

The nature and impact of technology

One of the most significant factors affecting how businesses have operated in the twentieth century has been the impact of new TECHNOLOGY. It is easy to see its impact when we consider some of the changes that have taken place in business.

- New products, such as camcorders, compact discs, laptop computers and services such as direct purchasing from television.
- New production processes, such as robotic welding, and computer controlled cutting machines.
- New materials such as silicon chips for computer circuit boards and polystyrene for packaging.
- Changes in business operations and new skills. For example, as a result of automatic cash tills in banking, many staff have been retrained to sell financial services.

There are many ways in which technology can be defined. One approach is to say that it is 'a creative process which uses human, scientific and material resources to solve problems and generate better efficiency'. Some examples make this clear. A business that uses video conferencing to communicate with branches spread all over the country is using technology. So is a plant which uses lasers to detect faults in products as they move along the production line.

How does technological progress take place? It is usually by means of **invention** and **innovation**. Invention is the discovery of something new. Some examples include the laser beam developed in 1960 by Dr. Charles Townes and the micro-processor developed in 1971 by Marcian Hoff in the USA. Inventions are then developed into products. The laser beam has been used for cutting in industry, micro-surgery in hospitals and spectacular lighting shows in displays.

Inventions are sometimes made by creative people 'outside' business. For example, the ball point pen was invented by a sculptor, and the pneumatic tyre by a veterinary surgeon. Today, research is carried out by teams of people working for a business, university or the government. The rewards to inventors can be very high, if their inventions can be used commercially and patented.

In business, innovation is the commercial exploitation of an invention. An invention is not usually in a form that consumers will buy. The product must be developed to meet consumers' needs, so that it can be sold profitably by business. UK firms have, perhaps, been reluctant to do this in the past. For example, the first working computers were developed in the 1930s. Since then Japan and America have led the world in hardware production and computer research. Enormous investment is often required to innovate once a technical breakthrough has been achieved.

Type of technology in primary industry

Primary industry has been affected by the introduction of new technology in a number of ways. In agriculture the use of tractors, combine harvesters, lifting equipment, grain drying machines and automatic milking and feeding apparatus have helped to increase output, reduce time and waste, and improve conditions. Agrochemicals and pesticides have raised crop yields. Biological research has helped to develop plants and crops which are more resistant to disease and more attractive to consumers. Genetically modified foods are argued to have better resistance to disease. In extractive industries, such as mining, cutting, lifting and tunnelling machines have all led to increased output.



Question 1.

Barclays, Britain's third biggest bank, is planning to cut 1,100 jobs in its processing centre in Poole, Dorset, over the next three years. The redundancies are the result of automation in more of its systems. For instance, cheques which were previously processed by hand will now be handled by computers. The cutbacks will leave just 850 employees remaining. The bank will also shut its Barclays House operation in Poole and seek out smaller premises in the town or nearby Bournemouth.

Unite, the newly formed union which incorporates finance branch Amicus, expressed concern about the 'large reduction of jobs in Poole'. Union official Steve Pantak said: 'Unite does, however, have robust agreements in place and the bank's plans are spread over the next three years, so we will be working with the bank to ensure the maximum number of redeployments and voluntary redundancies.'

The new premises will be 100,000 sq ft compared with the 300,000 sq ft currently provided by Barclays House. The bank has had operations in Poole since 1976. The job reductions will affect a number of areas, including cheque processing as well as IT support and some human resources functions.

Source: adapted from *The Guardian*, 10.5.2007.

- Using this case as an example, explain what is meant by automation.
- What problem does this case highlight when introducing new technology?

There have also been improvements in safety equipment and mining conditions for workers. The extraction of oil now takes place on large oil rigs with computer controlled drilling equipment. This improves the speed and accuracy of production. In fishing, the introduction of refrigerated boats has helped to improve productivity. Forestry has benefited from cutting, lifting and haulage equipment.

