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## U.S. Bureau of Land Management: The Perils of Implementing Strategic Information Technology

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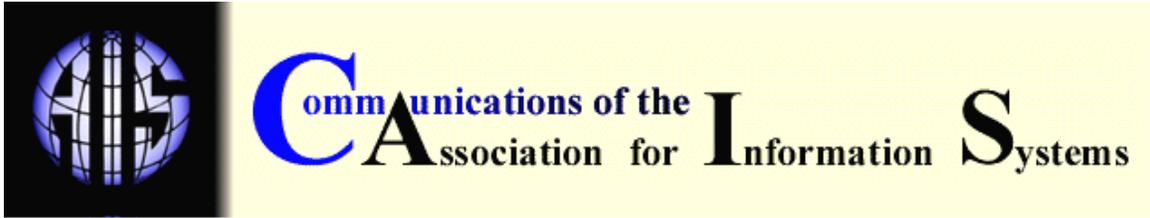
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## **U.S. BUREAU OF LAND MANAGEMENT: THE PERILS OF IMPLEMENTING STRATEGIC INFORMATION TECHNOLOGY**

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### **ABSTRACT**

The case describes the challenges faced by IT managers at the U.S. Bureau of Land Management (BLM) in their efforts to upgrade the Bureau's IT infrastructure while developing the largest, most complex strategic application ever attempted at the Bureau. After expending 15 years of effort and \$400 million, the BLM cancelled the program. The case identifies obstacles faced by IT and non-IT managers in attempting to implement strategic information technology in large, complex organizations. Obstacles identified in this case include: the BLM's culture of autonomy that tended to undermine support for the initiative, technological limitations that impacted the selection of technical standards, and organizational resource and knowledge constraints that adversely impacted the BLM's ability to manage such a large IT development effort successfully.

**KEYWORDS:** IT management, IT implementation, infrastructure, organizational culture

### **I. THE PROBLEM**

The Bureau of Land Management (BLM) spent more than 15 years and \$400 million trying to upgrade its information technology (IT) infrastructure and develop a major software application to automate land management processes. The centerpiece of this effort, the Automated Land and Mineral Record System (ALMRS), as delivered by the Bureau's primary contractor, was dead on arrival. Using the software was harder and more time-consuming than the stubby pencil processes it was intended to replace.

After cancellation of the ALMRS development contract, the challenges facing the Bureau were immense: the automation requirements that ALMRS was intended to support were still valid, users were dissatisfied with IT upgrades (desktop workstations and office applications) fielded under the modernization portion of the program, and a backlog of IT requirements built up while the Bureau was focusing on ALMRS development. Furthermore, the U.S. Congress, the General Accounting Office (GAO), and the Office of Management and Budget (OMB) would be constantly looking over the Bureau's shoulder when it came to any future IT investments.

Recollecting Santayana's classic warning that "those who ignore history are doomed to repeat it," understanding what went wrong on this effort is essential for planning the Bureau's next steps.

## II. BRIEF HISTORY OF BLM

Although the Bureau of Land Management was established officially in 1946, its roots go back more than 200 years to the time when the new republic of the United States was establishing policies for surveying and settling new territories. Through the 1800s, U.S. land-use policies focused on settling and economically developing the resources of the new territories gained in the nation's expansion across the continent. The BLM received a relatively unified legislative mandate only in 1976 when Congress enacted the Federal Land Policy and Management Act (FLPMA).

Today, the Bureau manages approximately 264 million acres of public land in 28 states, about one-eighth of the land in the United States. It also manages the mineral estates underlying another 300 million acres of lands administered by other government agencies or owned by private interests, and it supports fire suppression on an additional 388 million acres. Most of the BLM-managed lands are in the western United States and consist of grasslands, forests, mountain ranges, arctic tundra and deserts. Public resources managed by BLM include rangelands, timber, minerals, watersheds, wildlife habitats, wilderness and recreation areas, and archaeological and historical resources.

## III. BLM ORGANIZATION

The Bureau is organized into both functional and geographical elements. Functional areas reflect the Bureau's primary missions and the activities required for its internal management. They include:

- **Management of Renewable Resources** – fisheries, forests, range and wildlife. Cultural and recreational programs are also managed in this functional area.
- **Management of Realty and Mineral Resources** – solid and fluid mineral extraction and realty management.
- **Information Resources Management** – information technology and resources, Freedom of Information Act responsibilities.
- **External Affairs** – public, legislative, regulatory, intergovernmental affairs.
- **Business and Fiscal Management** – budget, finance, property and acquisition management.
- **Human Resources Management** – personnel and equal employment opportunities.
- **Helium Resources Management** – operation of national helium storage facilities.
- **Fire Protection Management** – detection and suppression of fires on public lands.

As shown in Figure 1, a combination of headquarters-level directorates and national centers supports these functional areas.

The Bureau is also divided geographically into 12 state/regional offices (BLM employees tend to use the term "state office," even though some of these offices actually include multiple states) that collectively include 59 district offices and 140 resource area offices. These geographically dispersed organizations are responsible for the on-the-ground, day-to-day execution and administration of Bureau missions.

