

# Guest Editorial

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## Dynamics of Innovation in the Upstream Oil and Gas Industry



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Creativity and innovation hold the key to today's success and tomorrow's growth and profitability. The world around us is changing at an astounding rate. Today's success may not repeat itself tomorrow. New companies are born every day, and well-established giants wither and die from changing market dynamics. Continuous prosperity mandates watchful business eyes and incessant infusion of innovative technologies to do what we have not been able to do before and to do it better and cheaper. The oil and gas industry is not immune to the dynamics of this change. Today's high energy prices may not be available in tomorrow's market. New technologies from entirely new players with innovative approaches to providing world energy needs may prohibit today's oil and gas industry from conducting business competitively with today's methods and costs of exploration, development, and production. Environmental and geopolitical issues may change market dynamics and mandate a higher level of energy self-sufficiency as well as provide financial sponsorship to other sources of energy. The question is: Are we prepared to survive in a business environment different from our traditional one?

Although oil and gas is the world's largest industry, as a percentage of revenue, its investment in technology and support of innovation is very small. Furthermore, because of the relative prosperity of the industry, it gets very little support from general funding sources, such as governments, nonprofit institutions, etc. Traditionally, acceptance and adoption of innovation have been closer to trickle flow than to a blowout. The prevailing culture of the industry is to sustain the known methods and accept their low risk and slow progress rather than explore the possibility of leaping ahead with bold new technologies.

Three separate processes determine the success of every creative idea. These are individual creativity, organizational support, and field acceptance. Below, the status of each of these in our industry is examined.

**Individual Creativity.** Given the large population of technical people in our industry, it is safe to assume that we enjoy the same distribution of creatively gifted people as any other. While some may argue that the heavy workload is distracting our colleagues from being creative, the fact is that the same situation exists in other industries that are viewed as highly creative. Other ingredients essential for individual creativity are work latitude and some degree of freedom

for the pursuit of unconventional ideas. But above all, what drives the creative mind is organizational support and peer recognition.

Some people believe that creativity is a God-given talent limited to the lucky few. But this is not so. To varying degrees, all of us have the talent and the urge to become creative. There are tools and methodologies that can open up the creative process in our minds. Our thinking processes occur in two different ways—vertical and lateral. In vertical thinking, each step is the logical consequence of the previous step. This is the thinking process utilized and developed in our formal education, especially in math and science. In lateral thinking, thought sequences are linked together through a fuzzy chain and are not necessarily logical. Lateral thinking is more focused on a search for a direction rather than following one. The process of creativity involves both types of thought. Lateral thinking sows the seeds of a new idea. Vertical thinking nurtures and matures it into a useful outcome. Individual creative talent can be enhanced through training and awareness of the process.

**Organizational Support and Sponsorship of Creativity.** Most creative ideas fail not because the ideas are bad but because the business plan conceived for their implementation did not take into account the realities of the marketplace. Most creative ideas are basically just that, "ideas." Their transformation into a sustained and profitable integrated business requires a great deal of dedicated organizational support (e.g., financial, manufacturing, marketing, sales, operations, technical, etc.). At this stage, the organization leads the creative effort, and the "creator" role is mostly as a team member. Introduction and marketing of innovation often requires a different set of business plans, practices, and skills from those for existing established businesses. Successful execution of new technology and selection of the best point-of-market entry are critical parts of this plan. Selection of a cooperative and supportive first client helps the development, and then validation, of the usefulness of the new technology.

Innovative organizations do not happen by accident. They are founded on a sound understanding of how management can nurture the human creative genius. They are built on occasional departures from the established culture and norm, an acceptance of change as an element of progress, and the willingness to accept failure as an essential ingredient of success. Espousing and fostering a culture of creativity is one of the primary functions of good management. The culture of an organization plays a big role in its ability to foster innovation. But culture is usually the result of historical actions and employee perception of the preferences and leanings of its management. The extent of support and encouragement provided by the organization goes a long way toward creating a positive attitude toward creativity within the organization and provides an unwritten constructive message to its staff.

**Field Acceptance.** The success of any innovation depends on how quickly the "field" accepts and uses it. By the word "field," we mean the community of potential users who will benefit from the new technology. This is the "make or break" phase of an innovation.