One problem with the use of more efficient technology is that resources are used up more quickly. It may be possible to control this in the case of **renewable resources**, such as timber, by replanting and managed forestry. However, unless new forms of power can be developed, there are likely to be problems in future with extracting large amounts of the world's finite resources such as coal and oil. There have also been criticisms of genetically modified food and its possible effects on humans.

Type of technology in secondary industry

New technology has led to major changes in manufacturing. Many factories and production lines employ complex mechanical, electrical and electronic systems. Even smaller manufacturing businesses have benefited from the introduction of new equipment and processes. Examples of new technology can be found in a number of areas.

Robots Robots are increasingly used on assembly and production lines. They have some form of arm, which moves to instructions given by a computer. Repetitive tasks, such as installing components, can be carried out many times with great accuracy. Such tasks may lead to boredom, lack of motivation, tiredness and human error if undertaken by employees. Robots may also increase the flexibility of a business. For example, in 1998 small robots, each with its own set of paint cans, were installed in the paint shop of the Volkswagen-Audi car plant in Germany. The robot could be activated at a few minutes' notice when a customer wants a colour which is not included in the current program. Using the robot means that customer demand for less popular colours can be satisfied without having to clean out the pipes of the main painting apparatus, which would be costly.

Computer aided design COMPUTER AIDED DESIGN (CAD) is now used by businesses in the design process, before a product is manufactured. Examples of products designed using CAD include vehicle bodies, plastic containers to hold milk and oil, furniture and clothing. Designing on computer allows a business to produce accurate drawings, which can be viewed in 3D and altered cheaply and quickly for a client. Designs can be accurately measured and tested on computer for faults, such as unsuitable components or dimensions, which might have caused problems during manufacture.

Computer numerically controlled machines Products can be manufactured using COMPUTER NUMERICALLY CONTROLLED (CNC) machines. Instructions are given to the CNC machine by the operator. The machine then carries out its

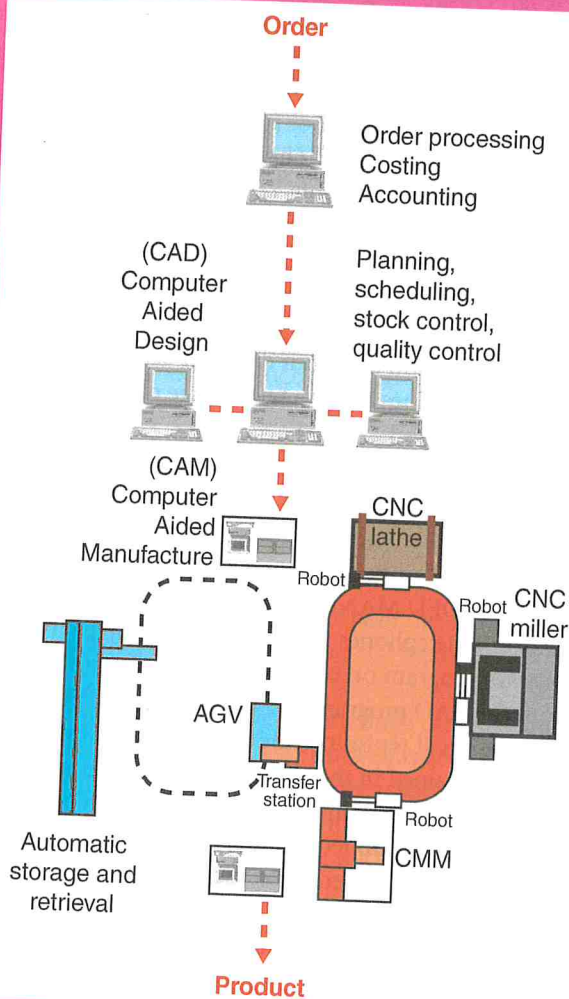
instructions, controlled by a computer. An example might be a CNC milling machine which is used to cut out a mould of a mouse in plastic. The computer controls the cutting to produce the shape of a mould. In the textile industry computer controlled sewing, cutting and printing machines are used. Some CNC machines make use of probes and **coordinate measuring machines** (CMMs). These are designed to make simple or complex measurements, check batches or components one at a time and inspect geometric or irregular shapes. CMMs are accurate to within a few microns. CNC machines can produce shapes and cut quickly and accurately. They can also carry out repetitive tasks without human error. The instructions can be changed easily to carry out different tasks. For example, JCB uses CNC machines to cut a wide range of patterns from metal plates for its mechanical diggers.

