Enhanced Computer Software Applications for Mining and Reclamation[1]

by

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Abstract. The use of computer technologies in mining and reclamation has grown tremendously since the late1980's and throughout the1990's. Every facet of mining and reclamation is now affected if not completely controlled through the use of computers and advanced software. The mine regulators have also gone through this dramatic change in the last two decades. As the regulated mining industry continues to look for more cost effective measures to meet the need for lower prices, computer technology will allow them to make savings in a formerly paper-dominated world. In order to utilize the mining industries electronic products the mine regulators must be in a position to accept electronically enhanced permits. The United States Department of Interior, Office of Surface Mining (OSM) has a multi-year initiative to promote the concept and eventually the realization of electronically enhanced permitting (EEP) and electronic permitting (EP). Many states are well on their way to accepting partial and in some cases complete electronic permits. The OSM has also provided the states with computer technology since the late 1980's through the Technical Information Processing System (TIPS). This system of environmental software packages and hands-on training has will continue to help the states meet their environmental regulation obligations in the new digital world.

Additional Key Words: environmental permitting, GIS, GPS, digital mapping

Introduction

The United States Department of Interior, Office of Surface Mining (OSM) implemented the Technical Information Processing System (TIPS) in the late 1980's at a time when cutting-edge hardware and software for land reclamation and permitting was not always common-place in state programs. Many of the states at this time had some of the TIPS tools such as early DOS based versions of AutoCAD, survey programs, and contouring packages. The TIPS program provided 15 off-the-shelf software packages that were hosted on a mainframe and loaded locally on DOS based computers. These early software tools were hard to use and unforgiving because of the hardware and communications limitations of the time. When conducting a drawing regeneration in AutoCAD there was sufficient time to take a coffee break. Mainframe based operating systems at this time provided the power needed to run these early environmental design programs but did not offer the ability to have a

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desktop computer based system. In the early 1990's TIPS moved to a UNIX based SGI (Silicon Graphics, Inc.) workstation. These new SGI workstations provided very powerful software tools and E-mail to many state users. The OSM also began a intensive investment in software training at this time.

During this same period the desktop personal computer (PC) continued to get more powerful and the ability of these systems to handle environmental design software programs began to emerge. The main hold-back was the ability to provide high resolution graphics. The graphics engines of the SGI workstations could not be matched by the desktop PC's. In the middle 1990's this started to change as more powerful graphics cards emerged along with much faster processors. Processor speeds were doubling every 17 months and the price of high resolution monitors continued to fall. Most of these hardware issues have disappeared because very powerful desktop PC systems are now available to run the majority of the environmental software applications.

In the spring of 1995, OSM developed a team to look at Electronically Enhanced Permitting (EEP) and Electronic Permitting (EP) in the state programs. At this time the State of Wyoming was accepting large portions of their coal mining permits in a electronic format and had modified their regulations and guidelines to accept this type of electronic data. Also the State of Texas was converting all permitting information into electronic format and actively encouraging the coal industry to submit electronically enhanced permits. Building on these successes in Wyoming and Texas the OSM developed a national Electronic Permitting Initiative. This initiative began in Federal Fiscal Year 1996 with a forum on Electronic Permitting in Denver, Colorado. This forum provided for a chance to interact with many emerging concepts on how to provide electronic information to the regulated community. This forum included examples from Geographic Information Systems (GIS), Computer Aided Drafting (CAD) systems, hyper-linked document handling (HTML), and a general inventory of software applications currently used by the Federal and State Government, the Coal Mining Industry, and associated Consulting Industries. After the EP forum OSM began funding specialized electronic permitting initiatives in the state and OSM Federal permitting programs. This funding has continued until present but has decreased over time as the state programs integrate this need for EP into their annual state grant requests.

The OSM sponsored another workshop in August of 1999 in Alton, IL, on Electronic Enhancement. This meeting indicated that most participants are well on their way to submitting and accepting electronic permits and changing State systems to encourage the Coal Industry to submit electronic permits (see appendix under mcrcc, EE workshop). Still many software and people-ware (i.e. accepting change) issues continue to challenge electronic permitting now and into the future.

