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Working With Robots in a Post-Pandemic World

Plug-and-play automation systems can be rapidly set up to meet sudden surges in demand — and quickly reconfigured when needs change.

Matt Beane and Erik Brynjolfsson • September 16, 2020   READING TIME: 11 MIN

Whether you turn to news outlets, tech magazines, or academic sources for insight, you're likely to hear that the COVID-19 pandemic is going to drive massive growth in automation, especially via robots.[1] The arguments in

favor of this view seem reasonable: Main Street might look dead, but companies that provide shippable goods have been facing double, triple, or even 10 times their previous demand. Robots, the thinking goes, should be able to reliably do that repetitive physical work when many workers aren't safely able or willing to set foot in the building. What's more, access to the technology is getting less expensive, with "robots as a service" models allowing companies to pay per touch rather than dipping into precious capital reserves. And robots are becoming more capable.

In just the past few years, for example, we've seen a small number of companies building and selling AI-enabled robots to pick things out of bins, handle parts, tend machines, and test the latest electronics. This is impressive because it's *high-mix* work — that is, the products, the work conditions, the processes, and the final output shift regularly but also in surprising ways. Until recently, this made automation via robotics a nonstarter, because previous approaches to things like object detection, grasp detection, and placement verification relied on stable products, conditions, processes, and outcomes. Now? Toss some new objects into a bin, change the lighting, change their position and orientation, and these leading-edge systems can often handle it. Robotics companies are making similar advances in automating other physical jobs, such as materials transport, sorting, and palletizing.[2] So why *wouldn't* robots start flying off the shelves?

Because successfully putting robotics into production is a complex undertaking, and most companies aren't equipped to implement and benefit from these advanced systems. As we've studied how organizations and front-line workers are adapting to next-generation, AI-enabled robotics in manual work throughout the U.S., we've found that successful adaptation is rare. That stands to reason. History and decades of research tell us that when a qualitatively new form of automation comes along — anything from punch-card-driven looms to automated call patching — organizations spend much more time and money than anyone expected to find productive uses for that technology. Erik and colleagues call this phenomenon the Productivity J-Curve: Radical new technologies require costly investments in business process redesign, worker reskilling, and organizational transformation.[3] These investments usually pay off eventually, but initially, productivity and performance, at least as conventionally measured, can take a discouraging dip.

But we also know from Matt's research that during such times — when well-understood means of adapting fail — a small minority of users will find rule- and expectation-bending ways to get results more quickly.[4] So, in our next phases of research, we'll continue to look for and learn from these rare deviants: How do they pull it off? We'll be collecting data from tens of thousands of U.S. enterprises with hundreds of thousands of employees. And to test for broader applicability, we'll be enrolling a selection of organizations to try out the practices,

conditions, and technologies that allowed for early
success in a few isolated cases.

Meanwhile, we're gathering and analyzing data from a
diverse range of venture-funded robotics vendors and
their business customers, watching implementations
from the beginning, and interviewing hundreds of
managers, front-line workers, and other professionals
involved in implementing the technologies. We're
covering a range of industries, too — warehousing, order
fulfillment, parcel handling, kitting, and food
preparation, for example. These industries center on
facilities and workforces that receive daily truckloads of
palletized products (perfume, apparel, ostrich jerky,
automotive glue, wooden toys), break them down,
catalog them, store them, and then sort and package
them to ship off to an end customer.

Reconciling Potential With Reality

These fulfillment processes, despite all the advances in
automation, are still quite manual at their core. People
have to move pallets; cut them open; lift, place, and scan
products; drive forklifts to store and retrieve products
from racks; place them into bins or sorters; pick them
out; put them into a final configuration; inspect, seal,
and label boxes; and move them onto outbound trucks.

For that reason, we've found that good people and good techniques remain essential to business results. The people can quickly invent new processes for new problems that crop up, deal with exceptions, and make improvements. And the techniques — combinations of work processes and technology automation — offer improved reliability and capability, allowing managers to reallocate people to more complex work. A simple example that illustrates the combined value of techniques and people is the moving assembly line, where automatic conveyors and the division of labor allow for incremental assembly.

Whenever they can see a decent ROI in a reasonable time frame, managers will invest in good techniques; they're less inclined to do so when the upside isn't immediately obvious. But their products, customers, and requirements are continually changing, so they tend to recognize that they always need good people. We've found that the managers who focus on both people and techniques are most likely to keep their operations running well and to reap the benefits of automation.

As we've studied deployments of AI-enabled robots, we've come to understand the automation techniques these managers have to draw on, ranging from the very simple (like machines that wrap pallets of boxes in plastic) to facility-scale systems that automate storage and retrieval in warehouses. But the pandemic has complicated matters by ratcheting up order volumes and urgency. Starting around March 2020, one

approach in particular — what we refer to as plug-and-play automation — emerged as more feasible and useful than others.

Plug-and-Play Automation

Managers want systems with a relatively small physical footprint and proven capabilities that are easy to connect to power, pressurized air (for robotic grippers that rely on suction), and the existing IT infrastructure. Such plug-and-play systems can be rapidly set up to deliver results and rapidly reconfigured when things inevitably change. Examples among the companies we're studying include modular, computer-controlled conveyors; automatic guided vehicles (AGVs); and sorting machines. They can be shipped on a pallet or two and be set up over a weekend, in some cases by the vendor's remote technical staff. This has all been critical because COVID-19-driven demand for shipped, assembled, or packaged goods created holiday-level orders for many organizations more or less overnight. And as customers' needs evolve, companies will strain to meet them.

