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CONTROL TECHNOLOGIES

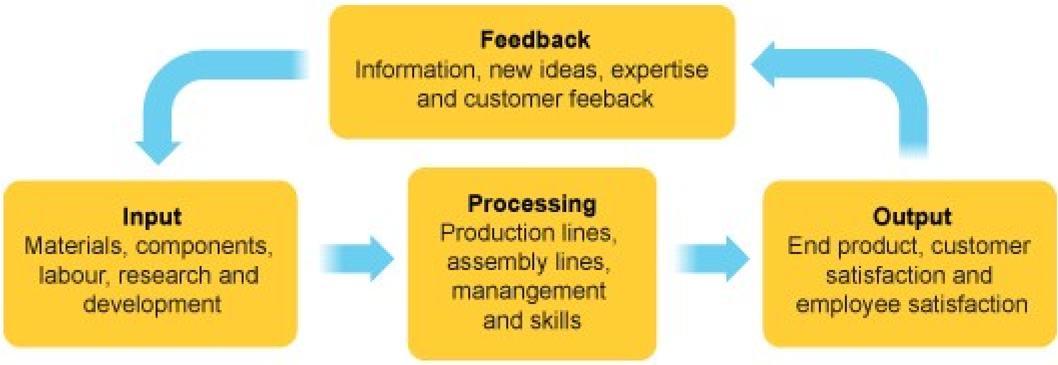
Systems and Control

A system is a combination of parts or components, which work together to control a task or activity. All systems have inputs, a process, and outputs.
All systems have three main elements:

- Input(s)
- Process(es)
- Output(s)

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.

Most systems need to be controlled, and this is usually done by means of a **feedback loop** which checks the outputs and feeds the results back into the system. A system with a feedback loop is called a **closed-loop system**. 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.

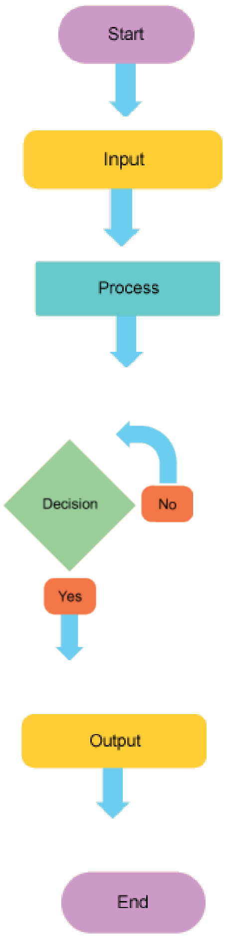


System flowcharts

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 *sub-*

routine – 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 table below shows the main flowchart symbols and how they are used in a system flowchart.

System flowchart symbols



All flowcharts begin with the **start** symbol. This shape is called a terminator.

Inputs are materials or components

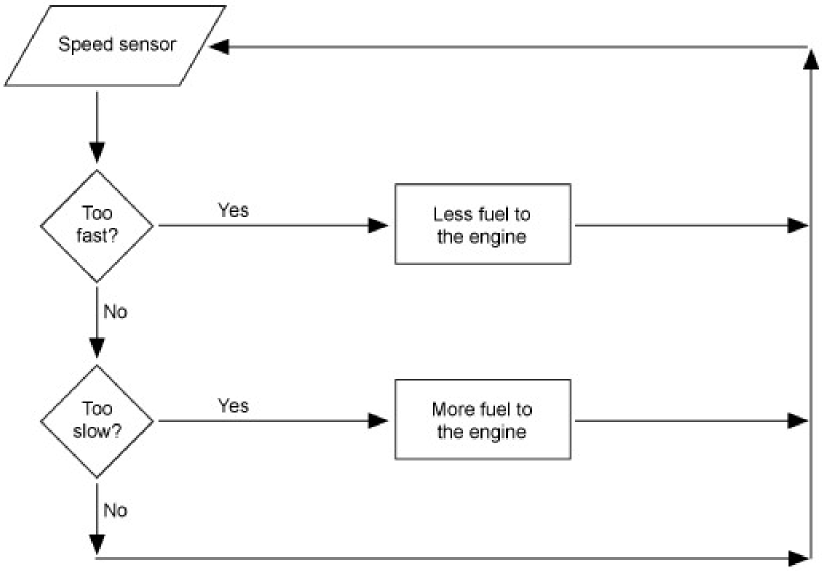
Processes, such as activities or tasks, are sometimes used to link to a subroutine (another flowchart) with more detailed steps.

