Automation of Technological Processes

Module 1 COMPUTERS

KEY VOCABULARY

Exercise 1. Read and guess the meanings of the new words.
1. *to embed.* Computers have deeply embedded in our lives.
2. *analog computer, digital computer.* We can speak about analog computers and digital computers.
3. *to measure a quantity.* Analog computers worked with physical quantities, such as weight, speed, temperature. They solve problems by measuring a quantity in terms of another quantity.
4. *to deal with numbers.* Digital computers deal with numbers.
5. *at the appropriate time.* A memory unit stores information and makes it available at the appropriate time.
6. *random-access memory (RAM), read-only memory (ROM).*The memory consists of the two main parts called the primary memory — RAM and the secondary memory — ROM.
7. *to perform calculations.* An arithmetic-logical unit performs calculations.
8. *processing unit.* The term "computer" refers to the central processing unit (CPU).
9. *to issue commands.* The central processing unit issues commands to other parts of the system.
10. *to be termed.* An input/output unit is collectively termed I/O.
11. *to insert, to remove.* An input/output unit inserts data into a machine and removes data from it.
12. *hardware.* The visible units are physical components of a data processing system, or hardware.
13. *to house the motherboard.* The case or chassis houses the motherboard.
14. *systems software, application software.* Software programmes are of two types: system software and application software.
15. *indispensable, irreplaceable.* Computers have become indispensable and irreplaceable in many spheres of our life.

Exercise 2. Read the words following the rules of reading. Pronounce correctly.
Computer, control, impossible, processing, command; performing, information, storage, formulae; system, keyboard, youth; about, application, called, parts; instructions, unit, further, put, function; issuing, precisely, item; feed, need, keep, speed; society, scientific; means, greater, widespread, read (read, read), measure, increasing; obtain, main; arithmetic, together, motherboard.

Exercise 3. Look at the following pairs of words and think if the underlined letters are pronounced in the same way, or if they are pronounced differently. Read aloud.
Amount — mouse; but — business; appropriate — intermediate; since — science; device — final; system — by; all — actions; machine — semiconductor; circuit — third; further — adjustment; media — voicemail.

Exercise 4. Read the international words, mind the stress.
Modern, manual, computer, idea, calculate, mathematician, automatic, control, progress, electronics, commercial, terminal, instruction, winchester, disc, result, component, industry, business, scanner, service, voicemail, machine, automatic, system, analog, communication, operation, primitive, data.

Exercise 5. Analyse the following words with different suffixes and divide them into two groups — nouns and adjectives, think of possible verbs:
specialist, general, important, memory, advantage, regular, digital, calculation, available, additional, electronic, visible, processor, communication, basic, numerical, information, computation, initial, likeness, performance, visual, magnetic, arithmetic, general, logical, storage, solution, environment, scanner, adaptable, printer;

Exercise 6. Divide the following words into two groups, those which describe a) computer systems; b) functional units of the computer.

Analog, input/output devices, control unit, measurement, application software, digital, software, arithmetic-logical unit, programmes, system programmes, memory, pocket computer, notebook, central processing unit.

Exercise 7. Think over the definitions of the words and
  a) agree or disagree with the following definitions

Computer is a programmable machine that can store, retrieve, and process data.

Memory is a physical device to store such information as data or programmes on a temporary or permanent basis.

Hardware is mechanical and electronic parts that constitute a computer system, as distinguished from the computer programmes that drive the system.

CPU (central processing unit) is a principal part of any digital computer system, generally composed of the main memory, a control unit and an arithmetic-logical unit.

Data processing is manipulation of data by a computer.
  b) match each word with its correct definition

character, data, to feed, random, to house

1. Information given in the form of characters.
2. A written language symbol.
3. To place, to locate something.
4. To insert information into the computer.
5. Chosen or happening without any particular method, pattern or purpose.

EXPLORING GRAMMAR

Exercise 8. Read the sentences, point out Participle I and Participle II. Give the Russian equivalents.

