1.2   Industrial robots - definition and classification

1.2.1 Definition (ISO 8373:2012) and delimitation

The annual surveys carried out by IFR focus on the collection of yearly statistics on the production, imports, exports and domestic installations/shipments of **industrial robots (at least three or more axes)** as described in the ISO definition given below. Figures 1.1 shows examples of robot types which are covered by this definition and hence included in the surveys.

A robot which has its own control system and is not controlled by the machine should be included in the statistics, although it may be dedicated for a special machine. Other dedicated industrial robots should not be included in the statistics. If countries declare that they included dedicated industrial robots, or are suspected of doing so, this will be clearly indicated in the statistical tables. It will imply that data for those countries is not directly comparable with those of countries that strictly adhere to the definition of multipurpose industrial robots.

- Wafer handlers have their own control system and should be included in the statistics of industrial robots. Wafers handlers can be articulated, cartesian, cylindrical or SCARA robots. Irrespective from the type of robots they are reported in the application "cleanroom for semiconductors".
- Flat panel handlers also should be included. Mainly they are articulated robots. Irrespective from the type of robots they are reported in the application "cleanroom for FPD".

Examples of dedicated industrial robots that should not be included in the international survey are:

- Equipment dedicated for loading/unloading of machine tools (see figure 1.3).
- Dedicated assembly equipment, e.g. for assembly on printed circuit boards (see figure 1.3).
- Integrated Circuit Handlers (pick and place)
- Automated storage and retrieval systems
- Automated guided vehicles (AGVs) (see "World Robotics Service Robots")

The submission of statistics on industrial robots is mandatory for IFR member associations. In some countries, however, data is also collected on all types of manipulating industrial robots, that is, both multipurpose and dedicated manipulating industrial robots. Optionally, national robot associations may therefore also submit statistics on all types of manipulating industrial robots, which will be included in the publication World Robotics under the respective country chapter.

Industrial robot as defined by ISO 8373:2012:

An automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications

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The terms used in the definition above are explained in more detail below:

- **<u>Reprogrammable</u>**: designed so that the programmed motions or auxiliary functions can be changed without physical alteration;
- **<u>Multipurpose</u>**: capable of being adapted to a different application with physical alteration;
- **<u>Physical alteration</u>**: alteration of the mechanical system (the mechanical system does not include storage media, ROMs, etc.)
- **<u>Axis</u>**: direction used to specify the robot motion in a linear or rotary mode

1.2.2 Classification by types of robots

In agreement with the robot suppliers, robots should be classified only by mechanical structure as of 2004.

Classification by mechanical structure

- Linear robots (including cartesian and gantry robots)

- SCARA robots

- Articulated robots

- Parallel robots (delta)

- Cylindrical robots

- Others

- Not classified

Figures 1.1 illustrates the mechanical configuration of these types of robots. Below, some further explanations and definitions are given for the various classifications by types of robots.

The number of axes should be understood as the basic feature supplied by the producer and not axes added later by the user.

Robots broken down by mechanical structure are based on the following definitions:

Cartesian robot: robot whose arm has three prismatic joints and whose axes are coincident with a cartesian coordinate system

SCARA robot: a robot, which has two parallel rotary joints to provide compliance in a plane

