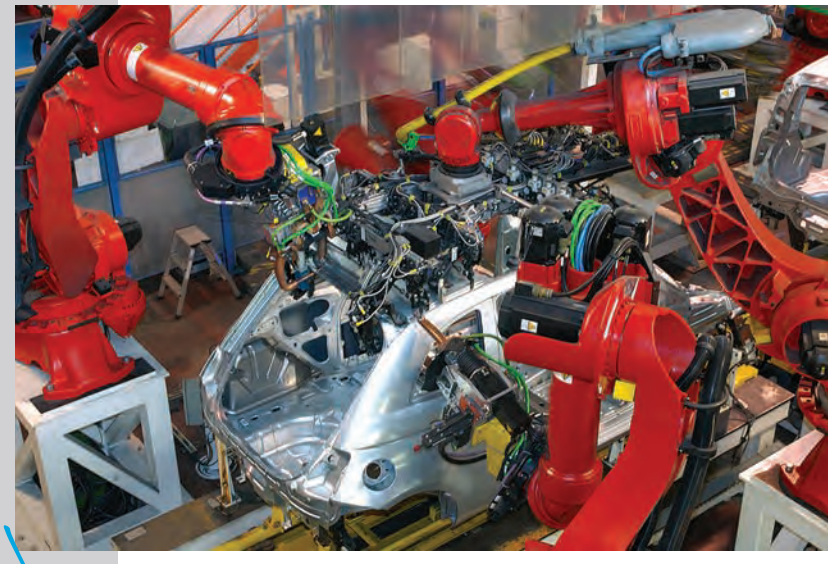
IFR International Federation of Robotics



Milestones

History of Industrial Robots

From the first installation until today

Milestones of Technology and Commercialization

Compiled by the International Federation of Robotics – IFR

2012

Important Contributors to the Robotics Industry

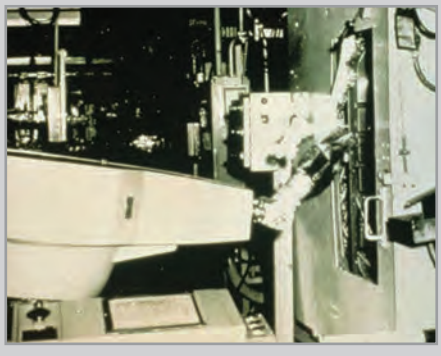
Unimation, the company that developed the Unimate

In 1956, George Devol and Joe Engelberger, established a company called Unimation, a shortened form of the words Universal Animation.

Engelberger, a physicist working on the design of control systems for nuclear power plants and jet engines, met inventor Devol by chance at a cocktail party. Devol had recently received a patent called "Programmed Article Transfer." Inspired by the short stories and novels of Isaac Asimov, Devol and Engelberger brainstormed to derive the first industrial robot arm, based upon Devol's patent, called the Unimate. Programmed Article Transfer became the seminal industrial robot patent which was ultimately sub-licensed around the world.

1959 Unimate is the first robot

The first industrial robot in Europe, a Unimate, was installed at Metallverken, Uppsland Väsby, Sweden **1967**



1959

Development of the first industrial robot by George Devol and Joseph Engelberger

It weighed two tons and was controlled by a program on a magnetic drum. They used hydraulic actuators and were programmed in joint coordinates, i.e. the angles of the various joints were stored during a teaching phase and replayed in operation. The rate of accuracy was within 1/10,000 of an inch.

1961

Unimation, USA, installed the first industrial robot at GM

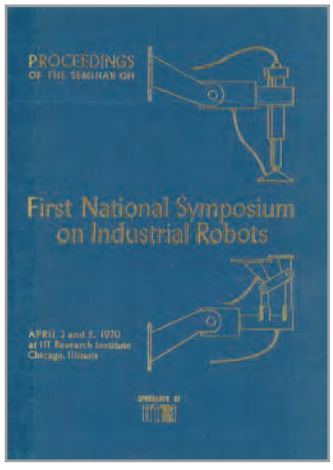
The world's first industrial robot was used on a production line at the GM Ternstedt plant in Trenton, NJ, which made door and window handles, gearshift knobs, light fixtures and other hardware for automotive interiors. Obeying step-by-step commands stored on a magnetic drum, the Unimate robot's 4,000 pound arm sequenced and stacked hot pieces of diecast metal. The robot cost US$65,000 to make but Unimation sold it for US$18,000.