The **decision** symbol checks a condition before carrying on, e.g. is the drilling accurate?

Outputs, e.g. Printed Circuit Board (PCB) with holes drilled.

All flowcharts end with the **end** symbol. This shape is called a terminator.

This *system flowchart* is a diagram for a 'cruise control' for a car.



The flowchart shows what the outcome is if the car is going too fast or too slow. The system is designed to add fuel, or take it away and so keep the car's speed constant. The *output* (the car's new speed) is then fed back into the system via the speed *sensor*.

Adapted from: http://www.bbc.co.uk/schools/gcsebitesize/design/systemscontrol/workingwithsystemsrev1.shtml

A) READING COMPREHENSION

1) Complete these sentences with information from the text.

1. The components of a system ………………………………………………………..……………..…
2. The three main elements ……………………………………………………………………….…..…
3. The difference between an open-loop system and a closed-loop system ……………………
4. Control ……………………………………………………………………………………..…………
5. Customers' opinions ………………………………………………………….…………..…………

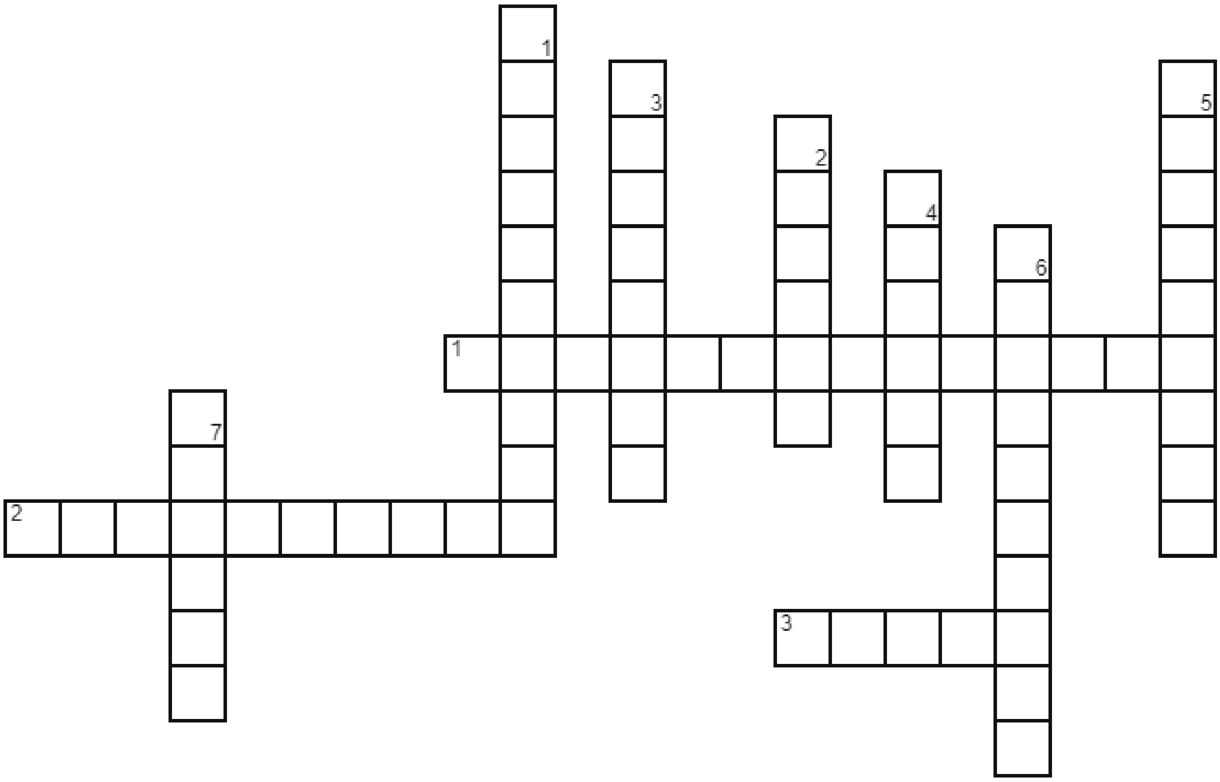
2) A) Design a system flowchart for a door alarm. Include these items:

door closed / door open / alarm bell off / alarm bell ringing / yes / no

B) Is it an open-loop system or a closed-loop system? Explain.

B) VOCABULARY

1) Solve this crossword with words from the text.



Across

1. They show inputs and outputs in the flowchart.
2. They show activities or tasks (processes) in the flowchart.
3. It is the first element of the system.

Down

1. They are used to design and plan control systems.
2. It is a combination of parts or components, which work together to control a task or activity.
3. It checks the outputs and feeds the results back into the system.
4. They show direction of the flow.
5. They are shown as rectangles in the flowchart.
6. It is a shape that starts or ends a flowchart.
7. It is the last element of the system.

C) GRAMMAR: Prepositions – Compound Words

1) Fill in the blanks with only one word.

Systems and control

There are many advantages to using a systems approach (1)……………… designing and making products. The systems approach asks the questions:

- What does it do? (output)
- How does it do it? (process) and
- What makes it do it? (input)

Systems need to (2)……………… controlled, to make sure that they start working in (3)……………… first place and continue working correctly. A *closed-loop system* is a good way (4)……………… achieving this. In this type of system the output can be checked, and the results fed back (5)……………… the system - to control it (6)……………… making changes to the input and/or process. A system controlling an automatic barrier at a car park, for example, needs control feedback (7)……………… the sensors which detect the approach of a car. If the feedback is positive, the system changes to 'barrier up' - (8)……………… negative, the system defaults to 'barrier down'.

Control systems in industry

In manufacturing, electronic, mechanical and pneumatic control systems (9)……………… used to process materials through a factory. Computerised systems may be used (10)……………… control the production lines, the ordering and receiving of materials and components, and the storage and shipment of finished products.

Programmed systems

Systems need to be controlled, to ensure that the system's output continues to be (11)……………… one we want. Digital control systems use a sequence of instructions called a **programme**. There are two main ways (12)……………… writing programs:

- graphically, using flowcharts
- using computer programming languages, such as BASIC, C, C++

Adapted from:
http://www.bbc.co.uk/schools/gcsebitesize/design/systemscontrol/workingwithsystemsrev1.shtml

2) Match the words in column A with the words in column B to make compound words related to the topic "Systems and Control".

A	B	
closed-loop	product	……………………………………
control	lines	……………………………………
computarised	feedback	……………………………………
production	loop	……………………………………
programming	systems	……………………………………
manufacturing	satisfaction	……………………………………
satisfaction	system	……………………………………
feedback	lines	……………………………………
assembly	languages	……………………………………
end	surveys	……………………………………
employee	process	……………………………………

CONSTRUCTION TECHNOLOGY

Better Materials Could Build a Green Construction Industry

Construction material entrepreneurs discussed efforts to create more environmentally friendly cement and other building products at a conference in California.

The construction industry consumes truckloads of basic materials, the manufacture of which consumes massive quantities of energy, producing prodigious emissions of greenhouse gases. If materials scientists and entrepreneurs could devise materials that can be fabricated with less energy, climate change would be slowed and many new manufacturing jobs would be created, fulfilling a much-anticipated promise of clean-tech innovation.