Computer aided manufacture In many factories computers are used to design products and the information is then fed into CNC machines. This automated operation is known as COMPUTER AIDED MANUFACTURE (CAM). For example, a manufacturer of telephones may design a new shape using a CAD software program on computer. The instructions may be taken from the CAD program and inputted into CNC machines. These machines will reproduce the shapes, guided by the information contained in the computer. Other examples of CAM include computer controlled manufacture of plastic bricks at Lego, computer controlled assembly lines at Sony and computer controlled temperatures, flow rates and ingredients for pizza production at McCain Foods. The computer controlled weaving system produced by Bonas stores designs on computer in one part of a factory and sends production information to looms in other parts of the factory. These then weave the designed fabric.

Computer integrated manufacture Some businesses have integrated the entire design and production process. Computers are used to guide and control the production of a good. Employees supervise the manufacturing part of the operation, checking that it is working effectively and repairing faults. This system is known as COMPUTER INTEGRATED MANUFACTURE (CIM). There is a number of stages in the operation. They are shown in Figure 1.

- Orders are received via email, fax or letter and inputted into the system. Costings are carried out on computer using spreadsheet programs. Customers are stored on databases. Accounts are kept on computer and regularly updated. Orders which are received are processed and invoiced at a later date.
- The design department uses CAD packages to design the product for a client, making changes on computer. The instructions to manufacture the design are produced and fed through to the production part of the system.
- Production is planned and scheduled. Parts and materials are ordered as required by the computer, which monitors

Figure 1: Computer integrated manufacture



- stock and automatically reorders where necessary.
- The instructions for production are passed to CNC machines which manufacture the product. CMM machines monitor the quality of the work.
- Robots are used to transfer products from one CNC machine to another.
- Automatically guided vehicles (AGVs) take components to the machines.
- Finished products are taken to the stores or sent for dispatch.

Type of technology in tertiary industry

The supply of services has in the past been relatively more labour intensive than in the primary and secondary sectors. This is because supplying services often requires direct and personal contact with customers. However, today the use of technology in the tertiary industry is becoming more widespread in a number of areas.

Government and private services There is a range of services provided by government or private alternatives. New technology

used in health care and dental care has improved services considerably. Developments in new vaccines and drugs have reduced suffering and cured diseases that not long ago may have led to deaths. Surgeons can carry out exact operations using lasers, viewing them on television screens with the use of fibre optics. Replacement teeth can be produced for patients which exactly fit jaw shapes from materials which will last for years. Government information can now be found easily on the Internet.

Financial services Businesses selling financial services match customers with appropriate financial products. For example, client information can be fed into a computer to identify the most suitable insurance policy or savings plan. The sale of financial products such as ISAs, pensions and insurance policies is increasingly carried out on the Internet. Some banks offer online banking services. Many financial organisations now have cash dispensers outside their premises. These can be used by customers who want to take out cash with a minimum of fuss or out of normal working hours. Some banks have cash dispensers inside, and customers can enter the bank in non-business hours using 'swipe cards' to open doors. This gives extra security to customers using the facilities.

Distribution The introduction of containers has made the handling of freight quick and easy. They can be hauled onto trailers and locked in position. This prevents movement during transport and possible damage and theft. At port or rail terminals, containers can be loaded safely and quickly onto trains or ships using cranes. Refrigerated containers allow perishable goods to be transported long distances without deteriorating.

Personal services Dating agencies use computers to match couples using personal information held on databases about clients' characteristics and preferences. Agencies also make use of video technology to record messages from clients. Online dating agencies allow people to register on the Internet.