What is TIPS?

The TIPS is a nationwide networked computer system developed by OSM, in close cooperation with 28 state and Tribal governments with primacy under the Surface Mining Control and Reclamation Act (SMCRA). TIPS is comprised of UNIX based (SGI) scientific and engineering workstations installed in each of the coal regulating states and select OSM offices. TIPS is presently undergoing dramatic changes because it is moving from a Wide Area Networked (WAN) based SGI workstation system to a Internet based individual user desktop PC (Microsoft NT/ 2000 Professional) based system. The

goals of this conversion are to provide the software tools needed by the State regulators at their desktop PC's when they need the applications, and to provide long term and just-in-time training to solve environmental problems. This mission directly interlinks with the OSM and State goals to achieve electronic permitting.

What is Electronic Permitting?

Many working definitions have been suggested for the terms Electronic Permitting (EP) or Electronically Enhanced Permitting (EEP). In general these all define the concept as the distribution, review and management of information on electronic media, which was traditionally recorded and utilized on paper documents. To be successful, electronic submissions must produce high permit quality, mutual convenience, efficiency and economy for applicants, the government entity and other partners.

Why Use Electronic Permitting?

A primary motivation for Electronic Permitting is that information is then readily accessible for all parties involved in the permitting process. For example in North Dakota paper-based coal mining permits fill 8 to 25, four-inch ring binders with about 8 additional binders holding revision, deletions, review and correspondence documents for each permit. Coal mining permits in most of the State programs are of similar size. In Wyoming it was found that 1 gigabyte of computer storage was equal to 10 to 100 feet of permit documentation shelf space . These volumes of paper are a administrative nightmare for all involved. In these days of 6 gigabyte DVD-ROM's (Digital Versatile Disk- Read Only Memory), 2 gigabytes CDRW's (Compact Disk Re-Writeable), and 600 meg CDR's (Compact Disk Recordable) data can be stored and managed in a much more convenient and cost effective manner. Availability of permits for review can be greatly enhanced. Currently many paper copies of a permit must be submitted in order to provide sufficient access to permit reviewers and the general public. With electronic permitting all reviews can be conducted from one CD shared by all reviewers in a CD tower.

The use of digitally produced data from the industry to the regulatory authority reduces data entry and associated errors. When the regulatory authority reviews a permit the tabular data and map accuracy must be verified. This data re-analysis and map measurement can cause differences from errors incurred by re-digitizing maps and entering voluminous quantities of water and overburden data. Removing some of this confusion between permit reviewer and the regulated industry creates a much improved review process and in turn enhances the permitting process. The use of one-time created digital data allows for a more thorough and timely review of permits. This results in meeting the environmental protection standards demanded by the public and meeting the demanding time frames of the coal industry.

What software is needed for Electronic Permitting?

Many states have tried various document imaging systems with all kinds of results. Document imaging systems and workflow software can be used for the text based portions of permit applications. The workflow component allows quality control and ease of management in the processes involved in the text based portion of the permit review. This would include assigning review projects and automating correspondence with the industry. These types of systems are starting to become reliable and show promise of long term support

and stability. The State of Kentucky began a project in 1996 to move incoming permitting information into a workflow system that had a document imaging front end. This system was proto-typed using the ownership and control portions of the permit applications. This prototype was successful and the final system was implemented in 1998. Since that time Kentucky has added minor revisions, and other permit changes to the system. As these types of systems continue to develop the electronic review and processing of permit applications has become a reality.

The use of geo-spatial relational database management systems such as SQL Server and Oracle will provide the engine for most of the technical portions of electronic permitting. Most states have stored permit information in relational databases and have accessed the data though Structured Query Language (SQL). Some have used SQL along with mapping programs to interactively query databases with the mapping information. These databases have been traditionally used to track the permit application from cradle to grave. They have also been utilized to provide annual report information to State legislatures and the Federal Office of Surface Mining. The Electronic Mine Permit Application (EMPA), developed by the Ohio Department of Natural Resources Division of Mines & Reclamation, utilizes Microsoft Access to provide an opportunity for the regulated industry to supply the text based portions of the permit in a database format. The State of West Virginia uses Oracle to access geo-spatial data stored on many other systems and connects them on Web based maps through the use of Arc/Info.