1962

The first cylindrical robot, the Versatran from AMF, USA

6 Versatran robots were installed by American Machine and Foundry (AMF) at the Ford factory in Canton, USA. It was named the Versatran from the words "versatile transfer."

Milestones in the History of Industrial Robots

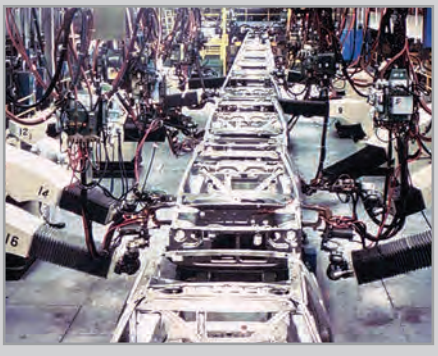


The first National Symposium on Industrial Robots was held in 1970 in Chicago, USA

A year later it was upgraded to an international conference and was called the International Symposium on Industrial Robots (ISIR). The purpose of this symposium was to provide researchers and engineers worldwide an opportunity to present their work and to share their ideas in the fields of robotics. In 1997 the symposium changed its name to International Symposium on Robotics (ISR) and included the technology of service robots.

Today the ISR still represents a meeting point for all scientific, technical and industrial topics related to robotics. One main goal is to bring academia and industry together. The symposium is organized annually by a national robot association either in America, Europe or Asia in conjunction with an international robot exhibition.

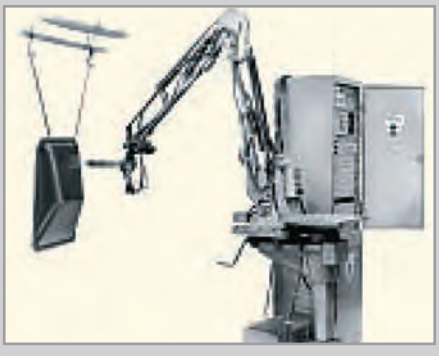
First National Symposium on Industrial Robots **1970**



1969

GM installed the first spot-welding robots at its Lordstown assembly plant

The Unimation robots boosted productivity and allowed more than 90 percent of body welding operations to be automated vs. only 20 percent to 40 percent at traditional plants, where welding was a manual, dirty and dangerous task dominated by large jigs and fixtures.



1969

Trallfa, Norway, offers the first commercial painting robot

The robots were developed for in-house use in 1967 to spray paint wheelbarrows during a Norwegian labor shortage.

1969

Unimate robots enter Japanese market

Unimation signs a licensing agreement with Kawasaki Heavy Industries to manufacture and market Unimate robots for the Asian market. Kawasaki regarded the development and production of labor-saving machines and systems as an important mission, and became Japan's pioneer in the industrial robot field. In 1969, the company succeeded in developing the Kawasaki-Unimate 2000, the first industrial robot ever produced in Japan.

The Japanese Robot Association (JIRA, later JARA) was established

This was the first national robot association. The Japan Robot Association was formed in 1971 as the Industrial Robot Conversazione, a voluntary organization. The Conversazione was reorganized into the Japan Industrial Robot Association (JIRA) in 1972, and the Association was formally incorporated in 1973.

1971 The Japanese Robot Association was established

1973 3,000 industrial robots in operation

1974 Björn Weichbrodt developed the first fully electric, microprocessor-controlled industrial robot for ASEA, Sweden.

1973

First robot to have six electromechanically driven axes

KUKA moves from using Unimate robots to developing their own robots. Their robot, the Famulus was the first robot to have six electromechanically driven axes.

1973

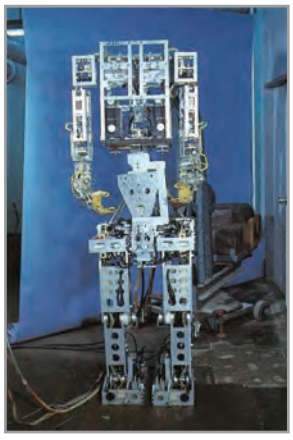
Hitachi, Japan, developed the automatic bolting robot for concrete pile and pole industry

This robot was the first industrial robot with dynamic vision sensors for moving objects. It recognized bolts on a mold while it is moving and fastened/loosened the bolts in synchronization with the mold motion.

