Manufacturing Process SMJP 2113

Automation of Manufacturing Process

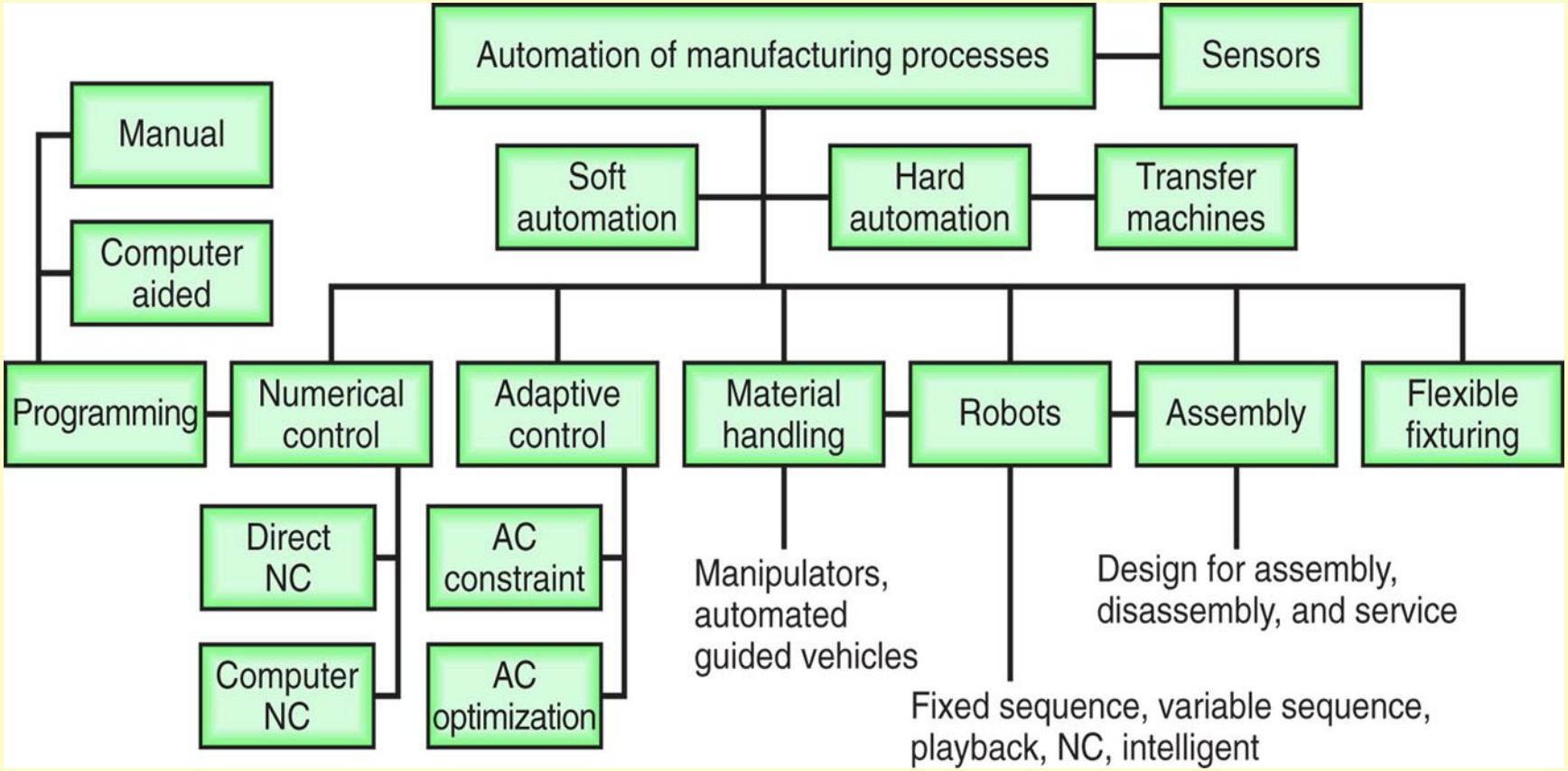
Dr.Aunglwinmoe
Senior Lecturer
Tribology and Precision Machining Laboratory
Malaysia-Japan International Institute of Technology

REF: © Manufacturing Engineering and Technology, Serope Kalpakjian

Automation: Implementation of Automation

Automation goals are:

1. *Integrate manufacturing operations*
2. *Improve productivity*
3. *Improve quality*
4. *Reduce human involvement*
5. *Reduce workpiece damage*
6. *Economize on floor space*


Automation of manufacturing processes
Sensors
Manual
Computer aided
Soft automation
Hard automation
Transfer machines
Programming
Numerical control
Adaptive control
Material handling
Robots
Assembly
Flexible fixturing
Direct NC
Computer NC
AC constraint
AC optimization
Manipulators, automated guided vehicles
Fixed sequence, variable sequence, playback, NC, intelligent
Design for assembly, disassembly, and service

