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Improved Drilling Technical Training and Communications for Effective Rig Utilization and Accelerated Promotional Schedules During the Big Crew Change and Associated Fleet Expansions

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Abstract

As oil prices inevitably rise and drilling programs expand, the need for knowledgeable staff to perform the work is expanding, even though productivity per employee continues to rise. Additionally, as drilling technology increases, there is an increased amount of knowledge that employees should be aware of on a 'per employee' basis. Third, as new rigs come online, the demographics of the workforce demand that average experience levels of each employee goes down.

The only solution in such an environment is accelerated training and promotion programs. While not perfect nor sufficient in and of themselves, drilling technical training offers an effective way to leverage available crew experience and rapidly promote better understanding of technology on the rig site by both contractor and service company personnel.

Similarly, as well programs become more complex in an experience-challenged workforce, the need for project communications and attention to associated pre-planning briefings becomes critical to project success.

Models for and examples of successful programs for land and offshore programs will be presented.

Introduction

The so-called "Big Crew Change" has been discussed *ad nauseum* for the past several years, with much gnashing of teeth focused on what to do when the current senior staffers retire in large numbers.

This paper focuses on a different aspect of a similar but *unrelated* problem, that might be described as the "Big Crew Up". Specifically, how in the world will the rigs in various stages of upgrading and new-building be suitably manned in the next few years.

It will become apparent that if we are to succeed in staffing the rigs, a new paradigm in rig crew training may be required.

Drivers – Will the Current Boom Last? "Big Crew Up" Coming!

There are numerous drivers to the problem looming for rig contractors. The clearest is the shear number of people needed to be hired "new" to staff the rigs in the next several years. While estimates vary, a recent one put the number of new builds on the books as we speak at 40 semis and drill ships and another 60 jackups.[1] This translates into upwards of 40,000 or more brand new hires to staff these rigs, all wearing green hard hats.

Land rig construction is booming too, though exact numbers are more difficult to find with accuracy. One report has Saudi Aramco bringing in 140 new land rigs in the next year or so alone.

Perhaps more to the point, it requires expanding the current number of senior rig site personnel (Derrickmen, AD's, Drillers, Toolpushers, Directional, Mud Engineers, and others) by a net increase of around 20% in the next 3-4 years!

The math says that this can only be accomplished with less experience on the job. The recurring notion of poaching employees from other companies only works in a relatively stagnant rig market. Employing it in an expanding one may actually make things worse, since as one observer noted, "considering that it is usually some months between the time an experienced professional is hired and when he becomes productive, the effect overall is a loss…"[2]

Of course, the rig builds are being driven by oil prices, which in turn are being driven by world energy demand. Is it reasonable to assume either of these will wane in the coming years or decades? While no ones crystal ball is clear or accurate, we can all benefit from a walk through history from time to time.

First, lets look at energy demand. For the US, energy demand increase since the Great Depression has been

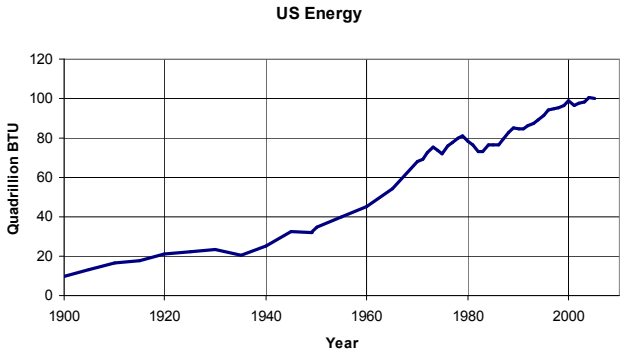

Figure 1-US Energy Consumption-All Sources

astoundingly constant, with a few perturbations around major price spikes.

The effect of major increases in pricing sets back consumption temporarily, apparently until people get over the "sticker shock" effect, and then demand proceeds upward as before. So far, consumers have decided that the freedom of mobility oil provides is worth the cost. There is little reason, outside of political rhetoric, to believe these trends in the US will abate soon.

