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Streamlining Quality Through Technology—An Electronic Workflow for Assessing Quality of Well Log Data

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Abstract

For wireline service companies, delivering accurate well log data to clients is crucial. Until now, assessing the quality of well log data was handled at the local level, with no global visibility or standardized assessment procedures. To address this issue, a streamlined electronic workflow was developed to monitor and significantly improve data quality, standardize log presentation throughout the organization, and ultimately ensure the quality of data delivered to customers.

Leveraging existing company processes, the Log Quality Assessment (LQA) system workflow allows field engineers, operations managers and geoscientists to share well data electronically and use this data to quickly and efficiently assess the quality of client deliverables at an individual service level. By directly linking the LQA grading system to the well log data uploaded to the company's existing WellLink well data management system (for the purposes of this paper, referred to as WDMS), the LQA system electronically streamlines the movement of log quality data from field engineers to operations managers to geoscientists, thereby speeding the process of problem identification and resolution. In addition, the LQA system is designed to allow expansion, including the evaluation of other data sets, services and business units. Reports generated nightly allow managers to evaluate log quality progress, spot emerging trends, and monitor overall performance by field engineer, service type, grade criteria, customer or geographic area. With this global electronic system, identifying negative trends in log quality can occur in a matter of days.

Introduction

The quality of log data delivered to customers is critical to ensure all exploration and production decisions made by a service company's customers are based on the most accurate information available. As log data is the wireline service company's primary deliverable to the customer, sustaining log data quality is crucial for building and maintaining positive client perceptions regarding the service company's capabilities and, ultimately, sustaining the business relationship.

Prior to the creation of a global, standardized log quality assessment system, our geographic business units worldwide established and maintained individual log quality assessment systems with varying results. Most locally initiated LQA systems were paper-based and presented efficiency, consistency and logistical challenges. Due to the inefficiency of such systems, many were quickly abandoned or underutilized during periods of peak business activity. These paper-based systems also resulted in severe inefficiencies as log data was manually distributed to relevant employees, in some cases requiring data to be mailed or couriered to each group. Results were entered and tracked through locally developed systems including spreadsheets, databases and paper filing systems throughout the organization. As each geographic area measured and tracked log quality results separately and inconsistently, developing metrics to measure LQA system participation and emerging data quality trends was nearly impossible.

To rectify these issues, four primary elements were identified as key components to a complete, successful LQA program:

- Global standardized LQA grading criteria
- Global LQA system participation measurement and tracking
- Automated, efficient transfer of knowledge between LQA user groups

- Global data quality trend analysis by service, geography, field engineer, grading criteria

A web-based system was designed for implementation across the organization to address each of these critical components. By using one LQA system globally, the organization was able to standardize and control grading criteria, track LQA program participation, and monitor emerging log quality trends immediately upon implementation. Automated, efficient transfer of knowledge between LQA user groups was achieved by partnering the web-based LQA system with the organization's existing WDMS to effectively store, route and retrieve well log data associated with each LQA during the log quality evaluation process.

Method

Introduction

The development of the electronic LQA system presented particular challenges due, in part, to the requirement that this new online system be designed, constructed and globally implemented in ninety days. For a project of this size, any one of the design, construction or implementation phases alone could require over ninety days. To meet these significant time constraints, proven project design, development and implementation techniques were required.

Previous success (reference 1) had been seen through the use of a software development process known as the Rational Unified Process® or RUP (reference 2) which outlines 4 stages;

1. Inception – define project scope and business case
2. Elaboration – specify features, plan project and system architecture
3. Construction – build application
4. Transition – test, train users and launch application

Design Process

The first phase of the project, Inception, was significantly accelerated by use of the RUP process. Most projects of this size begin with idea-gathering across the organization. Open discussions with groups representing different backgrounds, experience levels and geographic locations are facilitated and potential solutions are identified and prioritized by the project manager. Once the project manager narrows the list of potential solution designs, he or she then communicates the list to key groups for input, creating a time-consuming iterative process.

