Optimizing Borehole Data Management Workflows
Optimizing Borehole Data Management Workflows

Authors: John Fosdick, Account Manager, North America
Usman Khan, Consultant, Global Services
Amanda Smith, Principal Product Specialist, Information Management and Platform

Operators today are inundated with vast and growing volumes of digital borehole data. Not only are unconventional shale plays generating data from hundreds or thousands of wells, faster than ever before, but the sheer number of logs, cores, surveys and petrophysical analyses per well is growing too, while advanced downhole tools are capturing more expensive, more sophisticated information—including real-time data—in many different formats.

And that’s just new borehole data. Oil and gas companies may have thousands of historical wells and untold numbers of legacy data files scattered throughout the organization. Achieving efficient, timely borehole data management (BHDM) is rapidly becoming one of the most strategic challenges facing geoscientists, asset managers, E&P data administrators, and IT personnel worldwide.

Traditional Borehole Data Loading and Storage

Regardless of an operator’s size, every E&P organization must have a way of getting borehole data from vendors in the field to the applications and databases used by petrophysicists and other asset team members in the office. Without a specialized master database or corporate data management system, the traditional default approach is to load borehole data directly to the project environment.

Figure 1. In the past, raw borehole data files were stored on shared network drives or loaded directly into end-user applications and project data repositories. As users, projects, software tools and redundant copies grew, data management problems proliferated.

Description: Users or data managers usually log into an oilfield service provider’s FTP site and download original, raw borehole data files. Or they simply obtain files via email. These are placed either in folders on shared network drives or loaded into project data repositories attached to the
users’ technical software applications. Different tools have built-in loaders of various kinds, but the data loading process is almost entirely manual. There may be little or no quality control (QC) or data validation. If multiple users need to work with the same borehole data, copies are loaded to each of their individual systems. After analysis and interpretation, results are stored along with the original data either on a personal computer or network drive.

**Pros:** No major investments in advanced systems, maintenance and support are required. Data comes in, gets loaded, copied and distributed as needed to tackle the task at hand. For small independents, assets or business units with limited IT or data management resources, this approach may seem fast, reasonable and relatively cost-effective, at least for a period of time.

**Cons:** However, as the organization grows and the number of users, projects, applications, repositories, and data volumes increase, borehole data management problems begin to proliferate.

- Much of the data, for example, resides on individual hard drives, so others cannot easily reuse it for other projects. Information sharing and collaboration may be virtually non-existent.
- Users may have no idea that certain borehole data even exists, much less how or where to find it.
- Redundant copies and different vintages spread like viruses from drive to drive, often propagating errors, large and small.
- Since every application or project data repository handles data somewhat differently, manual loading processes tend to be painful and time-consuming, robbing E&P professionals of time better spent analyzing and interpreting borehole information.
- Original raw data and edited or interpreted curves become mixed together.
- Value-added results and hard-won knowledge may get misplaced or lost forever, especially when someone leaves the team, department or company.
- When data quality is uncertain or unknown, users may not trust it, so they may purchase the same data again and start over from scratch.
- Worse yet, users may assume poor quality data is indeed reliable, and make unsound decisions that lead to expensive mistakes in the field.

In general, operators cannot extract the full value from data assets in which they have invested millions of dollars. As the costs of this familiar approach to borehole data loading and storage mount, many companies seek more coherent solutions.

**More Coherent Approaches to Borehole Data Management**

Given the many disadvantages of loading borehole data directly into project databases and standalone technical applications, what alternatives are available to help reign in the chaos? Any coherent BHDM approach must enable asset teams and users throughout the organization to access known, high quality borehole data more efficiently, share information more easily, and preserve results more consistently.
At a high level, three viable alternatives to the traditional approach have been introduced to the industry, in stages, over time:

- **Option 1:** Adopting a specialized borehole master database
- **Option 2:** Customizing a mixed-vendor BHDM workflow
- **Option 3:** Configuring a standard, integrated BHDM solution

Each increasingly sophisticated BHDM solution has included either manual or automated components for (1) vendor data access, (2) borehole data loading, (3) data quality control, (4) master data storage, and (5) some form of distribution to users, teams and project environments.

Options 1 and 2 remain widespread today, while Option 3 is just emerging. Consider the advantages and disadvantages of each alternative.