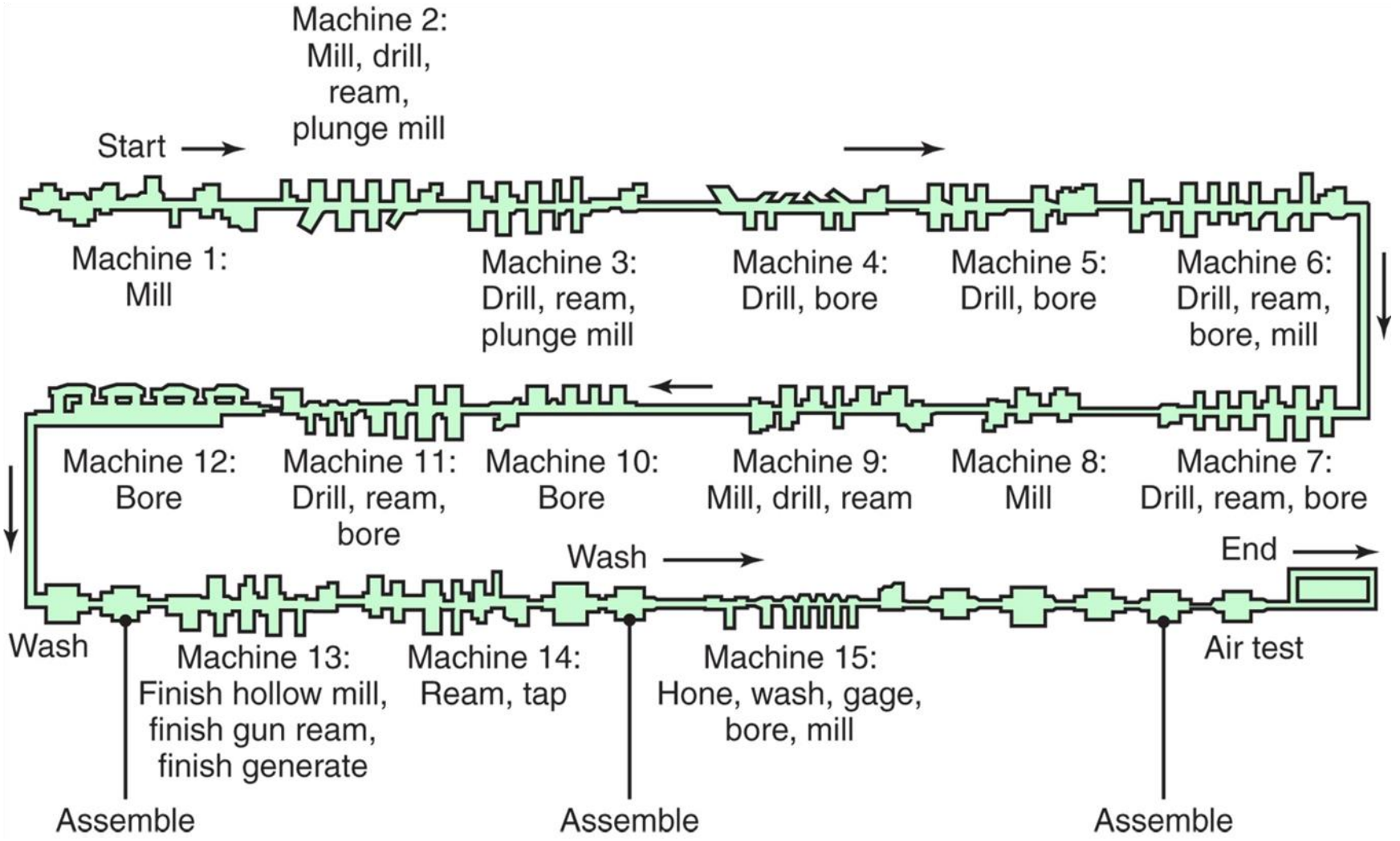
Approximate Annual Production Quantities

TABLE 37.2

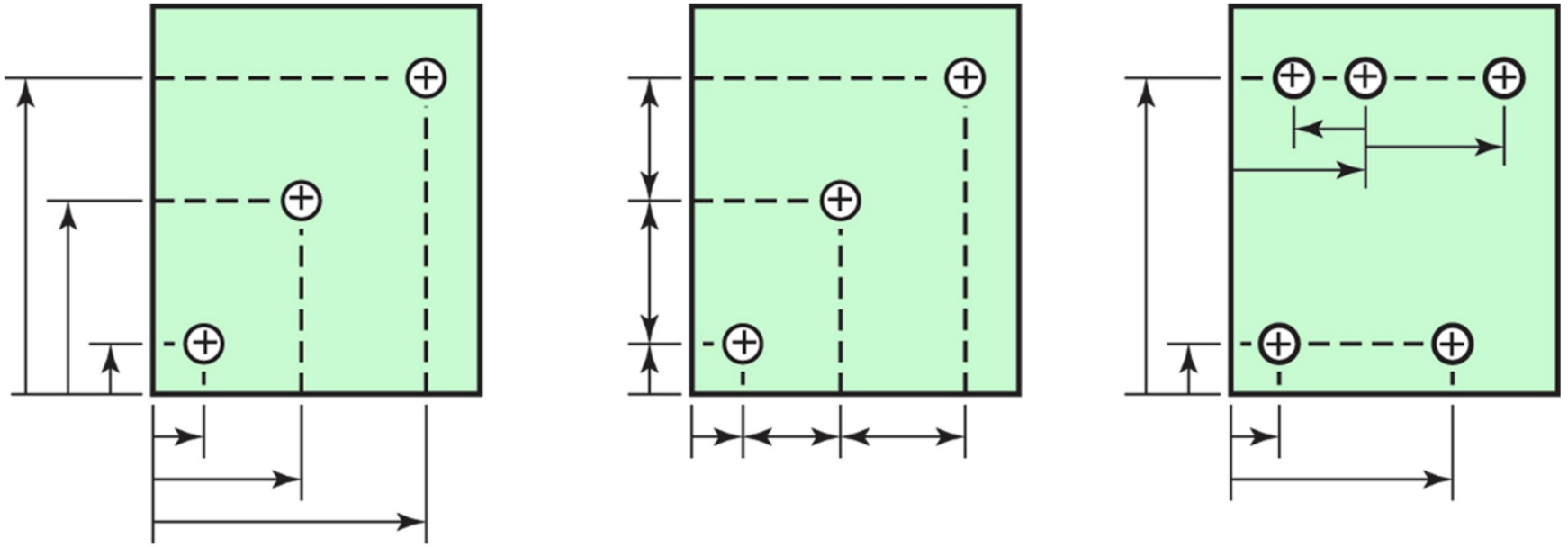
Approximate Annual Production Quantities

Type of production	Number produced	Typical products
Experimental or prototype	1–10	All products
Piece or small-batch	10–5000	Aircraft, missiles, special machinery, dies, jewelry, and orthopedic implants
Batch or high-volume	5000–100,000	Trucks, agricultural machinery, jet engines, diesel engines, computer components, and sporting goods
Mass production	100,000 and over	Automobiles, appliances, fasteners, and food and beverage containers

A large transfer line for producing engine blocks and cylinder heads. *Source:* Courtesy of Ford Motor Company.

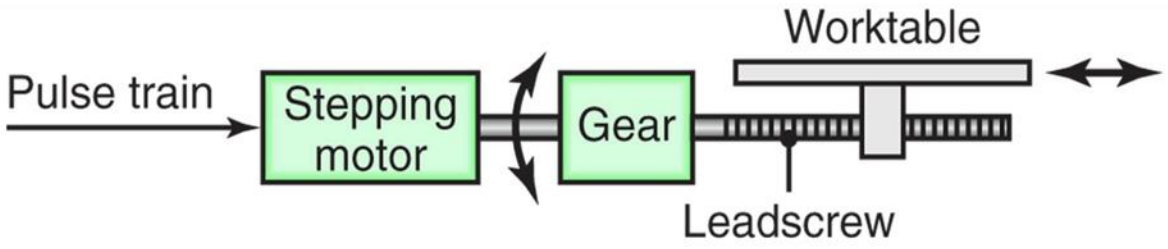


Positions of drilled holes in a workpiece. Three methods of measurements are shown: (a) Absolute dimensioning, referenced from one point at the lower left of the part; (b) Incremental dimensioning, made sequentially from one hole to another; and (c) Mixed dimensioning, a combination of both methods.

