Targeted Technology Development: A Tool for Cost Reduction

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Daneshy's experience includes many successful collaborative developments with oil companies and small entrepreneurial technology companies. He is an active member of SPE and recipient of its distinguished service and distinguished member awards. Presently he is the president of Daneshy Consultants International.

Industry's response to low oil and gas prices historically has been to reduce costs through restructuring, re-organizing, staff reductions, technology reduction, renegotiation of existing contracts, out-sourcing, etc. These actions, while essential and effective, are not likely to yield the same magnitude of results as in the past. Most low hanging fruits have already been picked off the tree. The industry's future depends on finding a different formula for cost reduction. Technology can contribute to this goal and should be directed toward it.

During hard times, the industry's approach to technology has followed its accounting definition–an indirect expense and candidate for reduction. The main disadvantage of this approach is its implied message. Technology should be, and should function as a creator of value, not an indirect expense. The real contribution of technology should be in the value it creates, which should be substantially higher than its associated costs. Any technical group whose absence brings more value than its presence is indeed a good candidate for reduction. The more prudent approach is to lead and manage technology to deliver means for reducing operating costs, as well as better reservoir performance. In this approach, technology is actively engaged in contributing to the well-being and profitability of the whole organization.

Structurally, only a small percentage of oil and gas producers and service providers have a dedicated technology or similar group. In reality, the number of staff engaged in technical work is substantially larger. Although most of this latter group is not directly involved in development of technology, it can still make a major contribution to cost reduction through application of technology; i.e., by actively directing or taking advantage of new or existing developments which can reduce cost or enhance reservoir performance. As users of technology, they can help developers by specifying product or process features and useful attributes, setting working and operational boundaries of the new developments, and by clearly specifying how the new or existing technology creates value for the user. But even more importantly, they can become the brave souls who champion the application of technology in their own organizations. Technology's role is too important to be left alone.

Value of Technology

Fig. 1 is often used to indicate the value created by technology. It illustrates the difference between early proactive adoption of technology and its late passive application.

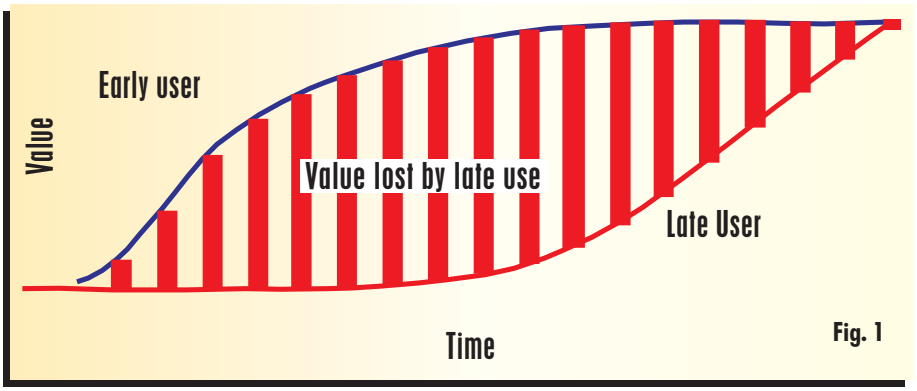
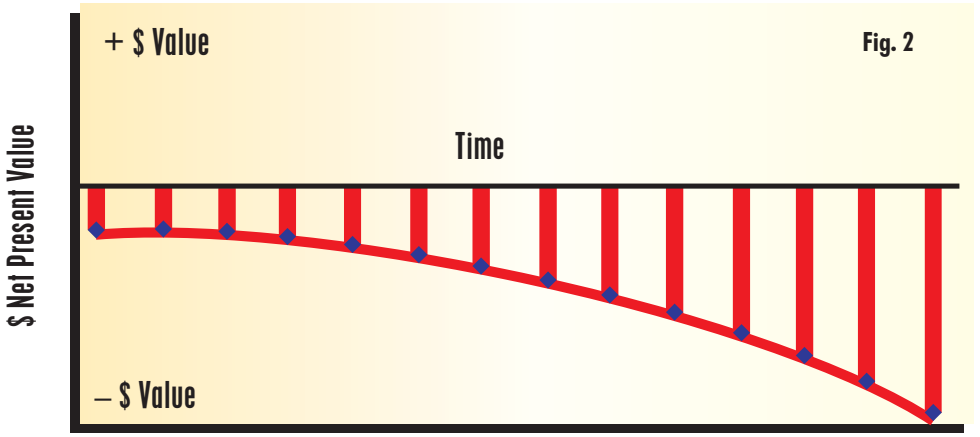


Fig. 1



Although good technology will permeate the entire industry eventually, the early user gets most of the benefits. The disadvantage of this graph is that it does not consider the cost of the absence of technology, which is shown in Fig. 2.

