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## **The Energy Company as an Advanced Digital Enterprise**

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The very manufacturing process by which we produce energy is in the process of being reinvented like we have never before experienced in this business. The oil and gas field of the future will be part of a much larger Information Technology (IT) network. Each field will be a wired, internet-connected, real-time monitored, remotely controlled, electronic venture. Each well, pipeline, rig, production platform, compression facility, and even the pumpers themselves, will have a IP (Internet Protocol) address. Any browser on any laptop in the company (with proper password protection) can log onto the live information coming from that facility at any time of the day or night -- from anywhere in the world.

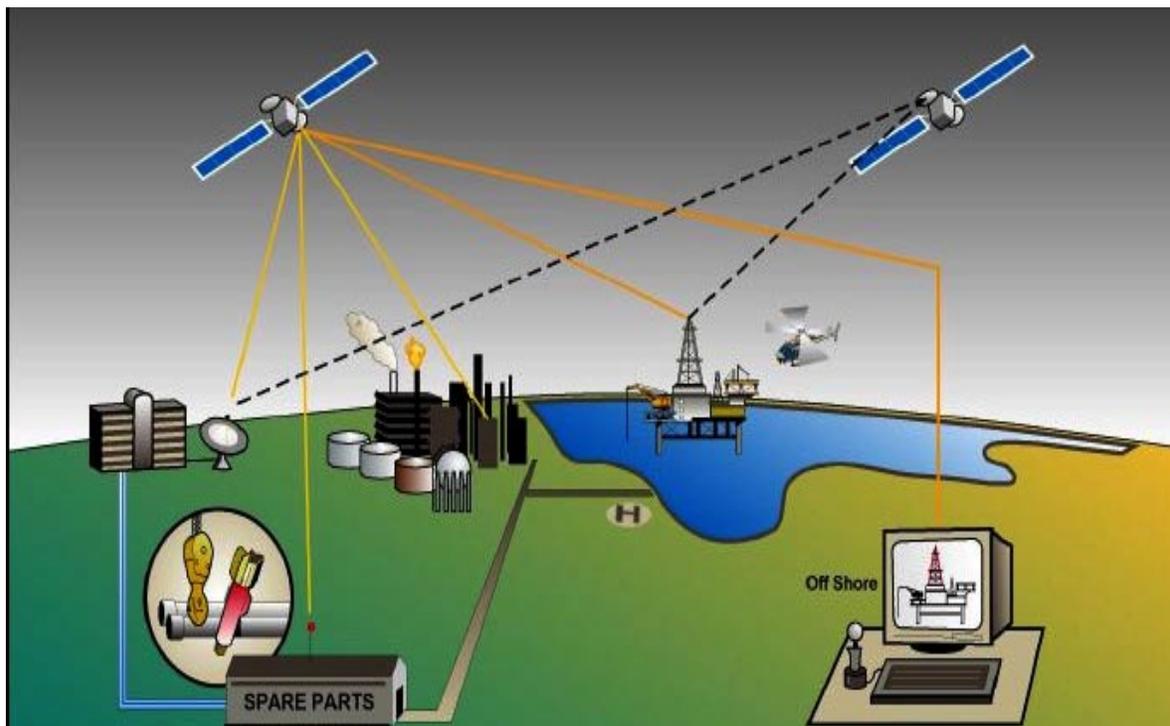


Figure 1. The real-time monitoring and remote control of the oil and gas portfolio of the future will become more like that in aerospace and other advanced IT industries.

However, there are fundamental reasons why such an integrated IT system for the oil and gas field is a difficult mission for the energy industry to pull off successfully. Principal among them is that the "last mile," as it is called in the communications industry, (the field connectivity to the manufacturing facility itself) is about as difficult an IT environment as could be imagined. Other IT savvy manufacturers around the globe also deal with multiple vendors, millions of customers, and millions of parts as we do, but our SITE of manufacture of energy products is NOT usually in a metropolitan area with communications infrastructure in place. Instead, it is found in whatever water depth or remote geography (usually rural) the oil and gas happens to be discovered beneath. And then, of course, the "very last mile" to the resource itself is under the ground and cannot be visited, or even imaged clearly.

