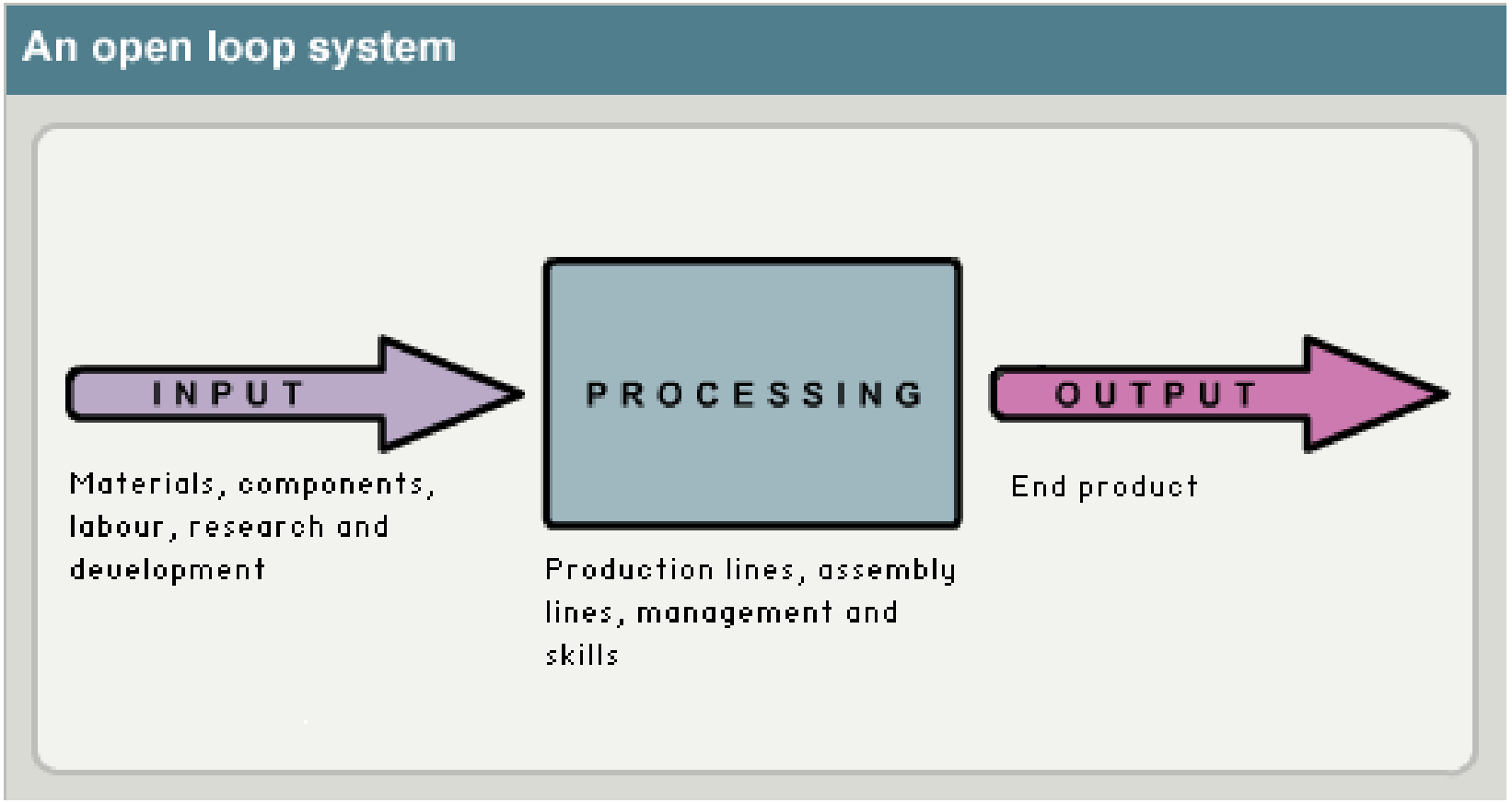
Control Systems

A **system** is group of components or parts that work together to perform a task or operation.