For the international picture, demand growth is even stronger, albeit starting at a lower absolute consumption level. This is largely due to three populous countries—China, Indonesia, and India. These three are industrializing in a big way and their small but rapidly growing capitalistic middle

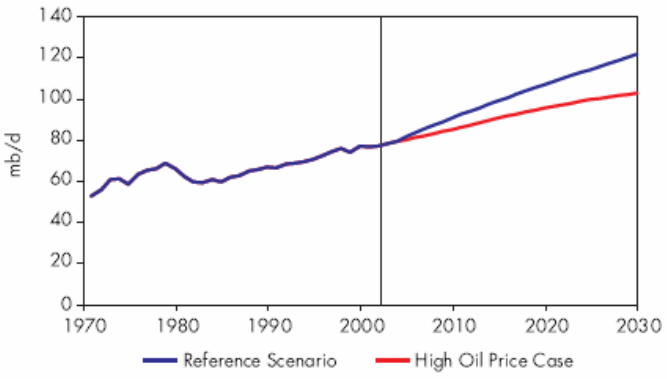

Figure 2-World Petroleum Demand (after WEO)

class is starting to drive cars. Cars do not run on rice. As shown below, non OECD energy demand is expected to rise even faster than that of the US and other already industrialized countries.[3]

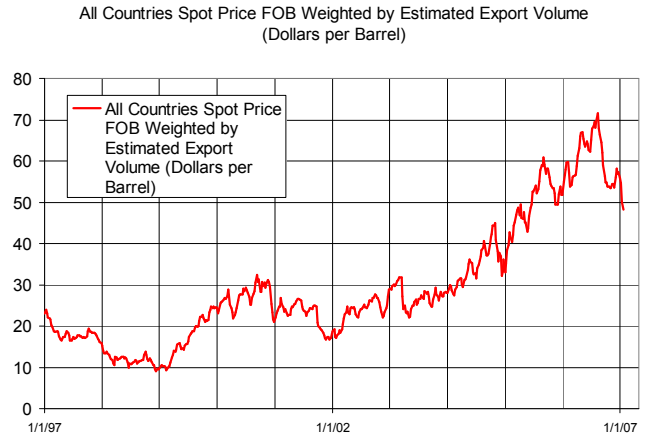

Figure 3-World Spot Price of Crude Oil

What will this growing world demand for petroleum products do to oil prices? Long term, the trend is clearly upward, as shown below. To be sure, there will be ups and downs shorter term, as appears to be the case at this writing (in late January, 2007), but the longer term picture is higher.

Economic principles dictate that as the oil becomes more difficult and costly to extract for the marginal producers then prices will escalate accordingly. Barring Middle Eastern flooding of the market (something that likely only Saudi Aramco has the capability, but no economic incentive to do), there is little to argue for any sustained decline in prices.

With both demand and pricing apparently secure, then the need for skilled and experienced rig site workers becomes even more imperative than at any time in petroleum history. One way that personnel managers are looking to fill the gap is through the use of greatly expanded training schemes to enable competent hires to advance more quickly than in the past.

Prerequisites - Language and Basic Math

Before any sort of accelerated advancement of new hires can take place, basic language and math skills must be in place. We recognize the critical need for this, particularly where English may not be the first or native language of the new employee, but we assume that any fast track advancement program will already have this taken into account.

Language skills may be obvious, but math may be more difficult to ascertain without formal testing. This author has found that some rig workers can have difficulty in even basic math operations being done *even with the use of a calculator.*

When math operations such as squares or square roots are required, even the concept of the terms themselves may be new to some rig workers.

Historical Model of Employee Advancement

Historically speaking, rig site personnel, and even many office workers, spend a considerable amount of time—months or even years—just ramping up to speed on terminologies and knowledge of basic equipment.

While rig site workers are amply trained in such things as team-building, leadership, safety, helicopter safety, and for at least senior personnel, well control procedures, there has been little to no training of rig site personnel on the *mechanics* and *machinery* of drilling.

What technical training that is done has historically been accomplished primarily "on the job", which while being very good quality training, unfortunately, takes a long time and mistakes along the way can prove extraordinarily costly, particularly for the offshore environment. Importantly, OJT may not always be correct or up-to-date, and there is little to no feedback mechanism to weed out incorrect technical concepts.

