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When Complexity Is Free

Thomas L. Friedman SEPT. 14, 2013

NISKAYUNA, N.Y. — IT'S easy to be depressed about America these days. We've got messes aplenty abroad and the Republican-dominated House of Representatives is totally paralyzed. Indeed, the G.O.P.-led House has become a small-minded, parochial place, where collaboration is considered treason, where science is considered a matter of opinion, where immigration is considered a threat, where every solution is a suboptimal compromise enacted at midnight and where every day we see proof of the theory that America is a country that was "designed by geniuses so that it could be run by idiots."

Fortunately, there is another, still "exceptional," American reality out there. (I am talking to you, Putin.)

It's best found at the research centers of any global American company. These centers are places where scientists and engineers from dozens of nationalities are using collaboration and crowd-sourcing to push out the boundaries of medical, manufacturing and material sciences, where possibilities seem infinite, where optimal is the norm and where every day begins by people asking: "What world are we living in, and how do we thrive in that world?" As opposed to: "Here is my crazy

Just to get a jolt of that optimism, and a chance to focus on what we should be talking about, I asked General Electric for a tour of its huge research lab here in Niskayuna, north of Albany. I wanted to see what new technologies, and therefore business models — and therefore jobs — it might be spawning that public policy, and education policy, might enhance. I have no idea whether or how G.E. will profit from any of these breakthroughs, but I saw the outlines there of three radically new business trends that the United States should want to dominate.

The first derives from a phrase tossed off in passing by Luana Iorio, who oversees G.E.'s research on three-dimensional printing: "Complexity is free," she told me. That is actually a very big statement.

In the old days, explained Iorio, when G.E. wanted to build a jet engine part, a designer would have to design the product, then G.E. would have to build the machine tools to make a prototype of that part, which could take up to a year, and then it would manufacture the part and test it, with each test iteration taking a few months. The whole process, said Iorio, often took "two years from when you first had the idea for some of our complex components."

Today, said Iorio, engineers using three-dimensional, computer-aided design software now design the part on a computer screen. Then they transmit it to a 3-D printer, which is filled with a fine metal powder and a laser device that literally builds or "prints," the piece out of the metal powder before your eyes, to the exact specifications. Then, you immediately test it — four, five, six times in a day — and when it is just right you have your new part. To be sure, some complex parts require more time, but this is the future. That's what she means by complexity is free.

"The feedback loop is so short now," explained Iorio, that "in a couple days you can have a concept, the design of the part, you get it made, you get it back and test whether it is valid" and "within a week you have it produced. ... It is getting us both better performance and speed."

In the past, performance worked against speed: the more tests you did to get that optimal performance, the longer it took. When complexity is free, the design-to-

There is a parallel revolution in innovation. When G.E. is looking to invent a new product, it first assembles its own best engineers from India, China, Israel and the U.S. But now it is also supplementing them by running “contests” to stimulate the best minds anywhere to participate in G.E.’s innovations.

Example: There are parts of an aircraft engine — hangers, brackets, etc. — that are not key to the engine, but they keep it attached and add weight, which means higher fuel costs. So G.E. recently took one bracket — described the conditions under which it worked and the particular function it performed — and posted it online under the “The G.E. Engine Bracket Challenge.” The company offered a reward to anyone in the world who could design that component with less weight, using 3-D printing.

“We advertised it in June,” said Iorio. Within weeks, “we got 697 entries from all over the world” from “companies, individuals, graduate students and designers.” G.E.’s engineers culled out the top 10, and they are now being tested to determine which is the lightest that conforms to G.E.’s specs and can be built on its printers. I saw one prototype that was 80 percent lighter than the older version. The winning prize pool is $20,000, spread out across 8 finalists, with awards ranging from $1,000 to $7,000 each. A majority of entries came from people outside the aviation industry.

Lastly, we are on the cusp of what G.E. calls “the Industrial Internet” or the “Internet of Things” — meaning that every major part of a G.E. jet engine, locomotive or turbine is now equipped with online sensors that constantly measure and broadcast every aspect of performance. Computers capture all this big data and use it to improve everything from the flight path to energy efficiency.

“We used to do monitoring and diagnostics,” said Mark Little, the director of G.E. global research: “We had sensors on a gas turbine. If something happened in your system, we could say: ‘You have an overtemperature on the backend, and here is how to fix it.’ And now we are using all this data to do prognostics. We are reading the signals and telling you something that will happen. You can proactively respond

engines, but how fast all its planes or trains go, how flight and train schedules are coordinated and even how its equipment is parked to get optimal performance and energy efficiency.

With this diffusion of sensors, says Beth Comstock, G.E.'s chief marketing officer, a company can assemble data so much more accurately to "observe performance, predict performance and change performance" so there is "no unplanned downtime." It can make an airline or railroad or power plant so much more "sustainable," in both senses of that word.

Watch this space, even if Washington doesn't: When everything and everyone becomes connected, and complexity is free and innovation is both dirt-cheap and can come from anywhere, the world of work changes.

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