1. When entering the Internet, I always find the required information. 2. If compared with the analog computer, digital computers have other functions. 3. When used, voltage represents other physical quantities in analog computers. 4. While dealing with discrete quantities, digital computers count rather than measure. 5. At the moment our computer systems are inputting, storing, processing, controlling, and outputting data. 6. Combined capabilities of both analog and digital computers belong to hybrid computers. 7. Having finished the research, they analysed the data obtained. 8. Having translated the programme into the machine language, he put it into a computer. 9. Having been well prepared for the test, postgraduates managed to answer all the questions the tutor asked them. 10. When entering data correctly into the computer system, they avoid the need for further adjustments by a person.

Exercise 9. Make up your own sentences according to the models.
  Model A: *When properly programmed, computers don't err.*
    Having been properly programmed, computers don't err.

1. When well regulated, the equipment operates well. 2. When documents correctly filled in, they don't need extra checks. 3. When loaded, the numbers are stored on the platforms of storage. 4. When loaded with cargo, cars can move between stations. 5. When moved, the ball located on the bottom side of the mouse turns rollers.

  Model B: *A smartphone is a mobile phone that offers a more advanced computing ability.*
    A smartphone is a mobile phone offering a more advanced computing ability.

1. A smartbook is a concept of a mobile device that falls between smart- phones and netbooks. 2. A smartbook is a gadget that delivers features found in smartphones. 3. BlackBerry is a line of mobile e-mail that functions as a Personal Digital Assistant (PDA). 4. Twitter is a social and micro blogging service that enables users to send and read other users' messages called tweets. 5. An

iPhone is a camera phone that includes text messages, visual voicemail, a portable media player, and web browsing facilities.

READING

*Exercise 10. Read the text, try to focus on its essential facts and choose the most suitable heading given below for each paragraph.*

1) Hardware
2) CPU
3) Software
4) The Functional Units of the Computer
5) Input/Output Devices
6) Memory

COMPUTER LITERACY

A computer is one of the most important items society possesses today. Computers have deeply imbedded in our lives, so we can hardly imagine our life without them. But what is a computer? What are the main parts of this gadget? Let's try to sort it out. As we know, all computer systems perform functions of inputting, storing, processing, controlling, and outputting. So, there should be units performing these functions. The functional units of a digital computer are:

— storage or memory — to store information and make it available at the appropriate time;
— arithmetic-logical unit (ALU) — to perform the calculations;
— control unit (CU) — to control and coordinate data movements within the central processing unit (CPU), between the CPU and the other components of the computer system;
— input/output unit (collectively termed I/O) — to insert data into a machine or to remove them from it for further consideration.
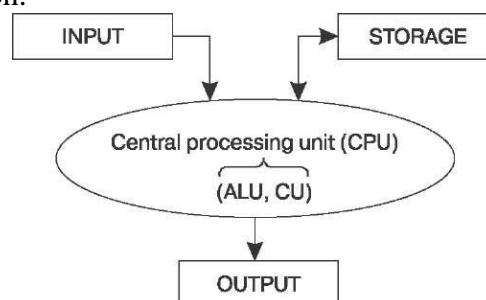
Functional units of a computer

Speaking more precisely, "computer" refers to the central processing unit together with the internal memory. The CU and ALU are collectively known as CPU. The CPU coordinates all the actions performed by various components of the computer, by issuing commands to other parts of the system and by acting on responses.

The memory, one of the basic components, is often called storage. It stores calculation programmes, calculation formulae, initial data, intermediate and final results. Generally, memory consists of two main parts called the primary, or internal memory (RAM), and the secondary, or external memory (ROM). The advantage of the primary memory is an extremely high speed. The secondary memory in its turn has a comparatively low speed, but it can store a far greater amount of information than the primary memory.

Now if we look at the computer, what can we see? The case, or chassis, houses the following units: motherboard holding the CPU and physically connecting all the other main parts of the computer; HDD (hard disc drive, commonly called "winchester" in the youth slang); and a power supply unit. The visible units are physical components of a data processing system, or hardware.

Not visible is the software. Software programmes are of two types: system software and application software. System software is the programmes designed to control the operation of a

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computer system. They do not solve specific problems. Application software is the programmes written to solve specific tasks.