Maps and plans have traditionally been produced in CAD systems such as AutoCAD and Microstation. These programs continue to be some of the main sources of digital mapping data available from the coal mining industry. Some specialized systems and software have been developed for the mining industry such as Minescape (see appendix under Mincom) and SurvCADD (see appendix under CarlsonSW). Map data is also generated by regulatory authorities to track the progress of the permits. Some of the features typically digitized include annual affected acreage, permit boundary, post mining land use/capability, bond release status, incremental bonded areas and violation information. Not until the more recent releases of AutoCAD Map (see appendix under AutoDesk) could files be easily interchanged with other software systems.

Geographic Information Systems (GIS) such as Arc/Info (see appendix under ESRI) have traditionally led the way for map coverage development. Once these geo-spatial data sets have been created programs like ArcView (see appendix under ESRI) and AutoCAD MAP allow them to be manipulated by desktop computers for analyses. The States of Illinois and West Virginia have developed comprehensive GIS's for their regulatory programs and Abandoned Mine Land programs. The State of Illinois Department of Natural Resources Office of Mines and Minerals has developed a GIS laboratory to explore opportunities for the use of GIS and the Internet for mining and reclamation applications. The State of West Virginia, Division of Environmental Protection has developed the Technical Applications and Geographic Information Systems unit (TAGIS). This system allows Internet browsers to access large geo-spatial databases which display all types of mining information. The State of Wyoming Water Resource Center at the University of Wyoming developed a GIS for use in the analysis of Probable Hydrologic Consequences (PHC's) and Cumulative Hydrologic Impact Areas (CHIA's). Other organizations in Wyoming are continuing this work of applying this technology to solving many regional

hydrology issues.

Concerns about Electronic Permitting

An overriding concern is trying to meet all review and distribution needs with one set of digital standards. This is probably un-attainable because of the different software packages and data and analysis needs of the individual users. Other concerns exist such as:

1. If hardware and or software access fails there is no paper backup.
2. The potential for poor security and misuse of data.
3. There is a possibility of accessing the permit data beyond the intent of SMCRA.
4. The availability of easy access and convenience to permit data may lead to more stringent review and greater environmental demands on the coal industry.
5. There is a potential for non-productive set-up time for reviewing permits and resulting permit review slowdown.
6. There is a potential slowdown of application preparation due to digital standards.
7. Converting existing paper documents into new digital formats could be a massive job.
8. There is still the potential to hear the top ten words that mean that EP is a failure: "And by the way, we still want a paper copy."

Challenges facing Electronic Permitting

A massive training effort will be needed by governmental entities, the coal industry, and supporting industries to move their management and staff to accept the concept of electronic permitting. This will require a multi-generational paradigm shift to a paperless government, mining industry, and society.

Other challenges exist such as:

1. The prolific use of Wide area networks (WAN's), Local Area Networks (LAN's), and now broad band Internet access, greatly complicates data security.
2. Users are frequently unwilling to learn necessary computer skills.
3. Regulatory software packages must be compatible with digital data created by coal industry and supporting industries.
4. Rapidly changing technologies requires continuous training and upgrades.
5. Highly skilled geo-spatial database administrators are required. Many low paid, easily filled positions are replaced with a few high skilled positions.
6. Organizational training is necessary for new staff to utilize digital data.
7. Stored data may becomes inaccessible due to changes in hardware and or software thus data must be move on a continual basis.
8. Backup procedures are mandatory and data security must be guaranteed.

The Future

In the future all paper copies will be imaged at the door by a digital specialist. Digital permit submissions will be loaded directly into workflow systems for processing. The majority of the permit information will be available through the Internet for public comments, permitting decision forums, and providing for providing the status of permit processing.