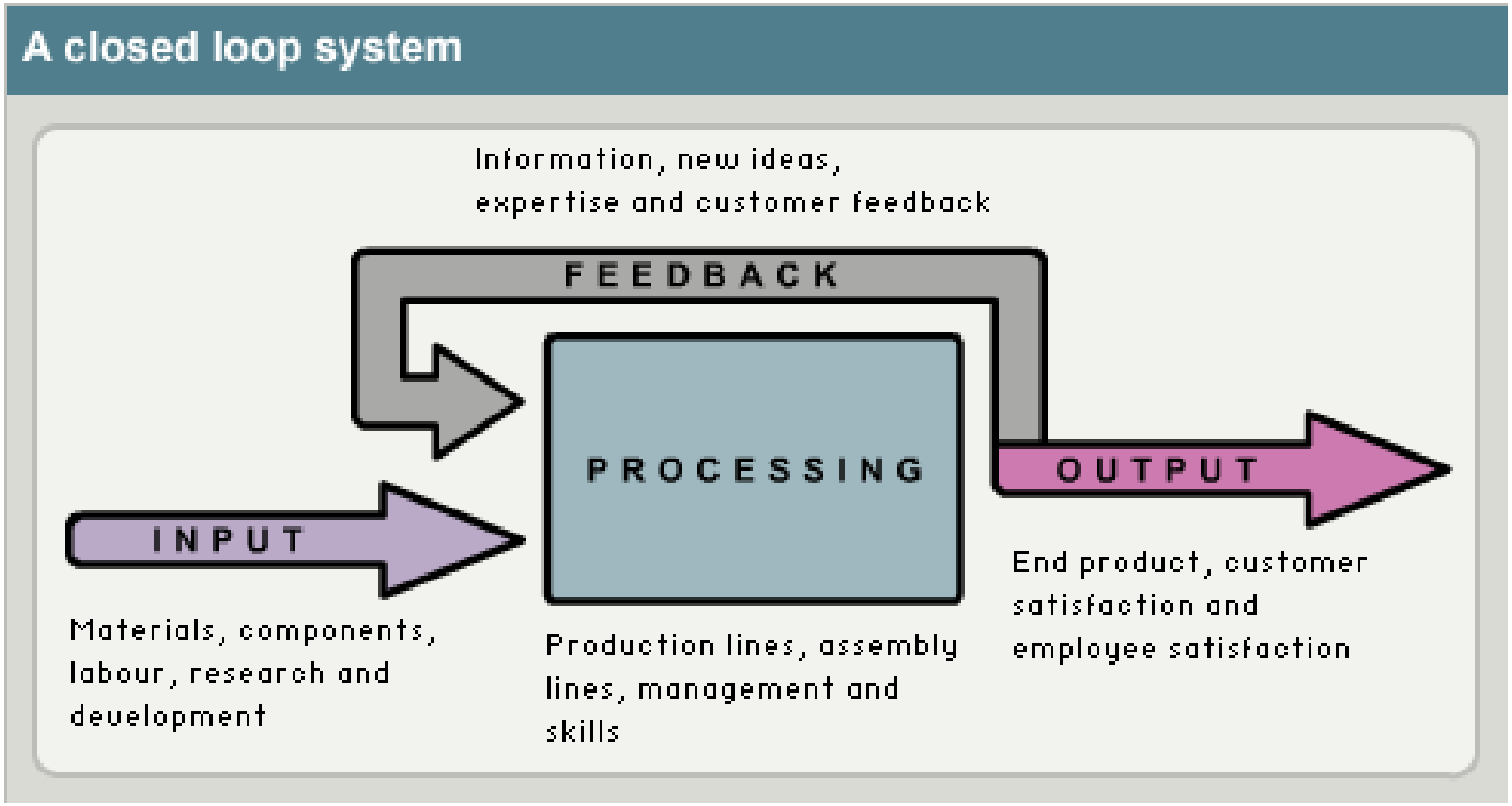
To **control** something is to make something do what we design it to do.

Every electronic or mechanical device has an input a process and an output.

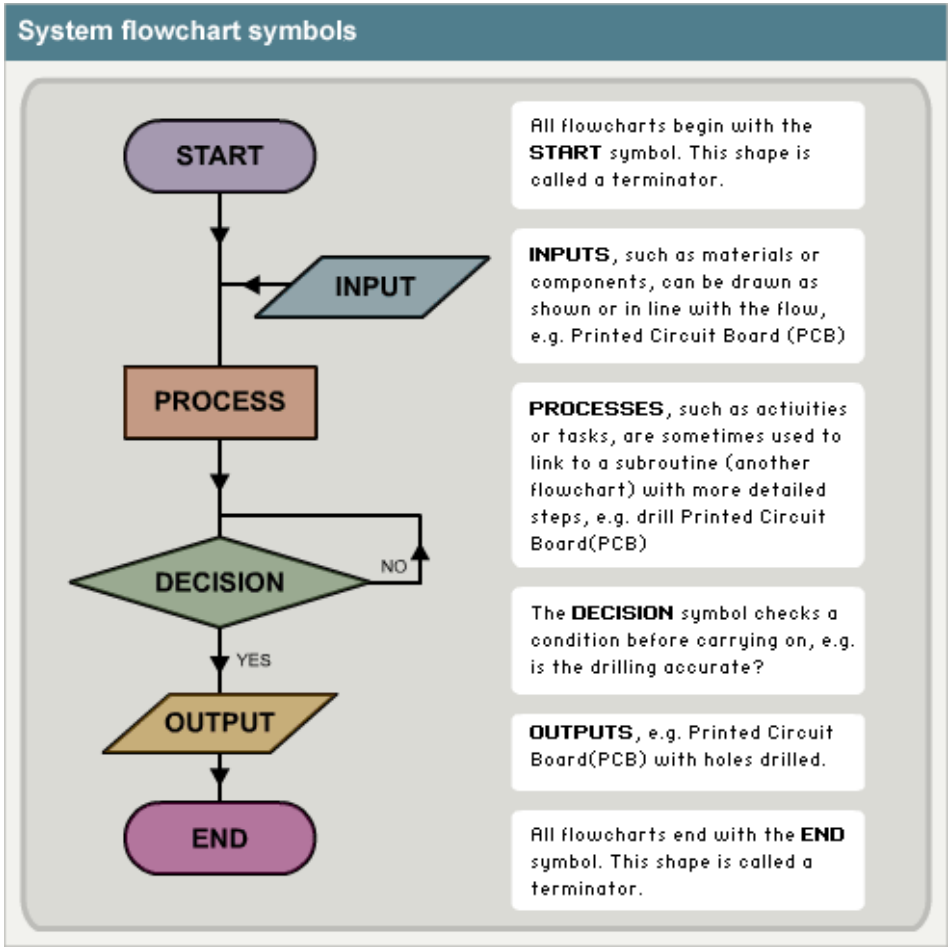
The most basic type of system is called an **open-loop system**. In this type of system, the input triggers the process and the process controls the output. The diagram shows an open-loop system in manufacturing.



