A Practical Approach Bridging Individual Learning and Organizational Learning: A Look at Organizational Learning in the E&P Industry

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Abstract

The E&P industry has identified that there is great potential for the use of an Organizational Learning (OL) approach in assisting with saving millions of dollars each year within drilling operations. This paper discusses OL from an E&P perspective and discusses why OL efforts must be implemented across four dimensions of an organization. Additionally, the paper presents an overview of a tool that has been developed to facilitate OL in one of the dimensions.

1 Introduction

During the drilling of a well, many things are learned that can be applied both to subsequent wells in the same area, and to similar wells around the world. Most of this information is captured, but in individual's heads, and is therefore not always available to the rest of an organization.

The exploration and production (E&P) industry has the potential to save up to 50% of its costs in some areas of operations just by not repeating mistakes [Bre98]. Knowledge about drilling in an area is often lost even within the same geographical areas of work. This is usually caused by members of the team leaving their teams and taking their knowledge of how to work in a particular area with them, or because of the break in operations which often occurs between exploration and development activities.

Information is often simply forgotten from one well to the next. This can be due to different rigs drilling within the same area and not sharing what they learn amongst themselves; or, it can be due to the long turn-around time between some wells, e.g. up to one year.

In a practical sense, major sums of money can be saved by implementing a learning approach [Bre86]. Two measures that BP Exploration (BPX) uses to calculate drilling efficiency are loss and waste. Loss is where an event occurs that was unplanned and causes the well to cost more than if the event had not occurred. Waste is when an operation takes longer than the optimum time. Typically, loss and waste together may account for up to 30% of the total cost of a well. BPX currently spends around $2 billion each year drilling and completing approximately 200 wells. It is estimated that by routinely tackling loss and waste through effective learning from one well to next within an asset, and by implementing rapid, effective knowledge transfer between BPX Assets, a prize of at least 10% of well costs may be realistically realized - a total of $200 million per year.

The approach OGCI Management (OGCI-M) has developed to solve this learning problem in the E&P industry is a practical methodology that bridges the theoretical gap between individual learning and organizational learning. Our approach facilitates capturing and securing knowledge from individuals and making sure that this knowledge is re-used by other individuals and not re-invented. OGCI-M developed an application, the Organizational Learning Systems™ (OLS), that provides a mechanism such that knowledge generated by individuals during ongoing work is easily and immediately captured. At the end of the project, this knowledge is prepared for use by other individuals in other projects.

The approach to organizational learning developed by OGCI-M is part of the toolset that BPX is using to help realize the $200 million annual savings goal.

2 Developing Organizational Learning Through Individuals

The theory that has emerged while developing and implementing the OLS with well construction teams

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(drilling and completion operations) is grounded in double loop learning, as proposed by Argyris [Arg77]; in control theory, as proposed by Deming [Dem82]; and, in systems theory, as promoted by Forrester [For61] and Senge [Sen90]. This section examines how the elements of the OGCI-M theory evolved by examining the working requirements of drilling project management and well engineering.

2.1 Understanding Organizational Learning in a Well Construction Environment

The drilling project management environment in which learning has to take place is naturally described by control and systems theory. Drilling project managers follow a repeatable process which has defined starting points, ending points, inputs and outputs.

The goal for drilling project management is, while meeting all regulations, to drill wells as safely and cheaply as possible, in as short a time period as practical, while optimizing the reservoir delivery as much as possible. This is based on the bottom line performance requirements of the E&P company. The actions required to develop, implement, and review a plan for drilling a well can, and should be, viewed as a process. In the case of a development well program with similar wells being engineered in succession, this is a repeatable process which can be optimized by quickly learning from previous mistakes and successes in how the project was managed; i.e., identifying chokes in the process and removing them.

A process requires a starting point, an ending point, inputs and outputs. For drilling project management, the starting points and ending points for well construction vary, but are approximately when the drilling team receives final subsurface information from the geology and geophysics team, and move the rig to another site, respectively. Input to the well construction process is the information from the subsurface team (G&G) and output is the completed well. We can go into greater detail on the inputs and outputs of the sub-processes of the well construction process and the work flow involved, but the main point here is that well construction can be viewed as a process and therefore control and systems theory are applicable to model and manage it.

