Ultra-deepwater E&P: How to operate as an advanced digital enterprise

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Technologies developed for aerospace systems offer unique cost savings alternatives to the oil industry. (Below) Oil companies must re-evaluate the assumptions behind all aspects of how they manufacture oil and gas facilities in ultra-deepwater – from the subsurface to the refinery.

The industry is projected to spend $100 billion in 2000 on deepwater oil and gas fields, pipelines, drilling rigs, and production platforms around the world, and those expenditures can only increase as the ultra-deepwater moves into full development. However, the very manufacturing process by which we produce oil and gas is in the process of being reinvented in order to assure economical success.

There are fundamental reasons why such systemic improvement to the production process is a difficult mission for the industry. Principal among them is that the ultra-deepwater "manufacturing process" is about as difficult a "factory" environment as could be imagined. Other giant manufacturers around the globe also deal with multiple vendors, millions of customers, and millions of parts, but the environment of manufacture of the ultra-deepwater energy product is not in a controlled factory environment. Instead, it is found in whatever water depth the oil and gas happens to be discovered in. And then, the resource itself is located a mile or more under the seafloor.

Not only must an oil company deal with constantly changing vendors and parts, but they also must develop their factories at remote, non-optimal locations, each differently configured. Each factory must be specified from the start to operate continuously for 30+ years, as part of an interconnected chain with other factories, all tied by pipelines and seaborne traffic to refineries that are often halfway around the globe.

Oil companies must re-evaluate the assumptions behind all aspects of how they manufacture oil and gas facilities in ultra-deepwater – from the subsurface to the refinery. This evaluation includes a re-examination of their traditional approach of high redundancy over-design and over-build.

Help from the far-field

Because of the tremendous scope of the deepwater industry, technological improvements that create even a small percentage increase in business productivity have a significant impact in absolute dollars on the profitability of even the largest of the super-major oil companies.

The successful implementation of more efficient manufacturing processes can result in increased profit margins. The success or failure of some of the world's great oil companies depends on the successful improvement of their deepwater enterprise.

That said, the best performing companies in the energy industry have been as well schooled in process improvement as in any manufacturing industry in the world. They can properly frame their problems, gather the facts that impact their decisions, decide quantitatively and decisively, and then monitor and react to the probabilities and contingencies of those decisions.

But what even the best energy companies are trying to improve is the integrated system itself: the enterprise-wide design/build/support system-of-systems necessary for "game changer" improvement in the offshore manufacturing process. The asset tracking, logistics warehousing, computer-aided manufacturing, business simulation, and optimization loops common to "easier" manufacturing industries (like automotive, aerospace, and pharmaceuticals) are not yet deployed in the energy industry. Process improvement within these other industries has been extensively documented to reduce costs by 30 to 40%.

Dave Lawrence, Shell's General Manager for the Deep Water Gulf of Mexico, which has 38 of the 79 discoveries being developed, made the following comment during his keynote address to the World Petroleum Congress in Calgary, June, 2000: "Shell approaches deepwater development on something of the same level that NASA approaches space projects. Deepwater projects are as remote as the moon and it costs about as much to work there.

"Like outer space, exploration of the deepwater poses huge risks, where even a minor glitch can be disastrous. It therefore requires detailed, advanced planning and is driven by the development of new technologies. Shell is committed to a reduction of deepwater development time and cost by 40% each, while at the same time increasing the environmental and safety programs to insure fewer accidents."

Integrated design/build/support

The "as is" situation in the offshore environment will be difficult to improve quickly because most oil fields are "one-offs." There has never been an integrated design / build / support manufacturing process in place to drive standardization and commonality. However, the developments in the ultra-deepwater triangle of the Gulf of Mexico, Brazil and West Africa are setting new standards for the design of all aspects of the "oil field of the future."

Such new projects could indeed provide "green-field" opportunities to test some of these integrated, design / build / support process-improvements from the aerospace industry. The Boeing Company terms this new manufacturing paradigm the "advanced digital enterprise."