Additionally, the nature of the work rotation, be it two-weeks on and two weeks off, or four-on four-off, or in the case of Norwegian workers, two-on four-off, means that critical but somewhat unusual operations may be missed by particular individuals, simply because they happen to be on "days off" when the particular operation occurred on the wells.

This results in a hit-or-miss technical training, where it cannot be safely assumed that a driller with five years experience has first hand experience with running liners or perhaps even stuck pipe recovery operations. Compound the

lack of exposure with the increasingly complex nature of many of the tools being used, and the problem rapidly escalates.

In terms of technical learning, whether about the machines or the downhole mechanics of drilling, a typical model of a career might look like that in Figure 4.

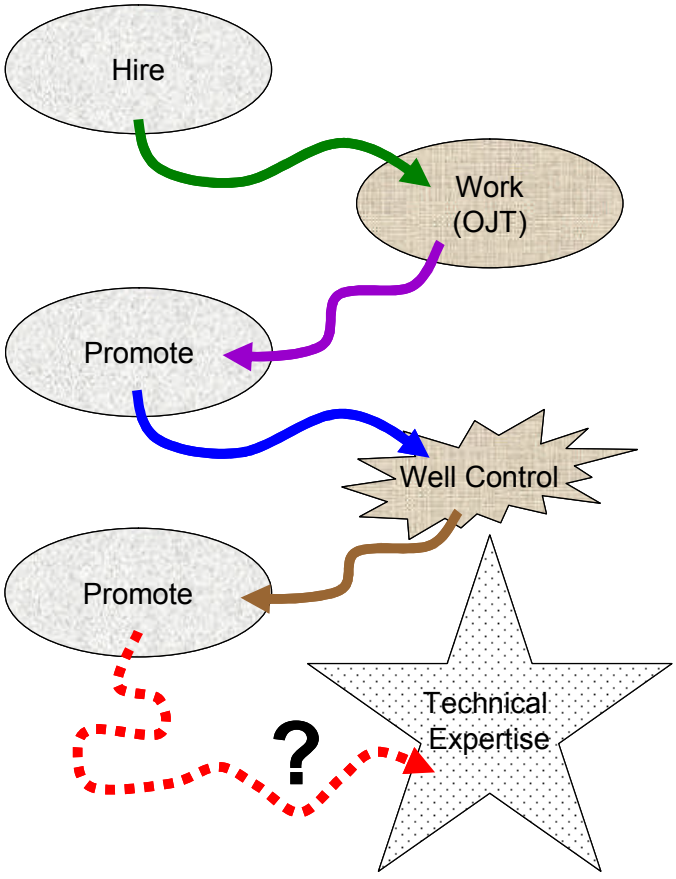

Figure 4-Typical Advancement Paths

Again, note that the path connecting training with promotions can be very obtuse, take many wrong turns, and in some cases never result in a technical "star" employee being developed. In the case of the technical training (beyond safety and well control), the path can be particularly uneven, as shown by the dotted line in Figure 4.

More critical to our current manpower crunch is the fact that such hit-or-miss on-the-job training takes a long time to develop a competent AD, Driller, or Toolpusher, who not only knows how to run the machine we call a drilling rig, but also why we do what we do and at least a usable level of technical skills.

If the upstream is going to rapidly accelerate the finding and production of oil for a growing world appetite for it, we must accelerate the development of key rig site personnel accordingly. It calls for a new paradigm of how to hire, train, and promote rig personnel.

The following sections discuss some ideas for accomplishing this lofty and ambitious goal.

Accelerating Everything

Every aspect of personnel hiring, training, and advancement must be on the table if we are to ramp up to man the iron coming down the pike.

Use Better Raw Materials

Anyone providing a manufactured product knows that a vital part of the quality of the finish product is the quality of the raw materials. The same is true of labor-related 'product'. If one company has a better qualified labor force, they will, all other things being equal, have a competitive edge on their competition. In a global labor market, the upstream needs to do whatever it takes, (most likely meaning higher pay), to obtain and retain the very best people available for the accelerated training and advancement programs. The old saw about all it takes to get hired on with a drilling contractor is to pass a drug test will no longer suffice.

Some companies have been working toward this, and have been doing extensive pre-employment testing and more recently, raising pay rates, to accomplish this.

An important part of obtaining and retaining better workers is having more workers to choose from in the first place. In this light, the industry could do much to improve public relations with the general public and the government.