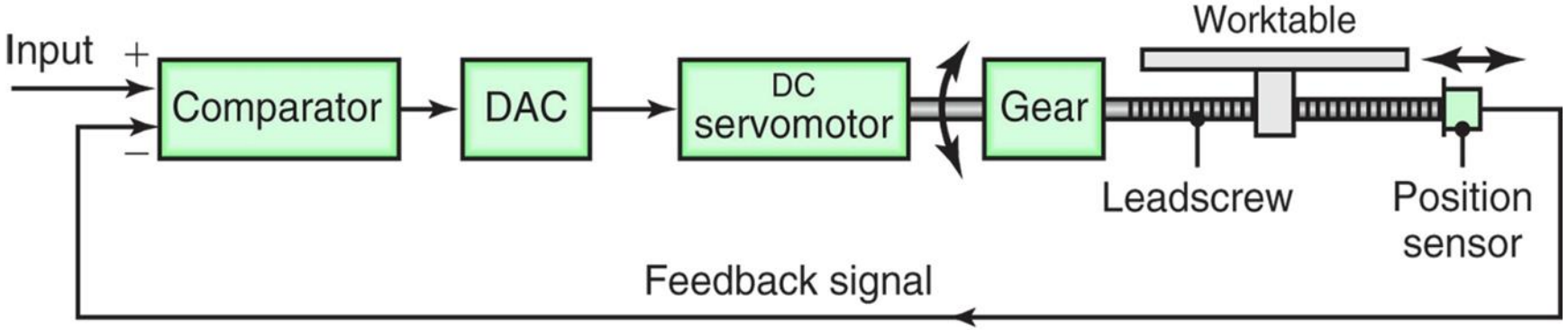


(a) Absolute (b) Incremental (c) Mixed

Schematic illustration of the components of (a) an open-loop and (b) a closed loop control system for a numerical-control machine.
DAC = digital-to-analog converter.

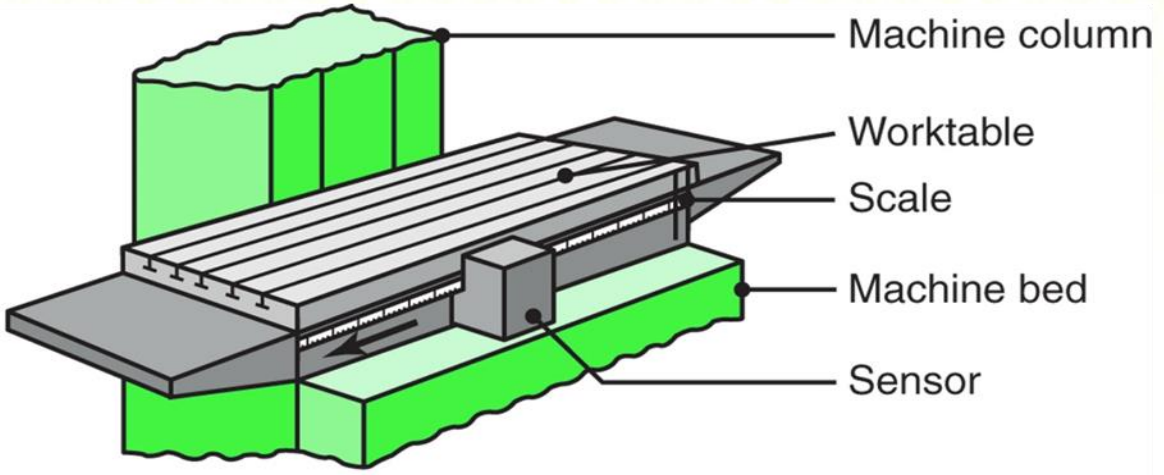


(a)

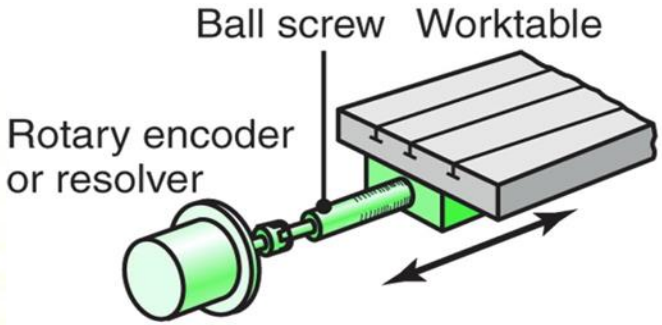


(b)

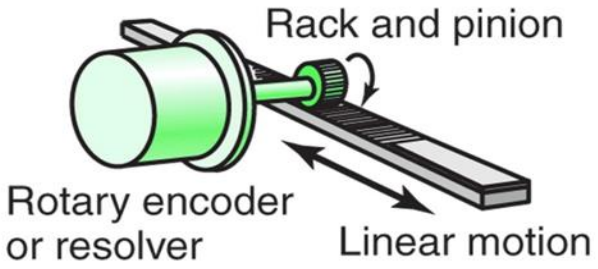
(a) Direct measurement of the linear displacement of a machine-tool worktable. (b) and (c) Indirect measurement methods.



(a)