Concerning the "to be" of future ultra-deepwater production facilities, the industry is searching far and wide for more cost efficient processes. Implementation of modern tools and processes such as those used by Boeing for the design and support of offshore facilities might lead to revolutionary cost and cycle-time savings. In the aerospace business, tools and processes were developed with expenditures comparable in size to oil and gas exploration budgets.

The services come in two forms: large-scale systems integration work-processes and digital tools. Companies such as Boeing would not be involved in the engineering or construction of the actual facilities, but could be engaged in the provisioning of these tools and services to the oil industry.

Cycle-time reduction

It is Boeing's experience that the average development cycle-time (the equivalent of discovery-to-first-production) is significantly reduced by these systems integration work-processes and digital support tools. Boeing has accumulated economic metrics that define the value of its four generations of digital enterprise evolution since the 777 started it all back in the early 1990s.

These tools and techniques would represent significant value to the oil industry if they could be translated to a $1.5 billion ultra-deepwater facility. The cycle-time could be reduced by 3 to 4 years and the cost cut in half!

Supply chain critical

Boeing's managers have found that the other big cost savings in the design / build / support enterprise comes from modern supply chain management. The "as is" supply chain in the offshore oil industry is classic bricks-and-mortar, having been built over the last 50 years to be composed mostly of company-specific inventory networks. That is, each oil and services company is basically on their own to provide spare parts and material requisition orders (MRO) for their assets in oil fields around the world, although there is some sharing of assets and resources.

Industry-wide, supply chain transactions involving original equipment manufacturer (OEM) spare parts are estimated to be a hefty $90 billion per year. Of that, $25 billion is spent on MRO expendables. There are more than 27,000 suppliers of MRO and OEM parts to the oil industry, and 90% of parts are supplied by 2000 of these companies - an unusually large number indicative of a fragmented supply chain network.

In the deepwater, up to 10% of operating expense is spent on parts, equipment, and consumables, and another 20% of that is spent on expendable MRO supplies. Thus, the supply chain must be considered in any "to be" re-design of the ultra-deepwater enterprise.

E-businesses are popping up all over the oil patch Internet as new procurement portals dealing with supply chain management open. Many of these portals have described plans to expand into virtual inventory management. We have encountered no company in the current e-marketplace, however, that is planning to link these to their own real warehousing and distribution network. This linkage of the "electron" world to the supply chain distribution and delivery system has proved the critical element to "game changer" efficiencies, currently being booked in the airline business. Based on Boeing's previous supply chain management experience, the potential exists for achieving the following:

- 5-15% price reduction in spare parts and MRO supplies
- 35-50% reduction in costs to store the inventory
- Increased average turn rates of spare parts from under once / year to more than four times per year
- A 70% reduction in administrative costs associated with the overall supply chain
- Each 1% reduction in the industry-wide supply chain costs brings $3.4 billion to the bottom line, annually.

This new supply chain model is a "new economy" that should be transferable to any heavy industry manufacturing process, such as that of the ultra-deepwater oil and gas industry. The basic concept is that the system allows Boeing to consolidate physical inventories from many customers and make them available through a virtual and real global inventory system. By taking control of the customer's inventories and aggregating with other customers' inventories, Boeing can drive the end-to-end supply chain to greater efficiencies than an individual customer could provide on its own. Better service levels can be provided with half the inventory.

We believe that the core of a new efficiency paradigm for the ultra-deepwater oil and gas industry should be a worldwide information system for design / build / support management that focuses on enterprise-wide optimization of the "manufacturing process." The system must be integrated end-to-end, designed through supply chain management. Without such a paradigm change, it will be difficult for the ultra-deepwater oil and gas industry to achieve required economic goals. We suggest the industry import the new technologies and techniques from the far-field necessary to achieve this systemic change.

The objective is to address system bottlenecks and redundancies, with a principal focus on advanced information and communication technologies worldwide, integrated with state of the art logistics support. We suspect that the application of such enterprise-wide tools linked to enterprise-deep services will dramatically reduce the time and costs associated with the ultra-deepwater design / build / support infrastructure.

Authors

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