Disruptive Technologies

"The world is moving so fast now-a-days that the man who says it cannot be done is generally interrupted by someone else doing it."

Those lines are as true today as when they were first published in the early 1900s. And it’s not just our every day worlds that appear to be evolving before our very eyes. Global supply chains are evolving at a faster rate than at any point in history. In the September 2015 issue of Supply Chain Management Review, I wrote about emerging markets, mega cities, millennial consumers, and e-commerce—the four global trends that supply chain executives must consider when designing their processes and networks (Four Compass Points for Global Supply Chain Management). Together, they form four interconnected points on the supply chain compass in response to the shifting demographics, markets, and economies that will impact where and how we manufacture and deliver goods to our customers.

As if those trends aren’t disruptive enough, the tools we rely on to manage distribution, manufacturing, networks, and data are also in the midst of a radical evolution. While distribution models formerly evolved slowly over decades or even centuries—as was the case in the move from horse-drawn carriages to trains to commercial trucks—these new technologies threaten to disrupt our field in
Drones: Laws, Human Employment, and Increased Efficiency

For years—and in some instances centuries—products have moved across the water, land, and air by ships and barges, trains and trucks, and airplanes. In some respects, very little has fundamentally changed in those technologies over time, with the exception of gradually increasing fuel efficiency, incremental improvements in speed, and the addition of digital and computer tracking technologies. Today’s semi-tractors and trailers don’t look all that different from the tractors and trailers that
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we were on the road 30 years ago; indeed, many of today’s cargo planes were put into service 30 years ago.

Enter drones, which are emerging as a potentially game-changing alternative to traditional modes of delivery for some processes. Like so many disruptive technologies, drones have their roots in the military, where they are used to limit the loss of life while accomplishing their assigned tasks with fewer mistakes, in shorter periods of time, and with less risk to the safety of the operators.

In the last few years, drones have caught the attention of the private sector. In the supply chain, drones could positively affect industries as varied as agriculture, medicine, and retail by reducing the number of steps in the chain and speeding up delivery. The potential benefits are astounding, and, according to author Peter Sachs, the technology and associated laws around the usage of drones are evolving almost weekly.

Corporations such as Google and Amazon were quick to realize that autonomous delivery could rapidly change how products make their way through the supply chain. Corporations such as Google and Amazon were quick to realize that autonomous delivery could rapidly change how products make their way through the supply chain.

and on to the end customer. Jeff Bezos famously interjected drones into the public conversation on “60 Minutes” in December of 2013. Eight months later, in August 2014, Google announced “Project Wing,” an initiative designed to develop an efficient and reliable global supply chain system where autonomous drones can reduce the time to deliver products to consumers. As Astro Teller, Captain of Moonshots at Google X, noted at the time, there has always been a level of friction in the transportation of goods, and drone delivery such as Google imagines “aspires to take another big chunk out of the friction of moving things around.” Indeed, Gartner estimates that by 2017, 20 percent of logistics organizations will exploit drones as part of their monitoring, searching, and event management.

There are hurdles that will have to be overcome before drones become a mainstream tool and not just a fancy of Jeff Bezos’ imagination. Drones’ military lineage has led the public to voice concerns—and more—about the potential for drones to increase surveillance and violate individual privacy rights. Already, we have seen news reports of a man in Kentucky who shot his neighbor’s drone out of the sky for hovering too near his property; meanwhile, in California drones operated by hobbyists have allegedly interfered with the work of firefighters and rescue workers following a massive highway pileup. For those reasons, Google and its competitors would do well to remind the public of the many beneficial technological advances that were developed first for military purposes, including microwaves and the World Wide Web. Just as those technologies caused suspicion before they became part of the fabric of our lives, so too can we accept drones. In fact, as reported by the BBC, the FAA has already granted permission to six television and film firms to use drones for their cameras; and they have developed restrictions and policies for such usage. Laws will eventually catch up to the technology in ways that make drones acceptable in our daily experience.