Post and communication Technology has helped to improve the speed and efficiency of postal and packaging delivery. Many businesses have franking machines that weigh and record the required postage. Bar codes allow a free postal or business service to be provided by firms. A customer can return a leaflet or envelope without charge to a business. Machines at the post office will read the bar code and bill the business providing the service. Post offices make use of video and television to advertise their services.

Most business now make extensive use of email to communicate. Emails can also have attachments. These can be documents that have been scanned or saved as jpeg files. This means that the post does not have to be used, preventing delays in communication.

Hotels, restaurants and transport In the travel industry

technology allows customers to travel without a ticket. They can book a flight over the telephone or the Internet using a credit card. The same card is then used to pick up a boarding pass from an airport machine or a check-in counter. Travellers to Australia can obtain an 'electronic visa'. Entry can be organised by giving passport details to a travel agent. These details are sent electronically to the appropriate port of entry. Booking for hotels or theatre tickets can also be made by credit card. Meals at restaurants can be paid for by a 'swipe or switch' card. The transaction is recorded by a machine and the money is automatically transferred from the current account of the customer.

Advertising In advertising, television makes increasing use of advances in filming technology and special effects to make adverts more sophisticated and entertaining. There is also a growing selection of advertising media. For example, advertisers have used electronic messaging on the 'touchlines' of sporting events and in city centres on the sides of buildings. The Internet provides worldwide advertising, but only to Internet users.

Retailing Retailing has benefited in many ways from new technology.

- The packaging of goods has changed greatly in recent years. New materials such as polystyrene and strong plastic wrap have improved the way in which goods are packaged. The materials have been lighter and stronger, have provided better protection, and have been easier to handle. Many firms have redesigned the packaging of goods to increase sales. In some cases new technology has helped. For example, Lucozade and other soft drinks have been packaged in flexible bags instead of cans and bottles.
- There has been a growth in home shopping. Computers and televisions have been linked together to enable shoppers to browse at home and then place orders by telephone or through a link. The Internet is a growing means of direct selling to customers at home.
- Payment has been made easier. Bar codes and hand-held recorders allow customers to register the prices of goods as they shop. This saves time and queues at the checkout. Goods can be paid for by credit or 'swipe cards', increasing security as the customer does not have to carry cash.
- Some supermarkets have unstaffed checkouts where customers can scan their own shopping and choose from a variety of payment methods.

Information and communication technology

INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) is the recording and use of information by electronic means. Some of the uses of **information technology (IT)** have already been explained in the previous sections. However, there are some common uses of ICT which may apply to businesses operating in primary, secondary or tertiary industries.

Administration Many routine tasks can be carried out quickly

Question 2.

Coilcolor is one of the largest independent paint coating lines in the UK, specialising in organic coating of steel and aluminium coils. It offers a wide range of protective finishes and colours to suit its customer's requirements. The company has the ability to produce both extremely low and high volume quantities, a wide choice of colours and short lead times. Among their prestigious clients are B&Q, Ikea and Jaguar.

The original stock control and sales processing system was implemented in 1992. Since then Coilcolor's business model has undergone substantial changes. The original system, with its ageing technology base, no longer serviced the demands of this highly competitive industry. Consequently the company had to invest in an upgrade. A company called Computerisation developed two highly sophisticated, bespoke systems for Coilcolor – a Sales Order Processing System and a Stock Control System. The new systems efficiently manage Coilcolor's complex product portfolio. This consists of many product variables including stock code, material, colour etc.

The new systems were created to work alongside Sage MMS, a computerised accounts system. This has reduced administration time and costs by avoiding the need for multiple data entry. Coilcolor has achieved a sustainable competitive advantage through its quick turnaround times within the intensive manufacturing process. Improved administration has enhanced that advantage which was made possible by the implementation of Computerisation's systems. From a customer service aspect its new systems provide the company with the ability to monitor stock efficiently, satisfying customer demand with low minimum order quantities.

Source: adapted from www.computerisation.co.uk.

- Explain how Coilcolor makes use of computers in its operations.
- What benefits has Coilcolor enjoyed as a result of using computers?

by computer. These may include customer invoicing or billing. Standard letters or memos may be produced which can be easily changed if necessary. Large amounts of information about customers may be stored on databases.