Permits will be taken to the field on digital pads (i.e. like a pad of paper) and heads up video displays mounted on the field staff safety equipment (i.e. hard-hat, safety glasses) Data will be obtained by voice activated

personal digital field assistant (PDFA) computer systems that are incorporated into the field staff safety clothing (i.e. vest, coat, belt). Data communications will be provided by wireless networks on or near the mine sites supported by satellites. Realtime intelligent geo-spatial data location querying will be accomplished through large geo-spatial databases integrated by GIS and GPS technologies. This will allow for just in-time information on any query needed in the field for existing permit requirements and real-time entry into the geo-spatial database on field observations. Field staff will be able to review permit designs and create re-designs in the field. This will be accomplished through the availability of realtime reclamation information on final grading, soil replacement (see appendix under Leica Dozer 2000 and CAT METS/CAES), and toxic materials scanning and handling (PDFA integrated field X-Ray Fluorescence devices).

Realtime remote sensing data will be available based on advanced satellite imaging and remote sensing systems being developed such as TAGIS and Terraserver. The TAGIS unit is currently working on integrating a remote sensing component into their geo-spatial database. The TerraServer started as a joint research project between Aerial Images, Inc., Microsoft, the USGS, and Compaq. Microsoft built the TerraServer application in cooperation with the USGS and agreed to host the SPIN-2 data. Eventually these types of technology integration will allow regulators to conduct virtual inspections from the office for many of the permit conditions.

Summary

The use of electronic systems has great potential in the regulation of mining through the SMCRA. State and industry partners continue to streamline the permitting process through the use of electronic permitting. Inspection, enforcement, and field design work will be revolutionized by personal digital field assistants (PDFA) interfacing with powerful geo-spatial databases and remote sensing information. The future looks great for the use of enhanced computer software applications in mining and reclamation. For more information please visit the WEB sites listed in the appendix.

Appendix

More Information on Enhanced Computer Software Applications for Mining and Reclamation

1. West Virginia, Division of Environmental Protection, TAGIS Unit Sites:
   http://www.dep.state.wv.us/iso/tagis.html
   http://www.dep.state.wv.us/imap/
   http://www.dep.state.wv.us/form/graphice1.html.new.html

2. Illinois Department of Natural Resources, Office of Mines and Minerals, GIS Lab Sites:
   http://dnr.state.il.us/mines/gis.html
   http://www.isgs.uiuc.edu/nsdihome/ISGSindex.html

3. Wyoming Water Resource Center Sites:
   http://www.wwrc.uwyo.edu/
   http://www.wrds.uwyo.edu/
   http://www.sdvc.uwyo.edu/

4. Kentucky Department for Surface Mining Reclamation and Enforcement Site:
   http://www.nr.state.ky.us/nrepc/dsmre/nrdsmre/

5. Ohio Department of Natural Resources, Division of Mines & Reclamation Site (EMPA):
   http://content.ag.ohio-state.edu/dmr/coal/index.html

6. USDI - Office of Surface Mining Sites:
   http://www.mcrcc.osmre.gov/ (Search for Electronic Enhancement Workshop and TIPS)
   http://www.tips.osmre.gov/ (Links to all TIPS software vendors and Training Schedule)
   http://www.wrcc.osmre.gov/ (Search for Electronic Permitting)
   http://www.osmre.gov/ (Search for Electronic Permitting)

7. Software Sites:
   http://www.carlsonsw.com/ (Search for SurvCADD)
   http://www.carlsonsw.com/dozer2000.htm
   http://www.mincom.com/products/minescape/
   http://www.leica-geosystems.com/GPS/PRODUCT/DOZER.HTM
   http://www.cat.com (Search for Mining and Technology Products, METS, CAES, VIMS)
   http://www3.autodesk.com/adsk/section/0,,130012,00.html (Search for AutoCAD MAP)
   http://www.esri.com/ (Search for Arc/Info and ArcView)
   http://www.microsoft.com/(Search for Access, SQL Server, and IIS)
   http://www.oracle.com/
   http://www.terraserver.com/

8. Hardware Sites:
   http://www.xybernaut.com/
   http://www.portableshopper.com/Future/future.html