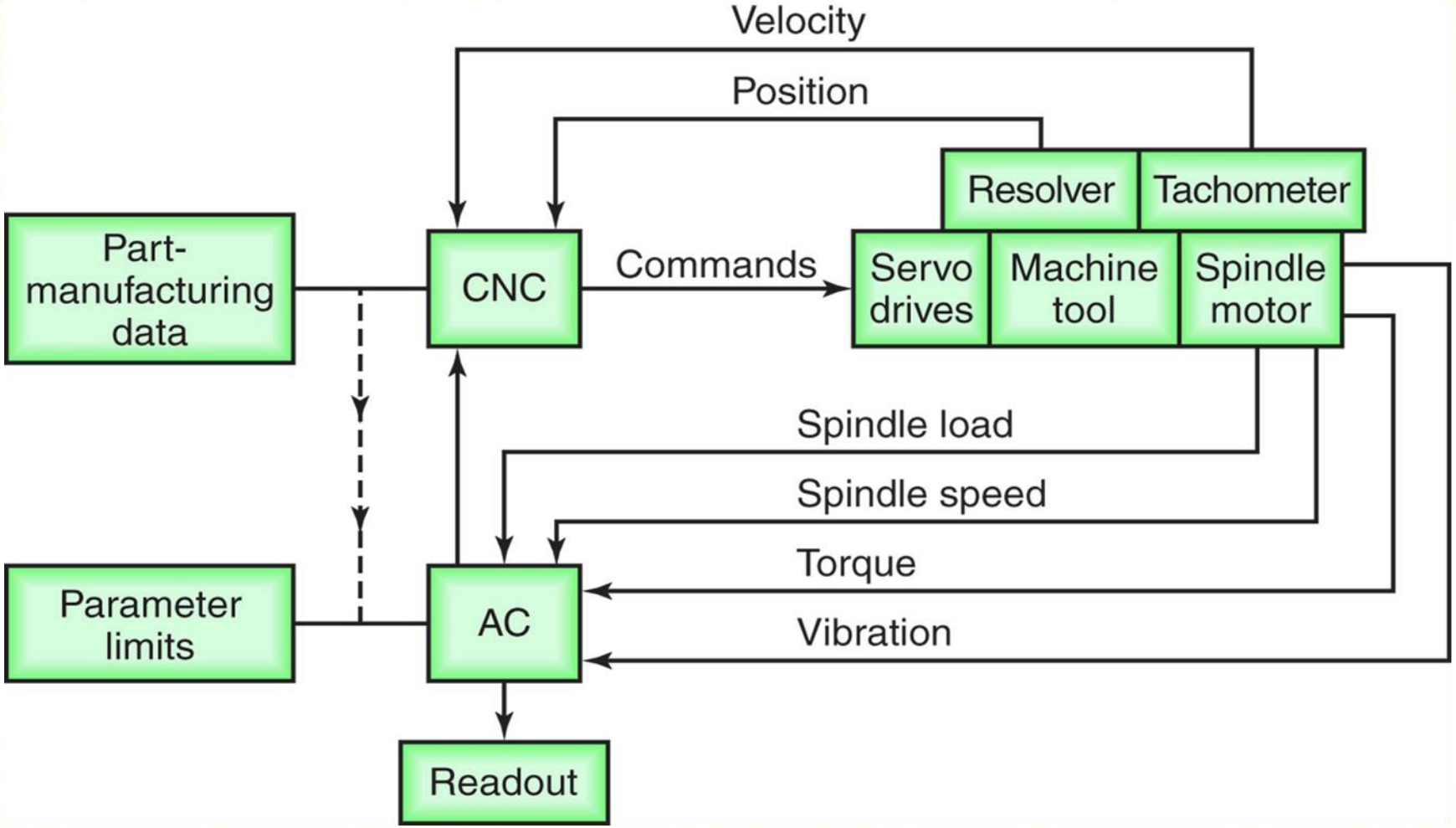


(b)



(c)

Adaptive control (AC) for a turning operation



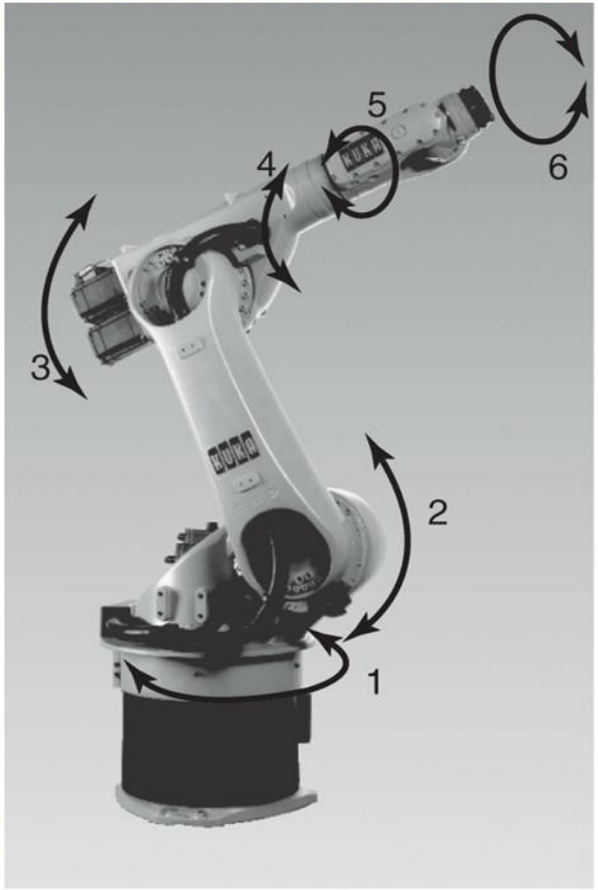
The system monitors such parameters as cutting force, torque, and vibrations. If these parameters are excessive, it modifies process variables (such as feed and depth of cut) to bring the parameters back to acceptable levels.

Industrial Robots: Applications and Selection of Robots

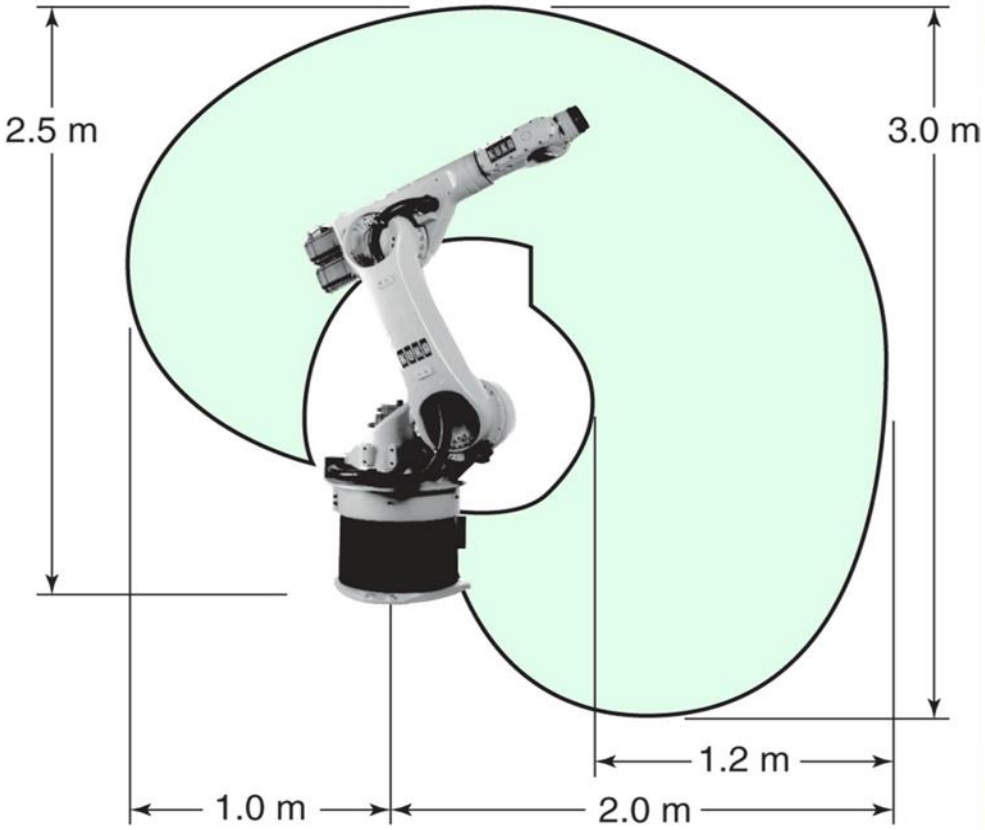
Applications of industrial robots:

1. Material-handling operations
2. Spot welding
3. Deburring, grinding, and polishing
4. Applying adhesives and sealants
5. Spray painting
6. Automated assembly
7. Inspection and gaging speeds

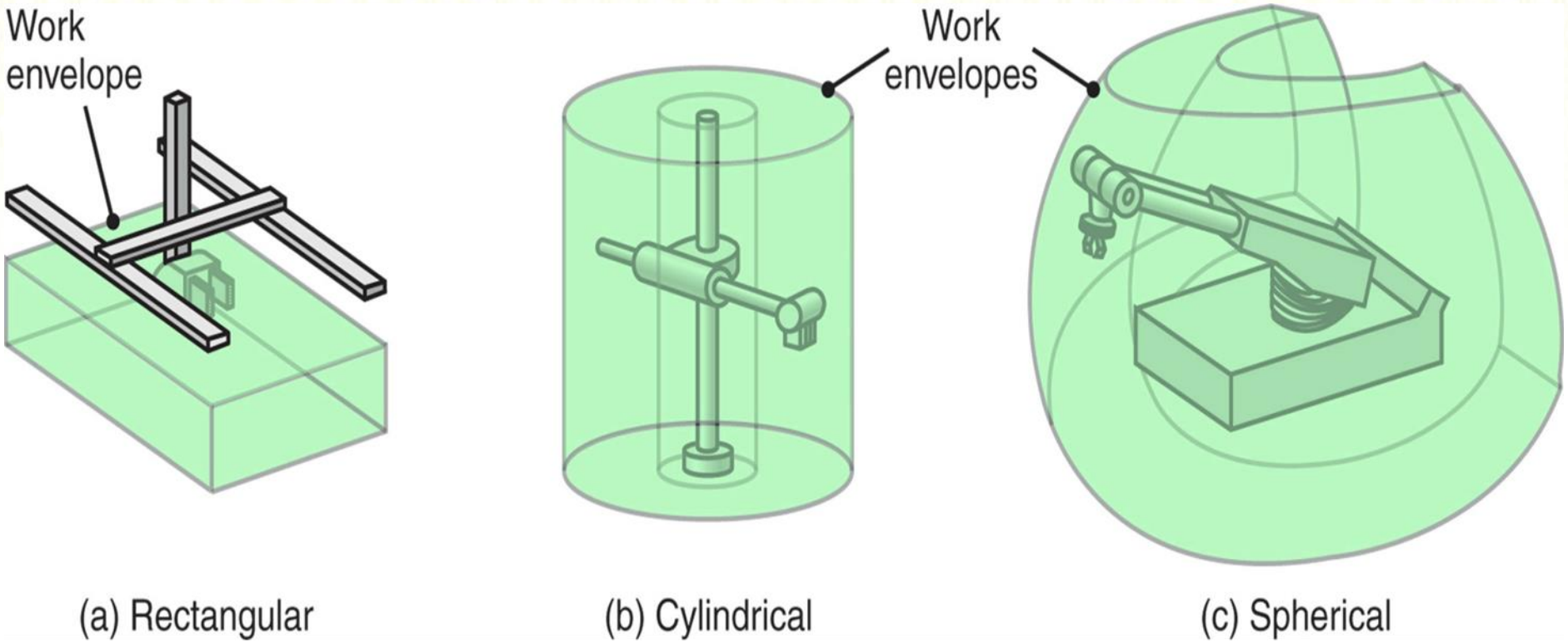
(a) Schematic illustration of a 6-axis KR-30 KUKA robot. The payload at the wrist is 30 kg and repeatability is ±0.15 mm (±0.006 in.). The robot has mechanical brakes on all of its axes, which are directly coupled to one another. (b) The work envelope of the robot, as viewed from the side. *Source:* Courtesy of KUKA Robotics Corp.



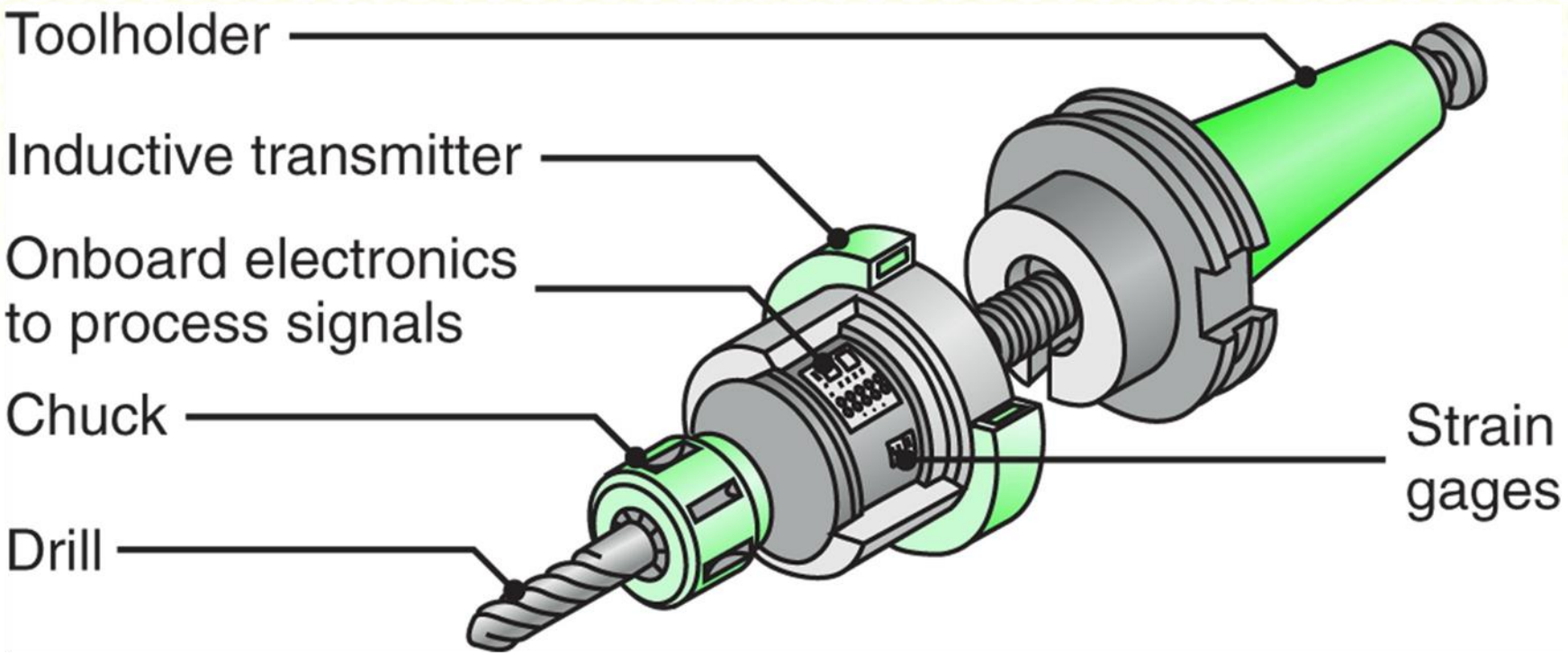
(a)