A select group of process experts, who were familiar with either the software frameworks we intended to build upon or the typical paper-based LQA systems currently in use, were gathered in one location to serve as the project's advisory board. By effectively facilitating discussions within this small but highly knowledgeable group, we quickly defined the vision and critical success factors of the project as follows;

Vision - Create a system that facilitates the grading and auditing of customer deliverables which would:

- Improve overall log data quality
- Drive global log standards across the organization
- Facilitate timely corrective actions
- Provide log quality data for trend analysis

Critical Success Factors

G O A L	**M E A S U R E**
Implement a web-based LQA system quickly	Launch by end of first quarter
Improve data quality	Customer satisfaction/perception
Drive Global Log Standards	Increase in conformance
Increase System Usage	50% adoption in 12 months
Facilitate Timely Corrective Actions	Flag for corrective action before next log run

The vision and critical success factors then served as a set of guidelines for the project. If a piece of functionality was suggested but did not directly support these items, it was modified, rejected or tabled for future system enhancements.

In the Elaboration phase the primary workflow for the main system components was defined using the expertise and input of the same group of process experts. For most information systems projects, the design phase involves identifying all functionality and workflow processes that could be advantageous to the system and users. Due to the imposed time constraints, the project management team decided that only those system components and processes that were critical requirements to achieving the LQA vision and goals would be included in the first release of the program. Any functionality or workflow which was deemed as advantageous, but not critical, was added to the list for future system releases. By focusing only on the critical core components and enlisting the help of a limited but comprehensive group of representatives, the design phase was completed in less than three weeks.

Construction and Testing

After completion of the elaboration phase, the project moved into construction with a third-party software vendor. Due to the exclusion of non-critical features and alternative workflows from the original design, the software vendor was presented with a streamlined, simple workflow design from which to construct the original LQA system. By using an iterative communication process which helped to efficiently communicate and clarify requirements, coupled with the simple workflow design, the software vendor met the challenging construction time constraints. After construction, testing began with representatives from all stakeholder groups including future users, LQA project managers, operations managers and third-party software vendors who worked together to identify and resolve system issues. As each issue was identified, program developers immediately worked to correct the problem and rapidly send a revised version of the system back to the group for additional testing. After system components were adequately tested and all issues were resolved, the project was ready for global implementation.

Implementation

Prior to construction completion, the software vendor developed a visual, non-functional version of the online system for use in the preparation of training materials and project communications. As implementation was expected to follow quickly after construction, this training material was used to begin the communication and training portion of the implementation process before construction was finalized, thereby shortening the critical path of the project. Upon construction completion, an electronic training package was distributed to all relevant parties (requiring approximately 20 minutes for completion) and an announcement regarding the availability of the system was distributed. Users who participated in the system testing phase provided valuable assistance in promoting the system and training new users after they returned to their geographic locations.

Traditionally, once a new information system is available, project managers visit key locations to present, train and discuss the new system to achieve global buy-in and full implementation. In this case, time constraints prevented this option and other methods were explored. Instead of travel, weekly conference calls were conducted involving groups of geographic location managers and LQA project managers to discuss any implementation issues. Vital to the success of any new software project is user acceptance, therefore these calls served to not only communicate with users regarding the use of the new system, but allow managers to discuss required business process changes and propose ideas for future enhancements. These calls were continued weekly until a particular location was operating the system at acceptable participation levels.

After the first month of implementation, the LQA project team began prioritizing system enhancement opportunities, including opportunities identified during the elaboration and testing phases. Through the third-party software vendor, a combination of maintenance releases (for smaller system adjustments and improvements) and enhancement projects (for major upgrades) were used to handle revisions to the program. One clear advantage to delaying the development of non-critical, complex functionality is that after users work with the system, they have a much clearer picture of how the system should operate for their business. Many of the non-critical functionality pieces which were put on hold during the initial program build were significantly revised or removed from the list after users incorporated the program into their daily work and developed more effective and relevant ideas for system enhancements.