Drones may improve the supply chain in several ways. For one, drones could be used in ports and in the air to make deliveries that require fewer individuals to handle materials. As an example, PINC Solutions, a provider of yard management systems, has deployed a solution that utilizes drones to identify the location of trailers, shipping containers, and other assets in hard to reach areas. Equipped to carry GPS, RFID, OCR, and barcode readers, the drones can fly overhead to quickly locate and identify assets that have been tagged in a yard or port. While drones will replace some traditional jobs, including some that are currently hard to fill like truck and delivery drivers, the operation of drones will create new jobs for employees with technical training and logistical knowledge. “Although drones are unmanned, they are not unpiloted,” the BBC has reported. “Trained crew at base steer the craft, analyze the images which the cameras send back, and act on what they see.” Moreover, the BBC predicts that human employment will come from loading, programming, and maintaining drone technology.

Drones will undoubtedly alter how consumers order products, given that the lag time between ordering and arrival can be drastically reduced in some circumstances. They will also alter how retailers function, from how, where, and whether they warehouse their products to whether they opt to maintain or move away from brick-and-mortar
and omni-channel in favor of e-retail.

Since Bezos’ “60 Minutes” announcement, Amazon gives every indication that it is pushing for the use of disruptive drone technology. As recently as the start of the 2015 holiday shopping period, it released a video touting the latest iteration of an Amazon Prime Air drone designed for the home delivery market. Amazon certainly faces technical limitations today—at present batteries are only good for 25 minutes on a charge—but “at a certain speed, the home-court advantage of local merchants dissipates,” Evan Schumann reported in Computer World. “That happens when an Amazon delivery takes no more time than the shopper would need to drive to a local retailer, complete the purchase and return home.” Drones, for instance, could increase the sales of an online retailer like Amazon during the last days of the holiday season, when online sales typically dip because it’s too late to make deliveries with conventional parcel delivery services and shoppers turn instead to stores.

The health care industry is also experimenting with high speed drones, especially for the delivery of crucial items. The efficiency and speed at which organ donations, key medications, and vaccines will be able to travel could make healthcare more accessible in urban spaces, bypassing road and rail traffic congestions, as well as to rural and third world locations where insufficient infrastructure might typically cause detrimental delays.

The Mayo Clinic, for instance, has already begun studies about the possible benefits of utilizing drones in the medical supply chain. Cornelius A. Thiel, a general surgery resident at the Mayo Clinic, notes in a Clinical Update that blood is the perfect testing ground for drone delivery “because it’s expensive and expires—platelets and thawed plasma last just five days—and the supply is very limited. In our region, the smallest critical access hospitals stock just two to six units of red cells and no fresh frozen plasma or platelets.” Currently, these supply lines are supported by helicopter and ambulance transport teams, which are incredibly expensive in comparison to the cost of flying a drone, according to Thiel.

Even emergency treatment, which currently requires an ambulance to arrive on the scene before technicians can treat patients and transport them to hospital emergency rooms, could undergo beneficial changes. Students at the Delft University of Technology in the Netherlands have rigged up a drone with a defibrillator and a webcam that can be delivered to patients with cardiac arrest faster than an ambulance can drive to the scene. According to the university, the webcam connects local bystanders to emergency medical personnel who can direct them on how to use the defibrillator, delivering life-saving treatments in a fraction of the usual time.

Similarly, drones were used to deliver small aid packages to remote disaster areas after the Haitian earthquake in 2012; and in Papua New Guinea, Doctors Without Borders used drones to transport dummy TB test samples from a remote village to the large coastal city of Kerema.

While drones still face technical limitations and legal hurdles, the technology will find its niche in supply chain management.

**Meanwhile, the promise of 3D printing is simplicity:** By producing products at the point of demand, supply chains become shorter, leaner, and less complex.

**3D: Cut Out the Middleman and Speed Product to the Consumer**

Manufacturing processes and their supply chains are complex and slow to respond. As manufacturing supply chains add even more suppliers, warehouses, and shipping components, they risk further delays in delivery as well as increased costs for storage and shipping.