The absence of technology to solve daily operational problems creates a great deal of direct cost for the industry. Formation damage is a good example. There is a direct cost associated with damage-removal services. Because draining a damaged reservoir takes longer, fixed and variable production costs will exist much longer. Also, the direct loss from a reduced well productivity continues as long as the damage impedes fluid flow.

Another good example is produced water, which has substantial costs associated for its production, separation, processing, and disposal.

While the previous examples apply globally, absence of technology can be on a local basis. For example, a remedial cement job is costly to the operator and the costs will continue until the causes are found and a permanent solution is applied to eliminate them. Such solutions are most likely available elsewhere.

The author's favorite example is the real case of an operator's problem with cement plugs. Three plugs were placed before one would be successful. The solution was quite simple–avoid short cutting the recommended practices for the perceived reduced cost. The result was 100% success. The solution took just a few days. Although the solution was technically simple, the operator had incurred the cost of many earlier failures.

Market-Driven Technology

During the last few years, some have adopted the view that the market itself is a good driver of technology development. This logic assumes that if there is a need, there is a way. The expectation is that once the service industry recognizes the need, it will provide the solution, as shown in **Fig. 3**. The process is expedited by actively informing the service industry and technology providers of the need and its potential market size.

The disadvantage of this approach is that the absence of a given technology does not impact its developer or provider in the same way as its user. As a matter of fact, unless the developer of technology is also its user, its absence will not cost the developer anything other than a potential future business. In the initial phases, the new development has a negative value for the developer. The gains come at a later date when the

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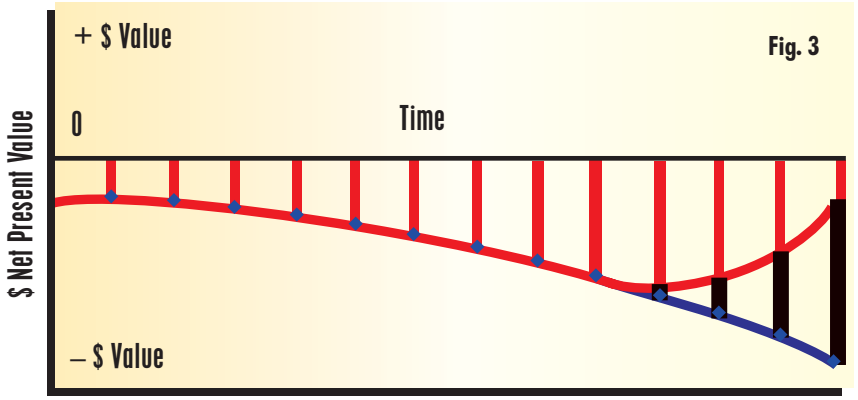

(Guest Editorial continued from Page 7)

product or service is profitably adopted and used by the industry.

At times of financial hardship, it is natural for the service industry to adopt a conservative approach and reduce its longer-term technology portfolio in favor of sustaining and improving its existing products or services. Even with higher oil prices, the service-industry's resources are limited and can address the needs only very selectively. Given these limitations, one needs a mechanism by which the service provider can be engaged proactively to find a joint solution for a costly problem in a win-win environment.

Another consideration is that technical solutions for the same problem are not applicable everywhere. Damage removal in fractured or unconsolidated reservoirs requires different sets of technologies. The solution for water flow in a prolific offshore reservoir in the highly regulated North Sea is different from that of a land well with modest flow. Even for the same technologies, the set of competencies required for their successful execution is different. Thus, the absence of technology and the solution to it, should be viewed in terms of its local financial cost, impact, and local applicability.

Direct Cost Reduction

Because oil price is expressed in terms of U.S. dollars per barrel, we can adopt the same formula for cost reduction.

Cost/bbl = Total costs/Total bbl produced

To reduce cost/bbl, one needs either to reduce total costs, or increase total barrels produced for a given cost.

Best Practices

A good and common method for reducing costs is transfer and implementation of best practices. The difficulty in this process is to identify the operations where best practices are absent. Most of us assume, and actually do, what we view to be the best that can be done under the circumstances. An outsider is in a better position to help with this process.

A higher value usually can result when best practices are applied to the way operations are integrated. For example, the way a well is completed will impact future options on what remedial services can be performed in the well. While a particular completion method may be the most cost-effective initially, it may not be so over the life of the well.