The LQA Process

Overview

According to company mandates, all logs delivered to clients must be graded using the online LQA system. Through this system, field engineers submit their logs for grading by their district's management team and a percentage of those same logs are forwarded for further review by the GeoScience group. To leverage the WDMS and attach the log data to the LQA form, the field engineer begins the LQA process by uploading logs to WDMS. Through this process, an electronic link to the logs is maintained within the LQA form so that during the grading workflow, each relevant user can quickly access the logs through the link provided by WDMS. The field engineer also has the option to submit an LQA form without uploading data to WDMS for locations with limited connectivity. Log data must be transferred to each grader manually if WDMS is not utilized.

LQA Grade Sheet

Each form within the LQA system asks users a set of 13 questions regarding the log (per service). This allows each field engineer to focus on the 13 criteria which the service company believes are critical to providing the highest possible data quality. Field engineers are asked to choose the geographic location where the log was run, well name, field, customer and service list. Much of this information is automatically populated within the LQA form if the field engineer initiates the form after uploading log data to WDMS. Once this "header" information is filled out, the grade form appears (Figure 1) and presents each question with the ability to choose Yes or No as the response. During the design phase, much consideration was given to ensuring this process would be as quick and easy as possible for the field engineers to complete. For an LQA with six services graded, the grading process for field engineers averages 1 minute, 27 seconds per LQA (with adequate network connectivity).

LQA Grade : Field Engineer

WellName

Edit Header

District: Pearland			**Engineer:** Firstname Lastname
Company: Context		**Job Date:** mm/dd/yyyy	**Manager:** Firstname Lastname
Field: Big Gusher	**Well Name:** Big Gusher	**SO Number:** 122345	**Reviewer:** Not Reviewed
			Submitted By : Firstname Lastname

Cancel <<Previous Next>>

		Service A	Service B	Service C	Service D
	PTS	E	E	E	E
Quality of Data Acquired					
Do the logs repeat?	10	Y	Y	Y	Y
Are the logs free from minor noise spikes and/or anomalous responses?	10	Y	Y	Y	Y
Are the logs free from serious anomalous responses?	15	Y	Y	Y	Y
If there are any anomolies, have they been relogged?	10	Y	Y	Y	Y
Are the logs reading correctly in known formations?	10	Y	Y	Y	Y
Information on Fieldprint					
Tool diagram, header and tail inserts are complete and correct.	5	Y	Y	Y	Y
Header remarks are comprehensive.	5	Y	Y	Y	Y
Equipment data section is complete and accurate.	5	Y	Y	Y	Y
Standard curve presentation and log labeling are used.	5	Y	Y	Y	Y
Display / Film / Print Quality	5	Y	Y	Y	Y
Operating Procedures					
Are all parameters / BH corrections set correctly?	5	Y	Y	Y	Y

Figure 1 – The LQA grade form for Field Engineers

Manager Review

After the field engineer completes and confirms the LQA form for each service run, and enters comments for any missed questions, the system sends an email to the designated operations (grading) manager. The email notification contains the name of the field engineer who submitted the LQA, the date the job (log) occurred, well name, customer name, and a link directly to the LQA grade form. After the grading manager accesses the link, the LQA form displays with the grades and comments submitted by the field engineer. If the field engineer submitted the LQA through WDMS, a link in the upper-right section of the LQA form is visible and directs the grading manager to the logs referenced in the LQA grade form. After the grading manager completes and confirms grades and comments for the LQA, the system sends an email notification to the field engineer notifying him or her that the LQA has been graded. Each field engineer is tasked with reviewing the grades and comments to facilitate continuous feedback and improvement on future logs.

Geoscience Review

The LQA system houses a random-selection engine which automatically selects a percentage of logs for further review by the GeoScience department. This percentage is determined by each region's management team and is set per geographic area. LQA forms that are selected for further review trigger an additional email notification to the GeoScience department where GeoScience personnel grade the LQA using a workflow similar to the grading manager's. This third grading step acts as an audit upon the initial grading and helps enrich and enhance the feedback and knowledge transfer back to the field engineer. An overview of the LQA workflow is shown in Figure 2.