Meanwhile, the promise of 3D printing is simplicity and speed: By producing products at the point of demand, supply chains become shorter, leaner, and less complex. While the technology is still emerging—and like drones, still faces technical shortcomings and cost hurdles—a broad range of fields, from fashion to automotive to aeronautics to medicine, are utilizing advanced printing technology to create products on demand. For example, Sinclair Interplanetary has begun using 3D printing to produce satellite reaction wheels. Industries that produce heavy equipment, such as commercial aviation, jet engines, and construction equipment, are utilizing 3D printing to produce parts that are critical to the production process but with limited demand. Manufacturers like Boeing find that they can manufacture a single part on demand on the factory floor more economically than they can purchase and
warehouse a minimum order quantity that might not be consumed for months. As the technology is honed, it will produce a wider range of products, with improved endurance.

By locating local production centers closer to strategic markets, 3D printing will have a positive impact on:
- reducing carbon footprints by cutting back on delivery transportation, improving an organization’s sustainability efforts;
- cutting back on warehousing costs by allowing quick made-to-order production;
- speeding up turnaround by quickly and cheaply producing replacement parts; and
- meeting consumer demands for the swift delivery of personalized products.

High-speed networks will aid the entire supply chain in downloading, printing, and distributing products with fewer steps in the supply chain and significantly less waste.

Take, for example, car racing, a sport that is incredibly fast paced and demands pit crews that can quickly make a repair and get the driver and car back on the track. In the past, pit crews have kept an inventory of “just in case” supplies on hand, leading to a surplus of material on the track side. In addition, there is the chance that a car will need repairs for which no equipment or parts are available on hand. 3D printing solves many of these problems by allowing crews to produce parts on demand and only when needed.

To see the potential effects of using 3D printing to cut back supply chain components in manufacturing, take a look at California-based SpaceX, where three years of research and development led to the use of 3D printing to build the emergency escape rockets on its new manned Dragon spacecraft. SpaceX developed materials that can withstand the demands of space travel even while being produced quickly; writing for Space.com, Elizabeth Howell reports that SpaceX has shown that “Printing the chamber resulted in an order of magnitude reduction in lead time compared with traditional machining—the path from the initial concept to the first hotfire was just over three months.” That kind of lead-time reduction has reduced costs and enabled SpaceX to outstrip NASA in developing and maintaining emerging contracts for space station supply chain.

It will come as no surprise that NASA is joining the 3D printing revolution, with plans to ensure that space station crews can, if necessary, produce parts on demand without having to wait for few and far between delivery missions: “NASA plans to send a 3D printer produced by California-based company Made in Space to the space station this year,” Howell continues, “and the European Space Agency has mused about using 3D parts to build lunar bases.” Doing this might allow NASA to reenter the game, which SpaceX had been threatening to claim in full. Meanwhile space station crews will be better equipped to maintain the station safely and on demand.

Cognitive Calculation: Surpassing Human Adaptability and Accuracy

For most of us, early PCs seem like tools from the Stone Age. While the Apple 1, comprised of a single circuit board connected to a keyboard and a television, was considered a marvel in 1976, the computer technology now available to any sixth grader can generate 3D designs, create high quality music, and store up to 6.0 terabytes of data. Meanwhile, super computers, such as the Tianhe-2 created by China’s National University of Defense Technology, are reported to have a wide range of capabilities including simulation, analysis, and government security applications. Performing 33.86 quadrillion calculations in one second, or nearly twice the speed of the U.S. Energy Department’s Titan, according to some analysts, such heightened computational capacity radically outstrips the human ability for calculation and efficient use of data. Super computers can perform tasks that formerly required large staffs of employees working at slower speeds and with less accuracy.