1974

The first minicomputer-controlled industrial robot comes to market

The first commercially available minicomputer-controlled industrial robot was developed by Richard Hohn for Cincinnati Milacron Corporation. The robot was called the T3, The Tomorrow Tool.



Ichiro Kato, Waseda University, developed the world's first full-scale humanoid robot, Wabot-1

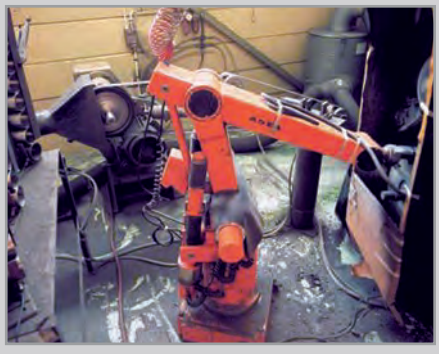
The robot consisted of a limb-control system, a vision system and a conversation system. The robot was able to measure distances and directions to the objects, and to communicate with a person in Japanese. The robot walked with its lower limbs and was able to grip and transport objects with hands that used tactile-sensors. This research led to various humanoid researches in Japan and other countries, including Kato's own "robot musician". This robot, which was exhibited at the science expo in 1984, could read a normal musical score with its eyes and play tunes on an electronic piano.

1973 The world's first full-scale humanoid robot

1974

The first arc welding robots go to work in Japan

Kawasaki, Japan, developed a version of the Unimate to be used for spot-welding, fabricating Kawasaki motorcycle frames. They also added touch and force-sensing capabilities in their Hi-T-Hand robot, enabling the robot to guide pins into holes at a rate of one second per pin.



1974

The first fully electric, microprocessor-controlled industrial robot, IRB 6 from ASEA, Sweden, was delivered to a small mechanical engineering company in southern Sweden

With anthropomorphic design, its arm movement mimicked that of a human arm, with a 6kg payload and 5 axis. The S1 controller was the first to use a intel 8 bit microprocessor. The memory capacity was 16KB. The controller had 16 digital I/O and was programmed through 16 keys and a four digit LED display. The first model, IRB 6, was acquired by Magnussons in Genarp to wax and polish stainless steel tubes bent at 90° angles.

1975

The Olivetti "SIGMA" a cartesian-coordinate robot, is one of the first used in assembly applications

The Olivetti SIGMA robot was used in Italy for assembly operations with two hands.

The Engelberger Robotics Award is the world's most prestigious robotics honor

The award is presented to individuals for excellence in technology development, application, education, and leadership in the robotics industry. Each winner receives an honorarium and commemorative medallion with the inscription, "Contributing to the advancement of the science of robotics in the service of mankind."

The Engelberger Robotics Award is presented annually by Robotic Industries Association (RIA). The Award recognizes outstanding individuals from all over the world. Since the award's inception in 1977, it has been presented to 114 robotics leaders from 17 different nations.

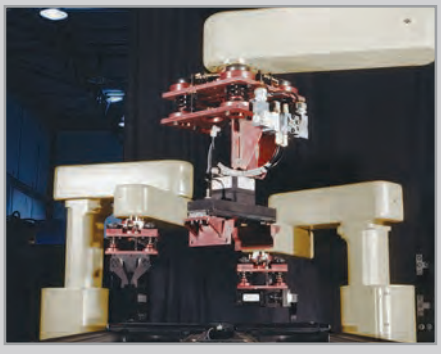
ROBOTIC INDUSTRIES ASSOCIATION

1977 First Engelberger Award Presentation

1978

Programmable Universal Machine for Assembly (PUMA) was developed by Unimation/ Vicarm, USA, with support from General Motors

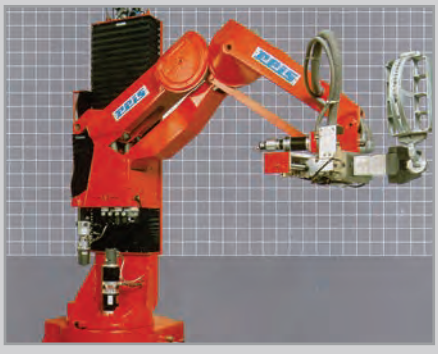
GM had concluded that 90 percent of all parts handled during assembly weighed five pounds or less. The PUMA was adapted to GM specifications for a small parts handling line robot that maintained the same space intrusion of a human operator.