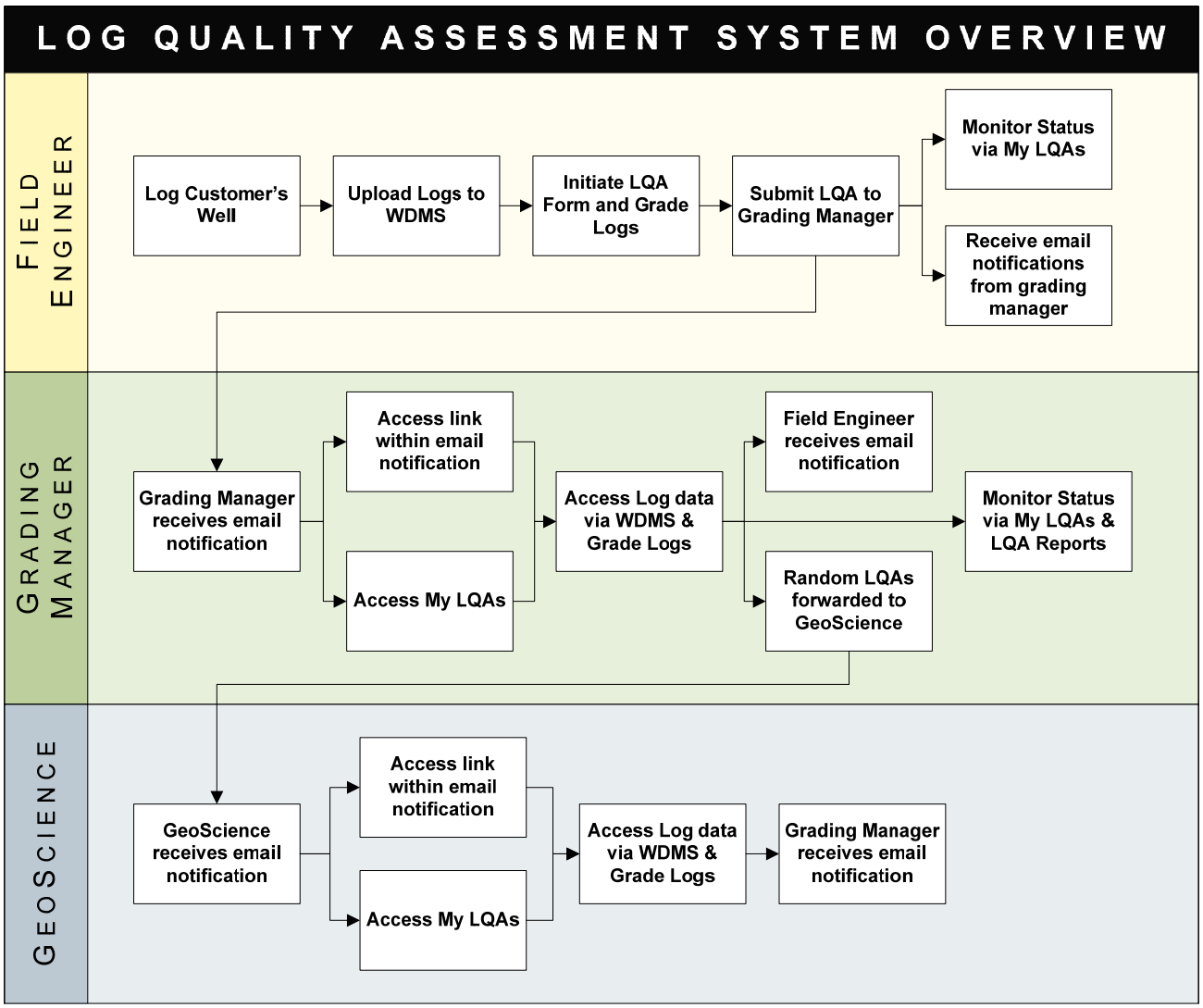

Figure 2 - The process and message flow of each graded log through the Log Quality Assessment System