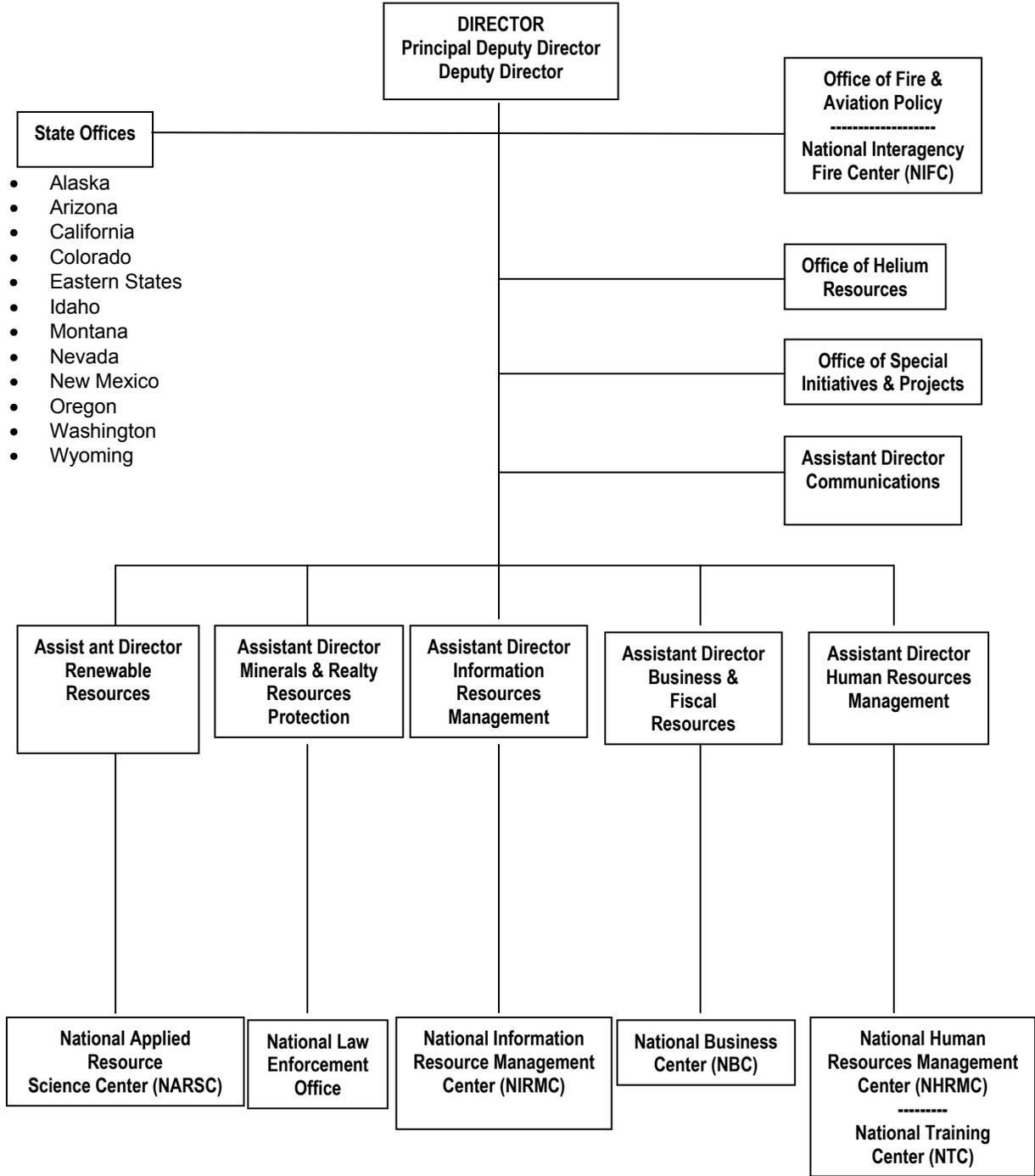


Figure 1. BLM Organization Chart

#### IV. INFORMATION RESOURCES MANAGEMENT (IRM) AT BLM<sup>1</sup>

Information technology (IT) expenditures made up more than 10 percent of the Bureau's total budget throughout the 1990s. Recognizing the increasingly critical role of information technology, the Bureau initiated significant changes in its IRM structure in 1996. The Bureau defined its IRM mission as follows:

*Information Resources Management is responsible for supporting the Bureau's mission by facilitating the development and implementation of IRM policies, standards and programs among its state/field offices, national centers and the headquarters office. Information Resources Management will also focus on providing timely and effective support and services to meet customers' expectations.*

As part of the 1996 reorganization, the Bureau established the National IRM Center (NIRMC) to provide collaborative technical guidance to state/field offices, national centers and the headquarters IT management group, and to provide lifecycle management of Bureau-wide systems.

In accordance with provisions of the *Information Technology Management Reform Act* (ITMRA), the Bureau also established the position of Chief Information Officer (CIO). The BLM CIO was charged with:

- Developing and maintaining the IRM strategic vision
- Implementing IT standards, methods and policies
- Developing and promoting the IRM strategic plan
- Developing and administering IRM policies
- Developing and implementing IRM performance measures to support BLM missions and goals
- Assessing technical competencies required to make use of modern technologies
- Developing, managing and administering IRM security programs
- Serving as the Bureau's external IRM liaison
- Overseeing effectiveness of IT programs.