Accelerating First Contribution – Basic Training

Depending on the worker and the job at hand, it can be weeks or even months before the worker makes a genuine contribution to the operation. Prior to that point, he or she may actually reduce the overall efficiency of the operation, as more senior workers are required to help train (and look out for the safety of) the new hire.

Much of this breaking in period involves learning basic terminology and concepts. For better or for worse, the oilfield almost has a language of its own, and until that language can be learned, one will not be very productive in the environment as are others who "speak the language".

A short yet effective training on introductory drilling concepts can dramatically shorten the time it takes to get the new hire to the status of a contributing worker. If a suitable rig is located near the school venue, some parts of the training can be reinforced with the rig equipment nearby.

A concept not often employed in the upstream is that of having a prospective new hire complete an introductory basic training course, and the decision to hire be at least partially dependent on the candidate's performance in that course.

Accelerating Experience - Intermediate Training

Much can be attempted in order to accelerate experience. Perhaps the most obvious item, the "low hanging fruit" so to speak, is to teach new hires what to look for. Then, when they actually see their first liner job or logging run, they will already have some degree of understanding of the operation and will glean much more benefit from what may only be a

relative handful of experiences they get firsthand before being promoted to the next level.

In a similar vein, the recruits with enough basic training and a little experience under their belt to adequately speak the language of drilling, can be taught why we as operators do what we do. This is a far cry from the nitty-gritty details as to exactly how we accomplish, say, a casing design, but just knowing the concepts behind preventing casing collapse, burst, tensile failure, or connection failure can again, accelerate greatly the employees benefit and understanding of operations as they are exposed to them the first few times.

Accelerating Expertise – Targeted Technical Training

Some technical items might not be amenable to learning on-the-job in an osmosis-like way. To advance to a thorough understanding of hydraulics, for example, requires that one study hydraulics principles in detail. Casing design, mud design and maintenance, and solids control would all be similar in nature. Whereas the introductory training would let you know what a shale shaker was, and the intermediate training would let you know more about how it works and convince you that it is important to remove drill solids, only the detailed technical training would make one competent to analyze and if need be, improve upon solids control equipment design and operation.

With these aggressive technical training programs in place, rapid assimilation of rig technology and its proper use could take place. More rapid assimilation of the technology would permit rapid advancement for the more gifted workers, and faster advancement even for the typical worker.[4]

A graphical illustration of these concepts is shown in Figure 2Figure 6.

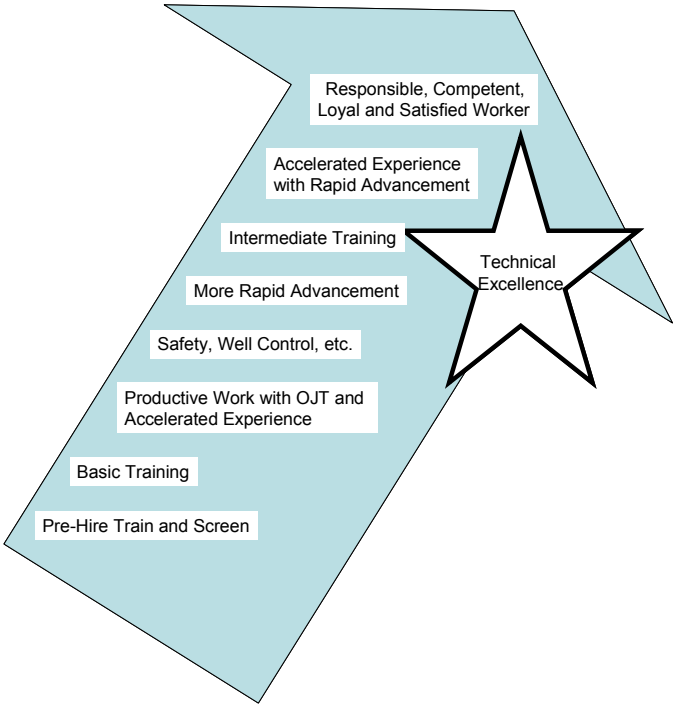

Figure 6-Accelerated Experience Training Model

To be sure, this accelerated experience model requires additional training compared with what a "typical historical" rig worker would receive. However, with rig and spread rates now topping $25,000 per hour in some operations, even a small savings in time or improvement in efficiency or single section of hole not lost would likely pay for the training and more.[5]

Reduction of Unscheduled Events

Trouble costs or unscheduled events have been a significant portion of drilling and completion costs, often topping 20% or more for offshore projects and even averaging 10% for relatively routine land operations.