Any automation project that's more complicated — that takes more time, more space, more expertise, more parts — is a hard "no" for the time being, because it would slow efforts to meet surging demand. For each category of activity — moving goods, sorting them, orienting them, stowing them, retrieving them — plug-

and-play systems offer a far greater return on investment than large-scale, custom installations.

For instance, automated storage and retrieval systems can certainly receive, index, store, and retrieve mixed product for a fraction of the cost of formerly state-of-the-art techniques that involve humans walking or driving forklifts down stacks of 40-foot shelving, scanning their destination, picking an item or two, and then walking or driving to the next spot until their tote is full. But these bespoke, IT-connected behemoths are more complex than a Swiss watch and must function even more reliably. We're talking perhaps $10 million and 10 months of coordinated effort across multiple departments before you can even turn them on. That's not a viable option right now, unless you're building a new facility — and even then you might first look to bootstrap yourself into immediate action through plug-and-play technologies.

There are also really interesting, relatively unproven systems hitting the market that will take a lot of learning, time, and improvement to become useful. These are, by definition, not plug-and-play systems. Only very large customers that can invest heavily in codevelopment are still making bets on systems like these, but even they try to avoid doing so during peaks in demand.

Who Has Access?

Since plug-and-play automation is still somewhat new, it
requires intensive customer support. This makes for an
initially bounded market, because it's easier for vendors
to work with customers they already know than with new
ones. It takes some savvy to stitch together modular
systems and keep them up and running, and vendors
provide higher-touch support to accommodate that
need. Think of an additional vendor employee who tends
a system that automatically bags returned apparel,
troubleshoots exceptions and connections with adjacent
work processes, and familiarizes workers with the
solution over time. Before a vendor can provide that level
of attention, it must get to know the customer's needs
and inner workings. That depth of knowledge doesn't
exist in new relationships.

Furthermore, when customers deliver shippable product
in the face of high demand, they may need every
available plug-and-play unit to be rushed to their
shipping docks right away. As a result, vendors that
report breakthrough sales are burning through a lot of
inventory trying to meet current customer needs while
much of the open market goes without. All of this
suggests that if you're not already using plug-and-play
automation via an established vendor relationship that is
serving you well, it'll probably be harder for you to start
now than it will be for other companies to build on what
they have.

What You Won't Get

There's been a lot of talk about how robots can keep workers safer and healthier by ensuring more space between people, fewer handoffs, or even "touchless" work processes. It's easy to picture: Where before you had a line of workers assembling subscription boxes as they went by on a conveyor, now you can put a six-axis robot arm at every other station and have workers stand 15 feet apart. Or instead of having people huffing and puffing COVID-19 aerosols as they take 30,000 steps walking product around in a building all day, just enlist an AGV to bring the product where it needs to go.

Across every one of our studied sites, however, this vision of robot-enabled, touchless work is a mirage. Plug-and-play technologies are often already in place to confer benefits like efficiency, quality, and analytics — and in those cases, there's not much more social distance you can buy. And the systems that aren't plug-and-play — those with robotic arms that can potentially handle pick-and-pack-style manipulation — are quite new and unproven. What's the "hot new tech" ensuring social distance in various work processes at every single one of our sites? Moveable plexiglass partitions, devised and put up in days by scrappy maintenance crews.

We're also finding that plug-and-play systems don't necessarily result in dramatic reductions to the human labor force. Before COVID-19, managers responsible for the efficiency of high-mix, repetitive, manual work were struggling to find, retain, and develop front-line workers. These workers could find alternative employment

quickly — often at another warehouse just across the street — and increasing wages didn't seem to have much effect on attracting or retaining them. This meant that managers in these facilities had a tough time keeping a predictable, capable workforce in the building and keeping product flowing steadily out of the shipping bays. Now it's even harder to do all of that.

So managers are still eager to hire good front-line workers; employment opportunities are up in industries that ship product to customers. True, the increased volatility in conditions and demand is a potent reminder to those managers that their ultimate job is producing predictable outcomes for their customers, and in the plug-and-play category, robots can deliver on that better than people can. We've met managers who will even accept a robot that's only 85% as fast and good as a human if that means they can *count* on that productivity. But on balance, that still increases their need for capable front-line workers, because someone has to work out the new way to interact with these robots to get the job done, and other, more manual parts of the warehouse process need to speed up to keep pace with demand.

Moving Forward

The received wisdom these days is that COVID-19-related automation pressures strongly favor large organizations with cash on hand.[5] Our observations call this assumption into question. Right now, everyone's

scrambling to adapt, and no one is all that confident that they know what "normal" will look like or when it will arrive. That means that in the short run, the game is a bit flipped. Historically, the best automation ROI has come through techniques available to well-capitalized giants. But now, smaller or more specialized companies can rightsize their plug-and-play investments to their operations and continue to get reasonable ROI from such systems when conditions inevitably change. Very large companies will come up short if they try to make those big plays of yore — but they're in the habit, and big companies often have a hard time breaking habits.

Companies and front-line workers are struggling to find their way in a sea of automation opportunity. A small minority will have some genuine innovation to show for it in general and when we get through the COVID-19 storm in particular. But a healthy economy does not turn on the atypical success of a few while most fail. We need to find and learn from those rare successes as quickly as we can so that everyone can adapt more constructively.

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