1978

Hiroshi Makino, University of Yamanashi, Japan, developed the SCARA-Robot (Selective Compliance Assembly Robot Arm)

By virtue of the SCARA's parallel-axis joint layout, the arm is slightly compliant in the X-Y direction but rigid in the 'Z' direction, hence the term: Selective Compliant. The second attribute of the SCARA is the jointed two-link arm layout similar to our human arms, hence the often-used term, Articulated. This feature allows the arm to extend into confined areas and then retract or "fold up" out of the way. In 1981, SCARA robots were launched by Sankyo Seiki, Japan and Hirata, Japan.



1978

First six-axis robot with own control system RE 15 by Reis, Germany

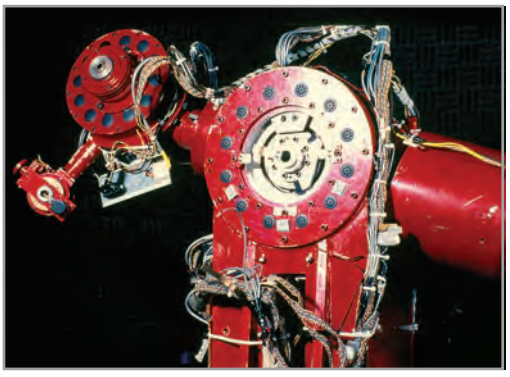
Loading and unloading of diecasting parts into trim presses. The robot was presented at GIFA show, Duesseldorf.

1959-1978

1979 TO PRESENT

IFR
International
Federation of
Robotics

Important Contributors to the Robotics Industry



Takeo Kanade, Carnegie Mellon University, USA designed the world's first Direct Drive Arm

He also founded the world's first doctoral program in Robotics, which he chaired from 1989-1993 at Carnegie Mellon. Direct Drive Robotic Arms are currently the best method of design for mechanical arms, due to the removal of transmission mechanisms between the motors and loads. rather than using reducers and chain belts which produce uneven movements. The result is an arm that can move freely and smoothly, allowing for high speed precision robots. Design of the arm was completed in 1981, and successful patent was obtained a few years later.

1981 The world's first direct drive arm

66,000 Industrial robots in operation **1983**

1979

Nachi, Japan, developed the first electromotor-driven robots

The spot-welding robots ushered in a new era of electric driven robots, replacing the previous era of hydraulic drive.

1981

PaR Systems, USA, introduced its first industrial gantry robot

Gantry robots provided a much larger range of motion than pedestal robots of the day, and could replace several robots. (PaR 50th Anniversary, 2010).

1984

Adept, USA, introduced the AdeptOne, first direct-drive SCARA robot

Electric-drive motors connected directly to the arms eliminating the need for intermediate gear or chain system. The simplicity of the mechanism made AdeptOne robots very robust in continuous industrial automation applications, while maintaining high accuracy.

Milestones in the History of Industrial Robots

Establishing an International Federation

The International Federation of Robotics (IFR) was established in 1987 in connection with the 17th International Symposium on Industrial Robotics ISIR as a non-profit organization by robotics organizations from over 15 countries. The reason was to promote and strengthen the robotics industry worldwide, to protect its business interests, to cause public awareness about robotics technologies and to deal with other matters of relevance to its members.

1987 Foundation of IFR and Publication of first Statistic Book

1988 IFR/UNECE published the first global statistics on industrial robots

1989 Unimation Inc. was sold to Stäubl

1985

KUKA, Germany, introduces a new Z-shaped robot arm whose design ignores the traditional parallelogram

It achieves total flexibility with three translational and three rotational movements for a total of six degrees of freedom. The new configuration saved floor space in manufacturing settings.

1992

Demaurex, Switzerland, sold its first Delta robot packaging application to Roland

The first application was a landmark installation of 6 robots loading pretzels into blister trays. It was based on the delta robot developed by Reymond Clavel, Federal Institute of Technology of Lausanne (EPFL).

1998

ABB, Sweden, developed the FlexPicker, the world's fastest picking robot based on the delta robot developed by Reymond Clavel, Federal Institute of Technology of Lausanne (EPFL)

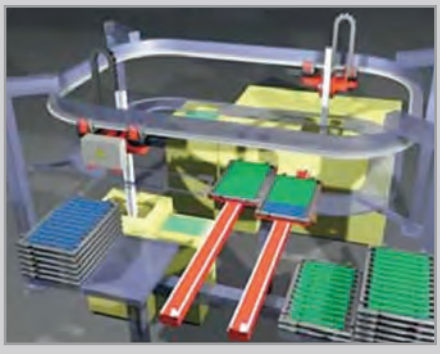
It was able to pick 120 objects a minute or pick and release at a speed of 10 meters per second, using image technology.