MyLQA

Throughout this process, users can access pending LQAs through various email notifications or through their personal MyLQAs link on the company web portal (Figure 3). This link acts as a user's personal window into the LQA system and allows each user to view, filter, report or manager their LQA grade forms. The field engineer's MyLQA window lists all LQAs submitted and allows the field engineer to view all grades and comments submitted by their manager and/or the GeoScience department. The grading manager's MyLQA link lists all LQAs submitted to the grading manager and allows the grading manager to view all LQAs submitted for a particular geographic location, if desired. This allows grading managers to efficiently share the grading workload during peak business activity, vacation or personnel changes.

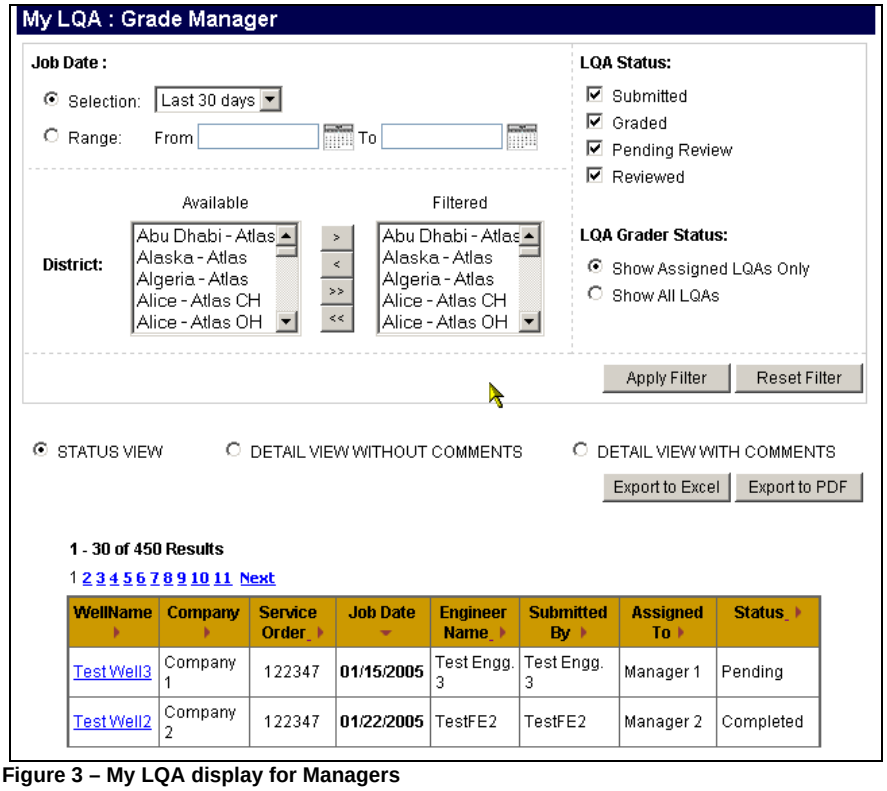

Figure 3 – My LQA display for Managers

The purpose of the entire LQA system, as stated in the introduction, is to continuously improve log data quality. This is accomplished through the communication loop between field engineers, grading managers and the GeoScience department, and created by the grades and comments submitted by each. Field engineers communicate, through their grades and comments, any problems experienced in the field which affected log quality. Both grading managers and GeoScience personnel then electronically comment on these issues, correct logs where appropriate, and propose possible solutions for the next job. By streamlining this process in the electronic workflow above, the knowledge transfer from each group progresses at a rapid pace, with much more data reviewed than was previously possible through manual LQA systems.