**Option 1: Adopting a Specialized Borehole Master Database**

Before energy companies adopted commercial borehole master databases, many used the project environment as a sort of ad hoc corporate repository. Typically, they would begin dumping as much log and borehole data as they could in one of their favorite analytical applications.

However, these software tools were designed to handle only moderate amounts of borehole data, not large volumes. They lacked the underlying tools, and utilities, search and security capabilities needed to scale up and manage corporate data appropriately. Operators began overwhelming these applications, causing stability issues, bottlenecks and data corruption. Organizing the data and getting it into and out of the system became increasingly unwieldy.

**Description:** In response, petrophysical software suppliers developed the first commercial borehole master databases, incorporating more robust data management tools. By installing a specialized system like this, for the first time an oil company could separate corporate-level borehole data from project data and end-user applications.

Today, an ideal master data environment provides a single location for all borehole data in the company, both live and archived. Original “raw” borehole data from oilfield vendors may include hundreds of log curves, but not all of these represent high quality data with high business value. By archiving copies of all original format data in one segment of the master database, E&P organizations can manage and maintain a separate—yet seamlessly integrated—“live” or online segment for corporate “gold” data. This higher value data includes the most frequently interpreted log curves, with complete data in all fields, as well as edited curves, and selected results returned from completed projects.

**Pros:** A good borehole master database is designed to efficiently and securely store, organize, and manage huge volumes of information—far greater than the usual project data store.
• Users or E&P data managers can easily find all relevant information for a particular project, without wasting time tracking down flat files on scattered network and personal hard drives.
• Productivity rises. Data sharing and reuse improve. Costly data duplication diminishes.

Cons: Historically, borehole master databases still required largely manual data loading, offered little to no QC prior to loading, and relied on clunky export mechanisms to populate the project data environment.

• Data managers and users could easily overlook errors, inconsistencies, and missing data values. In many cases, data quality was simply unknown. The general lack of corporate data governance, automation, and QC became problematic.
• What’s more, as data volumes continued to grow, more data management staff became necessary, incurring additional investments in training and support.

Each operator, therefore, had to weigh the savings gained through greater efficiency and lower redundancy against the costs of purchasing and maintaining more sophisticated technology. Nevertheless, many of the larger companies that adopted a borehole master database realized sufficiently impressive value to up the ante. They began bringing in additional components and customizing more comprehensive BHDM workflows to fit their particular needs.

**Option 2: Customizing a Mixed-Vendor BHDM Workflow**
**Description:** Inserting a specialized borehole master database into the workflow between raw field data and the project data environment represented a major improvement in borehole data management. The next step change, therefore, was to begin automating more of those largely manual processes surrounding the master database—vendor data access, data loading, quality control, and export.
• Historically, for example, some technology developers introduced new, automated data loaders and quality control modules as fully integrated add-ons to their master data repositories.
• Various third parties, including other application vendors and niche consulting firms, built bespoke alternatives.
• Other firms designed web interfaces to access vendor data, or custom connectors and middleware systems to transfer data from the borehole master to project databases and applications.
• Every implementation was somewhat different—not only between one operator and the next, but also among regions or business units within a single, global organization. Inevitably, internal or external R&D or IT teams had to customize some or all of the components and connectors.

Example: About five years ago, one international oil company (IOC) mandated all of its business units to adopt the same industry-leading borehole master database (Option 1). One of the IOC’s regional units had prior experience with the system and initiated a drive toward global standards. Assuming that “one size does not fit all,” each region was allowed to implement the borehole master with considerable variability to address its unique business needs. Within a couple years, every site was supporting a different custom version of the BHDM workflow (Option 2).

• While most sites began using a new commercial autoloader integrated with the borehole master, each business unit had to customize the internal business logic used in autoloading.
• Some regions stored incoming vendor data in a shared folder on a network drive, and set up the autoloader to scan it periodically and load data directly to the master database.
• Others had plans to attach a custom, third-party web interface or dropsite on the front end of the autoloader.
• Some sites adopted a new, automated QC module, fully integrated with the autoloader and borehole master. It, too, was customized using different business rules. Other units still performed manual QC, while a few adopted third-party QC tools.
• On the back end, diverse custom and commercial techniques and middleware solutions fed master borehole data to project applications and data repositories.
Even with the same master database, therefore, BHDM workflows varied—often dramatically—across the organization.