Output devices rendering information in the form of words, sounds, and pictures are a monitor, printers, speakers, etc. Input devices, enabling information to pass into a computer are a keyboard, a mouse, scanners, digital cameras, sound cards, etc.

Exercise 11. Agree or disagree with the following statements.
1. Computers have deeply embedded into our lives. 2. All computers perform functions of inputting, storing and controlling. 3. The functional units are storage, a control unit, and input/output. 4. The memory is often called storage. 5. The visible units are hardware, whereas invisible ones are software.

KEY VOCABULARY DEVELOPMENT

Exercise 12. Match the adjectives in column A with the nouns in column B to form meaningful phrases.

1) appropriate	a) speed
2) functional	b) results
3) digital	c) units
4) internal	d) time
5) initial	e) information
6) high	f) tasks
7) specific	g) memory
8) intermediate	h) computer
9) available	i) components
10) various	j) data

Exercise 13. Decide which of the verbs on the left collocate with the nouns on the right

1) to control	a) problems
2) to solve	b) operations
3) to insert into	c) parts
4) to imagine	d) information
5) to connect	e) data
6) to remove	f) calculations
7) to perform	g) units
8) to house	h) life
9) to store	i) machine
10) to issue	j) commands

Exercise 14. Complete the sentences: change the word in capitals at the end of each sentence to form a word that fits suitably in the blank space.
1. A ... computer deals with numbers DIGIT.
2. An input unit inserts data into a machine for further ... CONSIDER.
3. A computer has several ... units FUNCTION.
4. The secondary memory has a ... low speed COMPARE.
5. The secondary memory can store a far ... amount of information GREAT.

Exercise 16. Insert the words at the sentence level: fill in the blanks with the missing words (the first letter of each word is given).

1. The memory, one of the basic components, is also called s... . 2. M... stores programmes and formulae. 3. The C... coordinates all functions of the computer. 4. The memory consists of RAM and R... . 5. The C... and ALU are known as the CPU. 6. Memory makes information available at a time. 7. The ALU performs c… . 8. The CPU i…. commands to other parts of the system. 9. RAM is an i…. memory. 10. ROM is an e... memory.

GRAMMAR DEVELOPMENT

Exercise 17. Point out in the text the sentences with the Participle I and Participle II and provide the Russian equivalents.

Exercise 18. Fill in the blanks to streamline the use of the Participle I and Participle II.
1. A computer is ... numbers and orders into memory (to insert). 2. An electronic digital computer is a system …. and …. a very large amount of data (to process, to store). 3. The computer is a system ... numerical computations (to perform). 4. The computer is a device …. instructions with extreme speed (to follow). 5. The numbers and the instructions are . in the computer memory (to store). 6. The arithmetic-logical unit is a device …. circuits …. the arithmetic computations (to contain, to perform). 7. The codes …. by computer designers are ... on number of systems (to use, to base). 8. Having been coded the instruction … . to the central processing unit (to be transmitted). 9. ... the functions of storage units, we controlled the processing unit (to discuss). 10. ... to the CPU, the instructions made an arithmetic-logical unit perform some operations (to deliver).

Exercise 19. Make up sentences according to the models to practise the use of the verbals.
   Model A: Вам следовало бы прочитать об удивительных свойствах компьютера раньше.
   You should have read about wonderful features of computers earlier.
1. Вам следовало бы заказать эти устройства раньше. 2. Ему следовало бы ввести данные в запоминающее устройство раньше. 3. Вам следовало бы раньше рассмотреть эту систему как крупномасштабную цифровую систему. 4. Вам следовало бы знать об этом устройстве раньше. 5. Вам следовало бы выполнить вычисления раньше.
   Model B: Для того чтобы выполнять тысячи вычислительных действий в минуту, были разработаны компьютеры. *To perform thousands of computations per second computers were designed.*
1. Использовались транзисторы для того, чтобы сделать компьютеры более надежными. 2. Для того чтобы сократить время для вычисления, были применены эти устройства. 3. Аналитический двигатель был изобретен для того, чтобы хранить данные. 4. Для того чтобы интегрировать большое количество элементов электронной цепи в маленький чип, транзисторы были уменьшены в размерах. 5. Прикладное программное обеспечение используется для того, чтобы разрешить специальные проблемы, связанные с обработкой различных данных.

