developing:

- Streamlined business processes within and across state and local government
- Integration of systems and data between state and local agencies
- An online, consolidated service center to assist existing and prospective businesses to understand and fulfill their state and local regulatory requirements (licensing, permitting, taxation, filing of reports, etc.). This online service center

will provide a convenient, "one-stop" gateway to a variety of state and local government services and information sources.

These initiatives provided that state government entities must work together to streamline processes and make it simple for businesses to meet requirements so they can spend time operating successfully and staying in business. The Enterprise Business Portal is a central part of Washington's response to the concern businesses and citizens have about Washington's business climate.

WHY COORDINATION OF MONITORING AND DATA MANAGEMENT RESOURCES MAKES BUSINESS SENSE

Upper Columbia Regional Technical Team

Summary

The Upper Columbia Region is currently implementing many large programs that will increase the likelihood of salmon recovery. Large- and small-scale projects associated with salmon recovery are currently underway and information pertaining to the effectiveness of these projects is being collected. The Upper Columbia has already developed and begun implementing a coordinated monitoring strategy (Hillman 2004, 2006) that has made large improvements in standardizing monitoring protocols and indicators throughout the region.

During development of the monitoring strategy, the Upper Columbia Regional Technical Team (RTT) identified a need for coordinated management of monitoring data as part of the larger strategic plan for salmon recovery in the region. As part of the solution, a centralized, properly managed data repository and infrastructure are currently being developed. Along with this repository, the region is working to standardize protocols for compiling, storing, and analyzing information. These efforts will ensure that financial and natural resources are not wasted and general data access is assured.

Background

The salmon recovery plan, biological opinions for the federal hydro system, habitat conservation plans for local public utilities, and similar conservation efforts are being implemented. As such, information is being collected to monitor progress of implementing these complex programs.

To date, each entity that is implementing the above programs has determined protocols for collecting, storing, and analyzing data without a large amount of coordination between agencies. This has led in some cases to inefficiencies of labor, waste of money, and incompatibility of information between programs (if protocols or indicators differ). Additionally, there has not been a centralized data storage system so it is difficult to determine what information is collected and where the data are housed. This also leads to difficulty in conducting comprehensive analysis for stock status and action effectiveness.

Identifying a Solution

Having a well-managed data storage system will enable all entities currently implementing programs to have a better understanding of what is taking place within the Upper Columbia Region, and will ensure that resources are used in the most cost efficient manner.

Recognizing the need for coordinated data management, the RTT recommended establishing a locally operated, standardized, and coordinated data management system for Upper Columbia fish, habitat, and water quality data. The data management system will be managed and coordinated by a Data Steward, housed and supervised by the Upper Columbia Salmon Recovery Board (UCSRB).

Rather than starting the data management system from scratch, the RTT identified existing data management tools and resources within the region. Principally, NOAA Fisheries Service had already developed the Status, Trend, and Effectiveness Monitoring Databank (STEM Databank), and is currently utilizing this databank as part of the Wenatchee and Entiat River Integrated Status and Effectiveness Monitoring Plan (ISEMP). The RTT identified the various public and private entities collecting data on fish, habitat, and water quality in the region and concluded that most are willing to begin using the STEM Databank. For example, in the Okanogan subbasin the Colville Tribes hold monitoring data that can be rapidly assimilated into the STEM databank. However, due to agency obligations and time constraints, there is a need for additional technical support and guidance.

This additional technical support and guidance will be provided by the Data Steward. The function of the Data Steward will be to work with existing and future data collectors to refine data management protocols to integrate collected data into a regional data repository, the STEM Databank. Importantly, this process will also provide the individual practitioners with a more efficient and accountable data management system that will serve their agencies' needs. The finalized product is expected to be a comprehensive database, publicly available on the web and regularly updated, containing all the information collected from the various entities within the region.

In addition to benefiting the Upper Columbia Region, more coordinated data management within the Upper Columbia will facilitate larger Columbia Basin or statewide efforts, such as the NPCC Fish and Wildlife Program, FCRPS BiOp, Columbia River Initiative, Salmon Recovery Funding Board, and others.

Implementation, Cost Savings, and Benefits

By making the information publicly available in a consolidated location and regularly updated on the web, the UCSRB and RTT hope to avoid the access, incompatibility, and duplication of efforts currently encountered by resource managers. The Data Steward will start in October of 2007 to standardize data management protocols and continue (what ISEMP has started) working with data collection practitioners to use standardized database formats.

Cost Savings - Data Management Repository: Instead of multiple parties developing their own ESU-wide database, the Upper Columbia Region is electing to use an existing database. This is potentially a cost savings of over $500,000.[18]

Greater Utilization of Existing Monitoring Data: As part of their hatchery monitoring and evaluation (M&E) programs, the PUDs are responsible for collecting information related to abundance, productivity, spatial structure, and genetic diversity[19] of the populations where they have hatchery supplementation programs. The ISEMP and OBMEP (Okanogan Basin Monitoring and Evaluation Program) programs are collecting information related to these criteria as well as information pertaining to habitat restoration.

Since 2004, several million dollars have been spent to collect data across the Upper Columbia ESU. By ensuring that the information collected is coordinated and integrated with salmon recovery, duplication of effort will be minimized. If this information is collected, stored, and analyzed properly, NOAA Fisheries Service and others will be able to access the information more readily which is currently not the case. There will be greater utilization of the existing monitoring investments in the Upper Columbia Region.

