

# AI STARTS TO MAKE SOME SUPPLY CHAIN DECISIONS

Is it prime time for AI? Not yet. But, it is edging into the physical world of the supply chain. And there's no going back.

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**A**rtificial intelligence finds itself deep in a world of seeming contradictions these days. On the one hand, AI is believed to be a black box of universal truth. Yet, it is often not as sophisticated as a three-year-old. Most think of AI as a form of general intelligence. Yet, its most advanced forms are actually narrow intelligence. Some view AI as a stand-alone technology. Yet, it is also a feature of other technologies and applications.

Until most recently, AI lived almost entirely in a digital, academic world. Yet, it is now breaking into the physical world of the supply chain. Fortunately, AI is doing just fine living with all this turmoil. And there is one certainty about AI: It has already made the leap from the Tuesday Science section of *The New York Times* to the daily Business section. And it's not going back—especially in the supply chain.

## Early on

The contradictions of AI should not alarm: They are simply manifestations of how it is developing and being perceived—sometimes in exaggerated ways.

Despite how fresh it may feel, AI is not new (yes, another contradiction). Its origins trace back to the 1950s. Some link the concept of machine learning directly to Alan Turing, who created a model for a general-purpose computer in 1950. That said, 2020 is still an early time for AI.

“Things that are hard in AI today are easy for a three-year-old,” says Pieter Abbeel, co-founder of the AI robotics company Covariant and a Berkeley professor. Keep in mind, the whole point of AI is to make decisions as well or better than humans can make them. The example used by Melonee Wise, founder of Fetch Robotics, is a drawing of a giraffe. “Show a child a drawing of a giraffe and she can identify the giraffe at the zoo the next day. No AI algorithm can do that today or even make the inference,” she says.

AI itself is still learning. And there’s lots more to learn and plenty of maturation to come. While some might look at that three-year-old and see certain promising characteristics for future greatness, it’s way too early on in development to declare victory. But to read the popular press, it’s easy to think that not only is AI fully formed, but it is also a very short time away from eliminating a wide swath of people from the workforce. Not so, in either case. There is no black box of AI sitting on the shelf at Best Buy. But one day, AI will have a direct impact on the jobs people do in the supply chain and the jobs that machines do. And that time starts now; consider the following examples.

About three years ago, JDA Software bought an AI company called Blue Yonder. Today, the company is now called Blue Yonder, reflecting its commitment to making AI a foundational component of its supply chain software. It is already offering AI features in certain programs related to demand planning. These include AI to support pricing strategies as well as replenishment solutions. The latter creates accurate, granular intra-day demand forecasts that optimize product availability. Beyond that capability, AI

drives automated store replenishment, substantially reducing out-of-stocks.

Then just last month, *The New York Times* ran a story (yes, the lead story in the Business section) on the use of an AI-directed order-picking robot at Obe-ta’s electrical parts distribution center outside Berlin. The Knapp picking robot is powered by Covariant’s AI. “While it may not seem like much, this component-sorting robot is a major advancement in artificial intelligence and the ability of machines to perform human labor,” the article said.

Speaking with SCMR, Peter Puchwein, vice president of innovation and research and development at Knapp, explains this development didn’t just happen overnight. Knapp and Covariant worked together for more than a year to develop this application and its narrow intelligence—finding the right parts in a single tote and picking them to fill orders. Better yet, the robot picks as quickly as humans with equal accuracy—less than a 1% error rate, explains Puchwein. It’s also worth noting that this was not a new idea for Knapp. They had been looking for an AI partner for five years and had rejected at least 20 AI companies as unable to perform.

Knapp is not alone. As the *NYT*’s article points out, robot supplier ABB ran a contest last year to find its own AI partner. It invited 20 companies; half of which failed conclusively. Some came close. As it turned out, only Covariant “could handle every task as swiftly and efficiently as a human,” said *The Times*.

## If it looks like AI...

AI isn’t easy. And for that matter, it isn’t always easy to know what AI looks like. Because it’s so early in its development, there are many different views on the state of AI. So, knowing AI when you see it all depends on what you see and who you speak with. Here’s a greatly distilled rundown on what makes AI AI today.

Some say there is very fine line between a fancy algorithm and AI. Worse yet, there are some who try to pass off a fancy algorithm as being AI. At one end of the spectrum is Wise of Fetch Robotics. She’ll tell you straight out that “there is no such thing as AI.”

Her contention is that it is still so early in the learning-to-learn stage, that AI, well, doesn't exist quite yet. Now don't get her wrong, Wise is not an AI naysayer. Instead, she is very close to the challenges of AI and is being quite definitive about its state of development. She continues to say AI is just a term used to describe what people are trying to accomplish with machine learning (more on that to follow). "AI doesn't exist today. It's a branding problem," concludes Wise.