Traditionally, the upstream oil and gas industry has been relatively receptive to modifications, improvements, or minor variations of existing technologies, although in recent years, price differentiation has been more acceptable than performance. However, the response of the industry to truly significant innovations is largely dependent on whether its implementation takes place inside or outside the wellbore. Outside the wellbore, the industry is relatively receptive to new technology. For example, new data management and communication techniques have enjoyed relatively rapid acceptance in the exploration and development arenas. However, the industry is viewed to be risk averse and slow to accept radical ideas or innovations that are implemented inside the wellbore. This is a very unfortunate situation, since the main source of value in all of these activities is the produced fluid, which has to flow from the reservoir into the wellbore, and then through it to the surface. The way that the wellbore interacts with the reservoir determines the speed and completeness of the process. Examples of these technologies include horizontal drilling (which took years before it was accepted beyond a special-case application), underbalanced drilling, downhole wireless data transmission, downhole robots, coiled-tubing drilling, multilaterals, intelligent drilling, smart wells, intelligent completions, downhole oil/water separation and reinjection, expandable tubulars, etc. Indeed, in spite of industry pressure for their development, some of these technologies did not extend beyond the laboratory prototype and have not been accepted by the industry at all, resulting in substantial financial loss for their developers. The troubling point is that this situation is gradually getting worse. While rejection of new technology is nothing new and should be expected as part of doing business, in all of the above situations, the development of the new technology was at the urging of operators. If these technologies appeared beneficial to the industry, why did the operators eventually reject them, and did the operators inform the developers what changes were needed in the technologies to make them viable?

The process of field acceptance has four basic components: establishing the potential value of the innovation for its end user, its integration into the existing system, successful execution, and proof of reliability with time. Integration means the technical process of matching individual components and subsystems into a cohesive, efficiently functioning unit. These four components are intimately intertwined. The value realized from any innovation depends on how and where it is used and integrated into the existing system and on its useful life. A careful review of all of the above technologies shows that their slow start or failure usually was related to the perceived difficulties of integrating them into the existing completion, drilling, or production systems, and to questions about their long-term reliability. Within the oil and gas industry, the operator has usually retained the role of integrator and evaluator. This is particularly true for larger companies. But the process of integration often requires technical skills that are likely to be lacking, especially in the case of new and innovative technologies. The value of any innovation depends on how and where it is being used. As for reliability, no product has an infinite life. And the only measure of reliability is through historical performance. What is important is the value created by the innovation during its useful life. The blame here lies with the culture of our industry, which has not advocated closer collaboration between operators and service providers to define acceptable standards of performance and overcome obstacles to innovations that will have benefits all around.

### **Obstacles to Rapid Acceptance of Innovation**

**Risk and Reward.** As a general rule, in a specialty industry, innovative services and products create bigger financial gains for the users than for the providers of innovation. Furthermore, oil and gas pro-

ducers enjoy better profit margins than service providers and have a higher financial capacity to absorb risk. Historically, the operator has usually maintained an arms-length detachment from the financial risk associated with innovation, even though in the final analysis it is by far its biggest beneficiary. With no risk or commitment, the operator has no visible or immediate loss in the failure of new technology. Thus, the upper limit of technical innovation is set by the financial strength of the service sector and not by the creative output of its people. Given the limited resources of service companies, they do not have the financial strength to absorb all the risk and satisfy the technical needs of the entire industry. One factor that further increases risk for a service provider is the deliberate attempt to quickly commoditize the technology. Without a reasonable margin, where is the funding for the next innovation going to come from?

**NIH Syndrome.** In spite of management's best efforts, the "not invented here" (NIH) syndrome persists in many organizations in our industry. It is caused by inability to differentiate between the capability to do something and having the required capacity and resources to do it in a timely manner for the best financial outcome. Within the service industry, there is general willingness to license intellectual property rights (IPRs) from outside sources. But the extent of actual collaboration is often limited. This reduces the synergies that can be created by cross-fertilization of ideas from diverse backgrounds. The industry also can benefit from cross-licensing of IPRs between competing companies. Unfortunately, this is not a prevailing practice, and its absence has resulted in many reinventions of the same wheel to maintain competitiveness.

