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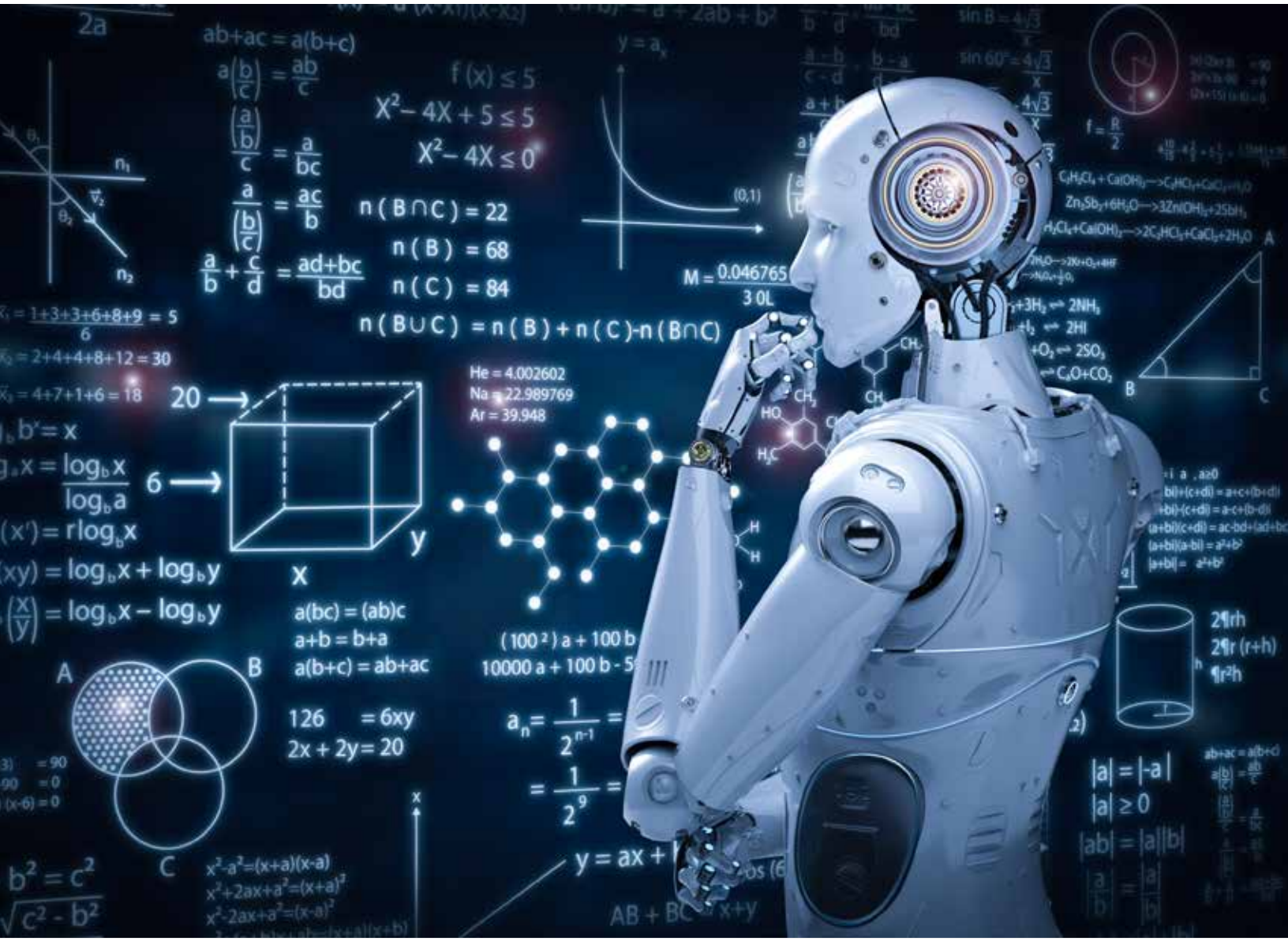

How Smarter Robots Will Disrupt Logistics

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HOW AI AND ROBOTICS WILL RESHAPE THE FUTURE SUPPLY CHAIN

New machine learning techniques are helping to create robots that are better and faster for moving products from origin to destination.

By Jim Romeo

Advances in robotics and artificial intelligence continue to drive the industry, but nowhere is this more evident than in today's modern supply chain. With speed and efficiency improvements, these technologies are reshaping the future of logistics in all facets of the global supply chain.