Double loop learning is an essential part of any proposed organizational learning solution for well engineering and construction. A typical problem for the engineers in exploration and development companies, is how to learn quickly during a development well program in which several similar types of wells will be engineered. This is achieved by ensuring engineering successes are built into future programs and that sub-optimal performance and engineering failures are not repeated.

There is a difference between the repeatable processes industrial engineers work with in, say, a bottling company, and the repeatable processes drilling engineers work with in drilling wells.

In a bottling company, the process for placing a cap on a bottle is repeated with the same parameters every time, i.e., the bottle and cap are the same size, the machine being used to place the cap on the bottle is the same machine used with the last cap and bottle, etc. The design remains the same, therefore re-engineering, or modifying the process of, bottling becomes an academic exercise involving optimum machine placement, personnel involvement, etc.

When managing or designing a well program, the subsurface conditions, or the parameters required for designing the drilling program, change with each well because the Earth is not homogenous. So, even though a team may be drilling a well very close to a previous one, the subsurface conditions can be completely different at certain points in the program. It would be like walking onto the production floor at the bottling company and having to account for different size bottles, different size bottle caps, and having the basic machinery for the bottling process change daily while still trying to implement a basic bottling process. The most important inputs to the well construction process, the subsurface conditions, change slightly or dramatically with each well.

Another problem for well construction teams is that the basic assumptions regarding the subsurface conditions are often proven partially or completely wrong during the construction process. However, until obtaining better information, the initial conditions are all the information the engineers have. The error in assumptions is due mainly to the fact that the data used to develop the subsurface parameters, usually seismic data, is subject to a certain amount of interpretation by the G&G team.

The team, when reviewing the results of the final product of the drilling program, the well, requires the use of root cause analysis to determine why the implementation of the drilling program did not go according to plan. They need to know whether they had generated a bad plan, or did they generate a good plan and the implementation of the plan was not performed correctly. They then need to be able to capture the knowledge of successes and failures of the program for future drilling programs.

We have discussed a few of the important operational parameters drilling teams face regarding learning from well to well. Let's now look at the requirements these teams need to meet in order to generate learning within a team and between teams in an organization.

2.2 The Six Requirements for Organizational Learning

To understand the requirements for an organization to learn, we have to look from a system perspective at how an individual learns and extrapolate the individual's requirements into organizational learning requirements. A diagram, with several key points, of how individuals learn is shown in Figure 1.

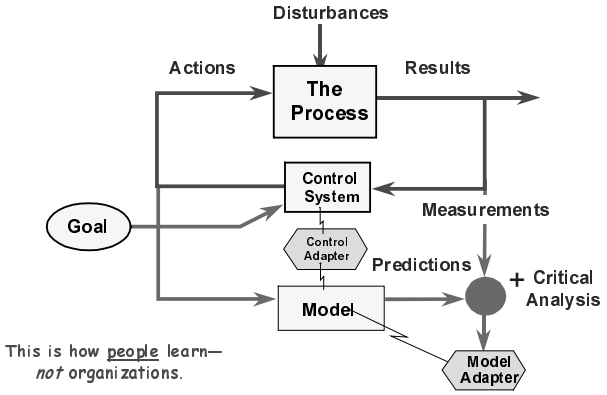

Figure 1. How Individuals Learn

Individuals have a mental model of how a process works, or how a given scenario should work out. A general understanding of models is that all models are wrong, whether by a small degree or large. The models are modified and improved through some sort of critical analysis after a situation is experienced, or when new information about a given situation is presented, that forces the individual to re-evaluate their mental model. Changing the mental model will have an effect on how the individual reacts when presented with a similar situation in the future; i.e., in control theory terms, the individual's control system will be modified based on the background model.

Organizations do have models. They create process maps of their business, but these processes are usually only updated during process re-engineering initiatives which occur far to infrequently for organizations to continually rely on them for learning. The problem, then, which many people have stated, is that organizations do not learn as quickly as individuals. Organizations need to be able to access a reservoir of experience to profit from past success or failure, e.g. the model; and they need to continually improve this experience.