Invention and Entrepreneurship in Robotics and Automation Award

In 2005 the IEEE Robotics and Automation Society (IEEE/RAS) and the International Federation of Robotics (IFR) agreed to jointly sponsor the Invention and Entrepreneurship in Robotics and Automation (IERA) Award. The purpose of this award is to highlight and honor the achievements of the inventors with value creating ideas and entrepreneurs who propel those ideas into world-class products. At the same time the joint disposition of the award underlines the determination of both organizations to promote stronger collaboration between robotics science and robotics industry.

IEEE and IFR jointly present the first IERA award **2005**

800,000 Industrial robots in operation **2003**



1998

Güdel, Switzerland, launched the "roboLoop" system, the only curved-track gantry and transfer system

The roboLoop concept enables one or more robo-carriers to track curves and to circulate in a closed system, thereby creating new possibilities for factory automation.

1999

Reis, Germany, introduces integrated laser beam guiding within the robot arm

Reis Robotics receives patent on the integrated laser beam guiding through the robot arm and launches the RV6L-CO2 laser robot model. This technology replaces the need of an external beam guiding device thus allowing to use laser in combination with a robot at high dynamics and no collision contours.

2004

Motoman, Japan, introduced the improved robot control system (NX100) which provided the synchronized control of four robots, up to 38 axis

The NX100 programming pendant has a touch screen display and is based on WindowsCE operative system.

IFR Round Table on the "The Future of Robotics"

CEO's of major robot companies from Europe, Japan and North America discussed on "The Future of Robotics". The main results of the discussion were:

- The automotive industry will continue to be the main driver of the robotics industry
- New materials, sustainability, more automation of assembly pose new challenges to the robotics industry
- The interaction of humans and robots
- Easier programming

First IFR CEO Round Table **2010**

2011

1.1 million Industrial robots in operation

Start of the Campaign

2006

Comau, Italy, introduced the first Wireless Teach Pendant (WiTP)

All the traditional data communication/robot programming activities can be carried out without the restrictions caused by the cable connected to the Control Unit, but at the same time absolute safety is ensured.

2006

KUKA, Germany, presents the first "Light Weight Robot"

Developed in cooperation with DLR, Institute of Robotics and Mechatronics, Germany, the outer structure of the KUKA lightweight robot is made of aluminum. It has a payload capacity of 7 kg and, thanks to its integrated sensors, is highly sensitive. This makes it ideally suited to handling and assembly tasks. Due to its low weight of just 16 kg – the first robot weighted two tons!, the robot is energy-efficient and portable and can perform a wide range of different tasks.

2010

Fanuc, Japan, launched the first "Learning Control Robot"

FANUC's Learning Vibration Control (LVC) allows the robot to learn its vibration characteristics for higher accelerations and speeds. Learning control reduces the cycle time of the robot motion by suppressing the vibration of the robot arm.

The word "**robot**" (from the Czech word "robota" for forced labor or serf) was used for the first time in a play called "R.U.R" (Rossum's Universal Robots) by the Czech dramatist Karel Capek. In the 1920 science fiction play, which portrayed robots as intelligent machines serving their human makers, the plot ended dramatically. Robots took over the world and destroyed humanity.

This scenario is far from reality!

Today industrial robots and robotic systems are key components of automation. More than 1.1 million industrial robots are operating in the factories all over the world:

- Improving quality of work for employees
- Increasing production output rates
- Improving product quality and consistency
- Increasing flexibility in product manufacturing
- Reducing operating costs

More information on the distribution of industrial robots by countries, by industries and applications:

IFR statistical department

www.worldrobotics.org

While only main information on the "History of Industrial Robots" is described in this brochure, more details are provided on

www.ifr/history

IFR International Federation of Robotics

IFR International Federation of Robotics
c/o VDMA Robotics + Automation
Lyoner Strasse 18
60528 Frankfurt am Main
Germany

Phone	+49 69 6603-1697
Fax	+49 69 6603-2697
E-Mail	secretariat@ifr.org
Internet	www.ifr.org