Presentation of Data and Results

Not only does the service company benefit from a much faster, more efficient and sustained log quality improvement process, but by utilizing one Global electronic system a wealth of analytical data is available. From a mere 22 user input data fields, we can analyze log quality trends by field engineer, macro-geographic level, micro-geographic level, product or service delivered, customer, well, field, grade criteria (question) or any combination (Figure 4). We can monitor the variance between the field engineer's grade, the grading manager's grade and the GeoScience reviewer's grade to ensure objectivity in grading. We can analyze trends per grading metric and determine which of the thirteen key log quality areas requires the most focus for improvement. Data can be mined to infer preliminary root-cause analysis conclusions such as environmental conditions, training issues (global), training issues (regional), tool performance issues (global), tool performance issues (regional), field engineer performance issues, etc. In Figure 4 below, June 2007 downturn in Total Services Submitted (B) is attributed to downturn in % Graded by Grading Manager (A) over the preceding months. By closely monitoring these trends, managers can quickly take corrective action resulting in rapid improvement as shown in the months following June 2007.

Figure 4 - Fictional data illustrates corrective changes possible through tracking trends in metric performance

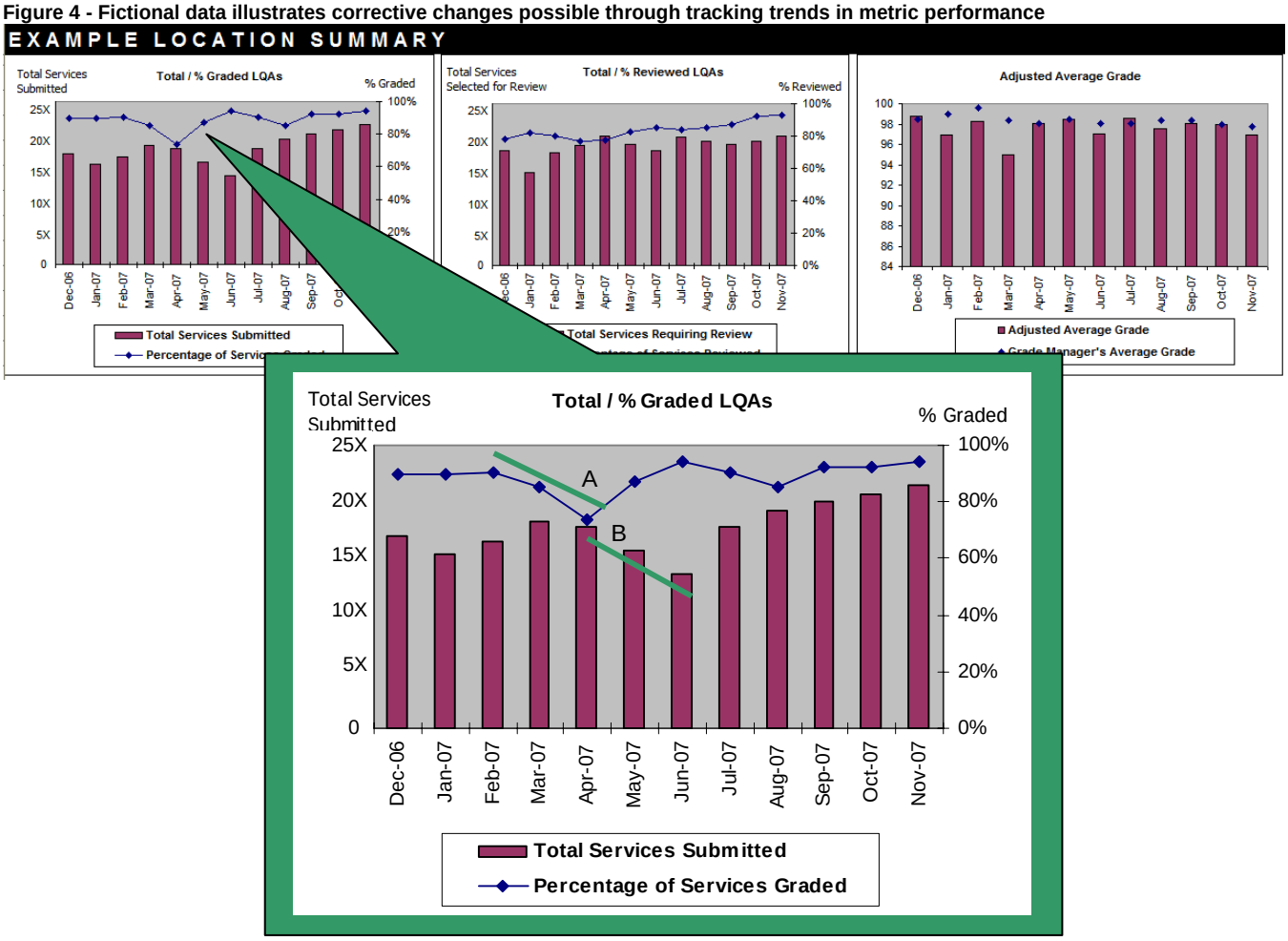

Figure 5 shows the rapid implementation and usage of the LQA system. The system became available online in May 2005 and almost immediately reached target participation levels which are still sustained today. The orange bar indicates the number of LQAs (by service) submitted to the system by field engineers. The green line indicates, of those LQAs submitted by field engineers, what percentage was graded by a grading manager.

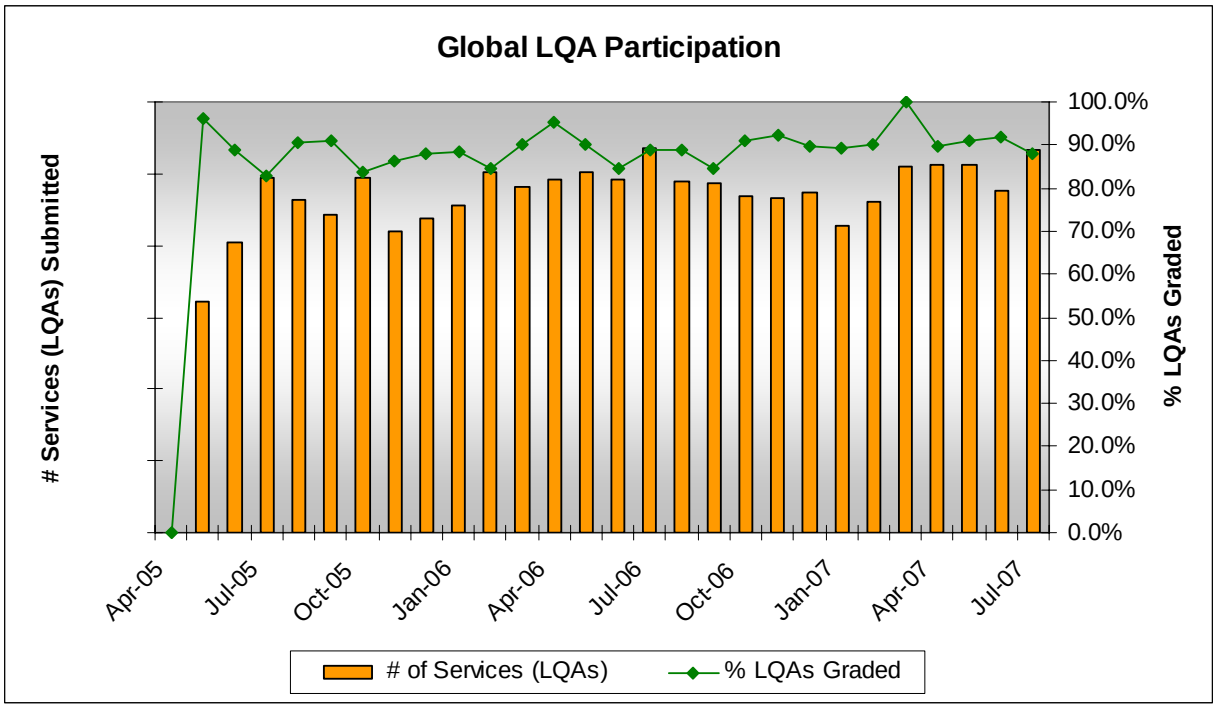

Figure 5 - The adoption of the LQA system across the organization

There are many ways in which LQA data can be used to track global log quality trends. Figure 6 shows LQA grades tracked by one particular grade criteria (or LQA question), referred to as Grade Metric G. As shown, the LQA grade for this metric was in slight decline from early to mid-2006, where it then declined to a new low in September 2006. After corrective measures were put in place the average grade for Metric G rose sharply and soon exceeded the highest grade average for Metric G since the program's inception.