Logistics, by its very nature, is a dynamic sector with many moving parts. Products, people, vehicles, and now robots all move about in an effort to get products from origin to destination without disruption or damage, and in the shortest time possible. Today's modern enterprise constantly seeks ways to improve their competitive edge – moving the supply chain smartly is a strategy that robotics and AI are helping with.

As robots and AI start to converge, companies will begin to see smarter robots that can go beyond initial, mundane tasks into more complex systems that create even more value for the companies that deploy them.

EXAMPLE: DISRUPTING THE GLOBAL SUPPLY CHAIN IN GERMANY

The Hamburg Port Authority (HPA) in Germany is the third largest port in Europe and 14th largest in the world. More than 132 million tons of freight travel through it annually, and that figure is expected to double by 2025. It's growing fast, but because of its location near downtown Hamburg, the port cannot expand beyond its current footprint.

Maciej Kranz, VP of Strategic Innovation at Cisco and author of *Building the Internet of Things*, successfully pioneered innovative uses of AI, machine learning, robotics and Internet of Things (IoT)

Credit: hh oldman

The Hamburg Port Authority is automating processes in order to move more freight without expanding its footprint.

technologies in dozens of enterprises. Cisco helped the port authority implement more intelligent and automated harbor operations through the adoption of new technologies.

For example, IoT-enabled sensors on assets such as cranes and pallet loaders, as well as infrastructure such as roads and bridges, help optimize efficiency by speeding freight turnover and moving cargo in and out faster. Sensor data is also used for preventive maintenance, helping to avoid costly downtime. Real-time analytics on asset health, and the ability to schedule preventive maintenance is one of the fastest ways to achieve return on investment, Kranz said, as the reduction in operational disruption alone may pay for the investment in AI and IoT technologies.

Maciej Kranz

Kranz also said the Daihatsu Motor Company is using technologies such as AI, IoT and 3D printing to connect its supply chain to enable mass customization in ways previously not possible. For example:

- Information can be shared in real time between each element in the supply chain;
- Buyers can click on the components they want;
- Suppliers can logistics providers can see what components are being ordered, and with rapid systems retooling they can adjust schedules appropriately, even on the fly.

HOW AI MAKES ROBOTS SMARTER THROUGH REINFORCEMENT LEARNING

Before robots can start disrupting the supply chain, they have to become smarter. One way companies are doing this is through reinforcement learning.

Rob May

"Advances in reinforcement learning have been useful in shaping robot capabilities," said Rob May, co-founder and CEO at Boston-based Talla and BotChain. "When robots get started, they have limited knowledge. The problem with deep learning is that it requires a large data set to train on. Reinforcement learning, by contrast, learns from a series of individual interactions. This allows a robot to update its model of the world after each thing happens."

The ability to use deep learning in robotics enables a robot to actually learn and solve problems, much like a human being. "AI has had a profound impact on the field of robotics," said Ruban Phukan, co-founder of DataRPM, and vice president of product for Bedford, Mass.-based Progress Software. "Techniques like deep learning combined with reinforcement learning have helped create approaches where a robot can automatically learn to perform a particular

task by trying out things on its own within defined boundaries. So rather than gathering a huge amount of upfront training data or writing complex rules, all a trainer needs to do is define the environment in which the robot operates, the actions that it can take, and assign rewards to specific actions taken from different states. The robot learns to perform the task by trial and error, where it identifies actions that generate the maximum rewards.

Ruban Phukan

"This is very similar to how we humans also learn in our early ages, by following actions that get a positive reward and avoid actions that cause negative rewards," Phukan said. "This helps a robot self-learn many complex tasks and adapt continuously by interacting with the environment directly or via simulations. With this approach, the robots can even learn to discover new solutions to problems on their own without requiring domain experts to explicitly program the robot or train them on those solutions."

By learning how to solve problems, AI can increase output and the efficiency of creating such output. "Within supply chain and productivity, robotic technology has the full potential of significantly increasing output," said Phil Renaud, executive director at The Risk Institute, a research center at The Ohio State University in Columbus, Ohio. "Machine learning can leverage the experience of the most productive technologies, order tasks, pick associates and leverage that learning and productivity across many applications. Equipment is then much better utilized, increasing efficiency and in turn reducing error rates."