The U.S., which lost millions of manufacturing jobs in recent decades, is in a strong position to capitalize on greener construction materials if research and funding are focused soon, according to panelists who spoke on Wednesday at the Going Green conference in Sausalito, Calif. *"We have such terrific materials science in this country",* said Marianne Wu, partner at Mohr Davidow Ventures. *"But for years it's all been applied to infotech and biotech. We simply have not been looking at building materials. There is pent-up expertise that can create all sorts of innovations".*

"Many basic building products can be improved so significantly that everything is up for reinvention", said Kevin Surace, CEO of Serious Materials. *"We're beginning to make less energy-intensive cement",* he noted, *"but maybe we can make better bricks, too. My company's new drywall is the first real change in decades. Double-pane windows were invented in the 1800s. The world just has not cared about working on this".*

The success of new cement from Calera Corp. shows how large gains can be. *"The production of Portland cement globally creates two and a half billion tons of carbon dioxide annually",* Calera CEO Brent Constantz said. Instead, new processes Calera is scaling up can actually sequester half a ton of the greenhouse gas for each ton of cement produced. And fresh water is created as a by-product. Furthermore, if the cement factories were installed next to coal-fired power plants, they could absorb the plants' carbon emissions as raw material.

Because the construction industry is so extensive, and because of the U.S.'s embedded materials expertise, Surace maintained that a transformation to cleaner technologies could bring basic manufacturing back to the country. *"We can get back to making things, which was the foundation of American industry for a century",* he said.

To make that transition happen*, "we need to build new Silicon Valleys of construction materials entrepreneurs, and we need universities to develop programs that can churn out people with the right expertise",* Surace said. Mohr Davidow's Wu noted that millions of jobs could realistically be created, adding*: "These materials are big, and heavy, so it makes economic sense to manufacture them locally, instead of shipping them thousands of miles".* She said that labor for this sort of manufacturing is low tech and therefore not expensive, making it harder for overseas competitors to undercut domestic producers. *"A clean-tech building materials industry really could bring lots of jobs back to the U.S.",* Wu said, *"in many local regions".*

Adapted from
http://www.scientificamerican.com/article/better-materials-green-construction-industry/

A) READING COMPREHENSION

1) Read the text and answer TRUE or FALSE. Justify the false ones by translating into Spanish the sentence or part of sentence that accounts for that.

1. Construction material industries are interested in developing environmentally friendly building products which will help to slow climate change.
2. Emissions of greenhouse gases produce large quantities of energy.
3. Cement factories could absorb carbon emissions from plants if located near coal-fired power plants.
4. A greener construction industry could create more jobs in the country.
5. Importing construction materials from overseas means low cost.

2) Choose the best translation for the underlined words in the text:

1. truckloads:	A) cargamentos	B) camiones	C) cantidades
2. prodigious:	A) grandes	B) prodigios	C) inteligentes
3. drywall:	A) muro	B) en seco	C) construcción en seco
4. sequester:	A) confiscar	B) aislar	C) secuestrar
5. churn out:	A) producir	B) producir en masa	C) producir rápidamente
6. undercut:	A) debilitar	B) minar	C) vender más barato que

B) GRAMMAR: Second Conditional – Modal Verbs

Second Conditional

1) Find and underline 2 examples of Second Conditional sentences in the text.

2) Put the vers in the correct form of the Second Conditional.

1. If my husband …………………(repair) the leak promptly, the roof …………………
   (not – collapse).
2. If the foundation ……………………(not – be) stable, it ………………………(not – support) the building.
3. If the architect ……………(not – include) the environmental control systems in his plan, the building………….. (present) problems as regards heating, lighting and ventilation.
4. That building façade …………………….(be) nicer if its owners ………………………(paint) it.
5. If Sam ………..(use) insulating barriers on the walls, he ……….………(not –have) moisture problems in the future.
6. We …………………(live) in a healthier world if more factories ………………(use) greener materials.
7. If we ………………………(can) reduce the use of fossil fuels, we ………………………(live) in a world without greenhouse gas emissions.
8. If you …………………… (call) a plumber, he ……………………(change) the bathroom pipes. They're too old.