Service-Quality Impact

Service-quality problems cost industry a great deal and deserve much attention from users as well as providers or developers of technology and associated services. The same is true for inefficient applications of technology or their inappropriate integration. Any new development which improves service quality is bound to have a positive financial impact.

The industry needs to target service quality as a major component of new technology development. This will require a higher level of standardization than currently exists. It also will require built-in service-quality monitoring and measurement techniques.

Risk

Another important contributor for reducing costs is to understand and quantify risk. There is a risk associated with most of the industry's operations, and it affects cost. Risk analysis requires good and reliable data, which are not usually available and not even collected as part of daily operations. Understanding and quantifying risk provides a way to more prudently select the best option for a given location.

Fear of "risk" is a major obstacle in adopting and implementing new or different technology. The industry's inability to quantify risk, even in very gross terms, has cost it dearly. Although some perceived risk is real, fear of the unknown accounts for some of the reluctance to adopt new practices and accept the changes they will bring.

The reality is that most organizations have excellent abilities for some operations, but only average or lesser abilities for others. Imagine the financial impact of raising the number of "excellent operations."

Reservoir Productivity

Increasing well and reservoir productivity will reduce the cost to produce a barrel of fluid. In fact, enhancements in productivity usually have such a major positive financial impact that the costs of associated services become rather insignificant.

Formation damage is the likeliest impediment to productivity. It is estimated that most wells produce with a positive skin factor. Damage can occur at any point in the life of the well, starting with drilling and continuing into completion and production. This is one area where having a "life-of-the-well perspective" is essential for success. Recent developments in underbalanced drilling have shown spectacular results. More technology is needed to develop appropriate completion technologies and to increase production options over the life of the well.

A great deal is known about reducing well damage, but the application of this knowledge has not been adopted globally by the industry.

One main reason is the fear of losing existing production, which reinforces previous comments about understanding and quantifying risk.

Another significant contributor to reduced well productivity is produced water. Unwanted water production is estimated to cost the industry billions of dollars annually. Because of nonquantifiable risks, some operators view water production costs as less of a problem than the potential for reduced well productivity caused by remedial operations.

Another impediment to greater well productivity is our inability to better define reservoirs and track fluid flow within them. The industry has recognized this problem for a long time and currently several efforts are underway to miniaturize sensor technology for downhole installation and monitoring. The development and maturing of these technologies will create a step change in the way the industry will explore and produce oil and gas.

Other notable technologies being developed that will impact future operations include:

- Multilateral wells.
- Expandable tubulars.
- Smart wells in which one can monitor well and flow conditions continuously.
- Intelligent completions in which one can monitor and control downhole well flow in real time.

Other technologies will allow downhole processing of the produced fluids, including downhole separation and reinjection of water and gas.

While most of these technologies are in their early development stages, the industry can impact their usefulness by pursuing and supporting their development and application more aggressively. They will also open the door to development of new concepts in reservoir exploitation and indeed for new architectures for reservoir development.

Targeted High-Impact Technologies

Obtaining a greater benefit from technology will not happen by accident. It has to be visible and part of the organization's strategy and tactics, supported by management.

Given limited resources, what are the steps that the industry could take to enhance these benefits? The answer lies in its choice of processes and resources, most notably human.

Targeted high-impact technologies are defined as technologies which can have a high financial impact on a targeted location. They do not necessarily have to be the latest developments or leading edge. Examples could include implementation of best practices to avoid mis-runs or enhance costly service-quality problems, applications which improve well productivity, improvement to service efficiency, or higher levels of integration to improve life-of-the-well economics.

The selection of high impact targeted technologies can be based on the following criteria:

- *Benefit/Cost Ratio*. This is a good criterion for early prioritization of prospects. The team should be asked to determine this up front and as a measure for its effectiveness. Realizing the optimism which usually prevails at the start of these projects, the expected benefits should be at least one order of magnitude larger than the associated costs.
- *A High Chance of Success Within a Reasonable Time.* The longer these projects take, the more likely that either the management or the participants lose their enthusiasm and focus. It is recommended that a time schedule be set up at the very beginning and projects prioritized on the basis of how quickly they can be implemented.
- *Local Capabilities and Technical Capacity.* One goal is to facilitate distribution of new technology in other parts of the organization or other fields, and develop a group of "well-informed buyers." One therefore needs to consider the availability of local technical staff to participate in the project and support it to its completion as well as serve as future advocates for its adoption by the rest of the organization.
- *Availability of a Delivery Mechanism.* Who is going to deliver the services associated with the targeted technologies? Availability of a reliable, dependable, and cost-effective service delivery mechanism at the specific targeted site is a *must* in this process.
- *Other Considerations.* One also needs to consider specific company or regulatory requirements for the implementation of the targeted technologies. It is important to identify these up front and include them while building the relationships that result from undertaking the projects.

