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The Future of Assembly and Logistics: Combining Robotics, AI and Big Data

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Current State of Assembly and Logistics

The use of industrial robots in manufacturing dates back to the 1950s and presently industrial robots have become a mature industry. We witness the use of industrial robots in assembly lines as evidence of automation. The use of robots for assembly purposes grew under the notion that there were precisely defined tasks for robots to perform and that robots could be programmed for these purposes. Therefore, the environment and the tasks assigned to robots were controlled without interruption neither by a human nor by another robot.

It is clear now that, the level of automation that can be reached in this way is limited as the number of tasks that can be accomplished by those robots is restricted. Today, companies satisfied with using robots in this limited manner are receiving minimal efficiency returns for a comparatively large level of investment.

Today's digital manufacturing landscape is allowing manufacturers to collect data from their machines to make better business decisions and overlay artificial intelligence (AI) to boost efficiency. This is especially true in the areas of assembly and logistics. According to Forbes, "Caterpillar's Marine Division is saving $400,000 per ship per year after machine learning analyzed data on how often hulls should be cleaned for maximum efficiency" [1]. Another example according to Forbes is "The BMW Group uses AI to evaluate component images in ongoing production lines to spot deviations from the standard in real-time."

The pandemic has provided a hard reset for manufacturers to grow stronger, more resilient and more resourceful. To accomplish this, industry must double down on analytics and AI-driven pilots. Combining human experience, insight, and AI techniques, they're discovering new ways to differentiate themselves while driving down costs and protecting margins [1]. Integration of robotics, AI, and Big Data is a critical step to the future of assembly and logistics of a successful manufacturing industry.

The global market for Industrial Robotics is expected to surpass $100 billion by 2027 [3]. While the adoption of traditional industrial robots decreased by 12.5% from 2018 to 2019 the share of collaborative robots increased by the same percentage. From 2017 to 2018, the adoption of collaborative robots increased by more than 45% while the percentage increase for traditional industrial robots was only 4.4%. These interesting trends suggest that the need for a new generation of robots is increasing. These new generation of industrial robots will be more versatile, more collaborative, and able to move between the lines of assembly.

The Future is Flexible

As variety in manufacturing grows, the need to have assembly lines that can perform flexible tasks grows. Fortunately, with advancements in robotics technology, manufacturers are no longer limited to using robots for unique, precisely defined purposes in mass production. Instead, they can now use robots to perform a wide variety of different tasks and manufacturers can automatically program their robots for such tasks.

For example, a single painting robot can now go beyond repetitively painting the same type of vehicle on an assembly line. Instead, such a robot can now paint a sedan vehicle after a truck and before a SUV vehicle. As a result, this robot has much more flexibility and larger impact.

Future robots will be designed with a much higher level of versatility. Think about all the tasks that can be accomplished by a human worker and the mobility of the human worker. An industrial robot pinned on the ground of a factory floor has a limited workspace and hindered mobility dictated by the geometry and load capacity of the robotic arm links. Meanwhile, a human worker can use their legs and torso to increase mobility and reachability. Unlike their static pinned robot predecessors, the next generation of robots will look and act much more human-like.

In an assembly line, if there is a delay for a part, the results can be detrimental to the production line. The future of robotics is moving from a single-task purpose to general-task purpose. Intelligence robots using reliable data will allow robots to learn on their own and deal with shifting variables.

Advances in robotics have reduced the need for the auto companies to own an assembly line. Instead, assembly can now be provided by another company that provides assembly services that are flexible, allow for multiple tasks, and tailored to an auto company's needs. This reduces the huge amount of initial investment by a single company and therefore results in cheaper final product.

Industry Examples

Stanley Black & Decker is working with partners, including a company called Bright Machines, on a flexible automation platform, bringing increased levels of agility into how the company builds and assembles its products. "We can change SKUs using software. You don't have to worry about putting in a brand-new automation system. We can just change the cell configuration, and automatically the whole line changes configuration." Stanley Black & Decker's CTO for Global Operations and Global Vice President of Industry 4.0 Sudhi Bangalore told Industry Week.