Organizations need to update their processes more quickly than they do now. In the E&P industry, process updates are accomplished by performing a post well review with the team that performed the planning and implementation of the well program. These post well reviews can be performed much quicker if teams have embedded process improvement processes in their normal day to day work flows and manage their work processes to accommodate the required root cause analysis for learning. Remembering how and why decisions are made is another key requirement for organizational learning.

Next, processes or scenarios rarely work the way an individual's mental models predict. This is due to some sort of disturbance to the process as shown in Figure 1. Focussed individuals have the ability to ensure actions are directed at meeting goals. They do this through continuous monitoring of the situation and resetting of their actions, i.e., they modify their control system through model adaptation. Organizations need to do the same.

The next point is that measurements, output data, of a process or scenario are not necessarily results. If your son or daughter came home from school and told you they scored a 68 out of a possible 100 on a math test without giving any other information, would you think they did well on the test? Or, not so well? Maybe a 68 was the highest grade anyone in the class received on the test.

In E&P terms, if it takes 100 days to drill a well in, say, Algeria, and you have drilled similar wells in other parts of the world in half the time, is this bad performance? Not if similar wells in Algeria are drilled in about 150 days. Accurately monitoring performance is another requirement for teams to learn. What gets measured, gets managed.

Finally, individuals set their own goals for their performance; control systems are not designed to set their own goals. Organizational systems, like company policies, do not have the ability to set and evaluate goals. They only set boundary conditions. Organizational learning will not take place for the sake of organizational learning. There must be a business driver for organizational learning [Nel97]. The organization must continually define and refine goals, and link them to the bottom line performance of the company.

Therefore, for an organization to learn, it must meet all of the following requirements:

- *Define specific goals linked to the bottom line.*
- *Access a reservoir of experience to profit from past success or failure.*
- *Ensure actions are directed at meeting goals.*
- *Accurately monitor performance.*
- *Remember how decisions were made.*
- *Improve an accessible reservoir of experience.*

Unless an organization's work processes are designed to meet these requirements, and the organization has the tools to support these requirements, that organization will show some organizational learning difficulties.

2.3 The Four Dimensions of Organizational Learning

OGCI-M has found that the above six requirements must be fulfilled along four separate dimensions. These dimensions, shown in Figure 2, are Mechanism, Structure, Culture, and Motivation.

Mechanisms for learning are the tools that are used. Mechanisms help the organization to organize and document those things that are needed for the organization to learn. Mechanisms are the means individuals use to share knowledge and experience.

Structure provides the organization with a means of learning and comes from the goals, roles and responsibilities, and processes that are used to capture, share, use, and build upon experience.. Structures provide a way for people to work together to learn and produce.

Culture is the shared beliefs about the organization and the demonstration of these beliefs in actions. The culture is the reason people work together to learn. It is exhibited by individuals in the things they do to show each other that they want the organization to learn.

Motivation is both intrinsic and extrinsic. The intrinsic aspects include the attitudes, beliefs, and practices of the individuals. The extrinsic aspects include the reward, recognition, and compensation systems. Motivation is why individuals within the organization want to learn.

Figure 2. Four Dimensions of Organizational Learning

The organizational dimensions of learning are Mechanism and Culture. To learn, we must have Mechanisms or tools the entire organization can use. OLS is the tool developed by OGCI-M and currently being used by BPX. The organization wide Culture must also support learning. If the Culture is such that when things go wrong, someone to blame is the first thing to happen, then people will not work together to learn.

Structure and Motivation are individual dimensions of learning, as shown in Figure 2. The Structure must be such that goals are properly defined and clear to individuals, processes are shared, and roles defined. Individuals must feel their opinions are valued and be willing to do what it takes to be successful.