Each of the Bureau's state offices maintained an internal IRM activity intended to serve it and its subordinate field offices' needs. State IT managers, who worked for the state directors, received most of their funding from the state office budget. Traditionally, they enjoyed a great degree of latitude in purchasing information technology and developing applications. The size and capability of the state IRM activities varied considerably, depending on the interests and funding success of the state supported. Prior to the modernization program, state IRM activities planned, implemented, operated, and maintained most of the local servers, desktop automation, local area networks and links to the Bureau's wide area network (WAN).

The Bureau established two IRM advisory groups to help formulate the Bureau's strategic IRM direction, coordinate standards and policies, and prioritize IRM investment tactics:

1. The Information Resources Management Review Council (IRMRC) and
2. The Information Resources Management Advisory Council (IRMAC).

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<sup>1</sup> The terms IT and IRM are used interchangeably in this case in recognition of the convention that government entities generally use the term IRM while practitioners and researchers employ a variety of terms, including: IT management, IS management and IRM. For discussion see: [Boaden & Lockett, 1991].

The IRMRC consisted of the assistant directors of the major program areas (including the CIO and the NIRM co-directors) as well as the assistant directors from each state office. The IRMRC was responsible for providing the following strategic guidance:

- Strategic direction in the use of information resources within the Bureau
- Investment strategy for the acquisition of information technology
- General direction on the management of the BLM information technology investment
- Strategic goals and objectives to be met in the management of information resources.

The IRMAC included the IRM directors from each of the state offices and selected national-level IRM managers. The IRMAC was intended to provide a forum for sharing IRM-related information among the state offices and to advise the CIO concerning local requirements, concerns, and capabilities in each region.

## **V. STRATEGIC IT IMPLEMENTATION AT BLM: MODERNIZING LAND MANAGEMENT INFORMATION RESOURCES**

Bureau managers faced an extremely large task to integrate and standardize IRM resources across eight major functional areas and 200 geographically dispersed locations. The BLM managed more than one billion paper documents related to its land management responsibilities such as land surveys and surveyor notes, tract books, land patents, mining claims, oil and gas leases, and land and mineral case files. Many of the land titles and much of the survey data date back to the birth of the nation.

In the late 1970s and early 1980s the Bureau began to use information technology to improve its core business processes. However, the BLM still found it difficult to handle its case-processing because its work load increased at the same time that its work force was reduced. Using a combination of manual and automated systems, the Bureau processed six million information requests per year.

### **IMPLEMENTING THE AUTOMATED LAND AND MINERAL RECORD SYSTEM (ALMRS)**

In the mid-1980s, the Bureau began planning to develop an automated land and mineral records system and defined the fundamental scope of the ALMRS/Modernization Program in 1989. This program consisted of the three major components identified in Table 1. In May 1991, the Bureau awarded a \$400 million contract to Computer Sciences Corporation (CSC) for infrastructure design, acquisition and installation, and development of the ALMRS and the Geographic Coordinate Data Base (GCDB) databases (Table 1). This contract was in addition to a separate contract, awarded to CSC in 1988, for developing the geographic data required to populate the GCDB database.

The Bureau's executive leadership endorsed the program, viewed ALMRS/Modernization as an important contribution to its strategic goal of serving current and future publics and designated the deputy director to serve as the ALMRS/Modernization Program Manager.

The BLM planned the ALMRS/Modernization implementation to proceed in phases. Over a period of four years, the Bureau fielded early capabilities by installing UNIX-based desktop workstations and servers, commercial office automation software, local area networks, wide area network connectivity, and electronic mail throughout the entire Bureau. By 1998, more than 6,000 workstations were installed and 8,000 employees trained. The Bureau also successfully migrated 11 legacy COBOL database applications to operate under the Informix database management system acquired under the ALMRS contract. The timeline, shown in Table 2 on page 684, summarizes major events in the development of the ALMRS/Modernization Program and the evolution of the program over time. Additional program implementation information is presented in Appendix I.

Table 1. ALMRS/Modernization Program Major Component Breakdown

<b>Major Component</b>	<b>Explanation</b>
Infrastructure Modernization	Selection, purchase and installation of enterprise-wide IT infrastructure, including: desktop workstations and office automation applications, servers, printers, groupware applications, local- and wide-area networking, and conversion of 11 legacy COBOL applications to the newly adopted standard database management system (DBMS).
ALMRS Development	Design and implementation of corporate data architecture, enterprise-wide database management system, geographic information system capabilities and multiple applications designed to automate critical Bureau business processes.
Geographic Coordinate Data Base (GCDB) Project	A geographic database that would contain coordinates of legal boundaries and other survey characteristics of public lands that would be linked to the ALMRS databases and hosted on the modernization infrastructure.