MENIAL TASKS NO LONGER

Increasing output and efficiency is a transformation from the past when robots were thought only to be suited for menial tasks. Now, with AI, robots become smart. They can think, learn, solve problems, and even predict. This is a radical transformation for the supply chain.

PRK Krishnan

"When robots were first used in the manufacturing industry, they were primarily suited for monotonous and unskilled jobs, as their capabilities were rudimentary," said PRK Krishnan, vice president and global head of Enterprise Intelligence Automation, Tata Consultancy Services in Mumbai, India. "But a combination of AI, robotics, and deep learning have allowed robots to acquire cognitive skills, so they can now be utilized for complex automation jobs they could never do before."

When this newfound intelligence is combined with motion, they now are capable of tasks that require accuracy and precision. "AI as it relates to the

"... A COMBINATION OF AI, ROBOTICS, AND DEEP LEARNING HAVE ALLOWED ROBOTS TO ACQUIRE COGNITIVE SKILLS, SO THEY CAN NOW BE UTILIZED FOR COMPLEX AUTOMATION JOBS THEY COULD NEVER DO BEFORE."

more mainstream views on robotics brings the ability to apply predictions to the actions of the robots," said Ron Wince, founder and CEO of Myndshft Technologies in Mesa, Ariz. "Autonomous vehicles are a good example of how the physical actions normally connected with robotics are enhanced by the ability for a machine to think, predict, learn, and act such as in AI. Simple robots are programmed to do fairly low level, routine tasks; but when enhanced with AI, they can actually make the robotics actions better and more accurate."

"The tides of technological change have met resistance since the Luddites [a radical group of English textile workers and weavers in the 19th century who destroyed weaving machinery as a form of protest]; yet the intent of technological advancement is rarely about displacing a workforce," said Renaud. "The intent is to improve quality, consistency and productivity; machine learning is capable of making those improvements on a massive scale."

THE DIFFERENCES BETWEEN AI, MACHINE LEARNING AND DEEP LEARNING

These terms are used, sometimes recklessly, to describe the emerging world of automation with robotics. Mounir Shita of Kimera Systems offers a succinct explanation of each:

Artificial Intelligence (AI) describes the act of computers and digital systems mimicking the cerebral thinking of human beings. AI is the idea of "thinking" machines. "Unfortunately, it turned out that intelligence is not as easy as we first thought and we've settled with machine learning," Shita said. More precisely, algorithms are designed to solve a specific task and become better at solving that one task. But they are limited to that task. A common example given is than an AI designed to play chess, no matter how well it plays chess, will never be able to use that knowledge to play checkers.

Machine learning is the idea that a machine can learn how to solve a task better and more efficiently. For example, a machine-learning algorithm that was designed to recognize cats in an image will become better at recognizing cats as it sees more and more cat images.

Deep learning is a machine-learning technique that has shown great results in identifying patterns. There are many different machine-learning techniques, but deep learning has shown the best result for most tasks. However, most scientists do not believe deep learning has a pathway to truly thinking machines.

The interrelationship of such characteristics — quality, consistency, and productivity — combine to complement their ability to be another worker.

"If you look at the root of the word robot, it means 'work,' " said Renaud. "Using AI for work is the way I think about robotics and AI together. It's important that we think of robotics as the hands, if you will, of this AI capability, whether they are mechanical hands or digital hands that are navigating software. Then, think about how most of us use components of the brain: you can enhance that robot or that worker to do things more thoughtfully, where it's looking at large, vast amounts of data, and making decisions; or it's using senses like touch, sight, taste, smell, in ways that can be beneficial to this work. I think that robotics and AI aren't mutually exclusive; rather, they complement and enhance each other."

HOW AI WILL RESHAPE THE FUTURE OF LOGISTICS

Once the robots become smarter, the next question is how will they disrupt and reshape the supply chain and logistics sector.

"Robots are starting to play an important role in the retail value chain, because managing an efficient and accurate supply chain is key to ensuring inventory availability, which impacts revenue, growth, and profitability," said Krishnan. "For example, robots and robotic technologies can be utilized in both front-end and back-end retail operations." Some examples include customer assistance (deploying robotic carts, delivering personalized engagement, offering services such as currency exchange, price comparisons, and dispensing loyalty coupons) and employee assistance (supporting faster

fulfillment, minimizing out-of-stock, ensuring planogram [visual representations of a store's products] compliance, and mitigating shrinkage and theft).