Personnel Personnel files are now easily kept on databases. They can be regularly updated. Spreadsheets also allow calculations of salaries and deductions.

R&D Computer aided design can be used to research new materials or new product ideas. For example, tests may be carried out on the endurance of materials using a CAD simulation. Recording, monitoring, regulating, forecasting and analysing data are all tasks that can be carried out more easily.

Finance Many firms record all financial transactions on spreadsheets. Some allow instant production of financial information such as profit and loss accounts or income statements, cash flow forecasts, budgets and financial ratios. It is

also possible to make checks on outstanding payments that are due from customers so that credit control will be effective.

Communications Developments in information and communications technology mean that information can be collected, stored and sent electronically in a fraction of a second. This saves money and makes sure information is passed correctly. Mobile telephones, faxes and email mean that people can work from a variety of locations. Information can be sent over great distances and at any time. The Internet provides wide ranging communication opportunities, including promotion, online buying and emailing.

Production information Information may be stored about the terms of suppliers. Production costs may be calculated on spreadsheets. The ordering of stocks or components may be carried out by computer. Purchasing may be undertaken using eSourcing, where the whole purchasing process is handled by online purchasing systems.

Stock control Technology is increasingly used to control stock. For example, retailers such as supermarket chains have a very sophisticated stock control system called EPOS (electronic point of sale). The system holds a record of every single stock item in the store. When a customer passes through the checkout every item purchased is subtracted automatically from the stock list. At any time a manager can enter the system to see how much of an item is left in stock. The system may even reorder stock automatically. Businesses may also have systems to reorder stocks online from suppliers, perhaps using intranets or extranets.

Information and sales Many businesses now have their own website on the Internet, providing company information. Some are using sites to provide information or to sell products to customers. A readers' survey by Marketing Technique about use of the Internet by businesses found 75 per cent of respondents worked for companies with their own site. Two-thirds of respondents used the Internet to monitor competitors' activities.

Benefits of new technology

There is a number of benefits to business of using new technology.

Reducing costs One of the main benefits of new technology to businesses is lower costs. If a task or activity is automated, people are replaced by machines which can operate more cheaply. For example, the cost to banks of dispensing cash has fallen considerably since ATMs were introduced.

Improving quality The quality of products is often improved when new technologies are introduced. This is because machines are usually more precise and consistent than humans. For example, robotic welders in car factories can maintain a consistent and high quality weld indefinitely once they have been programmed. This will help to improve the quality of the car.

Increased productivity More can be produced with less and, as a result, businesses may gain higher profits. In addition, fewer of the environment's resources may be used up.

Reducing waste Introducing new technology often results in time being saved and fewer materials being used. For example, technology has created printing machines which waste less paper when printing books or magazines. The ways in which resources are used have attracted a great deal of attention in recent years. As the world's population continues to grow it will be necessary to improve resource use even further.

Improving the working environment Statistics on accidents at work show that the working environment is safer as a result of new technology. Mining and manufacturing in particular have benefited. Modern equipment has made work easier and more tolerable. For example, fork lift trucks mean workers no longer need to load goods by hand. These improvements also help to remove workers' dissatisfaction.

Benefits to society Many new products have come onto the market in recent years. Personal stereo systems, video recorders, satellite and digital television, high performance cars and microwave ovens are some examples. New products mean wider consumer choice and possibly higher living standards. Other developments have helped to make our lives easier, such as ATMs, online shopping and mobile telephones.

Improvements in communications Faster means of transport (such as the jet aircraft), answerphones, email, computer network links and fax machines are all examples of inventions which have helped to improve the speed of communications.

Higher incomes If firms enjoy greater profits they can afford to pay higher dividends to shareholders and higher wages to employees. Also, if efficiency is improved then products may be sold at lower prices. As the country's income increases the government collects more tax revenue. This could be used to improve the quality of public services or alternatively to reduce the overall level of taxation or government borrowing.

Problems with new technology

The introduction of new technology can also cause problems for both business and society.

