Causing, preventing, and enabling links: *cause to, make, prevent, stop, allow to, enable to, let*

There are several ways to describe the relationship between actions.

Causing

cause + object + *to* + infinitive

make + object + infinitive

*Vibration or pressure can **cause a mine to explode**.*
*Vibration or pressure can **make a mine explode**.*

Preventing

prevent + object + *from* + *-ing* form

stop + object + *-ing* form

*The hard ground often **prevents the robot from uncovering** mines.*
*The hard ground often **stops the robot uncovering** mines.*

Enabling

allow / enable + object + *to* + infinitive

let + object + infinitive

*Digital cameras **allow / enable** the robot to navigate by itself.*
*Digital cameras **let** the robot navigate by itself.*

Sentence structure

There are two ways we can structure these ideas.

- Relative clause, using *which* + verb of causing / preventing / enabling

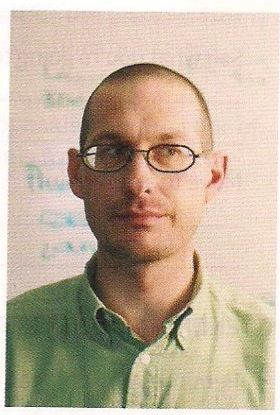
*Batteries run down quite quickly, **which** causes the robot to stop moving.*
*The Mars Rover is fitted with digital cameras, **which** prevents it from colliding with obstacles.*
*The robot is equipped with sensors that measure pressure, **which** enables it to handle delicate items.*

Note that the verb following *which* is in the third person singular, as it refers to the preceding action rather than to a singular or plural noun.

- Omitting *which* and using the *-ing* form of the verb that follows it. Compare:

*The robot has six legs, **which enables** it to walk delicately through mine fields.*
*The robot has six legs, **enabling** it to walk delicately through mine fields.*

It's my job



1 Before you read about Ikonen, Senior Manufacturing Systems Engineer, answer these questions with a partner.

1 What do you think Jaako's responsibility is?
2 One of his products involves biosensors. What do you think a biosensor is?
3 What do you think is the difference between mechanization and automation?

2 Read and check your answers.

3 Read again to find the answers to the questions.

1 What did he study at college?
2 Why did the mobile phone company need to automate?
3 What does a blood glucose monitor do?
4 Why must the process of manufacturing the monitors be automated?

It's my job

I = Interviewer, J = Jaako Ikonen

I How did you get interested in technology?
J I started making radio-controlled model boats at the age of 13.
I That's how you got started?
J That's how I got started, yeah. I loved playing around with the electronics.
I Did you go on to college at the end of school?
J Yes, I went to college and did Mechanical engineering with one year of Electrical and electronic engineering.
I What was your first job?
J Designing and building automated manufacturing systems for a mobile phone company. They needed to automate because production was going through the roof. Their old system simply could not produce enough phones.
I I'm not clear about the distinction between mechanization and automation.
J Big difference. Mechanization is the old world of machines with no brains, they could do only one thing – like Henry Ford's assembly lines. Automation means you are using a combination of software, of mechanical engineering, electronics, electrical engineering – that's the mechatronics side of things. There's intelligence built in. That's why it's called automation.

I You then moved to your current job?

J Yes. I'm Senior Manufacturing Systems Engineer for a large health care company. That means I'm responsible for developing all new processes and process automation for manufacturing our products.

I What do you make?

J One of the main products is blood glucose monitors for diabetics. It uses biosensors, which are coated in enzymes to measure the blood glucose levels in a drop of blood. Basically how much sugar there is in the blood.

I Where does automation come in?

J You can't make these machines by hand. There can't be any contamination, they have to be perfectly clean, and there can't be any defects in the production. Peoples' lives are involved so you cannot afford to be wrong. Also the volume is huge so only machines can achieve this.

I Is it done by robots?

J We use incredibly fast, vision-driven robots. They don't simply pick up and place components blindly. They can see what they're doing, they can teach themselves, and they check every move they make to ensure there are no errors.