The Bureau experienced multiple delays and cost overruns. Operational testing conducted after delivery in 1996 found more than 200 high-priority software problems. The Bureau and its contractors worked intensely to resolve the problems found in the 1996 testing. However, after an additional two years of development, the Bureau determined that the ALMRS software delivered in late 1998 still failed to meet the needs of its intended users. In early 1999, the Bureau concluded that it was unlikely that CSC would be able to correct the deficiencies identified and cancelled the program.<sup>2</sup>

**VI. IT ISSUES: IN THE WORDS OF BLM MANAGERS**

The objectives of the ALMRS/Modernization Program were developed from an extensive planning effort and were validated both within the BLM, by the Department of Interior and by the U.S. Congress. The following six narratives represent core issues identified and discussed by both IT and non-IT managers within the BLM. These narratives provide a rich understanding of the challenges faced in implementing the ALMRS/Modernization Program.

**ALMRS: AN “800-POUND GORILLA”**

ALMRS did provide a strategic capability for the BLM.

*In the strategic plan, there is a chapter on improving land resource title information.... This is ALMRS. (senior program manager)*

Despite the resource investment and fielding delays, this manager strongly believed the program was falsely maligned:

*To say BLM management does not support ALMRS is absolutely false... if you go to the state directors, you'll find pretty good support.*

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<sup>2</sup> The GAO reported \$67.5 million was spent on developing the failed software and another \$74.6 million in project management expenses. Additional expenses covered physical additions to infrastructure, legacy system conversion, data conversion to new systems, and training.

Table 2. ALMRS/Modernization Program Timeline

Timeframe	Milestone
Early-to-mid 1980s	Early program conceptualized as automated land and mineral case processing system with estimated lifecycle cost of \$240 million.
1988	ALMRS scope expanded to include GCDB and infrastructure modernization requirements, with estimated lifecycle cost of \$880 million.
1989	Program scope refined and cost estimate revised. Lifecycle costs estimated at \$575 million. A separate contract for development of GCDB awarded with final delivery projected for September 1993.
2 <sup>nd</sup> Qtr 1991	Major 10-year development and support contract for ALMRS/Modernization Program awarded to CSC at projected cost of \$403 million (the contract came in under the government estimate). Projected Initial Operating Capability (IOC): 3 <sup>rd</sup> Qtr 1995. Software to be delivered in three builds with installation to commence after successful integration testing.
1992-1994	Over 4,000 workstations installed, three legacy applications converted and build 1, consisting of approximately 46,000 lines of code delivered and successfully tested on time.
1995	Installation of modernization infrastructure continues. Delays experienced with the release of build 2 software (approximately 120,000 lines of code). IOC rescheduled from 3 <sup>rd</sup> Qtr 1995 to 3 <sup>rd</sup> Qtr 1996.
Mid-to-late 1996	Testing finds over 203 high-priority problems (problems causing system crashes, application halts, or failures to execute required functions) and serious performance problems. Problems are also discovered with data integrity and the performance of modernization workstations and servers. Based on congressional direction, BLM contracts with separate firm to perform independent verification and validation testing of CSC's development. IOC rescheduled from 3 <sup>rd</sup> Qtr 1996 to 3 <sup>rd</sup> Qtr 1997.
1996	BLM reorganizes its internal IT structure, hires a CIO, and establishes Bureau-wide IRM oversight committees: IRMRC and IRMAC.
1997-1998	BLM and contractors work to eliminate high-priority problems. Selected features intended for inclusion in the IOC release are deferred due to delays and cost overruns. Approximately \$100 million spent for technology refreshment: i.e., upgrading workstations and servers to support new versions of operating systems and applications and to increase overall system performance. IOC rescheduled from 3 <sup>rd</sup> Qtr 1997 to 3 <sup>rd</sup> Qtr 1998.
3 <sup>rd</sup> Qtr 1998	Operational acceptance testing revealed that the software as delivered did not support BLM business needs, was too complex, and would impede worker productivity.
1 <sup>st</sup> Qtr 1999	BLM cancelled the ALMRS/GCDB development effort.

Data for this timeline derived primarily from GAO reports cited in the Bibliography..

Another program manager predicted,

*There is going to be a lot of excitement as soon as they realize [what ALMRS can do]. Right now the impression is that we are only doing this for mineralogists and geologists... when we get it out there and people can see the various uses for themselves, it is going to sell itself.*

Even those who were concerned about how ALMRS was being executed understood its potential value.

*I am not being negative; I thought this whole thing (ALMRS) was thought- and planned-out great, it still is great and will serve the purpose, which is case processing... it is a lot of things that folks want. (state IT manager)*

Yet Bureau managers recognized that users were tired of waiting for ALMRS and “want to see it now... it should be a big benefit but we’ve been talking about this stuff for years and have not seen anything yet.”

The modernization infrastructure was another problem. At the time the program was conceived, UNIX-based systems provided the only standards-compliant, scalable computing platform capable of displaying complex land and title data on maps. To reduce the number of computing environments that IT staff would have to support, the Bureau decided to standardize its entire IT architecture on UNIX workstations.

Acceptance of the UNIX platform as a standard for office automation was almost unanimously poor. In a survey of Bureau staff, 110 out of 111 comments made regarding the ALMRS/Modernization Program were negative; most of the comments identified problems with the UNIX systems. In the view of the staff, the UNIX office automation applications were difficult to use, lacked functionality, and impeded the sharing of data with external organizations.