**Pros:** Replacing manual data loading and QC with automated processes can have a significant impact on staff time and productivity. Organizations that continue to load borehole data manually reach a point where data managers and technicians can no longer keep up with skyrocketing data volumes.

- Implementing automated workflows can reduce or eliminate backlog, and accelerate user access to critical information.
- Data loading personnel can be redeployed to perform tasks of greater value.
- Overall data quality increases substantially and duplication virtually disappears—especially with a solution that seamlessly integrates automated loading and QC with the borehole master database.
- The autoloader brings in new borehole data from suppliers and places it into a temporary “staging” area inside the master database. Automated verification processes check metadata attributes, data completeness, duplication, and abnormalities based on pre-determined business rules.
- Only data with something wrong requires human intervention. If nothing is amiss, data gets published to the corporate “gold” database. Either way, all data is tagged with known quality indicators, so even if issues remain, users can make decisions with greater confidence.

**Cons:** For companies with entrenched manual procedures, making the transition to automated loading and QC workflows could result in an initial “valley of pain,” as personnel learn new techniques, establish consistent QC rules, and discover—and have to fix—more data quality issues than before. The latter, of course, is a good thing from any user’s perspective.

The biggest downside to Option 2, however, lies in the sheer magnitude of time, effort and expense required to design, build, maintain, support, and continuously upgrade customized components and connectors.

- With every new release of some piece of the BHDM puzzle, outside vendors and internal IT resources have to get involved.
- Utilities or custom links may need to be rewritten, sometimes from scratch.
- Timing and coordinating upgrades can be a nightmare. Software versions can get out of date, and out of sync.
- Every business unit within a global enterprise must maintain its own support staff and budget for its own test and production environments.
- If technical users or data managers transfer from one region to another, they may have to learn a whole new set of BHDM tools and techniques, hampering cross-company collaboration.
- The organization may fail to gain value from economies of scale. From a corporate perspective, the overall cost of supporting multiple custom workflows could eventually exceed the costs of configuring a single, standard BHDM solution.
**Option 3: Configuring a Standard, Integrated BHDM Solution**

**Description:** A third alternative to borehole data chaos is emerging today. It entails adopting a standard BHDM solution with commercially integrated components and configuring—rather than customizing—it to the workflow at hand.

This fully automated, enterprise-scalable approach includes (1) web-based vendor data access on the front end and (2) self-service data distribution on the other, with (3) borehole data loading and staging, (4) quality control and verification, and (5) master data management at its heart. While smoothly integrating end-to-end BHDM technologies, many out-of-the-box features and capabilities can be turned on and off as needed. This allows operators and individual sites of varying sizes to adjust the commercial solution to their specific needs without having to create, tweak and support ultimately unsustainable customizations (Option 2).

**Example:** About two years ago, the IOC that had adopted a common borehole master database, yet allowed its sites to develop custom workflows, made the strategic decision to take BHDM to the next level. By forming a global governance board and central support environment, and establishing common standards and business rules, the company began replacing piecemeal, multi-vendor implementations with a fully commercial integrated solution.

**Pros:** First and foremost, Option 3 reduces costs at the global level. For example, by terminating custom application development, the IOC immediately saved $1 million.

- Obtaining a full solution from a single supplier can also open the door to more favorable commercial terms and service rates. Licensing is handled globally.
- Individual business units no longer need to maintain a full technical infrastructure and support team. Upgrades and enhancements are developed and supported by the commercial vendor, further reducing internal resource requirements.

![Configurable, Commercially Integrated Components and Workflows](image-url)
• The global organization benefits from significant economies of scale and scope. Reporting across the enterprise improves, while each region lightens its workload and lowers local IT costs.
• As personnel move from region to region, hard-won knowledge is preserved, data is efficiently reused, collaboration improves, and traditional learning curves flatten out or disappear.
• Long term, every site, every business unit, indeed every operator, benefits from enhancements and innovations gathered from across the broader industry and delivered in every new release.

**Cons:** Admittedly, there may be trade-offs in the short term between the global standard solution (Option 3) and local BHDM workflows tailored to unique technical or business requirements (Option 2). However, the degree of flexibility allowed in configuring the full commercial solution is substantial.