Not only must energy companies deal with a constantly changing set of IT vendors and bandwidth constraints from field to field, but each must be specified from the start to operate continuously for 30+ years, as part of an internet-connected portfolio. In the future, oil and gas fields will form an information grid with other fields, pipelines, land, and sea-borne traffic, refineries and storage facilities, etc. that form the complete enterprise of the company (Figure 1).

Add to this the present day Wall Street expectations that "bricks-and-mortar" companies convert themselves to information rich "clicks-and-mortar" companies, and you see that the energy industry has a difficult task, at best. Consequently, oil companies are in the process of re-evaluating the assumptions behind all aspects of how they manage their IT networks -- from the subsurface to the refinery.

### **An Integrated Design/Build/Operate/Support Infrastructure**

Because of the tremendous scope of the energy industry, IT improvements that create even a small percentage increase in business

productivity have a significant impact in absolute dollar terms on profitability. That statement is true for all sizes of company, from the smallest of independents to the largest of the super-majors and nationals. The successful implementation of integrated IT systems and processes has proven to result in increased profit margins in other manufacturing businesses throughout the world (Walmart and Toyota are perhaps the best known examples). IT driven process improvement within these other industries has been extensively documented to reduce overall cost by a staggering 30% to 40%! The survivability of even some of the world's best known energy companies may well depend on their successful implementation of this integrated IT infrastructure that produces what we call the networked "myenergycompany.com" of the future.

But implementing a real-time communications and data-streaming infrastructure that connects the oil and gas field to the home office is only the beginning point. What must be improved is the integrated system itself: the enterprise-wide design/build/operate/support system-of-systems necessary for "game changer" improvement in the manufacturing process. The complete range of digital asset tracking, logistics, warehousing, computer-aided manufacturing, business (to say nothing of geological) simulation and optimization loops common to "easier" manufacturing industries (like automotive, aerospace, and pharmaceuticals) are not yet fully deployed into the energy industry.

### **How to cut Project Costs and Cycle-Times in Half!?**

The "AS IS" situation in the "brown" oil and gas fields of the present will be difficult to improve quickly because most are "one-off's". There has never been an integrated design/build/operate/support IT infrastructure in place to drive standardization and commonality, let alone real-time communications and monitoring. However, the unbelievably expensive development of new "green fields" of the deepwater triangle (Gulf of Mexico to Brazil to West Africa) is setting new standards for the system-

wide integration of all aspects of the "digital oil and gas field of the future." Boeing terms its introduction of just such a company-wide manufacturing paradigm, the "advanced digital enterprise."