Cost Development, installation and maintenance can often prove costly. Also, businesses may have to lay off and retrain staff, leading to redundancy payments and retraining costs. If firms borrow to meet these costs, they will have to pay interest. Reorganisation may also be needed. Production may be changed from batch to flow production, job descriptions may be changed and in some cases a larger or smaller plant may be needed.

Labour relations In the past, trade unions have resisted the introduction of some new technology because of the threat to

Using technology in operations

their members' jobs. The growth of union and business partnerships after the year 2000 may have made the introduction of new technology easier.

Job skills New technology creates jobs which require new, technical skills, but replace manual jobs. These new jobs cannot be done by the existing workforce unless it can be retrained. Often, this is not possible.

Breakdowns Automated production lines are interdependent. If one part of the line breaks down the whole process may stop. There may also be teething problems. Breakdowns often occur when technology is first installed. For example, it is argued that the Stock Exchange Automatic Quotation (SEAQ) share dealing system was partially to blame for the 1987 Stock Exchange crash. The system automatically triggered selling instructions, causing big falls in some share prices.

Motivation Some staff may dislike working only with machines. This may affect their motivation.

Management The management of technological change is considered very difficult. One reason is due to the rapid pace of the change. When new technology becomes available business managers have to decide whether or not to purchase it, or wait for the next important breakthrough. Deciding when to invest in new technology is very difficult. The management of the human resources leading up to the change, and during the change, requires great skill. People are often unhappy about change in their lives.

Unemployment and employment Much new technology is labour saving. Tasks once carried out by people will be done by machines. As a result people may become unemployed. For example, in automated production lines tasks such as assembly and quality checks are done by robots and CMMs. One or two employees may act as supervisors. On the other hand technology has to be designed, manufactured, installed, programmed, operated, serviced and replaced, which may create new jobs.

IT problems Computer software can become infected by viruses. A computer virus is a programme written to deliberately damage or destroy software and files. Such viruses are very damaging. It is possible for businesses to use software to check the existence of viruses. They can then be blocked from entering the computer system if included on emails, for example. If a virus has entered the system, it can be removed. Computer software has other problems which can affect a business. They may have to constantly buy the latest software to be compatible with clients or suppliers who use more modern versions. Modern machines may not run older software. New software may not be able to convert older programs.

Leisure time People have gained more leisure time as a result of new technology. They need to learn how to use this extra time in

KEY TERMS

Computer aided design – the use of computers when designing products.

Computer aided manufacture – the use of computers in the manufacture of products.

Computer numerically controlled machines – machines which have their operations controlled by a computer program.

Computer integrated manufacture – the use of computers to control the entire production process.

Information and communication technology – the recording and use of information by electronic means.

Technology – a creative process which uses human, scientific and material resources to solve problems and improve efficiency.

KNOWLEDGE

1. What is meant by technology?
2. What is the difference between invention and innovation?
3. State four areas of a business that might benefit from new technology.
4. How has new technology been used in marketing?
5. How might a business exporting products abroad make use of new technology?
6. How has information technology been incorporated in production?
7. How has business security used information technology?
8. Why was the Data Protection Act introduced?
9. In what ways has new technology benefited (a) business owners; (b) management?
10. Briefly explain problems that (a) workers and (b) management may face with the introduction of new technology.
11. How might business exploit the Internet?

a constructive way. Businesses are taking advantage of this. For example, it is argued that there is enough demand in the UK for many more golf courses.

An ageing population Medicine has benefited greatly from new technology. One effect of this is that the population of many countries is now 'ageing'. As a result the pressure has increased on those in work to support the aged. Demands on public funds will also increase and the government will have to find money for facilities which are needed for the elderly.

Data protection

The rapid development in the use of IT has led to legislation about the collection, storage, processing and distribution of data. **The Data Protection Act 1998** includes eight conditions with which users must comply.

- Personal data should be obtained and processed fairly and lawfully.