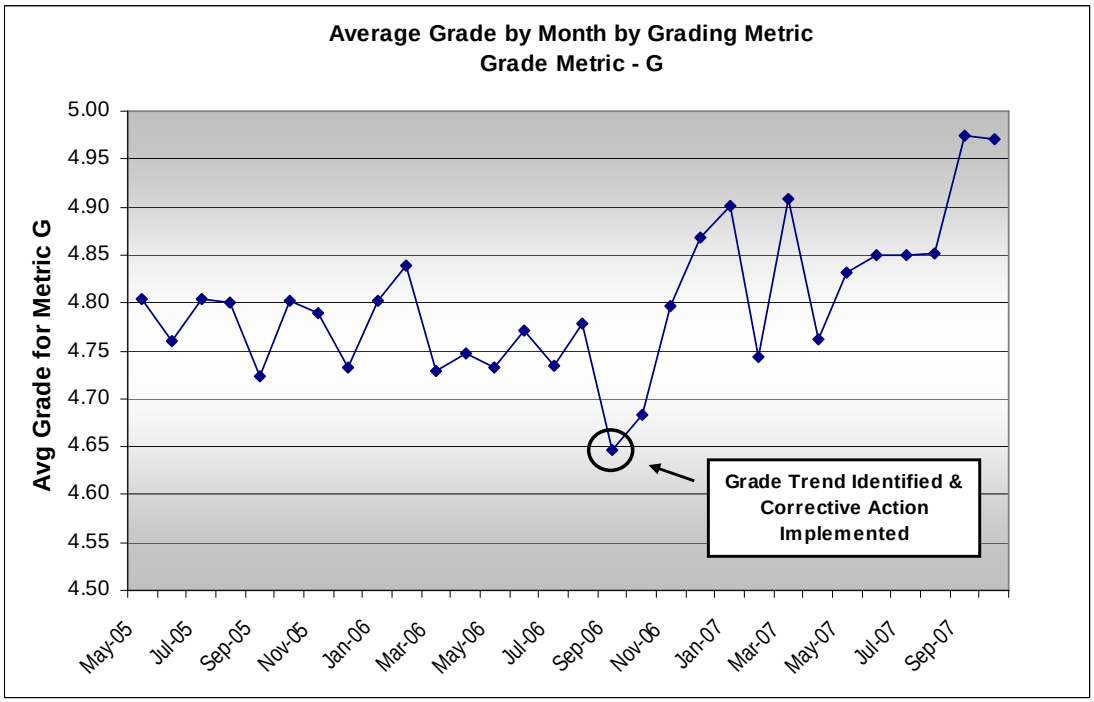

Figure 6 - Corrective changes possible through tracking trends in metric performance

Conclusions

The solution built accomplishes our mission by providing a globally visible, standardized measurement program across logs, districts and services, and a continuous communication loop between the field engineer, manager and the GeoScience department. Many operations managers have included this system as a part of their employee performance program due to the way in which the program simplifies performance evaluation. Immediate quality improvement has been noted in key areas due to the accountability and continuous improvement driven by the LQA system.

By using existing processes of log quality assessment and WDMS we experienced a ready adoption of the new system as more streamlined, efficient and effective than previous, paper-based systems. By providing a link between the company's well data repository and the log evaluation, managers are saved countless hours searching for logs during the grading process.

Simplicity of design was enforced through the use of a diverse group of subject-matter experts who participated in designing and testing the application. This helped ensure the final product was accepted and quickly put into use. The design was also conceived in a way that would ensure scalability to other services or product lines. As this is a browser-based application, no software installation or in-depth training is required, and system corrections or upgrades are transparent to the end user.

Acknowledgements

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