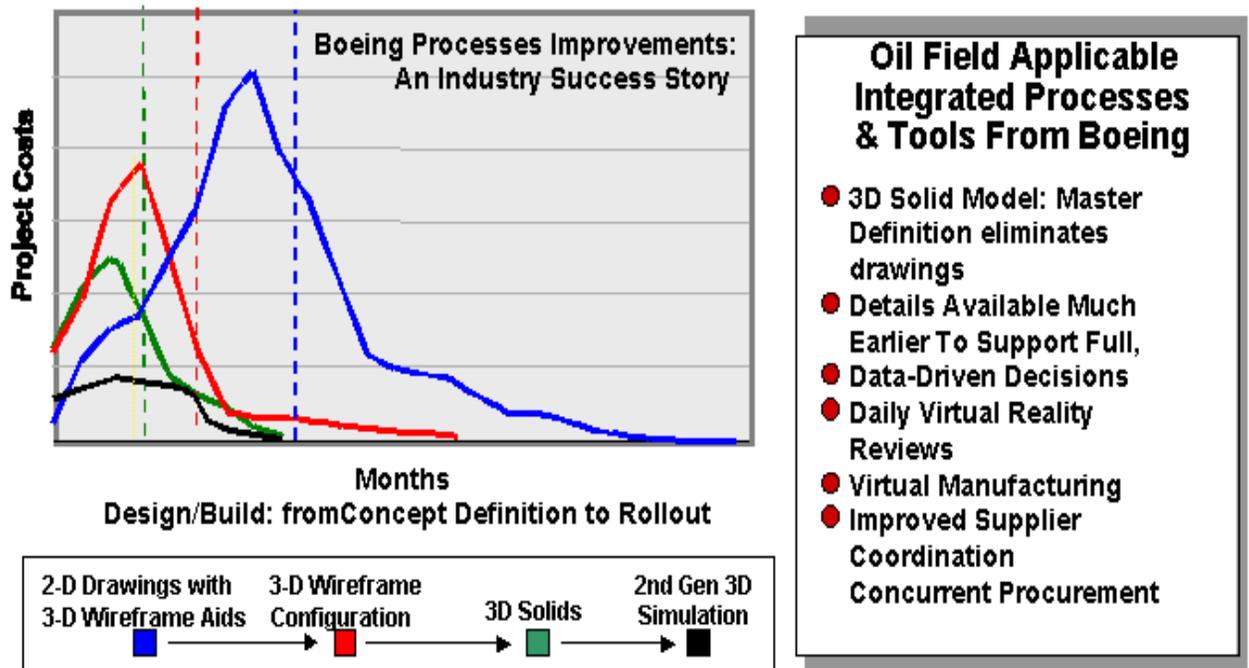


Figure 2. Industry-to-industry best-practices transfer can indeed create "Game Changers" if the IT process efficiencies turn out to be transferable.

Concerning the "TO BE" of future "green" facilities, the industry is already searching far and wide for more cost efficient processes. It is our prediction that the implementation of modern, integrated IT systems tools and processes such as those used by Boeing in its production of the 777 and four generations of airplanes since, will have profound impact on the energy industry. Use of modern IT tools and processes for the design, construction, operation and support of energy facilities might lead to revolutionary cost and cycle-time savings. They certainly have in the aerospace business. For example, these tools and processes have cut BOTH the time-to-first-product and the overall project costs in HALF at Boeing -- for each successive

generation of airplane. (Each curve, from blue to red to green to black, in Figure 2 represents a successive new airplane SINCE the 777, which would be off the chart in both time and cost).

However, the energy industry will not be able to develop these IT tools and processes on their own. The Boeing improvements were developed over many years with annual research and development expenditures specific to integrated IT systems that are comparable in size to our exploration budgets!

### **The implementation of 'myenergycompany.com'**

It may seem funny that we are describing a "myenergycompany.com" world of integrated IT systems management at a time of great transition in the "dot.com" world, both inside and outside of the energy business. e-businesses are in a state of flux all over the oil patch, as new portals dealing with a range of "commodity" services, such as surplus equipment sales and property auctions, seem to be opening, closing, and merging every day. The paradigm shift we are talking about, however, is corporate-wide, and involves electronic linkages of virtual and real data, events, operations, supplies, and people into an advanced digital enterprise currently only active outside the energy business -- with the possible exception of the energy trading floor.

The linkage of the "electron" world to the real production, distribution and delivery system -- through to the "last mile"-- has certainly proved to be the critical element to "game changer" efficiencies currently being booked in the airline business. Boeing's "Global Airline Inventory Network" (GAIN) is another example of a digital enterprise for which excellent cost saving metrics have been compiled:

- 5%-15% price reduction in parts and supplies
- 35%-50% reduction in costs to store inventory

- Increased average turn rates of parts from under once/year to more than four times per year.
- A 70% reduction in administrative costs associated with the overall supply chain

GAIN is a “new economy” supply chain business model that should be transferable to any heavy industry manufacturing process. The basic concept is that the GAIN system allows Boeing to consolidate physical inventories from many customers and make them available through a virtual AND real global warehousing 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 (Figure 3).