All of that computing power is made possible through smart chips and super computing technology that generate speed, information storage, as well as adaptable cognition that imitates human learning. Supply chain management may not need the power of the Tianhe-2 or the Titan just yet, but as super computing technology has expanded in the past decade, computer scientists have adapted these tools to create more practical solutions, such as robots that are not only programmable, but can perform complex functions within microseconds and develop new abilities through learning. These new developments in cognitive calculation and smart computing can reduce the need for human contributions that are at times erroneous and cause slow downs and disruptions in manufacturing, order fulfillment, and transportation. And, just as technology developed for the military, like drones, is finding a home in the private sector, so too are technologies developed in the computer world.

Baxter, a robot developed by Rethink Robotics for
collaborative industrial applications, is a good example of the potential for applying these advances in cognitive calculation and artificial intelligence (AI) in the supply chain. Using some of the most advanced AI on the current market, Baxter requires no traditional programming. Instead, the robot is "manually trainable by in-house staff, reducing the time and cost of third party programmers [and is] flexible for a range of applications and re-trainable across lines and tasks," according to its manufacturer. That means Baxter is capable of being taught to perform a multitude of tasks in the plant and distribution center, unlike its human counterparts who typically specialize in a single field. One robot, for instance, can be trained to handle line loading, machine tending, packaging, and materials handling. What’s more, when it finishes a task at one station, it can be easily moved to another station and taught the next task.

There is one other significant difference: Most industrial robots are not only designed to replace workers, they are typically in their own distinct work areas for the protection of workers. Baxter, on the other hand, is designed to collaborate with human employees. In one warehousing application, a Baxter robot loads products into a machine that wraps and seals them for shipment while an associate at the same workstation unloads and visually inspects the products before putting them on a conveyor. Rather than replacing associates, the robot requires contact and monitoring of human behaviors in order to efficiently learn to process and replicate tasks.

Collaborating with these technologies within supply chains means that robots can perform monotonous tasks and free up skilled labor for higher level, value-added tasks. Beyond taking on monotonous tasks, cognitive technologies can also tackle potentially dangerous tasks in the fields of manufacturing and military operations, reducing injury or loss of life and allowing employees to put their skills to work more safely.

**Following the Compass**

Early on, I referenced the four global trends that supply chain executives must consider when designing their processes and networks. They are what I refer to as the four interconnected points on the supply chain compass. Follow them, and they will aid supply chain managers as they respond to shifting demographics, economies, and global markets. Each of the three technologies I have just discussed will be important tools for supply chain managers as they follow the compass to address these new and rapidly evolving issues in our networks.

**Millennials are not only comfortable and conversant in the use of emerging supply chain models, but they also expect the companies they do business with to harness these technologies for their benefit.**

Take, for example, the rise of millennial consumers, who have come of age during this time of rapid change. Millennials are not only comfortable and conversant in the use of emerging supply chain models, but they also expect the companies they do business with to harness these technologies for their benefit. For example, they demand selection; visibility into their orders; and speedy, accurate, reliable, and economical delivery.

More importantly, millennial consumers have made it clear that sustainability is an important factor in who they choose to do business with. Recent regulations, and perhaps the Paris accord on climate change, may also push sustainability to the forefront. Each of these new technologies not only improves efficiency, they allow global supply chains to address major sustainability concerns of the future, including:

- energy consumption;
- CO2 emissions;
- traffic congestion; and
- water consumption.

Those are just some of the reasons I believe that the new technologies will gain traction and become acceptable more quickly than past disruptive technologies. The transition process will require supply chain managers, stakeholders, and consumers to focus on the future rather than the past. New training, new methods of collaborations, and entirely new supply chain career paths will open. To advance within the field, supply chain managers must continue to educate themselves and their teams, and encourage new approaches to lean thinking and innovation.

Navigating the complex world of modern supply chains requires managers who have an eye to the major compass points of the field—with the likely North being millennial consumers who drive organizations toward new technology, into emerging markets, and toward developing megacities. Employing the evolving and disruptive technologies including drones, 3D printing, rapid networks, and smart chips will be critical for us to meet the demands of these consumers. But effective thought leaders will see the possibilities of harnessing these technologies to meet demands, expand into desirable markets, and do so with heightened lean efficiency.