

## **Manufacturing Applications for Industrial Robotics**

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**Abstract:** As new technologies are invented and developed, manufacturers look to leverage them to improve various aspects of their manufacturing processes. Robotics has seen a number of improvements and applications in various manufacturing sectors and has allowed for a number of improvements in process. In the automobile industry, robots are allowing us to be more competitive and profitable in the global market. In high demand parts production, robots are having tremendous impact on lead time. In aerospace manufacturing, those improvements are usually driven by reducing costs and lead time. In the coal industry, robotics has had a large impact on both efficiency and employee safety while working in coal mines. While there have been some negative stigmas associated with industrial robotics and job security, proper employee education and perspective on how robots can benefit their careers can help to increase employee support of incorporating robots. This paper looks at how robotics has impacted these fields and speculates on future applications and improvements.

**Keywords:** Robots, Manufacturing, Robotic Impact, Benefits Robotics

### **I. Introduction**

Large manufacturing groups such as Pratt & Whitney, Sikorsky, Boeing, General Motors, and the US Government are pushing to reduce pricing and make the manufacturing process more efficient and quicker. Manufacturers have that dilemma, that as labor increases, costs of materials are higher, pricing has to decrease. A solution for this is that as new technologies are invented and developed manufacturers can incorporate them to improve various aspects of their processes. A prime example of this is robotics.

The purchasing and usage of industrial robots has continued to grow exponentially over the past few years. Even though the highest sales of robots are in Asia, Europe and the United States are also increasing their purchasing of industrial robots to try and remain competitive. It has been shown through a study by the Flex Company [1] that Asia, the United States, and Europe are the most heavily invested in robotics.

Manufacturers are investing in robots for a better and smarter future. Usually robots are very efficient, consistent with the high value production, and able to run continuously to reduce lead time. Money invested in robotics can be returned within a couple of years. This return on investment is largely realized through increased production rates, which allow companies to reduce prices and fill orders more quickly, therefore being more competitive on the market.

A recent article in Automation.com illustrates how robots are finding their use in manufacturing. The author notes that collaborative robots are the highest impact development among all automation technologies today. These robots are accessible and able to improve manufacturing for manufacturing enterprises of all sizes [2].

Collaborative robots can perform repetitive and mundane tasks that were previously performed by an operator. One common example is the implementation of robots to tend and/or operate CNC machines and inspection processes. Operators are no longer forced to stand at a machine for hours doing repetitive, mindless tasks. This dramatically improves productivity and quality while freeing up workers to perform tasks that require more advanced (and interesting) skills. Shorter and more predictable cycle times; greater precision and accuracy; improved quality; protection of operators from hazards; and empowerment of employees to concentrate on more valuable tasks including improvements, decision making, and problem solving are other great examples of how robotics can satisfy the expectations of manufacturers, their employees, and their customers.

In the manufacturing industry, technology can provide seamless connections across production and distribution chains, easing the process of getting products from the assembly floor to the customer. During the coming years, human workers will be doing decreased amounts of planned physical work, data processing, and information collection. More automatic real-time data feeds and data monitoring systems will be utilized, which will not require entry or analysis by workers. Instead there will be a greater need for employees who can spend time making decisions based on the data collected, managing others and applying expertise.

The latest research confirms the extent that new technology and automation will continue to impact workforces across the globe. A recent study by McKinsey Global Institute reports that “it shouldn’t be a surprise that the jobs most susceptible to automation are those involving physical tasks or operating machines in a physically predictable setting” [3]. This study estimates that it is currently feasible to automate 78 percent of

these activities, which tend to be most common among jobs in manufacturing, food service and accommodations, and retailing. Some job categories, such as sales and customer service, tend to be at this time less able to be improved by automation. Jobs like this, which involve interpersonal skills and judgment-based decision making, are only about 30 percent automatable.

## **II. Robotic Impact on the Automotive Industry**

The automotive industry is very well known for having been impacted by industrial robotics [4]. Industrial robots have found a large number of applications in this industry including part fabrication, coatings, and assembly. Due to this, the automotive industry has incorporated more robots than many other industries around the globe.

This large increase of industrial robotics within the automotive industry has spurred a number of technological advances, such as multiple robotic work cells, remote supervision, and safety controls. These advances have helped to increase the output performance of manufacturing facilities, while maintaining or even decreasing the associated costs [5]. It has been found that through the use of robotics and simulation, manufacturers can decrease needed storage space during the manufacturing process without causing production starvation, due to the increased efficiency of industrial robotics [6]. This leads to a decrease in required facility footprint and material stockpiles, which directly impacts cost efficiency.

### **2.1 Safety of Industrial Robotics in Industry**

It has been found that while many companies claim to care about employee safety when involved with industrial robots, 60 percent of robots used in industry have a limited barrier or no barrier, as well as having demonstrated poor conformance to OSHA regulations and guidance [7]. Due to this, there is now growing research into developing safer robots that can help protect employees even when companies do not incorporate these additional barriers. The industry is beginning to create collaborative robots or “cobots” with the intended goal of having safe robots working in close proximity to human employees. There is growing research into various levels of collaboration to help determine what requirements would be needed to keep employees safe while working with these cobots [8]. Future advances in the collaborative robot field should help employers continue to see the manufacturing improvements provided by industrial robots, while also keeping employees safe.