Significant Improvements to Prioritization of Projects: Coordinated monitoring and evaluation data is essential for assisting in the prioritization and development of projects to restore salmon in the Upper Columbia. Many efforts require prioritization of projects as part of their programs, such as the Federal Columbia River Power System Biological Opinion, ESA recovery implementation, the Salmon Recovery Funding Board, the NPCC's Fish and Wildlife Program, and the State and Tribal salmon recovery and management efforts. A coordinated monitoring and data management program in the Upper Columbia will significantly improve our understanding of habitat limiting factors and project effectiveness that will lead to better prioritization and sequencing of restoration and protection projects.

Conclusion

The Upper Columbia Region has identified the need for coordinated management of monitoring data. This has culminated in key decisions by recovery partners, such as selecting a databank and associated data management protocols to populate a monitoring repository. By selecting an existing databank, initial capital costs are directly saved.

In addition to direct cost savings, the coordination of data collection and management will improve return on existing and future investments. Tremendous investments of monitoring, restoration, and protection dollars are being made in the Columbia Basin. The objective to increase return on investments necessitates greater utilization of the existing monitoring data. By having a well managed, centralized data storage system, all of the agencies involved with data collection and analysis will be assured that information is collected in a quality controlled and cost efficient manner. This information will significantly improve the prioritization of projects in the Upper Columbia Region. The coordination of these data collection efforts will ensure that all of the various goals (salmon recovery, mitigation for hydro losses, and effectiveness of hatchery programs) and objectives will be achieved quickly and efficiently.

CONCLUSION

Understanding information management costs and benefits is a key to being able to respond to regional data sharing and integration opportunities. Decision makers want assurance that improvements to regional information management arrangements would benefit the Pacific Northwest Region as a whole, and as individual Federal, State, Local and Tribal sectors.

These "Snapshots" and "Case Studies" provide examples of costs and benefits from a variety of information management efforts across federal, state and local sectors. They also provide lessons in what helped to make these efforts a success.

The chance of success is improved when an enterprise approach is adopted, when planning prevents avoidable costs, when there is a clear connection between the improvements and the planned use of the regional information, when organizational and administrative arrangements are in place, and when there is strong executive support.

The case studies identified significant tangible dollar benefits (in excess of costs) and also some intangible benefits (benefits that could not be assigned dollar values) for information sharing and management improvements at different scales, for example:

- The EPA reported Return On Investment (ROI) from Exchange Network Projects ranging from 15 to 62% with payback periods from 1.6 to 6.9 years.
- Minnesota Department of Natural Resources Lake Survey Project saves thousands of work hours and over $216,000 annually, ensures better quality data, and allows easier sharing with the public.
- National States Geographic Information Council estimated that applying uniform standards and applying other improvements to imagery acquisition and processing saved $160 million per three-year cycle, an ROI of 19%.
- The Federal Drug Administration reported savings of $10 million over a $200 million dollar IT budget.
- The state of Oregon predicted staff efficiency/productivity increases as annual savings of more than $80 million for state agencies, at least $100 million for city and county governments throughout the state with a fully deployed GIS utility and actual cost savings and revenue enhancement (increase) of well over $80 million over a 10-year period.

- The Department of Housing and Urban Development reported a $12 million dollar return from a $9 million dollar investment.
- An Illinois mapping consortium of local utilities, IMAGIS, in 1992-93 showed over $24 million in business benefits for city, county and utility participants including over $7 million in cash return or cost prevention.
- Six "*Snapshots*" showed benefits ranging from $50,000 per year to $4 million per year.
- The Upper Columbia Regional Technical Team identified direct cost savings of approximately $500K and improved return on existing and future investments through greater use of exiting data, a central data storage system and common collection and quality control procedures.

Other reports or examples identified costs that would have been avoided from improved information management planning: $68K for the NBII-Sain Roan Mountain study and $251K for the NPCC subbasin planning data recovery. These identified benefits are really avoidable costs. If the projects had addressed these issues up front, the costs would not have accrued and therefore are potential benefits.

Importantly, the studies also identified practices and actions that contributed to these business successes:

- The use of an enterprise level (or framework) approach can significantly increase the likelihood of success in terms of products and in terms of cost savings for IT decisions. Enterprise methodologies require an iterative approach – and most importantly documentation of the business needs.
- Basic information management planning can avoid costs that must be paid later if information is needed at a different scale from the scale of collection, e.g. regional instead of local.
- Organizational and administrative arrangements are especially necessary for information management efforts that cross organizations – whether for a shared GIS resource in Indianapolis, or the management of National Traffic Safety data at the National Highway Traffic Safety Administration (NHTSA).
- Significant effort is necessary to coordinate, develop and maintain organizational arrangements. For example, the NHTSA learned that information sharing is much more than databases and networks (IT).[20] Groups working to share information put

only 20 percent of their effort into technical issues; with 80 percent spent creating organizational arrangements for information sharing and exchange.

- Active executive support is a factor in successful long term efforts.
- Convention investment in IT can benefit when they are 'blueprinted' on a planned or Enterprise Architecture approach. IT alone does not automatically provide needed information management goals, or the motivation to apply it.
- Northwest Environmental Data Network reported multiple lessons learned from many regional information system improvement efforts.

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