By far the largest component of these costs is stuck pipe, accounting for around 50% of most operators total downtime for a typical year. To address this, BP, and later Amoco, developed "Stuck Pipe Prevention" schools, which focused mostly on awareness issues in their early days.[6] The concept was that well control training had shown a demonstrable effect in that well control risks were down compared to pre-training days, and there was good reason to believe that the same could be accomplished with Stuck Pipe performance.

Though not as successful as Well Control training, stuck pipe prevention proved to be well worth the training effort, and in the mid 1990's Amoco extended the concept to include many other categories of downtime as they developed their "Training to Reduce Unscheduled Events", or TRUE training program. Often this class was combined with safety and

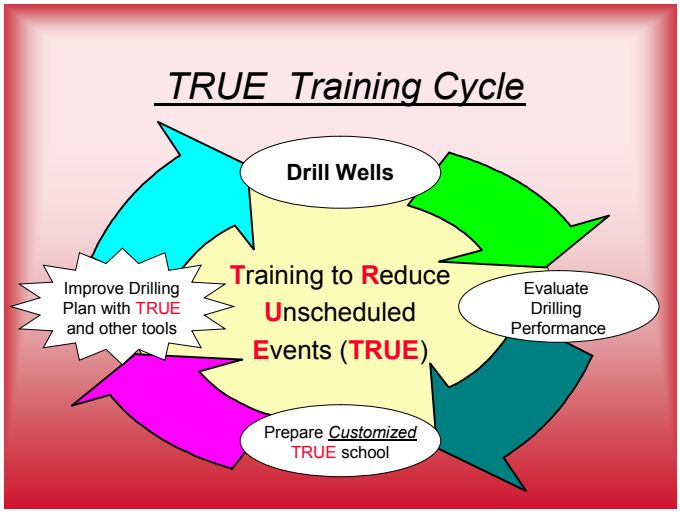

Figure 5-TRUE Training Cycle (after Amoco)

teambuilding topics to simultaneously develop working relationships between the operator and contractor and third party services personnel, and impart technical training.

Note that the TRUE schools were tailored somewhat for the upcoming well. Only areas of trouble that were reasonably expected to be encountered for a well were covered. In this way, the TRUE training was a "just in time" type of training, best undertaken immediately prior to the well spudding.

Being customized for each well, it could be held multiple times with a given rig crew, since each "school" was somewhat different. The original TRUE training cycle, a typical Plan-Do-Evaluate-Learn cycle, is shown in Figure 5.

Appreciation ran deep by rig personnel after a typical attendance at a TRUE school, since this was one of the first schools to teach true technical concepts (in an overview, mostly non-math intensive manner) to rig personnel.[7]

Though not as trendy as it once was, some companies continue to teach TRUE from time to time.

DWOPS & CWOPS

For the operator picking up a new rig or a rig for the first time, a tried and true way to improve well site performance involves sponsoring well-specific meetings and short training sessions to address or re-address challenges with a specific well. A classic embodiment of this concept, made popular by Shell, was the Drill Well On Paper (DWOP), and later, the Complete Well On Paper (CWOP) meetings. Rather than being a classroom school in the classic sense, these were and continue to be highly interactive planning meetings, best conducted a month or two or more before spud or completion operations commence, to review a "straw man" procedure with senior personnel from the operators, contractor, and service company sides. Benefits range from identification and avoidance of pitfalls in the initial plan, to tweaking of procedures, to the rapid dissemination of best practices since the participants are almost always a very diverse group representing numerous different backgrounds, geographic regions, and experiences.