Modal Verbs

3) Underline examples of CAN / COULD in the text. Do they mean “possibility” or “ability”?

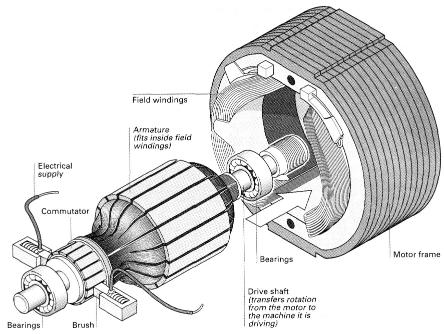
4) Complete the second sentence so that it has the same meaning as the first. Use the words in brackets.

1. I’m certain he’ll fix the acoustical system. (definitely)
   He………………………………………………………………………………………………
2. It is possible that the builder will finish with the interior partitions. (might)
   The builder ……………………………………………………………………………………
3. The architect might not go the Works tomorrow. (may)
   The architect …………………………………………………………………………………
4. The electrician will probably charge us a lot. (think)
   I ………………………………………………………………………………………………..
5. I don’t think these foundations will support the building. (doubt)
   I ………………………………………………………………………………………………
6. They will definitely make greener building materials soon. (sure)
   I ………………………………………………………………………………………………

PHYSICS

The electric motor

Electric motors are found in many of the devices that make our modern society move, from cars to clocks to the cooling fan in your computer.



Source: Oxford English for Electrical and Mechanical Engineering

1 An electric motor creates rotational, or circular, motion. The central part of the motor is a cylinder called the **armature** or **rotor**. The armature holds the rest of the components and is also the part of the motor that spins. Around the armature is the **stator**, which holds insulated coils of wire, usually copper. When a current is applied to the motor, the stator generates the magnetic field that drives the armature. Depending on the design of the motor, you might also find **brushes**, or fine metal fibres that keep current running to the opposite side of the motor as it spins.

2 You may have noticed that, when you have two magnets, opposite poles attract and like poles repel. The electric motor uses this principle to create torque, or rotational force. It is not the electric current per se, but the magnetic field it creates that generates force when an electric motor is in motion. Electricity moving through a wire creates a circular magnetic field with the wire as the source and centre of the rotation. When you add current, the stator and armature form a stable magnetic field and an electromagnet that is pushed or rotated within that field, respectively.

3 The basic motor runs on DC, or direct current, but other motors can run on AC, or alternating current. Batteries produce direct current, while the outlets in your home supply alternating. In order for a motor to run on AC, it requires two winding magnets that don't touch. They move the motor through a phenomenon known as induction. These induction motors are brushless, since they don't require the physical contact that the brush provides. Some DC motors are also brushless and instead use a switch that changes the polarity of the magnetic field to keep the motor running. Universal motors are induction motors that can use either source of power.

4 Now that you have the basic parts and principles, you can play with the concept at home. Make a coil from lower gauge copper wire and poke each end through an aluminium can to suspend it. Place a small, strong magnet on either side of the suspended coil to create a magnetic field. If you attach a battery to both cans using alligator clips, your coil will become an electromagnet and the copper wire rotor you created should start to spin.

Adapted from
https://sciencing.com/electric-motor-work-4569196.html

A) READING COMPREHENSION

1) Skim the text and label each paragraph with these titles:

a) Different Types of Electric Motors ....
b) Building a Simple Electric Motor ....
c) Parts of an Electric Motor ....
d) Making It Work ....

2) In the text, find information about these items. Explain what they are and their function.

Electric motors	
The armature	
The stator	
Brushes	
Magnetic field	

B) GRAMMAR: Passive Voice

1) In the text, find two examples of Passive Voice (to be + past participle).

………………………………………………………………………………………………………

………………………………………………………………………………………………………

2) Complete this description of a motor with the correct form of the Passive Voice in the Present Simple.