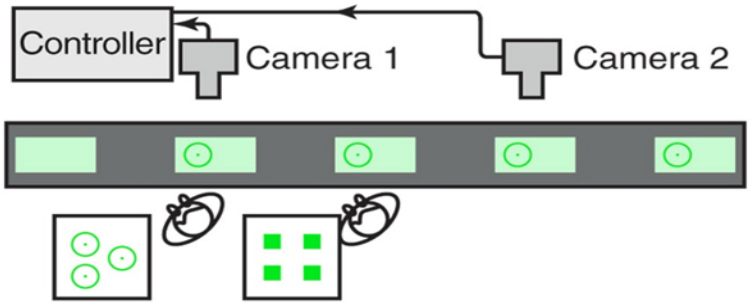
(b)



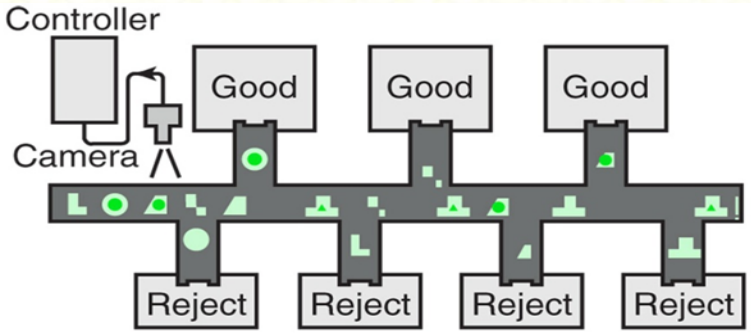
Work envelopes for three types of robots.
The choice depends on the particular application.



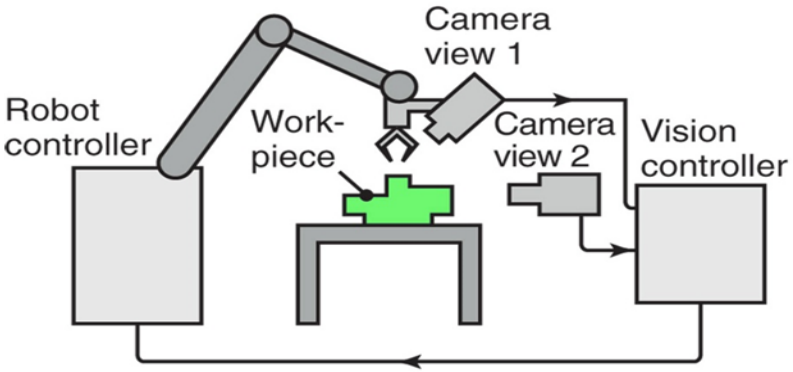
A toolholder equipped with thrust-force and torque sensors (and thus a smart toolholder), capable of continuously monitoring the cutting operation. Such toolholders are necessary for the adaptive control of manufacturing operations. *Source:* Courtesy of Cincinnati Milacron, Inc.



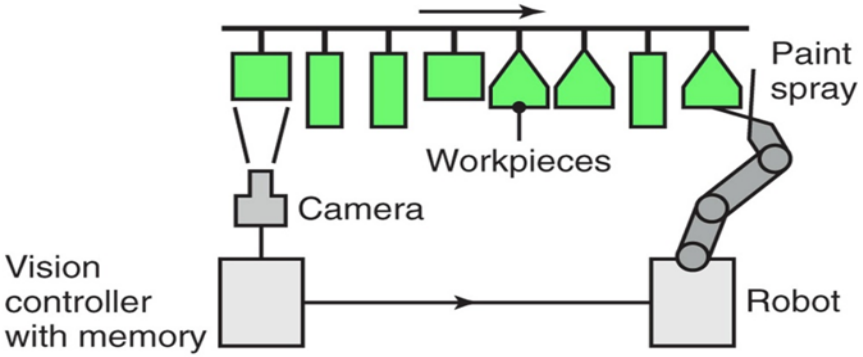
(a)



(b)



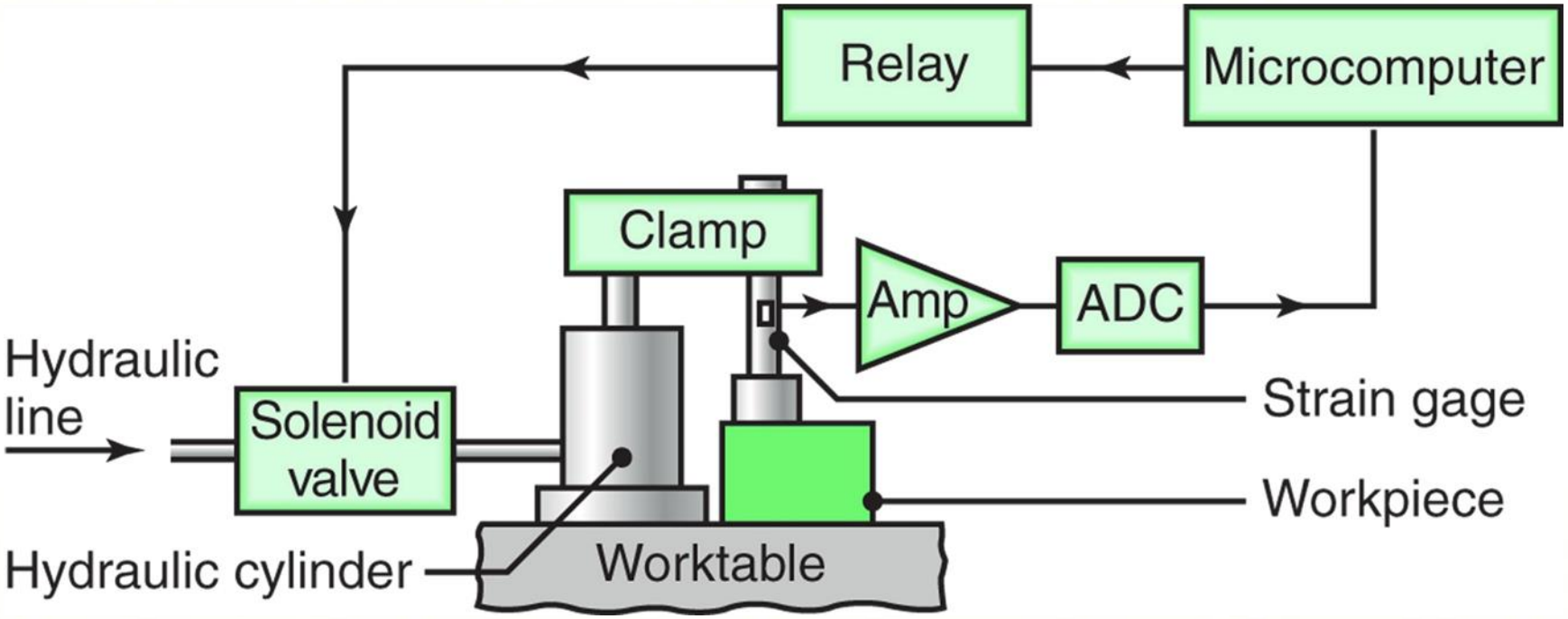
(c)