Krishnan said AI brings the efficiency that supply chain leaders are so hungry for. For example, the order-to-cash cycle is a key process in supply chain management. But variables such as supply shortages, demand variation, communication gaps, quality variations, and others create bottlenecks and increase costs.

He said the root cause of these variables differ on a day-to-day basis and are difficult to forecast using pre-defined rules. But AI with machine learning uses real-time analytics and action points to define potential challenges and predict them well in advance. By using algorithm models, retailers can process large volumes of supply chain data very quickly to avoid bottlenecks, reduce revenue loss from returns, and improve customer satisfaction with on-time delivery.

Credit: NextShift Robotics

Smarter robots with enabled AI will allow them to work more efficiently with humans in warehouse settings.

Much of the efficiency occurs when the granular intelligence rooted in the engineering of AI is put into action. "AI in supply chain logistics has the distinct ability to increase productivity and efficiency, " said Renaud. "Machine learning and automation can decrease risks associated with over- or under-stocking, which can often create a disaster for companies. Beyond the warehouse setting, there is much opportunity to increase equipment utilization. With machines leveraging the experience of the most productive equipment and optimizing it, equipment is then better utilized."

Renaud said that to make those efficiencies possible, there are variables to consider such as the skill set of the order picker and the mix of SKUs (stock

keeping units) within a given facility. Machine learning/AI would increase efficiency of order picking toward the higher end of human productivity and even beyond, while also allowing for a better deployment of SKU slots toward optimum positioning.

BETTER, FASTER, AND CHEAPER

There's no slowdown in the science and engineering behind AI that lets robots behave and act like human beings. As robots adopt more and improved AI, investment in AI will increase and improve. Robotics and robotic technologies have a high return on investment when companies realize their benefits.

"The technology will continue to get better, faster, and cheaper," said Myndshft's Wince. "As it becomes cheaper and more widely used, and enterprises get smarter, more agile, and more capable, it will get more embraced.

"You will see the technology move from augmentation (its current highest usage) to automation, where AI is able to replicate how a human might make decisions. For this to take place, companies will need to gain more comfort and trust with AI, which takes place with more reps. We are a long way from the self-aware AI that you see in movies. I'm not sure we will ever achieve that level of thinking, but we will get a lot closer."

THE NEXT STEP IN LOGISTICS

What are some applications of AI for the next generation of logistics management? There are many. Some are obvious, others not so much. Like most technology adoptions, applications are discovered in time and then improved and altered with use of the application.

Mary Ellen Sparrow, the co-founder and CEO of NextShift Robotics in Lowell, Mass., provided us with a list of applications where AI will help improve the logistics environment.

Workflow

AI enables a system to adjust paths dynamically, based on stored knowledge of the warehouse's workflow. This adjustment reduces the time it takes for robots and human workers to perform tasks and the distances they both travel. Quicker, more logical path planning helps prevent worker fatigue and increases throughput.

Metrics

AI provides the warehouse with key metrics on the operation of their business by increasing the transparency in their internal performance processes, key shippers, and external partners.

Inventory

AI predicts inventory replenishment numbers, enabling accurate order fulfillment without carrying extraneous and expensive inventory. It allows the scheduling and forecasting of order fulfillment in real time for faster delivery of labor-intensive packaging and shipping of consumer goods.

Workforce

AI allows augmenting the work force with flexible, scalable automation to change the roles of human workers, increasing productivity while reducing physically demanding tasks for people.

Safety

Supply chain transportation companies strive to reduce accidents and insurance claims. Truck driver fatigue is so widespread, lawmakers have legislated mandatory breaks to keep drivers alert. Researchers are currently working on facial recognition technology to identify driver fatigue and stop trucks automatically and safely to avoid accidents.

Order

Advances in vision and deep learning will solve the classic "bin picking problem," in which a robotic gripper may grasp items that are semi-transparent, flexible, or overlaid upon each other, causing loss of inventory.

Language Fluency

Advances in Natural Language Processing will allow easier transfer of information within global suppliers from systems designed in different languages. In addition, systems that require language will evolve to rely less on exact "catch phases" and more on their ability to decipher human language and colloquialisms.