*Many of my co-workers and I are abandoning the UNIX system because it is inflexible, and I cannot purchase the software I need to do my job. (Bureau employee)*

Some comments were harsher.

*Modernization is a fiasco. It seeks to employ obsolete hardware platforms that will be utilized to run applications that are not designed to work with networking. The users find it very non-user-friendly.*

Other users provided specific examples of their problems:

*I am hindered by the X-terminal platform. It is unstable, which is frustrating, especially when it locks me out during annual work-plan assignments... our IRM, one person, can't always be on duty, and it's impossible to get work done if the machines don't work.*

Another serious problem with ALMRS was the resources allocated to the program. Quite simply, the ALMRS/Modernization Program was so large and complex that national-level managers were unable to devote sufficient attention or resources to other Bureau IT needs.

*We are doing IT work with internal resources. The IRM folks are pretty much 100 percent looking at getting ALMRS running. And pretty much the rest of the computer needs are not only backseat, I'd say they're in the trunk of the car somewhere! So we are kind of on our own. (program manager)*

This opinion was not isolated

*ALMRS is an 800-pound gorilla. The problem (of accomplishing other IRM functions) has been ALMRS consuming so much of the IT resources and management attention, particularly with continuing delays. (national-level IT manager)*

## **TECHNOLOGY DRIVES A RE-EXAMINATION OF BUREAU IT MANAGEMENT PRACTICES**

With expanding use of network-enabled office automation, information technology became essential for performing mission-related work. Senior program managers discussed the impact of prolonged LAN outages that virtually brought work to a standstill at BLM headquarters. One commented,

*A (LAN) server went out for four or five hours yesterday... we need a rerouting capability so we can stay in business. Systems are becoming mission-critical;*

*when the power goes down we are forced into paralysis.* (senior program manager)

The senior program managers and their staffs were not merely inconvenienced by such events; they were effectively “out of business” during the outage. Accordingly, these managers recognized the importance that IT was playing in their daily operations and were vitally interested in ensuring that adequate investments be made to minimize operational disruptions.

The senior management level increasingly recognized that technology was driving the Bureau toward standardization.

*Technology is forcing us... to work together, to have standard policies and procedures to follow.* (national-level IT manager)

A senior program manager commented,

*Where local IRM folks have their own [mini-computers] and their own applications, as we implement modernization, that will have to go away, because we will not be able to maintain a national network.*

Yet, technical standards represent a serious source of tension.

*IRM needs to quit dictating what kind of computers we have. Standardization does not work. It only adds resentment and lack of local control... Standards may have a place... but to apply standards carte blanche is counterproductive.* (Bureau employee)

Many managers recognized the need to balance the tension between technical standards and local innovations.

*Some standards about the way data go in and come out have to be maintained, or the system collapses, but there must be a balance between dictatorial standards and local innovations.* (senior program manager)

The rapid evolution of commercially available information technologies represented another source of frustration. Some users and managers viewed the technology fielded with ALMRS as being outdated before it was delivered.

*We need to make sure we invest to keep everything top notch – to make the system better.* (program manager)

However, other staff strongly felt that continually implementing new technology was counterproductive.

*We need to balance our real needs versus the fact that everyone wants the latest and greatest technology.* (Bureau employee)

A state-level IT manager emphatically declared that the Bureau needs to “quit chasing technology.”

*Each year everyone wants new toys, and we end up managing data rather than [land] resources.* (Bureau employee)

## **POLICIES DO NOT ENSURE ADEQUATE FUNDING**

One area of near-unanimity was the agreement among Bureau program managers, IT managers, and staff about the inadequate resources available to accomplish the Bureau’s mission. Competition for internal resources was the single most contentious IT management issue in the Bureau. The investment in ALMRS necessarily reallocated money and staffing from other mission-related programs.

*There was always frustration; there is no problem that you could not use more resources on. But [the money] has to come from somewhere.*

In addition, the allocation of IT investments was an issue. How much of the resources should be invested in developing the strategic infrastructure versus how much should be spent for IT support of day-to-day operations?

*There are 20-year-old systems that require redesign that are being ignored. (state IT manager)*

Resource limitations directly impacted the effectiveness of the ALMRS implementation and user acceptance of the modernization products that were delivered. Shortfalls in the development budget prevented the Bureau from including all of the desired features and capabilities in the proposed initial software release. Numerous comments concerned the lack of adequate training on the new systems and applications:

*Training is always the first thing to cut when dollars are thin.*

Bureau IT managers also found it difficult to fund unanticipated hardware upgrades required to support new software releases.

Finally, resource constraints limited the ability of Bureau management to comply faithfully with federal IT management policies.

*Money and time: even if you have the money, it is difficult to find the time and training to comply with federal IT management policies. ... Policies provide no funding for solutions. (state IT manager)*

#### **SENIOR-LEVEL TECHNICAL EXPERTISE AS GOOD AS THE FIELD'S**

The IT staff expressed concern about how well senior managers understood the capabilities and limitations of technology.