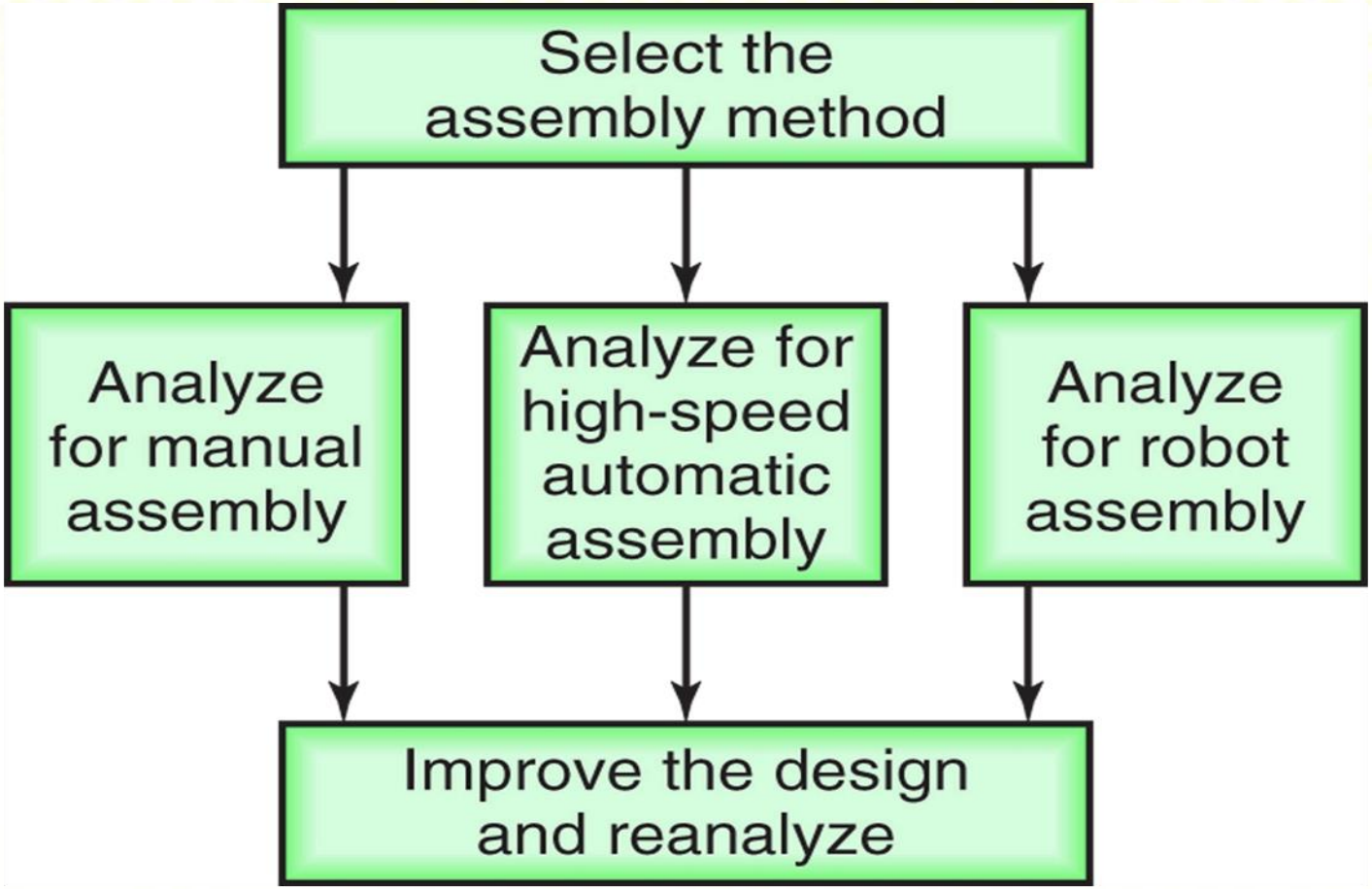


(d)

Examples of machine-vision applications. (a) In-line inspection of parts. (b) Identification of parts with various shapes and inspection and rejection of defective parts. (c) Use of cameras to provide positional input to a robot relative to the workpiece. (d) Painting parts having different shapes by means of input from a camera. The system's memory allows the robot to identify the particular shape to be painted and to proceed with the correct movements of a paint spray attached to the end effector.