These four dimensions also relate to the quadrants of the human brain and the focus of each quadrant [Her96]. As

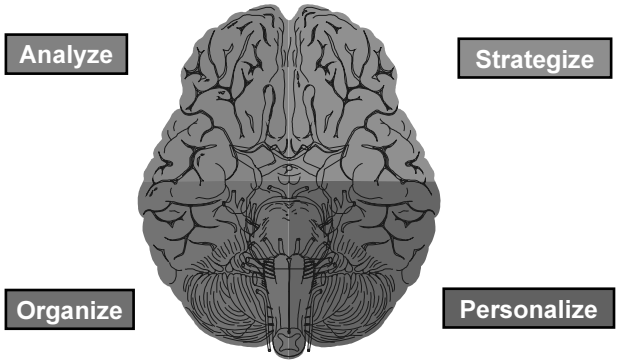

Figure 3. Quadrants of the Human Brain

shown in Figure 3, the Analyze, Organize, Strategize, and Personalize brain quadrants tie back to Mechanism, Structure, Culture, and Motivation; respectively.

When the six required organizational learning actions are fulfilled along each of these dimensions, the organization and the individuals within the organization are improving performance through learning.

3 The Organizational Learning Systems™ (OLS) Tool

OGCI-M has found the Mechanism to be the most significant bottleneck to organizational learning. Much of the Organizational Learning community has focussed primarily on the theory of organizational learning without developing the fundamental tools, or Mechanism, necessary to carry out this theory. In addition, those tools which have been developed are primarily focussed on assisting the user to search for information lost in a maze of files. These tools don't assist front end loading of knowledge into a structured system.

The OLS is a practical answer to most of the Mechanism requirements. The OLS facilitates the organization of acquired knowledge by the user with that knowledge. It then facilitates access of information by the next user seeking the knowledge.

3.1 Operating Environment

OLS is designed to run specifically on Microsoft Windows 32 bit Operating Systems – Windows 95 and Windows NT. It is also designed to work with Microsoft Office 97 and Microsoft Project 98. OLS takes

advantage of numerous features in Project 98 that will help you and your team to work better.

3.2 User Interface and Program Features

The OLS uses the OLS Explorer, see Figure 4, as a navigation tool allowing you to access all your documents. The OLS Explorer provides convenient access to all the necessary documents, forms, charts, images, and other support files that teams need to carry on a business process and project work in their organization.

The main features shown in Figure 4 include OLS Projects, Templates, Suggestions, and Compliance. To assist you with managing your work processes, the *OLS Explorer Wizards* simplify project and template setup, *OLS Compliance* deploys a company or team policy compliance model, and the *OLS Suggestions* feature greatly eases the process of collecting and reviewing project feedback during post analysis.

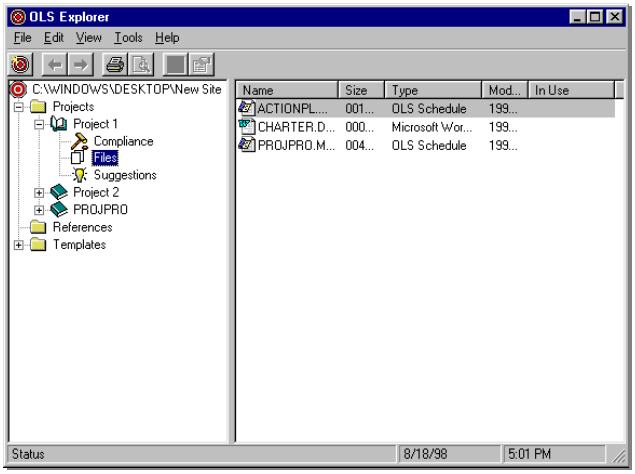

Figure 4. The OLS Explorer

An OLS Site is a file system folder that contains OLS projects for a designated business location and the corresponding OLS templates from which they were created. To use OLS, simply open a specific OLS site and work with its OLS projects and templates. Your organization can have more than one OLS Site, although OLS Explorer will only "see" one site at a time. OLS Sites can be located on your local hard disk or on a network folder.

An OLS template is a special kind of OLS project that you can reuse to create new OLS projects of the same kind. Improvement suggestions are used to improve the templates over time. In this way, templates are used to house and share best practices.

An OLS project is created from an OLS template. An OLS project is a collection of files and other items used by one or more people assigned to a given project. The collection of files usually consists of all the necessary documents, forms, charts, images, and other support files required to carry on a business process in your organization.

The backbone of the documents teams use with OLS projects is a process document. The suggested format of the documents is an MS Project file. There are three types of uses for MS Project files in OLS, as an OLS Schedule, Process, or Check List.