## **III. Robotic Impact on the Coal Industry**

While the automotive industry is one of the most well known industries impacted by industrial robotics [5], the petroleum and coal industries have seen some of the largest benefits from robotics. Between 1982 and 1984 there was a 45 percent improvement on capital stock per robot in the petroleum and coal industry, far outpacing all other industries[9].

This is in a large part due to how robots improved the coal mining industry compared to conventional mining, which had had very little in the way of improvements prior to the incorporation of robotics [10]. Through the use and implementation of industrial robots, coal mines were able to now extract 75 percent of the available coal per vein, up from 50 percent achievable with conventional mining [8]. This also required far fewer workers to take part in the actual mining of the veins. By incorporating 22 new mining robots, the required workforce to mine 55 million tons of coal decreased from 23,000 employees to 9,500 employees [8]. Through these staggering improvements to cost and efficiency, the coal industry is able to benefit greatly by incorporating industrial robotics.

### **3.1 Future applications**

The coal mining industry is still looking to leverage industrial robots to improve, now focusing more on employee safety. With catastrophic collapses in coal mines around the world gaining international attention, research has begun on two new paths of robots. The first is the development of robots to navigate collapsed coal mines to locate survivors and provide assistance in freeing the trapped miners. Researchers are looking to deal with the issues of the extreme terrain the robots would need to deal with, as well as the lack of communication with the robot that would normally be possible on the surface through wireless communications [10]. The other application is to create unmanned coal robots that could be operated remotely. This would allow the miners to conduct their same functions they currently have, while being safe from any potential cave ins [11]. This has similar challenges as the search and rescue robots, as communication between operator and robot at the depth of the veins is not feasible with current technology. Researchers are working on new communication technology to allow for these unmanned robots to be possible and will help remove employees from the dangerous environment of coal mines [11].

#### **IV. Social benefits of robotics**

One important aspect of industrial robots is the fact that in many cases they will be working alongside, operated, or overseen by humans. As companies continue to try and leverage robots to be used in their facilities, there are social barriers and expectations that are faced, such as displacement of workers [12]. To help address these concerns, employee perception and education on robots and their application is needed to produce positive effects on the workforce.

##### **4.1 Employee Education**

When employers and managers look at industrial robotics it has been found that they tend to refer to robots as tools and resources, while looking at them simply as a means of improving manufacturing. This can cause a bit of a concern for employees, and a mindset that is resistant to incorporating robots that are seen as replacements and competition for human employees [9]. To help combat this, it is important for employers to address these concerns and properly educate their employees as to the intent and use of the robots, not as replacements for the workforce, but rather as an aid to it.

When informed of potential uses for robots to assist an employee while they are sick or diagnosed with temporary or permanent disorders to support them and allow them to continue to meet productivity requirements, surveyed employees were more open to incorporating robots in their workforce [13]. By educating employees and employers as to the possible roles and benefits that industrial robots can provide, employees can be more open to an increase of industrial robots. Without proper consultation and education of the employees, there can instead be an increased strain on employee/employer relations [12].

##### **4.2 Employee Perception**

A large factor in employee acceptance of robotics into industry can rely on how employees perceive the robots, as it impacts the way employees interact with the robots and how they feel towards them [4]. Part of this perception is tied to how robots are referred to. When working closely with industrial robots that allow for interaction, most operators view these robots as having humanlike aspects, and even begin to believe that the robots have personalities and intent [4].

It has been found that when viewed as a team member that could help assist with work, as opposed to a competitor, employees were more open and accepting of having robots to aid their work [13]. Employers must stress the difference between viewing industrial robots as aids to the workforce as opposed to being replacements of the workforce. This can lead to a new employee perception of seeing the robots as helpful to their job, as well as an increased feeling of safety when working with the robots [4,7].

#### **V. Conclusion**

As mentioned in this paper, as many industries have found ways to leverage new robotic technologies to improve manufacturing. The primary application has been in efficiency and quality in order to create cost savings with their manufacturing lines. Now as robots are being used in more locations, research and technology is focusing more on employee safety. Future improvements in the industries may not have large gains to costs of products, but instead will lead to safer employee environments. Research into new technologies are also showing that in the future, jobs may be open to more people who have short or long term disabilities as robots are utilized to assist them. As improvements have been made in major manufacturing applications, the technology that is used becomes more available and more affordable, leading to improvements in other fields. This could be seen through more robotic assistance in our day to day lives. It is important to begin thinking about how and where those robotic applications could be utilized. Simply think of the self-serve pump next time you stop for gasoline. Such progress was hard to imagine when gas stations began. Perhaps in the future we will see gasoline being pumped for us by robots.

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