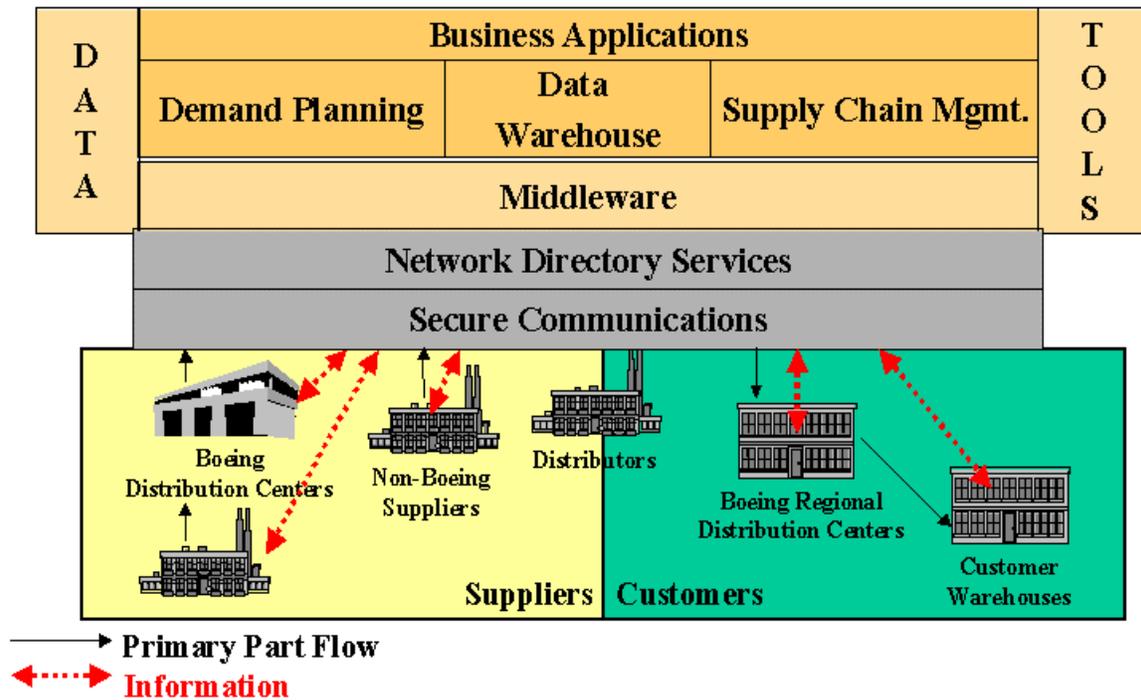


Figure 3. The GAIN system architecture combines the IT hierarchy (top) with the real inventory consolidation and distribution system (bottom).

## Summary

We believe that the core of a new efficiency paradigm for energy companies should be an integrated IT system for design/build/operate/support management that focuses on enterprise-wide optimization of the "manufacturing process." The system must be integrated end-to-end, be live-on-the-web, and be designed from first build, through supply chain, to abandonment for optimal performance as part of a company-wide portfolio. Without such an IT paradigm change, it will be difficult for the energy industry to achieve continued economic health regardless of the prices of the underlying commodities, in our opinion.

We suggest the industry import the new tools and processes from the far-field that are necessary to achieve this systemic IT improvement. The objective is to produce a "myenergycompany.com" that is continuously addressing system bottlenecks and redundancies, with a principal focus on real-time information and communications integration company-wide, combined with state-of-the-art logistics support. We predict that the application of such enterprise-wide IT tools and processes will dramatically reduce the time and costs associated with the energy industry's design/build/operate/support infrastructure.

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Digitalized energy systems in the future may be able to identify who needs energy and deliver it at the right time, in the right place and at the lowest cost. The impact of these tremendous digital advances and their rapid deployment across the energy landscape raise the fundamental question of whether we are on the cusp of a new digital era in energy. IEA analysis attempts to answer this fundamental question. Digitalization's impact on energy. The energy sector has been an early adopter of digital technologies. Investment in digital technologies by energy companies has risen sharply over the last few years. For example, global investment in digital electricity infrastructure and software has grown by over 20% annually since 2014, reaching USD 47 billion in 2016.