Comprehensive Pre-Spuds

The last part of the just-in-time training consists of holding large and comprehensive pre-spud meetings, ideally scheduled when possible to be the day or two prior to crew change to go do the work. The meetings are not so much intended to put major changes in the project plans, as much as to inform everyone on the rig just what the plans are in a non-threatening non-chaotic environment, get suggestions for improvements in execution (manpower, skills, equipment, interface issues, prior problems with similar operations, etc.), and as with TRUE, build a little camaraderie and allow people to at least put a face to the name to facilitate better project communications.[5]

To be effective, these pre-spuds must include value for all participants—operator, contractor, and service companies alike. Recognizing that rig personnel will be attending during their usual days off, the pre-spuds should be structured and professionally conducted such that they are genuinely beneficial and not simply "another meeting" to attend. The latter will not play well when compared to time with family, hunting trips, and other competing interests.

Testing

A delicate subject that many will not address is the need for and the value of formal testing. It can be nearly universally recognized that a typical worker, whether rig-site or office-based, will not particularly enjoy testing. However, the benefits of testing are well known and consistent. It is routinely done in nearly any critical service, ranging from aircraft pilots to police officers to our own well control schools. It works. It is time we recognized the need for it in drilling operations.

Testing accomplishes two primary functions:

- Provides feedback as to how well the material is being learned by the student, and
- Provides a clear incentive for the student to try harder to learn the material in the first place.

Note that the first item can be used by management as a data point for decisions regarding future job responsibilities. Importantly, it can also be indicative of the skill of the instructor as well—consistently higher grades on standard or near standard tests can indicate a superior training ability on the part of the teacher.

The second item is often something even the grumbling test-takers are willing to acknowledge.

Given the dearth of technical training afforded most rig-site workers, the results can be stunning. When the TRUE training was being initiated, both pre-TRUE and post-TRUE testing was given, in part to evaluate the effectiveness of the TRUE course itself across a wide and growing range of instructors and training companies. Some of these early results are shown in Figure 7.

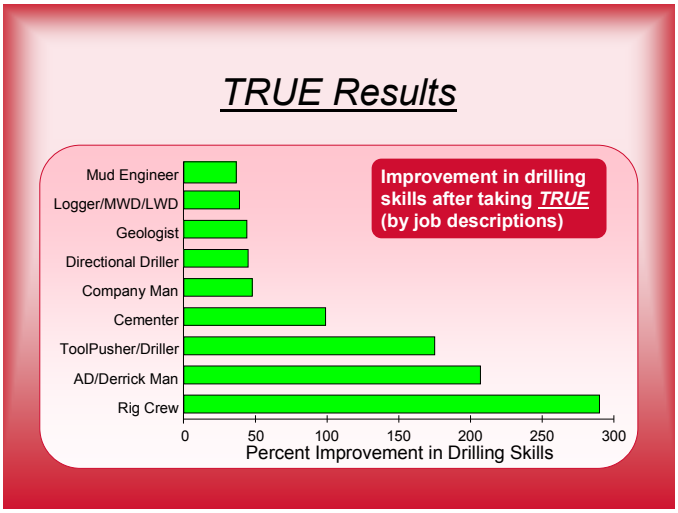

Figure 7-TRUE Training Results

Note that the improvement in drilling skills as measured by the testing is less for more experienced personnel—they already know more—but is still impressive, from a low of around 40% for Mud Engineers to nearly 100% for Cementers. Importantly, all categories of drilling contractor personnel improved well over 100%, with entry level personnel approaching 300% improvement!

These results also support the idea that the technical training can jumpstart or accelerate the benefit from what may

be limited exposure to certain operations for a given individual.

Conclusions

To summarize key points:

- There is an urgent need for new drill site personnel, driven not by the "Big Crew Change" but rather by the "Big Crew Up" for new build rigs coming onstream in the next few years.
- This need is likely permanent as the world's appetite continues for liquid energy.
- The historical model of hiring and sporadic classroom or on-the-job training is inadequate for todays drilling rig needs.
- More rapid assimilation of drilling technology is needed.
- Additional training offers the potential to accelerate experience benefits and promotional opportunities.
- Operators continue to be concerned about unscheduled event avoidance.
- TRUE, DWOPs, and CWOPs can improve efficiencies and reduce downtime costs.
- Comprehensive pre-spuds offer significant advantages, particularly when picking up a new build rig or a rig for the first well under a contract.
- Testing should be considered in any training course as a device to measure and enhance learning.

Acknowledgments

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