Two Harvard Business School professors, Marco Iansiti and Karim R. Lakhani, talk about weak AI and strong AI in the January/February 2020 issue of *Harvard Business Review* and on a webcast. "You need only a computer system to perform tasks traditionally handled by people" to have what they call weak AI. On the other hand, "machines that can think and act in a way that matches or surpasses human intelligence" are strong AI, Lakhani and Iansiti say. That's a pretty good baseline.

That said, AI needs to learn to become AI in the first place. In other words, Wise's statement is not as outrageous as it may seem at first. It's all a matter of degree. AI needs data (lots and lots of it) before it can start to create the algorithms that guide decision-making—and ultimately outcomes. That data can come from people or from data networks. In a more primitive form of learning, people feed data that will teach AI to learn and alter its decision-making process, resulting in new algorithms and outcomes. Step it up a major league notch and machine learning takes over, moving from people-directed data input to that fed by data networks. People don't have to

get involved, but typically do.

Drilling down one level deeper in machine learning, there is deep learning. The idea behind deep learning is to imitate how people learn. Deep learning can run either unsupervised by humans or supervised by humans. Other forms include reinforcement and transfer learning.

Deep unsupervised learning speaks for itself, literally, but today is very rare. The vast majority of AI has at least some human involvement. Quite simply, AI, for the most part, is not running on its own in the supply chain or anywhere else, for that matter.

Deep supervised learning relies, at least in part, on human input. As Maria Jesus Saenz, director of MIT's Digital Supply Chain Transformation research program, explains humans don't have to supply all of the data, but they can provide relative insights and intuitions, and augment the data streaming into the AI. As the technology learns to learn, people can teach it about data from other sources and incorporate it into the learning process. There are great opportunities for the AI applications when the expert human and smart algorithm team up.

Reinforcement learning is what makes the robot at Obeta smarter every day. As Abbeel and Puchwein explained to *SCMR*, all of the robot's actions during the day, both successes and failures, are recorded and sent back to the AI engine. At the end of day, it evaluates what went well versus not so well, making adjustments in how to pick on the next shift. It reinforces what has already been learned with new learnings that enhance decision-making and performance.

Transfer learning is the fourth variant of deep learning today. It takes data and decisions that solved one problem and transfers those to another problem. There are sure to be plenty of opportunities for transfer learning in the supply chain in coming years.

While machine learning comes in different forms, its output or intelligence all has a similar profile at this stage of its development—we're a long way from any intelligence that could be called general. AI is not making sweeping changes in the supply chain. Instead, AI is at the front end of developing narrow intelligence that performs a specific action or makes a tightly defined decision.

It is also worth noting that AI in any field is not a universal truth regardless of its variant of machine learning. In fact, AI can look quite different depending on the humans who are involved—or even its country of origin. People still affect how AI learns and the decisions it makes. In fact, that's the basis for claims of bias in AI applications such as facial recognition.

### **AI and an ocean of data**

Given all the hype surrounding AI, it's easy to exaggerate what it can do. Many have already.

"Expectations are outsized," says Sergio Caballero, research scientist at MIT's Center for Transportation and Logistics (CTL). "People expect AI to have a huge impact on business. But what many of these people lack is a clear understanding of what AI is and what it can do at this point," adds Caballero.

As captivating as it is, AI is not the center of the digital supply chain. It is just one component,

albeit a potentially very important one. The possibilities go so far beyond an order-picking robot. But at this point, there are many other possibilities that lie in the future. There's work to be done first, and it's not just in the development of smarter AI.

Before AI can reach its potential, the supply chain has to put its digital landscape in place. That's the only way all that needed data can flow to where it will be put to work. Quite simply, AI has to sit in an ocean of data to be effective to any degree. And the only way that is going to happen on a large scale is with a successful digital transformation of the supply chain.

"Digital transformation requires a previous analysis of the main value propositions for supply chain transformation, not to mention digital technologies and transaction data," says Saenz of MIT. "These value propositions bring the 'what that supply chain wants to achieve' and more importantly the 'why they want to achieve it in the first place,'" she adds.

"Digital transformation requires a technical exercise known as digitization that collects all transaction data of any form from all of the silos and puts them into an electronic state in a central location," explains Rich Sherman, senior fellow with Tata Consultancy Service.

Doing that consolidates previously siloed data. That means, that not only is all data commonly available, Sherman says, but it can be shared across all functional silos. It also codifies data across the company's supply chain, and puts all decision-making on the same footing. Suddenly data becomes Big Data when it's available on such an unprecedented scale.

And the Cloud is increasingly becoming the home of all that data. Wise of Fetch Robotics sees the availability of Cloud data as essential to giving AI a seat at the decision-makers table on the plant or warehouse floor. "The Cloud delivers the computational power that will allow AI to scale and manage Big Data sets with high accuracy and have the maximum impact on operations," she says.

In other words, Big Data is still just data until something is done with it. As Sherman says, "Big Data is like crude oil. It needs to be refined into something before it becomes valuable." And the value of data here is its ability to create time in the supply chain by shrinking time in individual supply chain processes. "The real value of the digitization of data is that it removes latency from the supply chain," Sherman continues. "Digitization removes the time delay in communicating conditions across the supply chain as they change in real time. That gives people more time to respond to change and makes decision making more timely," Sherman says.

