Many profound trends in today’s production fields are driving automation’s adoption by the oil and gas industry. Among them are emerging workforce challenges, such as scarce talent, higher labor costs and impending retirements; growing cyber-security threats; intensifying competitive pressures; and rising regulatory burdens. But one trend trumps them all: production costs are rising faster than profit margins.

That’s why producers need to make more than incremental improvements in their extraction efficiencies. But are they moving fast enough to get ahead of their production-cost curve? In a word, no. While new automation technologies can enable quantum gains in upstream productivity, the industry has historically been conservative in their deployments, preferring what it considers time-tested production methods and technologies. It’s time to change that thinking.

In fact, below-ground innovations like zipper fracking and stacked laterals, along with the drilling of longer laterals and injecting ever greater amounts of proppant, are increasing the use of multi-well pads above ground. According to research from PacWest Consulting Partners, nearly half (49%) of all horizontal wells in the U.S. at the end of 2013 were drilled on multi-well pads. That’s almost double the proportion just three years earlier and is expected to grow.

Why this growth? The answer is simple: More closely spaced wells found on multi-well pads not only increase drilling efficiencies, but they also provide greater economies of scale and asset utilization. An obvious example is transportation: Trucking in people, equipment and supplies to just one multi-well drilling operation (and trucking out expended materials like used proppant) costs much less money and time than if the wells were located miles apart.

Historically, automation in upstream oil and gas production comprised standalone mechanical and relay-based solutions localized to specific production operations. Today we’re seeing more and more communications-based automation using smart instrumentation and field-bus technologies that are replacing copper wire and can extract more than one data point.

Today’s solutions are setting the stage for even greater automation tomorrow, the dawn of so-called integrated operations envisioned by all major producers and enabled by advancements in information and communication technologies. Integrated operations refers to the real-time gathering, consolidation and analysis of data spanning the entire oil and gas value chain, from upstream production to midstream transport and downstream refining.

Upstream, integrated operations can connect the data spawned by an oilfield’s entire operations, from the tip of a drill bit at the bottom of a bore hole to the flow of oil and gas out a pipeline to a refiner or consolidator. Producers can use these capabilities to make better, more informed decisions at all management levels—field office, corner suite or boardroom—about how to optimize asset utilization, while gaining more operational visibility and information-sharing across their enterprises.
Ultimately we envision the entire production process being fully optimized via intelligent sensors monitoring all points of mechanical operations and flows, as well as the sensing fabric itself. All of this will feed programmable logic controllers, or PLCs, that manage it all in the field. In turn, the PLCs will communicate all this operational data in real-time over industrial Ethernet and highly secure wireless networks, whether WIMAX, cellular or satellite, to an enterprise cloud that’s accessible from anywhere in the world by almost any smartphone, tablet or laptop with a network connection. And though this may be tomorrow’s vision, it’s entirely possible with today’s technologies.

What’s gone are field hands with clipboards in their pickup trucks, making costly, time-consuming rounds of remote production facilities to ensure their sound operation. Instead, self-diagnostics and predictive maintenance will enable self-healing systems whenever possible, especially in field production. If human intervention is needed, an alarm is issued and recorded, dispatching a field technician with precise information about the work order along with any parts required. While hardware functionality will remain important, the key to all these capabilities is software.

Enabling the future coming of oil and gas “factories”

As service intensity rises on multi-well pads so does the need for applications of industrial process automation technologies to improve the cost- and time-efficiencies of those services. But that requires a shift in mindset from extractive to manufacturing, with perhaps a blend of the two being ideal. Many upstream operators are starting to think this way and their increasingly sophisticated production facilities reflect it—looking more and more like manufacturing sites that happen to be outdoors and, most often, in extremely remote places.

The technologies enabling this transformation involve the automation and control of frac equipment and complex services during drilling stages as well as the post-completion well-heads, pipelines and storage tanks that make up a multi-well facility. An example that spans one key part of the fracking process would be automating the injection of hydraulic fracturing fluids, monitoring their storage tank levels (both pre- and post-fracking inventories) and scheduling the transportation of new supplies in and expended ones out.

Based on decades of experience in automating literally millions of factory production processes worldwide, here are four key automation design precepts for upstream producers to consider, if they want to accelerate their progress toward greater automation of their operations:

1. Eliminate. Map processes in detail, then get rid of all unnecessary steps. Advancements in process automation technologies can render many process steps superfluous. If a step doesn’t add value, cut it out.

2. Simplify. After eliminating as many steps as possible, combine those remaining wherever feasible. Also think about simplifying the context of a process. That is, identify and eliminate (or minimize) external physical, data or schedule I/O dependencies. Reduce or eliminate custom engineering, which always adds cost, time and maintenance issues.

3. Standardize. Design and implement using open standards and uniform interfaces that span just about every facet of industrial automation and enable the use of lower-cost commodity hardware components. Standardized solutions can interoperate with legacy systems as well as those from other vendors. They also make installations and reconfigurations much easier and scale better. Maintenance, repairs and keeping spares become more economical, too.

4. Virtualize. Move as many hardware-based functions like relays, switches and terminals to software, which can then be reprogrammed as needs change. Software code can be stored in libraries and re-used across many different deployments. Wireless and cloud technologies can offer further cost savings because expensive infrastructure like cabling and data centers can be eliminated or greatly reduced, the latter by leasing shared cloud-based facilities instead of building and operating your own.

In considering their automation strategies for their drilling and well-head operations, oil and gas producers might heed the following observation, also based on decades of experience across just about every industry in the world: Efficient automation starts with efficient engineering.

With a comprehensive engineering framework like the Siemens TIA Portal, producers can reduce their design and engineering costs by as much as 30 percent, while dramatically accelerating their development timeframes. For example, by using drag-and-drop code from vast software libraries of proven automation programming functions, engineering teams don’t have to develop custom code, which is time-consuming with all the steps of writing, compiling, testing and debugging required—and often the code is not reusable for other projects.

An integrated software development platform lets geographically dispersed engineering teams access shared development databases 24x7 over their corporate networks to collaborate much more. They can even pursue round-the-clock, “follow-the-sun” global development schedules to cut cycle times dramatically, even to a fraction of what they once were. This also can provide with the flexibility to try out and easily test new approaches with little if any marginal costs.

The days of fully automated oil and gas “factories” with integrated operations across the entire production enterprise are not far off. Producers’ situations today relative to this vision aren’t a question of “if” but “when.” The sooner they can deploy advanced industrial automation in their upstream facilities, the greater the edge they’ll enjoy over their competition and the bigger the payoff they’ll realize in increased profitability from new efficiencies and reduced costs.