Articulated robot: a robot whose arm has at least three rotary joints

Parallel robot: a robot whose arms have concurrent prismatic or rotary joints

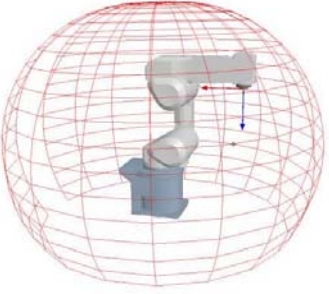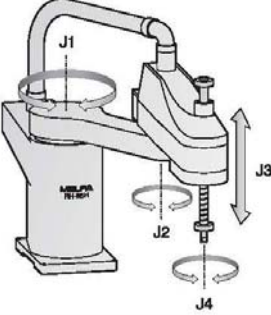**Cylindrical robot**: a robot whose axes form a cylindrical coordinate system
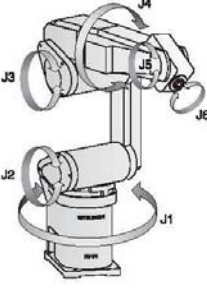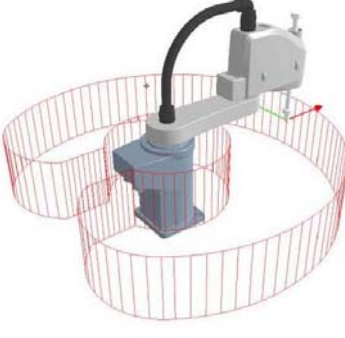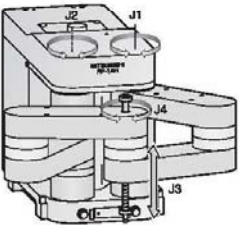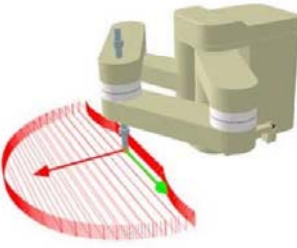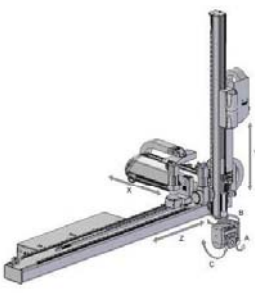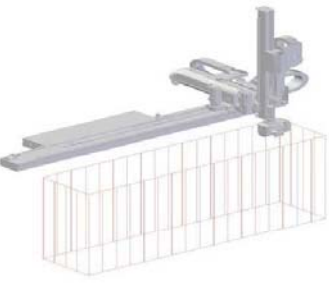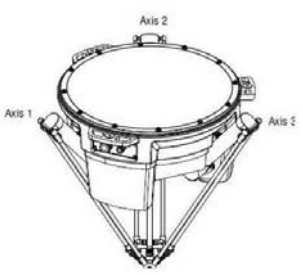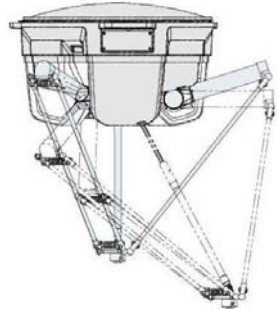
Principle	Kinematic Structure	Photo
Articulated Robot		
SCARA Robot		
SCARA Robot		
Cartesian Robot		
Parallel Robot		

Figure 1.1: Classification of industrial robots by mechanical structure

Examples of articulated robots

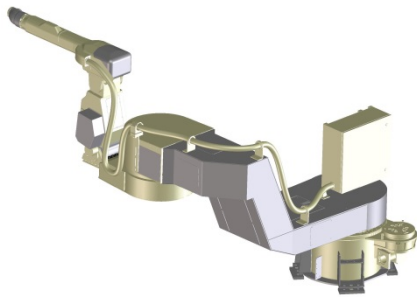1,200 kg payload capacity - Handling of largest parts and structures

Flexible mounting possibilities – optimized working range

Welding robot

The Swingarm is an articulated robot combined with SCARA elements
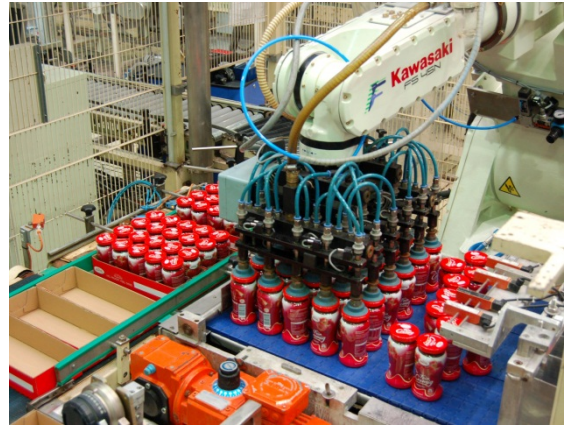
Different dualarm robots:

Examples of applications of articulated robots

Handling for metal casting

Palletizing

Welding

Painting

Packaging

Handling for forging

FDP Handling

Wafer handler

Examples of SCARA Robots

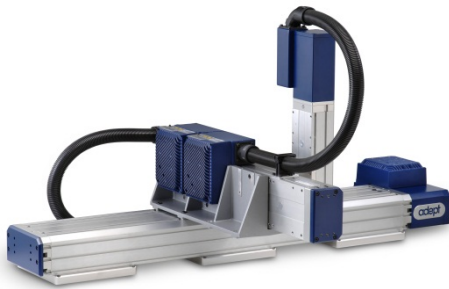**Examples of applications of SCARA Robots**

Assembly

Packaging

Examples of linear/cartesian/gantry robots
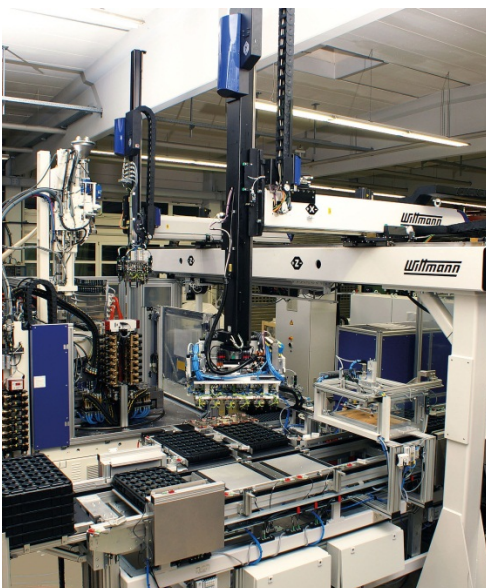

Linear Robot

Gantry Robot

Examples of applications of linear/cartesian/gantry robots

Handling for plastic moulding

Sealing

Laser Welding

Pressing

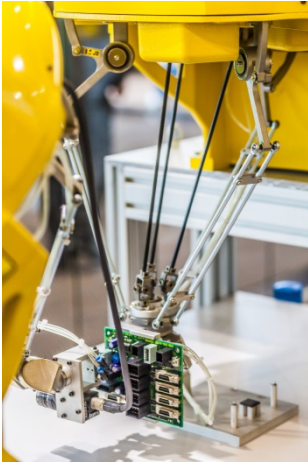**Examples of parallel robots**

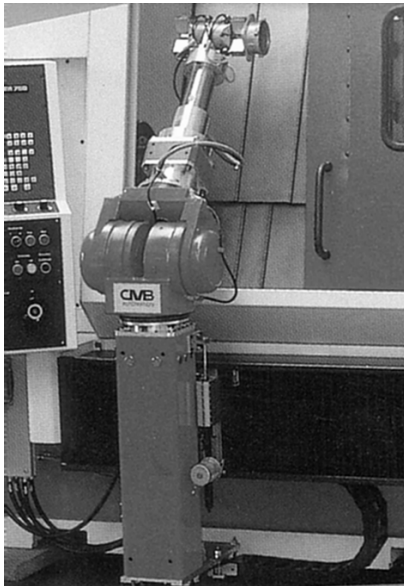**Examples of applications of parallel robots**
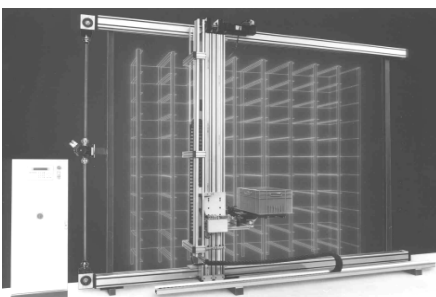

Picking and placing

Assembly

Handling

Examples of dedicated industrial robots not to be included in the statistics

Dedicated machine-tool loader   **Printed circuit board assembler**

**Automated storage and
retrieval system**