Often implementation of these technologies requires outside assistance. This can come from service companies, consultants, or small technical companies with specialized know-how useful to the project's success. Prudent selection of these participants is an important aspect of this undertaking. Past track record of reliability and competency are crucial for success. Also important is to prepare an honest appraisal of existing local competencies and reinforce technical and operational weaknesses through external sources.

Operations groups of the operator and service provider need to be represented to facilitate execution of the associated services. Their full

participation in this effort is essential and will prevent last-minute discoveries, which result in delays or misfits between the technology and its target.

The first charge of this team is to formulate its own vision and mission. It is recommended that the team be asked to define "success" up front in both operational and financial terms. The team is also charged with developing the action plan and time schedules, financial plan, and expected benefits.

In selecting team members, consideration should be given to keeping the team small and making sure every team member has a critical contribution essential to the success of the project.

The team's first undertaking is prudent selection of targeted technologies and delivery site. Next comes selection of team participants. A local service company with a good track record can be a valuable participant in the process.

Next, there is a need for contractual relationship between participants. This can be an extension to existing service contracts or a new one with new participants. In formulating the contracts, all participants should keep in mind that the aim of the relationship is to create winners for the entire team. Any gamesmanship or power play at this stage can muddy the water and become a recipe for failure.

The contract should address issues related to intellectual property rights, confidentiality, financial responsibilities of all participants, service delivery mechanism and costs, termination clauses, liabilities, and a mechanism for resolution of issues that are likely to be encountered during the project execution.

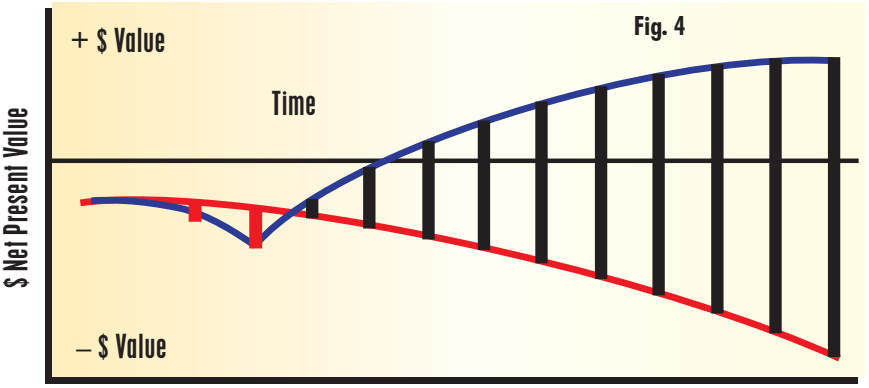

Fig. 4

Although these steps may appear elaborate, they actually are not much different than the existing contracts, which are used in daily business operations.

A simple project to resolve service-quality problems can be handled by a team consisting of just two engineers, the operator and the service provider, without the need for any additional contract. On the other hand, incorporation of a highly integrated new technology can involve several companies and comprehensive contracts. Qualified consultants can provide the necessary help and facilitate the entire process as well as provide project management.

Some soft issues are equally critical. Successful implementation of targeted technologies requires:

- Management attention and sponsorship; the visibility will motivate the team.
- A high level of trust and willingness to share (occasionally sensitive and traditionally confidential) information.
- A win-win attitude.
- Ability to work in a team environment where all participants are equal.
- Decisions made by consensus.
- Tenacity and consistency.
- Flexibility.
- Urge to innovate.

Finally, commitment is the glue that holds the team together and secures success for everyone involved.

With a proactive pursuit of a solution, the user creates value and cost reduction, as shown in **Fig. 4**.

To sum up, technology should be managed to deliver a means for reducing operating costs, as well as to provide better reservoir performance. Technology should be led and expected to engage proactively in contributing to an organization's well being and profitability.

Cooperation between operators, service companies and small entrepreneurial technology providers can provide opportunities and synergies for step changes in cost reduction. A new format for these relationships will expedite full appreciation of their potential.

Selecting a targeted location for the application of technology will help prevent it from "sitting on the shelf." The user's participation and input will substantially expedite early and successful execution and use of new or existing developments.