A more complex type of system is a **closed-loop system**. Like an open-loop they have inputs, processes and outputs, but they also have another element called **feedback**. Feedback is information from the output of a system which is "fed back" into the input to control the way the system works.
The following diagram for a manufacturing process shows feedback from customer and employee satisfaction surveys being used to control the process, by adjusting inputs and thereby modifying outputs.



Flowcharts are used to design and plan control systems. All flowcharts use the same symbols, linked with arrows to show direction of the flow. Flowcharts start and end with the oval "start" and "end" symbols. Inputs and outputs are shown as parallelograms and processes as rectangles. Sometimes the process box links to a **subroutine** - another flowchart with more detailed steps, which then feeds back into the main process. The diamond shape is a "decision box", which checks an input or condition before carrying on.
The diagram below shows the main flowchart symbols and how they are used in a system flowchart.



Systems need to be controlled, to make sure that they start working in the first place and continue working correctly. A Closed loop system is a good way of achieving this. In this type of system the output can be checked, and the results fed back into the system - to control it by making changes to the input and/or process.

A system controlling an automatic barrier at a car park, for example, needs control feedback from the sensors which detect the approach of a car. If the feedback is positive, the system changes to 'barrier up' - if negative, the system defaults to 'barrier down'.

In manufacturing, electronic, mechanical and pneumatic control systems are used to process materials through a factory. Computerised systems may be used to control the production lines, the ordering and receiving of materials and components, and the storage and shipment of finished products.

Just-in-time manufacturing systems rely on efficient control systems to ensure that the inputs, processes and output are perfectly synchronised to avoid delays.

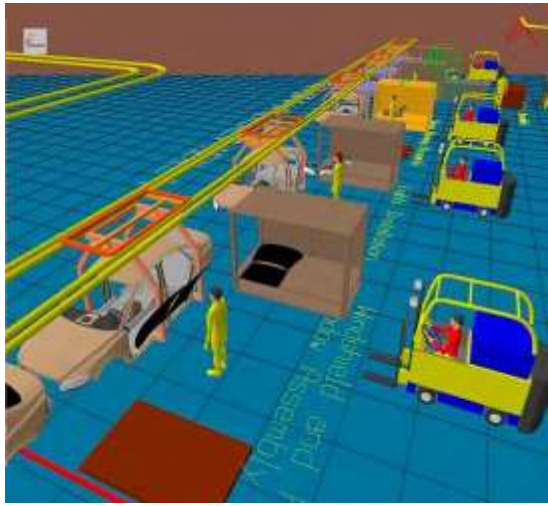
Computer-integrated manufacturing (CIM)

The manufacturing approach of using computer's to control the entire production process.This integration allows individual processes to exchange information with each other and initiate actions.
Through the integration of computers, manufacturing can be faster and less error-prone, although the main advantage is the ability to create automated manufacturing processes. Typically CIM relies on Closed loop process's, based on real-time input from sensors. It is also known as *flexible design and manufacturing*.[

The term "computer-integrated manufacturing" is both a method of manufacturing and the name of a computer-automated system in which individual engineering, production, marketing, and support functions of a manufacturing enterprise are organized.

In a CIM system functional areas such as design, analysis, planning, purchasing, cost accounting, inventory control, and distribution are linked through the computer with factory floor functions such as materials handling and management, providing direct control and monitoring of all the operations.

As a method of manufacturing, three components distinguish CIM from other manufacturing methodologies:



•Means for data storage, retrieval, manipulation and presentation;
•Mechanisms for sensing state and modifying processes;
•Algorithms for uniting the data processing component with the sensor/modification component.

CIM is an example of the implementation of ICT in manufacturing. CIM implies that there are at least two computers exchanging information, e.g. the controller of an arm robot and a micro-controller of a CNC machine.
Some factors involved when considering a CIM implementation are the production volume, the experience of the company or personnel to make the integration, the level of the integration into the product itself and the integration of the production processes. CIM is most useful where a high level of ICT is used in the company or facility, such as CAD/CAM systems, the availability of process planning and its data.

Control systems in manufacture:

- provide a high level of accuracy
- automate quality control checks
- monitor safety and performance
- automate tedious repetitive tasks
- are quick and can operate continuously