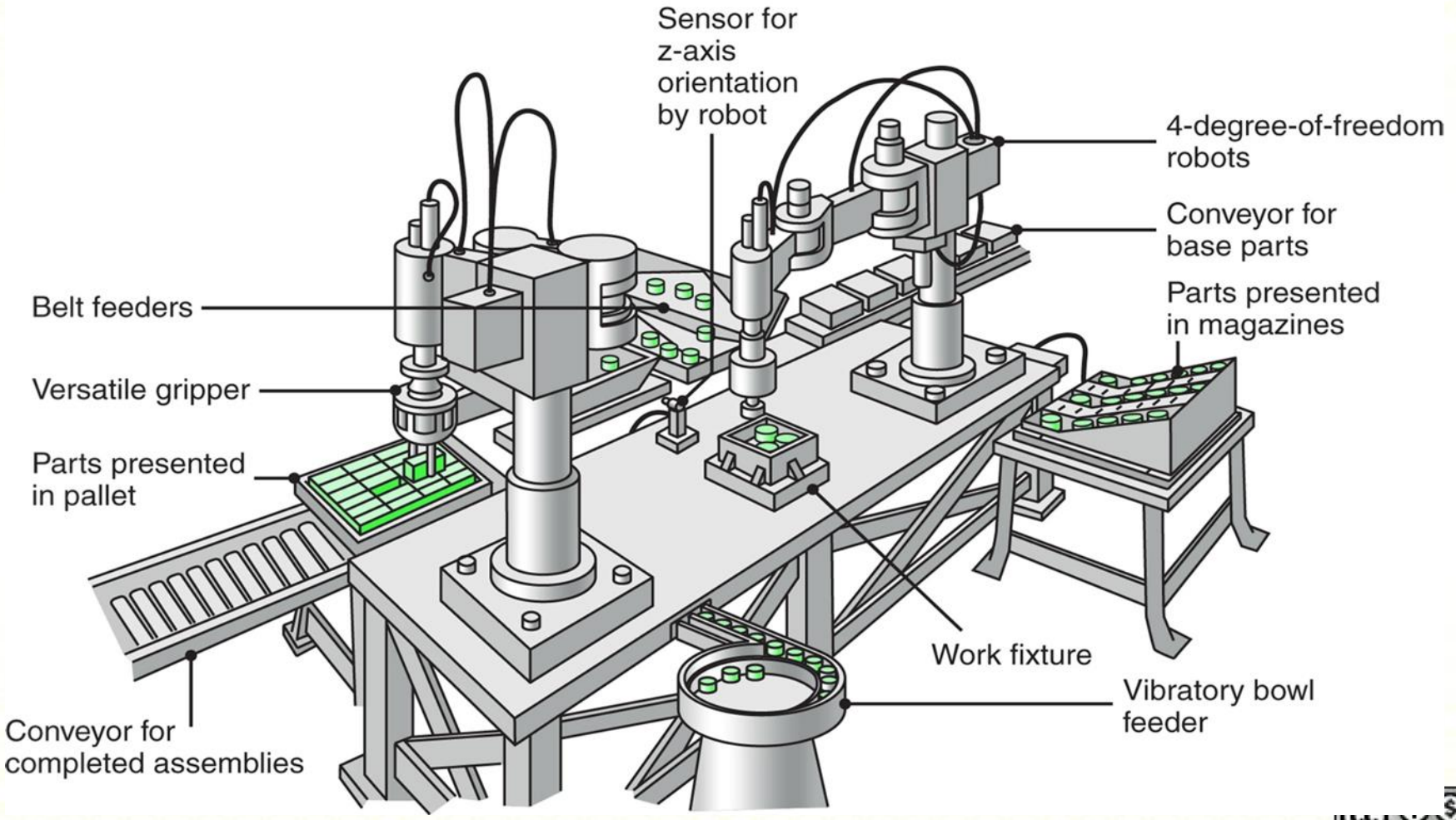
Schematic illustration of an adjustable-force clamping system. The clamping force is sensed by the strain gage, and the system automatically adjusts this force. *Source:* After P.K. Wright.

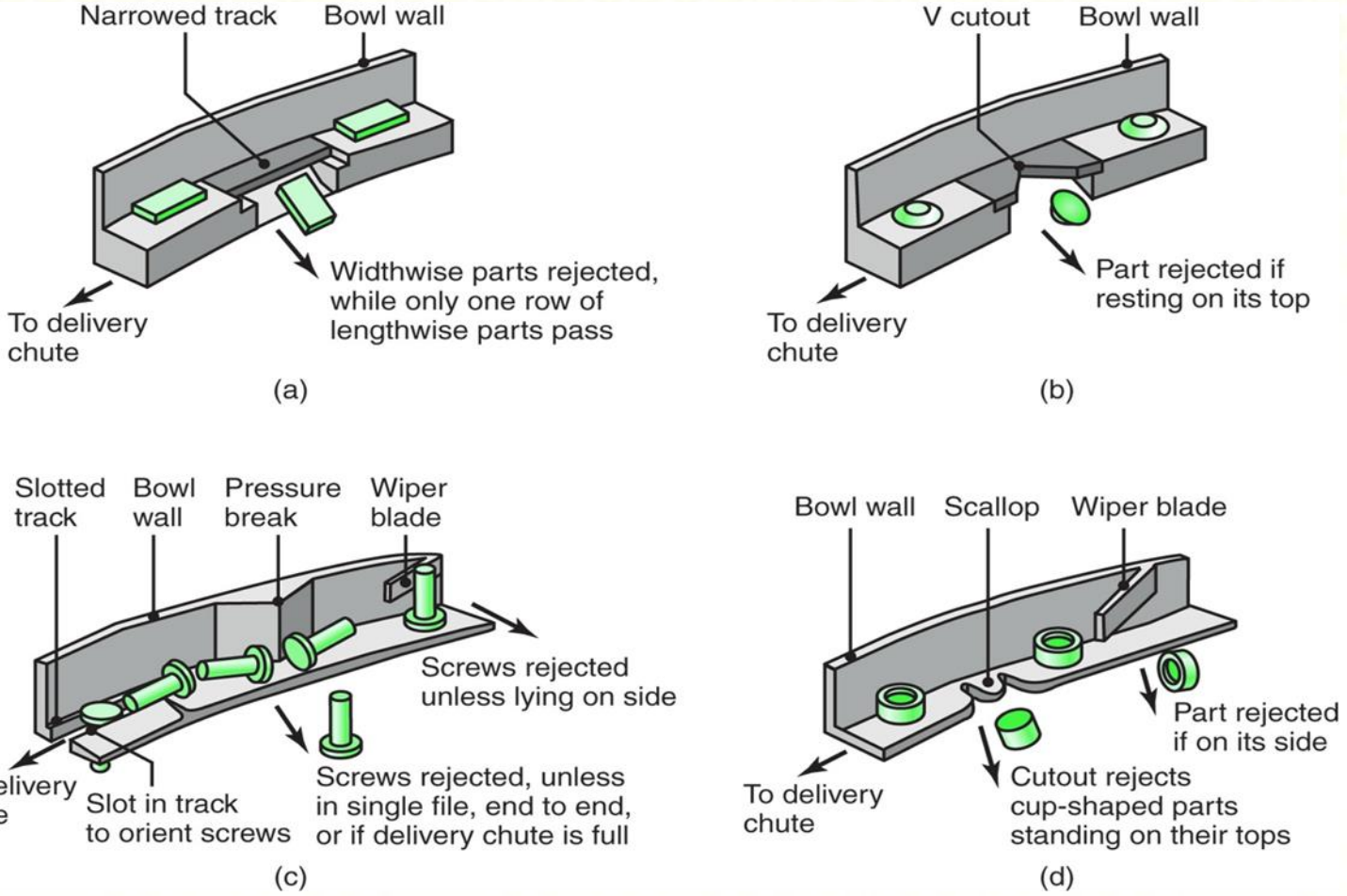




Stages in the design-for-assembly analysis. *Source:* After G. Boothroyd and P. Dewhurst.

A two-arm robot assembly station





Examples of guides to ensure that parts are properly oriented for automated assembly. *Source:* After G. Boothroyd.

THANK YOU