*Non-IT managers are quick to criticize high cost and lack of solutions to business problems, but they fail to accept technical realities and complications inherent to building Bureau-wide solutions. (national-level IT staff member)*

Anticipating an upcoming meeting, a senior IT manager worried that listeners' "eyes are going to glaze over" during an upcoming discussion of linking technology to business needs.

IT managers also expressed concerns about their own technical and project-management abilities. A state-level IT manager was concerned that higher-level IT staff no longer maintained day-to-day contact with the users and the systems they operated. The loss of knowledge was not purely technical. Understanding of user problems, capabilities and needs also diminished.

*There is an issue of getting into management and losing the day-to-day involvement and use of the applications. So management can be good, but I am seeing problems with folks who are making the decisions that do not really know the day-to-day stuff.*

A national-level IT manager admitted that,

*As the central folks concentrate on keeping informed on ALMRS capability and technology, the field is trying to pay attention to what the field wants and is more in tune with what is needed.*

Further indication of the erosion of the technical skills of higher-level managers came from another national-level IT manager. He recognized that if the central IT activity were going to successfully manage Bureau-wide IT systems,

*You are going to have to get a lot of technical expertise that is at least as good as what the field has,*

implying that this level was not achieved.

### **BLM CULTURE: "I'M NOT SURE IF YOU CAN CHANGE IT; JUST WAIT UNTIL THEY ALL DIE OFF!"**

BLM people interviewed believed that the organization's culture played a significant role in determining how information technology was managed within the Bureau. They recognized attitudes and operational practices that worked against establishing a strong, centralized IT management function.

Once funding allocations were made, the 12 state offices operated with considerable autonomy.

*The BLM is organizationally decentralized... field offices are independent from state offices, which are independent from national.... The Bureau culture is very state-oriented. Oregon is different from Idaho. (program manager)*

At the state level, IT staffing and funding decisions were made by local directors. Over time, the differences in state-office funding and priorities led to significant differences in size and capability among the state IRM organizations. This variation made building consensus on Bureau-wide capabilities extremely difficult

*The BLM's state IRM organizations function as 12 different companies... this reflects BLM culture. (national-level IT manager)*

*There has been tremendous suspicion when a state wanted access to district data: 'Why? Would they use it against us?' There's always a tendency toward suspicion because somebody's looking over your shoulder for the wrong reasons. The attitude is so inherent. (another national-level IT manager)*

The manager continued,

*There has been a certain amount of arrogance by the state office staff, and I speak through experience at several levels. Attitudes are hard to change, I'm not sure if you can change it; just wait until they all die off!*

### **A CONTROL MENTALITY AT THE TOP CREATES A PULL TOWARD DECENTRALIZATION IN THE FIELD**

Disparaging comments were made about the lack of central control: e.g., "the psychology has been against centralized control."

*The programs have a lot of independence: If Oil and Gas needs to develop a program, it will budget for it; there is almost no control. (national-level IT manager)*

Control was also on the minds of some who did not view it so favorably. They thought too many "old-school control types [within the IT function] still pushing the central organization."

*IT management works best when it is part of the management team, not sitting in a dictatorial or control mode." (program manager)*

Program managers were also concerned with losing control over their information systems. One manager insisted that, "users must be able to tweak things."

While the NIRMC focused on the ALMRS/Modernization Program, the state IRM activities were left largely on their own implementing unique applications in support of local requirements. However, Bureau-wide funding constraints were starting to inhibit local development, and as existing state-office mini-computers were replaced by the UNIX systems, state IT managers were concerned about losing even more local flexibility.

The previous BLM CIO found herself pulling for centralization with respect to the Bureau's internal IT operations; yet she desired little control from the Department of the Interior's (DOI) CIO. Concerning possible development of a DOI-wide IT architecture, she simply stated,

*I do not think that makes sense. The department has pretty much delegated that down to Bureau, so there is a lot of independence to work things out within the Bureau.*

The CIO recognized that the centralized IT activity (the NIRMC) did not have the resources to control all aspects of information technology within the Bureau. For example, the Bureau inventoried its data applications and identified more than 800, the vast majority of which were developed at the state level. While the CIO worked under the policy mandate to reduce incompatible and often redundant “stovepipe” systems, she recognized that it was not possible to tackle all of these systems at once.

*The approach we have agreed to is, when we start making changes, or someone is coming up with a new system, that’s when we need to stop and look at it...We do not get rid of redundancies for the sake of getting rid of redundancies; we time it so that it makes sense.*

## **VII. WHAT WENT WRONG: MULTIPLE PERSPECTIVES**

Section V presented an overview of the ALMRS/Modernization Program accomplishments and its cancellation. Section VI provided insights into the thinking of Bureau IT and non-IT managers about the ALMRS/Modernization Program and the general impact of information technology on the Bureau’s mission and organization. The interviews on which Section VI were based occurred prior to the program’s cancellation. This section discusses results of interviews held after the program’s cancellation.

The ALMRS/Modernization Program received considerable management oversight by department-level IT managers, OMB, GAO, and Congress. Program oversight consisted primarily of monitoring Bureau compliance with federal IT management policies. The extensive external oversight, particularly by the GAO, provided a unique opportunity to compare the documented observations about the failure by external personnel with those of Bureau IT managers.