An OLS Schedule is a MS Project file in which duration, start and end dates, predecessor relationships, and time-tracking of each individual task is essential for the proper execution of the tasks in the file and for the overall OLS Project.

An OLS Process is an MS Project file in which the timing and duration of only the entire process, and not individual tasks, are essential for the proper execution of the tasks in the file and for the OLS Project. Individual duration of tasks is not worth tracking. An OLS Process is used, when it is still important, however, to manage the sequence of particular tasks.

An OLS Check List is an MS Project file in which only the completion status of each task is essential. Tasks have no predecessors and the order in which tasks are executed is not important or is not worth tracking in the context of the overall OLS Project.

Processes have inputs and outputs. In OLS these are OLS Input/Output documents and Reference files that are linked in the MS Project files. You can view all linked files in an MS Project file quickly and easily, view the complete file names, and add and manage multiple links to a single task without confusion with the OLS Task Files Links feature. A dialog displays all the files that are linked to a current task in an MS Project file. You may open the linked files, edit the links, or remove the links. The OLS Task Files Links function also takes advantage of the new hyperlink feature in MS Project 98 that allows you to assign one hyperlink to each task.

The ability to make process and system improvement suggestions *as one works* is a cornerstone of OLS. The model for capturing improvement suggestions on the job presents a common interface for all types of OLS files in a project.

The OLS Suggestions feature includes automatic user name and date/time stamping, easy management and retrieval of OLS Suggestions, and the ability to review OLS Suggestions across OLS Projects in an OLS Site. If you want to compare feedback from several different business locations, you can do so.

OLS suggestions are processed from within the OLS Explorer. This interface is intended to provide an easy to use, familiar way for teams to review, analyze, and print improvement recommendations. Processing OLS Suggestions with OLS Explorer also allows the review of suggestions within individual files, complete OLS projects or OLS templates. Reviewing suggestions at the template level allows teams to access all comments made from projects that were started from a common template at any specific OLS Site.

The OLS Import Wizard steps you through the import process. OLS Projects and Templates created in previous versions of OLS may be imported as either templates or projects, allowing you maximum flexibility in updating your system. OLS Templates and Projects may only be imported as templates and projects, respectively, creating a secure environment for your templates. Importing OLS Templates and Projects to other OLS Sites makes your OLS Site 100% portable. In addition, when OLS Projects and Templates are imported, all file links are automatically updated.

OLS provides security and policy compliance features that allow the system to meet stringent requirements for an audit trail. Owners of OLS Template libraries can designate events or items that must meet regulatory or company policy guidelines. The OLS Compliance Items, accessed through OLS Explorer in a similar method to OLS Suggestions, enables teams to document and track their compliance with critical policy items. In addition, Compliance Items may only be updated by the owner of the item, ensuring that only the responsible party can document when a policy's compliance requirements have been met.

The OLS is the Mechanism for your organizational learning needs if you are: 1) interested in the ability to easily create, collect, and review process improvement suggestions, especially between projects; 2) currently using business location or function to define projects, and would like to be able to manage your projects more easily, or, would like to maintain multiple projects more effectively; 3) interested in maintaining a better policy compliance trail; and 4) want a truly portable system, so that you can move OLS Projects from one physical server to another, even when the servers are not integrated.

4 Conclusions

The problem facing the E&P industry is that it has the potential to save up to 50% of its costs in some areas of operations just by not repeating mistakes. With today's offshore rig rates in the area of $200,000 per day, saving even one day from a project schedule is a significant accomplishment. BPX is responding to this problem by challenging themselves to save at least 10% of total well costs. This is about $200 million per year.

Working from a model of how an individual learns, it has been shown that the critical requirements for an organization to learn are:

- *Define specific goals linked to the bottom line.*
- *Access a reservoir of experience to profit from past success or failure.*
- *Ensure actions are directed at meeting goals.*
- *Accurately monitor performance.*
- *Remember how decisions were made.*
- *Improve an accessible reservoir of experience.*

It has also been shown that there are four dimensions in which these requirements must be met.

Finally, a tool has been developed which meets the OL requirements for the Mechanism dimension. This tool captures the knowledge of the individual as a natural process of how they work and retains this knowledge for future use by the organization.

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