I What qualities do you need to be successful in your field?

J You must be innovative. You must be able to work across functions and be able to communicate with non-technical people.

I Can you give me any examples of communicating with non-technical people?

J I work in R&D and we have to constantly communicate with Marketing – they know what the customers want. We just have the ideas.

Speaking

Assessing explanations

1 Work in groups of three, A, B, and C.

Student A Go to p. 110.
Student B Go to p.113.
Student C Read text C below.

2 A plays the role of Speaker first, telling the others about their text using only notes to help. B plays the role of Reporter, taking notes from A's talk and reporting it briefly. C plays the role of Assessor, listening carefully to both talks and judging how accurately B has reported. If there is disagreement, you can refer to the texts.

3 Continue until each member of the group has played the part of Speaker, Reporter, and Assessor once.

C

FIRST – For Inspiration and Recognition of Science and Technology – is a US organization founded by Dean Kamen, inventor of the Segway. FIRST has run an annual Robotics Competition since 1992 for teams of high-school students. Teams have six weeks to design and construct a robot to solve a particular task, which differs each year.

Teams usually consist of about 25 students with three or so professional Engineers who volunteer to assist them. They often include subteams who look after different aspects of the design of the robot, such as pneumatics, control systems, mechanics, and electrics.

Each team is supplied with a standard set of components including a remote control receiver and transmitter, a microprocessor and software, motors, sensors, a power pack, and mechanical parts.

More than 1,300 teams from seven countries, although mainly from the US, took part in 2007. FIRST also organizes robotics competitions for younger students.

A

HeartLander is an experimental miniature robot designed to allow surgeons to treat damaged hearts without major surgery. It has been developed at Carnegie Mellon University in Pittsburgh. The robot is two centimetres long. It can be inserted into the body by a small incision in the chest. It moves by a combination of suction and push-pull movements provided by wires driven by motors outside the body. The movement resembles the way a caterpillar moves. It can travel at speeds of up to 18 cm per minute.

A computer monitors its position and controls its movements.

HeartLander can be directed to crawl over the surface of the heart while the heart is beating. Its inventors hope to use it to attach leads for pacemakers, to inject drugs straight to the heart, and to take samples from the surface of the heart for analysis.

To do this without major surgery would be an important advance in the treatment of heart problems.

B

Geminoid is a humanoid robot which looks and sounds just like its creator, Hiroshi Ishiguro of Osaka University in Japan. Its features are made from silicon moulds of his own body. It has the same hair colouring and style, and wears the same glasses and clothes.

Dr Ishiguro demonstrates his robot by using it to teach his classes. What makes this robot so convincing is that it appears to breathe, its eyes blink, and it fidgets just like a human. It also speaks with his voice. These effects are achieved by technology which includes 50 sensors and motors under Geminoid's skin to give expression to its face and to replicate human movements. The breathing effect is caused by compressed air forced into the chest. A motion capture system tracks the real Dr Ishiguro's mouth movements which are then copied by the robot. His voice is relayed through a speaker in the robot.

Dr Ishiguro believes that in future, humanoid robots will stand in for people who cannot be present at an event. We may have not only robot teachers, but robot politicians and singers.

We should have – in rather cheap machines – human level intelligence in well under fifty years.

Hans Moravec

Research Professor in the Robotics Institute of Carnegie Mellon University, 1990

Webquest

FIRST is not the only robot competition available. Work in small groups to research some others and report back to the class what you have found out. You should get information about what the rules are, where the competition is held, and what type of competition it is. Is it based on a competitive sport, such as football, or is it a race or a challenge?

These sites may help:

www.dcs.shef.ac.uk/~noel/competitions.html

www.ecsel.psu.edu/~avanzato/robots/contests/

http://robots.net/rcfaq.html#LNK077

http://cswww.essex.ac.uk/staff/hhu/competition.html

http://robogames.net/index.php