Industrial robots

Though not humanoid in form, machines with flexible behaviour and a few humanlike physical attributes have been developed for industry. The first stationary industrial robot was the programmable Unimate, an electronically controlled hydraulic heavy-lifting arm that could repeat arbitrary sequences of motions. It was invented in 1954 by the American engineer George Devol and was developed by Unimation Inc., a company founded in 1956 by American engineer Joseph Engelberger. In 1959 a prototype of the Unimate was introduced in a General Motors Corporation die-casting factory in Trenton, New Jersey. In 1961 Condec Corp. delivered the world's first production-line robot to the GM factory; it had the task of removing and stacking hot metal parts from a die-casting machine. Unimate arms continue to be developed and sold by licensees around the world, with the automobile industry remaining the largest buyer.

More advanced computer-controlled electric arms guided by sensors were developed in the late 1960s and 1970s at the Massachusetts Institute of Technology (MIT) and at Stanford University, where they were used with cameras in robotic hand-eye research. Stanford's Victor Scheinman, working with Unimation for GM, designed the first such arm used in industry. Called PUMA (Programmable Universal Machine for Assembly), they have been used since 1978 to assemble automobile subcomponents such as dash panels and lights. PUMA was widely imitated, and its descendants, large and small, are still used for light assembly in electronics and other industries. Since the 1990s small electric arms have become important in molecular biology laboratories, precisely handling test-tube arrays and pipetting intricate sequences of reagents.

Although industrial robots first appeared in the United States, the business did not thrive there. Unimation was acquired by Westinghouse Electric Corporation in 1983 and shut down a few years later. Cincinnati Milacron, Inc., the other major American hydraulic-arm manufacturer, sold its robotics division in 1990 to the Swedish firm of Asea Brown Boveri Ltd. Foreign licensees of Unimation, notably in Japan and Sweden, continue to operate, and in the 1980s other companies in Japan and Europe began to vigorously enter the field. The prospect of an aging population and consequent worker shortage induced Japanese manufacturers to experiment with advanced automation, opening a market for robot makers. By the late 1980s Japan—led by the robotics divisions of Fanuc Ltd., Matsushita Electric Industrial Company, Ltd., Mitsubishi Group, and Honda Motor Company, Ltd.—was the world leader in the manufacture and use of industrial robots. High labour costs in Europe similarly encouraged the adoption of robot substitutes, with industrial robot installations in the European Union exceeding Japanese installations for the first time in 2001.

The manufacturing industries rely heavily on automation. Some of the most advanced automated systems are employed by those industries that process petroleum and iron and steel. The automobile industry operates elaborate systems that include computer-controlled robot devices. Other assembly industries have also begun to use such industrial robots. Aircraft manufacturers employ single-arm robots for drilling and riveting body sections, while some electronics firms utilize high-performance robot mechanisms together with computerized instruments to test finished products.

Another development that has greatly affected the manufacturing industries is the integration of engineering design and manufacturing into one continuous automated activity through the use of computers. The introduction of CAD/CAM, which stand for Computer-Aided Design and Computer-Aided Manufacturing, has significantly increased productivity and reduced the time required to develop new products. When using a CAD/CAM system, an engineer sketches the design of some mechanical part, such as an automobile part or aircraft component, directly on the display screen of a computer terminal with a special pen. The computer programs that are provided by the system can be used to manipulate this first draft to improve it.

After the design has been revised as needed, the system prepares instructions for numerically controlled machine tools and places orders for materials and auxiliary equipment. In essence, a CAD/CAM system enables an engineer to sit down at a computer terminal, perform all the activities of engineering design while interacting with the computer, and then walk over to the computer-controlled machine tool and pick up the finished part.