AI is one digital tool that also removes latency from the supply chain. And its potential is huge. "Ultimately, AI will be able to predict having the right amount of stuff at the right time in the right place," explains, Michael Feindt, founder of Blue Yonder.

"Digitization and what's going on in AI today are early steps toward building the autonomous supply chain from orders to warehousing and transport," he continues. "We are at the very start of this. The next step is to move AI into the distribution center then back up the supply chain back to manufacturing. Carry this goal all

the way to its logical conclusion and AI will ultimately predict what people want to buy," says Feindt.

He says it's all about repeatedly making decisions based on real time data. Key decisions can go as far as predicting customer behavior correctly to precisely drive replenishment decisions that are both customer facing and supplier facing. Feindt even sees AI as a powerful pricing tool. "With all of its influences in the supply chain, AI will ultimately determine price and profit of even seasonal products," he adds.

### **Can it work here?**

Getting to Feindt's vision will not be easy. Just ask Caballero: He sees it every day.

MIT's CTL works with about 80 companies on various supply chain research projects. Caballero estimates that 50% of them currently do not use AI in any form. About 25% have some AI pilots, and only 25% are actually using AI to any degree.

Those that actually use AI are fundamentally different from other companies, says Caballero. "They understand up front that AI is not magic and is not a solution for everything. Beyond that, they have a solid idea of what AI can do for them. And they understand the need for abundant data," he says.

Saenz of MIT agrees and says not every company is a candidate for AI or any other innovative supply chain technology for that matter. "Those that will succeed already have an innovative culture and are able to rise up to the challenges of innovation," she says. "For too many companies, innovation is not part of their culture; it's not part of their way of thinking. They feel comfortable in their present



state and are not likely to succeed at innovation,” she says.

Saenz sees some other key characteristics, too. Ten to be precise. These companies are:

- agile;
- responsive;
- customer focused;
- technology savvy;
- data driven;
- collaborative;
- comfortable with experimentation;
- constantly challenging the status quo;
- adaptable to change; and
- ambidextrous.

That last one is the most important of all. Quite simply, a company must be able to go right or go left based on circumstances and not some predisposition. If a company is not ambidextrous, it will fail at innovation. “Ambidextrous is a state of exploring and exploiting,” explains Saenz.

### **Making decisions differently**

Going right or going left solely based on conditions is not a natural state for many people let alone companies or supply chain operations. There are rules, more rules, and often even more rules. Supply chain professionals are often committed to the faithful execution of processes because otherwise, chaos waltzes in. Freelancing is not generally encouraged. Well, AI is here to break many of those rules. But AI will only do that when appropriate, when it has a smarter outcome. Accepting that value proposition will not be easy, however. Mostly

that’s because we generally think humans and our existing processes are smarter than machines no matter how much learning they’ve done. As Feindt of Blue Yonder says, it’s good to remind ourselves that AI is in the time of narrow intelligence, delivering tangible benefits.

Obeta is the perfect example of that. Despite the initial success of the AI order-picking robot there, Puchwein of Knapp knows this a long game. He hopes to install 100 robots over the next two years. But over time, his vision is to move from 20 human order-pickers to one technician overseeing 20 robots. Quite simply, Puchwein’s customers tell him that they can’t find the workers to do those monotonous jobs any longer; they need robots in their facilities. At the same time that this is narrow AI, it solved a highly complex problem, explains Abbeel. The robot is not picking a perfectly positioned item from a geometrically stocked shelf. Items are randomly placed and often have reflective surfaces that can drive the robot’s vision system crazy. So, while this might be narrow intelligence, the Obeta robot relies on really smart narrow intelligence.

Beyond robots, demand planning is another emerging domain for AI in the supply chain. “AI should compare expected demand with actual demand to determine what really drives accuracy and how best to balance inventory flow,” explains Saenz of MIT.

Consider Reyes Holdings use of AI to improve the forecast for its beer products. In late 2018, Pamela Armella, Reyes’ data science

leader, launched the company’s first machine learning models. The absolute forecasting percent error declined was cut in half from 38% to 19%. That was reported by Armella and MIT’s Caballero in the September/October 2019 issue of *SCMR*.

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Over time, that error rate declined as the model learned further. It also allowed purchasing to modify some of its practices. “AI/machine learning is a disruptive technology that challenges current thinking and ingrained practices...The (data science) team asked users not to trust their intuitive judgment, but not to dismiss it either because the models were still learning,” the article said.

The two primary benefits of AI, says Caballero, are improved visibility and more accurate predictions of supply chain activities. “If you know today what orders will come in during the next few days, you can start filling them now,” he adds.

Feindt of Blue Yonder says that AI is all about progressing from today’s solutions to future more intelligent solutions. “Even narrow AI can help to unify supply chain processes. The result will be improved efficiencies and ultimately profitability,” says Feindt.

It should prove to be a fascinating ride. ☞☞