Thales SA, a leading supplier of electronic systems to a wide spectrum of industries, is using machine learning to predict preventative maintenance for high-speed rail lines throughout Europe. The company collects historical and current data on thousands of sensors, train parts, and the current state of subsystems across European transcontinental rail systems. Drawing on the data, it has developed an AI algorithm to predict potential problems and identify when specific parts need to be replaced, attaining a high level of reliability in the process. They have developed a dashboard from their TIRIS Big Data Analytics tool for Predictive Maintenance, supporting the rail industry to achieve a zero unplanned shutdown approach. Schneider Electric created a predictive IoT analytics solution based on Microsoft Azure Machine Learning service and Azure IoT Edge to improve worker safety, reduce costs, and achieve sustainability goals. Schneider Electric data scientists use data from the oil field to build the models that predict when and where maintenance is needed. Data scientists use automated machine learning capabilities to intelligently select the optimal machine learning models and automatically tune machine model hyper parameters to save time and improve efficiency. When the company deployed the Azure Machine Learning service-based solution, it helped operators increase efficiency by 10 to 20% in just two days. [1]

Nissan is piloting the use of AI to design new models in real-time, hoping to reduce time-to-market for their next-generation model series. Nissan calls the program DriveSpark, and it's been in existence for four years. Nissan designers are using the DriveSpark system to create entirely new models that comply with the latest industry compliance and regulatory requirements. They've also used AI to extend the lifecycles of existing models as well. [1]

Challenges and Opportunities

The impact of Big Data and AI in the future of assembly and logistics will be tremendous. When combined, Big Data, AI and robotics enable factories to deliver customized products that cannot be made today. For example, imagine having a customized car. Imagine you design the parts of your car from the website at your home and your auto company builds the vehicle on demand. Although this cannot be done today, AI makes it a future possibility. AI systems can also assist manufacturers by providing predictive maintenance to improve efficiency while reducing machine failure cost.

In addition, AI can increase the efficiency of manufacturing tremendously between factories. It allows participants to communicate. For example, if there is a problem or delay at one side of the assembly line or even at another company, AI-enable systems can make decisions on events and associations with them. AI can detect the problem and manages the production among all these factories to move in an optimal and efficient way, so there will be no need to store the parts that cannot be used or shutdown part of the line because some parts have not been received.

AI transformation can also help manufactures with frequently facing operation challenges. As robots are operating to make parts, there are different objectives that determine their movements. Either controlling the robot to result in the most energetically efficient moves or to result in the fastest moves. If there are foreseeable delays that are coming, AI can coordinate the planning between the robots in real time to mitigate the problem. Some robots operate with one objective and some with other objectives. Considering the number of productions, this results in saving a lot of energy and time. AI makes it possible for this coordination to happen at the multi-factory level or for multinational products between the shipments.

Optimally, AI-enabled systems can propose the most likely influential decisions and leave making the final decision to humans. Or, it can identify the most important parameters and introduce them to humans for further analysis. However, manufacturers repeatedly report that data complexity, talent scarcity and a lack of trust in AI systems are hindering their digital transformation. AI systems depend on large amounts of data. The challenging aspect is determining what data is good and what is not. According to IBM, 60% of organizations are challenged in managing data quality. To succeed in Industry 4.0, manufacturers will need to place an emphasis on data management and governance, the hiring of data scientists and data engineers, and develop a framework and approach for human review of AI decisions and actions. These factors will be your differentiator and provide you with a significant competitive advantage.

Action Items

Manufacturers should start implementing AI algorithms now to small parts of the process. Remember that AI learns from its previous decisions, and, therefore, gradual implementation will yield better results. There will be challenges, especially as AI learns the job. It's important to remember that AI is not a black box that knows everything from the beginning. There are algorithms that learn the consequences of the decisions as the decisions are made. These algorithms can be tuned by simulation using past data. The results can also be tested to achieve a high level of reliability. However, the final results can only be fine-tuned by the full implementation. This means the sooner manufacturers use this technology and fine tune the parameters, the more efficient they will become.

The benefits of combining AI, Big Data and robotics result in having more efficient and more versatile factories that can handle customized products. It means lower production cost and therefore less expensive products that are customized for the customers' needs.

Some key steps manufactures can take before proceeding with full implementation of Big Data and AI in assembly and logistics include:

- Identify and prioritize manufacturing bottlenecks and information flows,
- Ensure you have a data-driven culture and the right talent to execute,
- Ensure your organization has the right systems and tools,
- Start with a pilot project,
- Scale up with a detailed integration plan that addresses existing systems and processes.

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