- Personal data can only be held for specified and lawful purposes.
- Personal data cannot be used or disclosed in any manner which is incompatible with the purpose for which it is held.
- The amount of data held should be adequate, relevant and not excessive.
- Personal data should be accurate and kept up-to-date.
- Personal data should not be kept for longer than is necessary.
- An individual shall be entitled to:
 - (a) be informed by any data user if he or she is the subject of personal data and also have access to that data;
 - (b) where appropriate, have data corrected or erased.
- Security measures must be taken by data users to prevent unlawful access, alteration, disclosure, destruction, or loss of personal data.

The **1990 Computer Misuse Act** identified certain offences relating to use of computers.

- A person causing a computer to perform a function with intent to secure access.
- Unauthorised access to a computer with the intent to commit a further offence.
- Unauthorised and intentional modification of computer memory or storage media.

An offence is committed if access is unauthorised or if the person knows it is unauthorised. Many codes of practice state that employees may only access information held on a computer which is a relevant part of their work.

There is some legislation regarding the use of the Internet. EU legislation prevents the downloading of copyright music and allows businesses to block downloading, for example. EU legislation in 2003 made it illegal to send junk e-mail, known as spam, by businesses to individuals.

Case Study: Minco Manufacturing

Minco Manufacturing is an American company. It produces over 250,000 fuser rollers a month for more than 400 models of copiers, printers and facsimile machines at its state-of-the-art production plant in Colorado. Its products include sleeved, silicone and hard coated upper fuser rollers, and silicone coated lower pressure rollers.

As a result of adopting 16 new Stäubli robots in its production cells the company has improved product quality and reduced costs. The robots are used for a variety of tasks such as operating lathes. Robots keep labour costs down, allowing Minco to compete internationally. 'By using robots and reducing labour costs, we can compete with companies that make parts in China, for example,' said Brian Duff, manufacturing engineer. 'We are able to keep the work in the United States and still be competitive with the cheaper labour rates in Asian countries.'

'Once the robots have been programmed they just run. ... That frees up the operator to do inspections and move parts in and out of the cell, instead of having all these people loading lathes for 10 to 12 hours a shift,' Duff said. Stäubli robots are known for high-speed performance, and this speed also generated savings. Before the robots were installed, this process required an additional finish turning lathe. We had an operator manually feeding two lathes to work the ends and then feeding a third lathe to do the finish turn work. The finish turning machine was actually capable of twice the production that was possible by hand,' Duff explained. 'With three robotic cells currently running, we've saved three lathes that we can transfer into making another cell.'

They've also saved about 50 per cent more floor space. 'It allows us to design extremely compact work cells,' Duff said.

The quantity of fuser rollers produced and the level of quality

needed, demanded repeatability as well as speed. 'Repeatability is key to the robot's performance in this application because of how we are locating the part into the draw tube. If we didn't place the part against the stop very accurately then we would have too much fluctuation and we could not control the quality of the roller,' Duff said. 'We need to meet a length accuracy of less than .005 of an inch, but we're not seeing even that much variation. We're seeing .002 or less.'

After the initial 16 robots are installed, Minco's plan is to integrate robots into other processes that could benefit from automation. Then the company will start replacing their older robots. 'We've talked to Stäubli about adding robots to load the initial paint station. It is very labour-intensive, because every roller we make gets painted. Rollers weigh up to eight pounds so it is exhausting work. We get a lot of operator fatigue and production begins to drop,' he said.

Minco Manufacturing is also considering installing robots to unload rollers off a conveyor after the coating has cured. 'This is very labour intensive, but also has to be done very carefully. At this stage the rollers cannot get nicked or scratched,' Duff said. Robots are also ideally suited for Minco's packaging process.

Source: adapted from www.roboticonline.com.

- (a) Explain how robots are used in operations. (6 marks)
- (b) Explain why the introduction of robots is an example of automation. (6 marks)
- (c) How will workers benefit from the introduction of more robots? (6 marks)
- (d) Discuss the benefits enjoyed by Minco Manufacturing as a result of employing more robots. (10 marks)
- (e) Discuss the problems Minco Manufacturing could encounter when making more use of robots. (12 marks)