A simple DC motor consists of a field magnet and an armature. The armature …………………………(place) between the poles of the magnet. The armature …………………………(make up) of a loop of wire and a split ring …………………………(know) as a commutator. The loop …………………………(connect) to the commutator. Current …………………………(supply) to the motor through carbon blocks …………………….(call) brushes.

3) Turn these sentences about the history of the electric motor into the correct form of the Passive Voice in the Past Simple.

1. Thomas Davenport developed the first real electric motor in 1834.

   The first real electric motor...

2. Henry and Faraday created early motion devices using electromagnetic fields.

   ....

3. Davenport's motors ran a model trolley on a circular track.

   ....

4. They built full sized electric trolleys 30 years after Davenport's death.

   ....

5. Trolleys transported millions of people to work in the 1880s.

   ....

C) AUDIOVISUAL COMPREHENSION

1) Watch the video *"DC Motor, How it works?"* (up to "3) and choose the correct option. https://www.youtube.com/watch?v=LAtPHANEfQo

1. The armature, which is the rotating part, is a simple.................
   a) coil b) brush c) commutator
2. The armature is connected to a DC power source through a pair of ....
   a) fields b) commutator rings c) coils
3. When the current flows in the coil, an electromagnetic force is induced on it according to the Lorentz Law, so the coil will start to ....
   a) move b) turn c) rotate
4. As the coil rotates, the commutator rings connect with the power source of opposite ....
   a) polarity b) direction c) type
5. As a result, on the left side of the coil, the .... will always flow away. And on the right side, the................. will always flow towards. This ensures that the torque action is also on the same direction throughout the motion so the coil will continue rotating.
   a) current b) energy c) electricity
6. Adding loops to the motor, solves the problem of the ....of the rotor.
   a) irregular motion b) irregular energy c) irregular magnetism

2) Watch this video and take notes of the things you need for this experiment. https://www.youtube.com/watch?v=-xSgw12hfLc

3) Watch the video again and order these sentences which describe the steps of the experiment:

…………….. a) Strip off the insulation from just one side of each end.
…………….. b) Push the needles into the putty at each end of the battery.
…………….. c) Use the putty to fix the battery to a hard flat surface.
…………….. d) Wind the wire around the cylinder 30 times.
…………….. e) Rest the coil in the needle eyes and ensure it's well balanced.
…………….. f) Give the coil a spin. Hold the magnet nearby and watch it go!
…………….. g) Loop the ends around the coil, then point them out to the side.

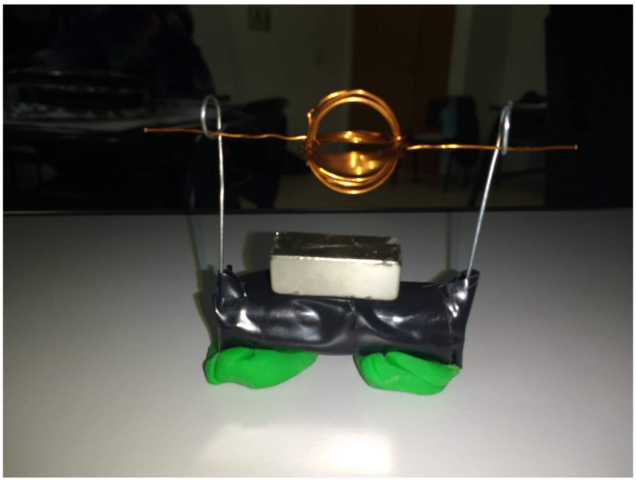
4) Watch this other video.
https://www.youtube.com/watch?v=5BQxAMFdRq8

A) What is the difference with the previous video as regards the items used?

B) Use these words to explain the difference:

IS/ARE PLACED
IS/ARE REPLACED
IS/ARE USED

5) In teams, make the simple electric motor shown in the videos.



An electric motor made by 3rd year students of IPS (2018)