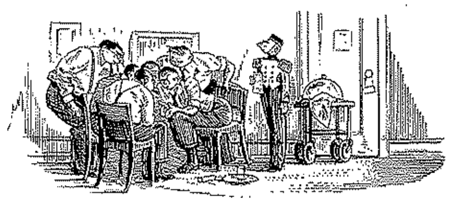


Will Exxon Get Googled?

by Mark P. Mills

THE IMAGE OF THE OIL INDUSTRY IS CAPTURED (admittedly, deliciously) by Bruce Willis playing the rough-and-ready character of an oil roughneck in the 1998 Hollywood blockbuster *Armageddon*—driving golf balls off an oil platform aimed at a Greenpeace ship. Dirty, tough, old-world, almost Jurassic. Oil, in short, is seen as old tech. So yesterday.

Energy in the 21st century surely belongs to the denizens of high-tech Silicon Valley and similar domains from Boston to Bangalore. Many accomplished tech entrepreneurs are hyperventilating over prospects for "disruptive innovation" in the globe's sprawling energy markets. The promise? To shake up the energy world, most particularly the nearly $2 trillion oil business, as profoundly as computer and Internet companies upended global communications in the late 20th century.

But is such disruption really likely? Will Exxon soon get Googled? Not likely. And likely not ever. The reasons? Well, first, the physics of oil and information are quite different—politics and wishful thinking aside, physics actually matters here. And, without fanfare, the oil industry—Bruce Willis aside—has already morphed into a tech-centric enterprise, assimilating the tools and materials of the digital age. In short, Exxon and Google are already more similar than dissimilar.

But first the physics. The tantalizing phenomenon oil disruptors want to emulate for Pontiacs is the technology that lies behind the Pentium. Today's cell phones are more powerful than your first desktop computer 20 years ago. Imagine an energy technology that could follow the kind of doubling of computer power that has happened every 18 months, yielding an entirely new constellation of mega-corporations the likes of Intel, Apple, Microsoft, and Google. The problem is that the physics of information just doesn't translate into the world of energy, at least not in the way popularized.

Here's why. The essence of digital-silicon technology is that more and more information can be stored and transported in ever smaller, profoundly less energy-intensive ways. Millions, soon billions, of ever tinier information engines (a.k.a. transistors) are etched onto a sliver of silicon. On top of this, software engineers use clever mathematical codes made ever more powerful by microprocessors, to parse, slice, and shrink information itself, compressing it without loss of essence. The combination is powerful. Compared to the dawn of computing, today's information-moving hardware consumes *one million* times less energy for a logic operation and can store data in a physical space 100 million times smaller. And progress continues.

But in the world of atoms and aircraft, not bits and YouTube, things tend to expand, not shrink. The energy needed to move a ton of people, or heat a ton of steel (or silicon), is fixed by properties of Mother Nature. Moving 1,000 pounds 1,000 miles at 50 or 500 mph has a specific, knowable, and immutable minimum energy requirement, dictated by laws of gravity, inertia, friction, mass, heat transfer, and the like. An aircraft's or car's engine is not about to shrink in size a thousandfold and be etched onto a sliver of silicon, or increase in power similarly. On top of that, in the physical world there is just no analogue to compression software (mathematical trickery that puts even more information more efficiently into small spaces). Only in *Star Trek* can you compress people to the size of ants to put more in a smaller space.

And while nothing in our current energy infrastructure operates at the theoretical limits, pretty much everything is within spitting distance of Mother Nature's hard stop in terms of energy density and efficiency. Of course, there's room for progress. A 20 to 30 percent gain in efficiency in our national energy bill translates into serious money. Airlines, as well as most businesses, do back handsprings for such efficiency gains. But compared to the efficiency-created disruptions in the digital-info world, 30 percent is chump change.

The reality is that we are stuck with limitations imposed by things like, well, Earth's rotation and distance from the sun, which determine the maximum energy possible from solar power. Or the biochemistry of photosynthesis, which ultimately determines biofuel economics, or the physical chemistry that dictates potential energy per pound of oil, ethanol, or lithium.

So, using fundamental energy metrics, it is easy to understand the relentless pursuit of oil—the challenge in disrupting our "addictions" if you will. Consider how far a Prius-sized vehicle can travel on a highway using two cubic feet of fuel (roughly, a suitcase's worth): that much volume in lead acid batteries lasts 20 miles; switch to lithium batteries and you get 100 miles; compressed natural gas, 150 miles; ethanol, 400 miles. Fill the same two cubic feet with oil? 700 miles.

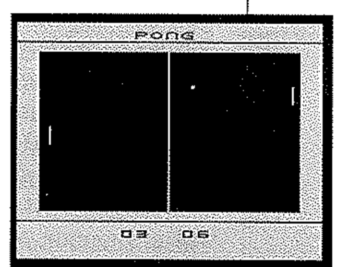
OIL IS A REMARKABLE ENERGY SOURCE that is also uniquely easy to transport and store. Keeping up with civilization's insatiable appetite for this elixir has involved much more than building ever bigger oil rigs and unleashing more Bruce Willis types. The oil industry has quietly and profoundly employed the wizardry of digital technology. Both directly and indirectly, a 21st-century oil well is the physical extension of super-computing. It's not all that different from the relationship between your PC and printer, connecting the virtual to the physical. It has enabled the deepest offshore oil platform to go from sitting in barely 500 feet of water in 1969 to today's almost 10,000 feet. Horizontal drilling didn't even emerge until 1982, going a distance of 2,000 feet then, compared to 30,000 feet now.

Sit in an oil conference today and you will hear about digital technology and software: cloud computing, remote servers, bandwidth constraints, high-speed wireless, terabytes of storage, GPS, laser mapping, virtualization, 3D mapping, virtual-reality caves, satellite imaging, smart sensors, and robotics. You'd be hard-pressed to know whether it was a meeting for Google or Exxon. Companies such as IBM and Hewlett-Packard are intimate and integral parts of the global oil enterprise.

The oil industry has quietly and profoundly employed the wizardry of digital technology. Both directly and indirectly, a 21st-century oil well is the physical extension of super-computing.

And just as in the info-tech world, while the behemoth companies get the headlines there is a whole host of smaller tech-savvy companies, many the innovation leaders, and most unfamiliar on Main Street. Oceaneering has emerged, for example, as the preeminent (underwater) robot company; Transocean is the hot ticket in offshore drill rigs; and private innovators like Great White Energy Services provide high-tech services on the front lines (where, full disclosure, our fund has an interest).

A lot has happened since NASA put a man on the moon in 1969—I mean, that's three years *before* Pong, the first video game—a time when the oil industry had barely progressed beyond its early 20th-century roots. The scope of digital technology now employed on a day-to-day basis, the fusion of steel and silicon in the oil fields and oceans, was inconceivable 40 years ago.



One thing has not changed in 40 years: perpetual-motion-machine-style wishful thinking. While emerging energy technologies offer exciting (essential) promise, none of them are about to disrupt the oil industry. Terrorism, terrible policies, and wars can. Energy tech is the hope to sustain, not disrupt, our oil-dependent economy. The future, to stretch the analogy, is Bruce Willis with a Ph.D. in nanotechnology. ✠

Mark P. Mills, *a physicist, is co-founding partner of Digital Power Capital, an energy tech venture fund. He writes the "Energy Intelligence" column for* Forbes *and is author of* The Bottomless Well *(Basic Books).*