In an interview by *Federal Computer Weekly*, the GAO concluded that over the course of a lengthy planning and implementation process, project requirements became stale and that the BLM was “using technology that had really been eclipsed by the Windows technology of today” [Tillett, 1999]. That article also quoted a Department of Interior employee as stating that Bureau managers “should have recognized the problems five years ago.”

Before Congress, GAO testified that the lack of system architecture was a “key reason why ALMRS’ initial operational capability (IOC) did not meet the Bureau’s business needs” [General Accounting Office, 1999]. The GAO also reported on several program deficiencies that it deemed contributed substantially to the ALMRS failure. According to the GAO, the BLM did not develop a system architecture nor formulate a concept of operations nor ever develop a credible schedule. In addition, the GAO determined that BLM faced “serious risks” throughout the ALMRS/Modernization Program because the BLM had not:

- Established a robust configuration management program
- Established a security plan or security architecture
- Established transition plans
- Established operations and maintenance plans
- Planned a complete stress test

Not surprisingly, senior BLM IT managers expressed a somewhat different perspective on the failure of their program. After the decision to cancel was made, key IT managers identified the primary cause of the program’s cancellation to be the prime contractor’s failure to provide applications that met usability and performance requirements. Unfortunately, the functional requirements included in the contract did not adequately specify required user-system

interactions and system performance. The IT managers recognized that the lack of performance specifications probably contributed to the contractor's failure to deliver an acceptable product.

The IT managers also expressed disappointment with the services obtained from the independent verification and validation (IVV) contractor. Under the direction of Congress, the BLM hired Mitre Technical Services Corporation (Mitretek) to help manage its prime contractor. Only later did the Bureau determine that the IVV contractor had taken a managerial approach in determining whether recommended development processes were being followed. This approach failed to reveal *how well* the processes were being executed from a technical perspective. BLM's IT managers concluded that Mitretek employed "management folks" on the project instead of engineers and systems designers capable of reviewing the appropriateness of the technical solutions offered by the prime contractor and consequently did not identify design deficiencies during the development process.

BLM IT managers also argued that external direction and policy-driven guidance were, at least in some cases, detrimental. For example, Department of Interior officials directed that the Bureau's deputy director be put in charge of the ALMRS Program. As a result of this decision, the director whose unit would be the primary beneficiary of the ALMRS application was not active in managing that aspect of the program. Senior BLM IT managers felt that that director's lack of involvement may have resulted in poorer user participation in the development process.

Furthermore, in the BLM IT's managers view, the strong management support of the program within the Bureau and the Department of Interior perhaps contributed to continuing the program for so long. The Bureau documented more than 200 high-priority deficiencies with the application design and seriously considered canceling or refocusing the program in 1996. According to the IT managers interviewed, Department of Interior personnel strongly urged the Bureau to "stay the course." The managers believed that the basis for this decision may have been the Department of Interior's unwillingness to admit to Congress the full extent of the program's problems.

## VIII. EPILOGUE

With the termination of the ALMRS/Modernization Program came a turnover in senior IT management. The Bureau hired contractors to assess the Bureau's IT management capabilities and to assist in the development of a new Bureau-wide information architecture. The BLM analyzed the ALMRS software and documentation and concluded that, due to the advances in technology that occurred since the project was formulated, little could be salvaged from the software development effort.

## TEACHING NOTE

Teaching notes for this case can be obtained by people who are listed as faculty members in the IS Faculty Directory. Contact the author at [beach@cob.isu.edu](mailto:beach@cob.isu.edu)

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## APPENDIX I. THE EXTERNAL ENVIRONMENT FOR ALMRS/MODERNIZATION IMPLEMENTATION

A potential difficulty in analyzing this case is appreciating the changes in both information technology and software development techniques that occurred during the extended life of the ALMRS/Modernization Program. While there is still ample opportunity to critique the performance of the Bureau's IT managers, we must be careful not to judge them solely in light of today's technology and development practices. This appendix provides some additional technical detail and a little historical context to help in analyzing this case.

### SOFTWARE DEVELOPMENT IN THE MID-1980S

The BLM pursued a classic "waterfall" approach to systems development in contrast with "spiral" or rapid application development (RAD) models more commonly used to develop large complex applications today. In the 1970s and 1980s, systems analysts would be assigned to work with users to develop a comprehensive set of requirements documents to be turned over to the developers. Several difficulties are associated with this approach. First, it can be difficult for users to understand and articulate their functional requirements fully early in a project because they may not fully appreciate the capabilities of the proposed technology to support their business processes. The user requirements are represented in a series of documents that users may have a difficult time understanding. These requirement documents would often form the basis for development contracts. Second, the waterfall model as generally applied tends to

aggregate too many functional requirements into too few software releases -- thus making each release larger and more difficult to manage. Lengthy delays can occur between the development of the requirement and the delivery of the initial software release. Requirements may change, but when so much development effort is expended there is a legitimate reluctance to change the fundamental application design even if users are dissatisfied. Historically, this type of development effort tends to isolate the developers from the application's intended users.