**The Smart Way to Optimize Borehole Data Management**

Having investigated three alternatives to storing borehole data directly in project databases and applications, we strongly recommend the third option—configuring a complete, commercially-integrated BHDM solution. All five of the components briefly described below are seamlessly integrated, consistently enhanced, and fully supported by Landmark, based on years of experience with E&P organizations worldwide. We begin with the master database at the heart of the solution.

**Comprehensive borehole master database.** The Recall™ Borehole master data repository is Landmark’s industry leading solution. A substantial portion of the world’s well log data is stored in this database.

Recall software provides a corporate, trusted source for all borehole data types. It consists of two integrated, highly configurable databases. The Recall Live database stores only high-value, standard or “gold” data that asset teams use daily for interpretation and reservoir characterization. With data structures optimized for access speed and bulk storage efficiency, users can easily browse, locate and access any type of edited borehole data sampled in depth or time. The Recall Original Format Digital Well Archive provides safe, long-term storage for raw data in original acquired format. Validated upon registration and archived online, near-line or offline, original data can be automatically extracted at any level of granularity.

**Automated data loading.** Recall Borehole software today comes with the seamlessly integrated Recall™ Autoloader module, which replaces all the painful manual loading processes of the past. It automatically identifies the formats of borehole data submitted for loading, collects complete well master information to the data, and then loads it into a preliminary “staging” area within the Recall master database.
Automated data quality verification. Once borehole data is placed in the Recall staging environment, the Recall™ Raven automated verification engine goes to work. Driven by configurable rules based on each operator’s unique requirements, the Raven engine runs a variety of tests on borehole data sets. It can, for example, identify metadata issues, detect common formatting problems and anomalies due to data acquisition issues, identify duplicate curves, and verify overall data completeness. Pre-publication testing determines whether a particular piece of data passes or fails the specified business rules. Only data with a fatal error is subjected to further QC and cleanup. Data that passes is assigned quality indicators, moved out of the staging area, and published to the Recall Live database. After an asset team completes a project, results can be run through Raven verification processes to confirm data quality before returning borehole information to the central Recall repository.

Web interface to vendor data. At the front end of the corporate BHDM workflow, data managers need easy, intelligent access to borehole data from oilfield service companies in the field. Landmark’s DecisionSpace™ Dropsite™ Data Loader provides a web interface and special tools for data managers to access, browse, and select data to verify and autoload into the master database. It replaces inefficient email and FTP, and custom web applications with cutting-edge technology tightly integrated with the rest of the commercial Recall solution.

Enterprise data transfer and self-service. At the other end of the BHDM workflow, high quality corporate borehole data needs to be distributed to projects across the organization. In place of third-party middleware and custom connectors, Landmark’s integrated PetrisWINDS® Enterprise™ software orchestrates the secure and efficient transfer of borehole data from Recall (as well as other databases) to applications or project data stores—and back again. This web-based technology provides users with a single “self-service” portal, where they can easily search for data, accelerate delivery, and load data directly to their projects.
Benefits of Integrated Borehole Data Management

Operators struggling with borehole data inundation and skyrocketing costs can choose from three more coherent approaches to borehole data management. Historically, most companies have implemented these approaches in stages, accumulating greater value with each transition to more integrated workflows. A quick summary of benefits include:

- Managing huge volumes of borehole data in a single place
- Eliminating time wasted tracking down scattered files
- Streamlining user access to critical information
- Improving the sharing and reuse of high quality data
- Avoiding data duplication or repurchase
- Enhancing data quality and consistency
- Redeploying data loading staff to higher value work
- Establishing global data standards and workflows
- Eliminating the time, effort and expense of customization
- Minimizing the support infrastructure at each site
- Lowering the global costs of storing and managing data
- Configuring workflows to fit different needs and budgets
- Facilitating collaboration across the enterprise
- Preserving knowledge and information

About Landmark

Landmark’s integrated software and technology services support industry standards and encompass a complete range of information management solutions for E&P. They include the underlying data and information repositories along with the tools you need to extract knowledge from all your E&P data. From tiered solutions for master and project/operational data, to big data associated with analytics, Landmark can provide everything you need to enable cross-domain workflows and effectively solve complex business challenges.

Our goal is to help you transform your business and maximize assets by enabling the safe, fast, and accurate decisions needed to find and recover every last drop of hydrocarbons. For more information, contact your Landmark account representative or send an inquiry to Landmark@Halliburton.com.

LandmarkSoftware.com