**Limited Collaboration.** Earlier, integration and reliability were identified as critical issues for the acceptance of innovations. An effective way to expedite success is through collaboration between developers of new technology and its end users. A realistic assessment can be made up front of the user expectations, what additional skills and technologies will expedite the process, and how to secure their inclusion through appropriate means, such as employment, partnership, alliances, etc. In this approach, all parties commit jointly to the successful implementation of the innovation, and end-user input is sought throughout the development process, its implementation, and expected useful life. In collaborative technology development, the benefits of the transaction go beyond its immediate boundaries and involve substantially larger gain for both parties. Management has a critical role in this process and should facilitate and encourage acceptance of this type of relationship.

**Competition.** Competition within the oil and gas service sector is intense. This culture is also supported and nurtured by the operators. While competition is an essential ingredient of free enterprise and promotes superior services at better prices, blind pursuit of competitive spirit is harmful and unproductive. A common competitive response to the threat of new technology is to play the "spoiler" role and raise doubts about the usefulness of new technology by highlighting and exaggerating its real or imaginary difficulties during the "teething" process. Since the market does not have a historical reference point for the new technology, there is a natural reluctance and unease about its use. The net effect of this approach is that it kills the new potential market for all its players. Advantages of collaboration between end users and providers of an innovation include the reduction of risk and the defining of accepted norms of performance.

**Development and Launch Practices.** Service companies do not have the financial and human resources required to undertake sev-

eral major projects simultaneously. Their general approach is to treat these as projects within the broader framework of employee workload and financial allocations. The disadvantage of this approach is that it views the innovation as a mainly technical issue and does not recognize the critical role of time and business input in the development process.

The financial impact of some innovative ideas is large enough to justify dedication of full-time resources to their successful and timely implementation. The process can get a substantial boost by engaging the participants in the risks and rewards of the new innovation. This requires setting up separate business entities and affiliates with their own financial scorecards and special performance-based bonuses for their employees. There are numerous advantages to this process, such as clear business planning, focus, speed of development through employee motivation and dedication, better tracking of financial performance, and easier involvement of outside funding. This approach also creates an arms-length business relationship between the parent company and the new entity, which is useful in case of divestiture, licensing, or sales to competitors.

### **Role of Venture Capital**

The oil and gas industry was built on venture capital and still uses this method to finance reserves purchases. But this source is rarely used for new technology development. Part of the dilemma is again cultural. Technology-development groups have traditionally used internal funding and have little or no knowledge of how venture capital works or can help. Furthermore, contractual relationships with venture capitalists are highly specialized and require specific skills that are not usually available within the technical community. Venture capital requires a separate business entity to have its own business objectives and profit/loss statement. All of these have contributed to the current absence of venture capital in upstream technology.

Involvement of venture capital is a common practice in many industries (e.g., pharmaceuticals, electronics, medical systems, and computer hardware and software). In addition to funding, venture capital brings other competencies that contribute to the success of the business. These include sharp business focus, expertise in the introduction of new technology, time urgency, business planning, and business value. This investment vehicle also provides an effective and inexpensive way for operators to participate in innovation while satisfying their own technical and operational needs. By becoming a direct investor, the operator becomes part owner of the new technology. At the same time, the participation of the operator gives the technology the validation it needs to attract venture capital at reasonable financial terms. The operator always has the option of divesting itself from the venture when its investment objectives are met while continuing to reap the benefits of the availability of the superior technology in its operations. The benefits to the service companies are availability of capital and reduction of risk, direct participation and commitment of the operator in the entire process, faster and more focused implementation of the technology, and better financial returns. The biggest obstacle to this approach is lack of history, but this can be overcome easily with management support and commitment. Participation of a knowledgeable champion will expedite the process.

In recent years, some operators have set up venture capital groups to either attract or provide technology funding. More widespread use of this practice throughout the industry, and especially by major operators and service companies, will benefit everyone. Larger-sized operators hold the key to success of innovation in our industry; their active participation and support in all aspects of innovation is essential for our success and survival.

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