It is possible to infer that several of these problems occurred on the ALMRS development effort. Some of the functional requirements were fairly clear since the Bureau already automated some of its mineral and oil leasing processes. However, the earlier automation efforts were constrained because much of the information that the users would need was only available in hard copy format. A key element of the ALMRS development effort was to convert the billion-plus documents containing relevant land information into a readily retrievable electronic format. Note, however, that this effort pre-dates the vast majority of document and content management products available today. In addition, a significant portion of land management information is in the form of maps. While some of this information can be represented adequately in a structured text format, some critical information is displayed more effectively graphically (e.g., depicting elevation data with contour lines).

Because ALMRS was to serve as the BLM's primary organizational database, the Bureau tried to identify virtually all its data needs. That is, in addition to mineral and oil leasing, the ALMRS applications were to support diverse data and processing requirements associated with range management, timber sales, wildlife habitat management, historical preservation, and recreational use of public lands. The breadth of functional processes and associated data greatly increased the size and complexity of the development effort and consequently the technical challenges facing the Bureau and its primary development contractor.

Commercial geographic information system (GIS) applications and the capabilities of commercial relational database management systems (DBMS) were in relatively early stages of development at the time the ALMRS program was initiated. The BLM (actually its primary contractor) was attempting to develop an application that effectively integrated relational and spatial data and supported a wide variety of transaction processing requirements. Fifteen years later, in 2003, we see commercial applications such as ESRI's ArcGIS that, while extremely complicated, are more capable of supporting such requirements.

### **INFORMATION TECHNOLOGY IN THE MID-1980**

The desire to develop applications combining complex relational and graphical data potentially accessible from 200 geographically distributed locations posed a significant challenge to the technology available at that time. The Bureau considered a mainframe-based solution (along with the networking expenses that such a solution would require) too expensive and proposed implementing a distributed, client-server architecture<sup>3</sup>. Relative to current technology, processor speed, memory capacity and IO performance were relatively limited for these distributed servers. Many developers in the mid-'80s and early '90s failed to recognize performance requirements that multi-table relational databases placed on servers. These performance limitations even led to the development of specialized hardware optimized for hosting relational databases: i.e., database machines.

Given the powerful capabilities of current Windows-based systems, it is easy to forget that at the time the Bureau made its decisions, the Intel-based systems simply were not capable of supporting the projected performance and graphical display requirements required by the ALMRS and GCDB applications. While it might have been possible to select a vendor proprietary system such as a DEC PDP series computer running the VMS operating system, Unix was widely viewed

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<sup>3</sup>See [http://www.sei.cmu.edu/str/descriptions/clientserver\\_body.html](http://www.sei.cmu.edu/str/descriptions/clientserver_body.html) for a brief introduction to client server architectures.

as the most open enterprise-class operating system.<sup>4</sup> The selection of Unix-based servers was consistent with federal standards and emerging industry practice.

The case discusses user dissatisfaction with the selection of a Unix-based desktop standard. Unix workstations were required to provide the graphic display capabilities (X-windows) on the desktop needed to access the ALMRS and GCDB applications. The X-window emulation packages for PCs were becoming available during the early 1990s, but their performance was generally considered unacceptable. Accordingly, all staff needing access to ALMRS would require Unix workstations.

Note also that Wintel systems at that time did not include native support for the TCP/IP protocol stack required to access the Unix servers. Software capable of supporting TCP/IP protocols could be purchased but also proved problematic given the memory constraints still existent in the later versions of Microsoft DOS (e.g., DOS 6.0) and the earlier versions of Windows operating systems (e.g., Windows 3.1).

It is important to recognize that some technical decisions that appear somewhat dubious in terms of current technology were much more justifiable given the technology available at the time those decisions were made. However, nothing written above is meant to suggest that the program could not have been implemented successfully.

#### LIST OF ACRONYMS

ALMRS	Automated Land and Mineral Record System
BLM	Bureau of Land Management
CIO	Chief Information Officer
CSC	Computer Sciences Corporation
DBMS	Database Management System
GAO	General Accounting Office
GCDB	Geographic Coordinate Data Base
FLPMA	Federal Land Policy and Management Act
IOC	Initial Operating Capability
IRM	Information Resources Management
IRMAC	Information Resources Management Advisory Council
IRMRC	Information Resources Management Review Council
IT	information technology
ITMRA	Information Technology Management Reform Act
IVV	independent verification and validation
NIRMC	National IRM Center
OMB	Office of Management and Budget
PRA	Paperwork Reduction Act
WAN	wide-area network
Wintel	Systems architectures based on Microsoft's Windows operating system and computers incorporating Intel central processing units

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**John Beachboard** is Assistant Professor of Computer Information Systems at Idaho State University's College of Business. He completed a Ph.D. in Information Transfer and an M.S. in Information Resources Management at the School of Information Studies, Syracuse University and an M.S. in Business Administration from Boston University. Before launching a career in academia, he spent 20 years as an IT practitioner holding numerous staff and management positions related to the development and operation of a variety of government information and data communications systems. He is keenly interested in the development and application of

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<sup>4</sup> Note that the Unix offerings by major workstation/server manufacturers, such as HP, DEC, IBM and Sun, were not absolutely compatible.

information technology management policies in both the private and public sector. He published several papers on the subject in *Government Information Quarterly*.

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