SPEAKING

Exercise 20. Share your vision of computers using the following phrases: to my mind, in my opinion, if I am not mistaken, as far as I remember, it seems to me, etc.
   1. What is a computer?
   2. What types of computers do you know?
   3. What are the main functional units of the computer?
   4. What is storage? What storage units are you familiar with?
   5. Do you happen to know anything about the CPU? If yes, list its constituent parts.
   6. How can you input and output information? What devices can be used?
   7. What are the specific features of hardware and software?
   8. What can you say about application of computers?
   9. What manual predecessors of computers do you know?
   10. Who built the first analog and electronics computers? When?

Exercise 21. Make up general and disjunctive questions, and answer them according to the models to enhance your speaking skills.

   Model A: *Computers have circuits to perform arithmetic operations.*
   Do computers have circuits to perform arithmetic operations? — Yes, they do.
   Computers have circuits to perform arithmetic operations, don't they? — Yes, they do.

1. Computers have devices to accept information in the form of instructions. 2. They have programmes to provide information needed to solve the problem. 3. Computers have devices to feed information in and get results back. 4. Computers have circuits to make thousands of logical decisions without becoming tired. 5. Computers have devices to print the information.

   Model B: *The device had means of coding.*
   Did the device have means of coding? — Yes, it did.
   The device had means of coding, didn't it? — Yes, it did.

1. It had a binary code storing data and instructions. 2. It had devices of printing information. 3. It had some transistors. 4. That device had a vacuum tube. 5. It had capacitors for storage.

Exercise 23. Make up special questions according to the models, and answer them to streamline your speaking skills.

   Model C: *That garget was used as the base for the first computer.*
   What was used as the base for the first computer?

1. The electronic device was invented in the 20th century. 2. The first vacuum-tube computer was built at that time. 3. The first vacuum-tube computer was referred to as the first-generation computer. 4. A transistor was used in the second-generation computer. 5. An integrated circuit was used in computers of the third generation.

   Model B: *Computers can process information.*
   What can computers process?

1. Computers can accept information in the form of instructions. 2. Computers can perform mathematical and logical operations. 3. The programme can tell the computers what to do. 4. The programme can also provide the information needed to solve the problem. 5. Computers can keep instructions in their memory.

Exercise 22. Ask questions and use the words in italics in your answers.

1. *Electronic computers* are comparatively *modern* invention (what, what kind of). 2. *J.Napier* devised a *mechanical* way to multiply and divide (who, what kind of). 3. *Most computers* have *circuits* for performing arithmetic operations (what, what). 4. *Integrated circuit technology* was used in computers of the third generation (what kind of, what). 5. *Computers* can solve *a series of problems* and make thousands of *logical* decisions (what, how many, what kind of).

Exercise 23. Read the following dialogue, sum up the information and act out a similar dialogue.
COMPUTERS

A. : They say you have bought a computer.
B. : Yes, now I have got my own computer.
A. : That's fine. And what type of a computer have you got?
B. : The most common type, a digital one.
A. : By the way, do you know what "a digital computer" means?
B. : It goes without saying. Digital computers deal with numbers. All data — pictures, sounds, symbols, and words — are translated into numbers inside the computer.
A. : Yes, you are right. Digital computers are so widespread that the word "computer" almost always refers to a digital computer. But there are 3 types of computers: digital, analog and hybrid.

B. : I do know about it. Analog computers work with a physical quantity, such as weight, speed, temperature. They solve problems by measuring a quantity in terms of another quantity. Do you understand what I mean?

A. :Yes, certainly, for example, they measure temperature in terms of the length of a thin line of liquid in a thermometer.

B. : Good for you. And when are you going to buy a computer? You know so much about the computers.

A. : You see, I haven't got such a large amount of money.

B. : Take it easy. You may use my computer.

A: Thanks a lot.

B: You are welcome.

WRITING

Exercise 24. Complete the following sentences in a logical way.

1. Computers perform functions of inputting, storing, processing, ...
2. The functional units of the computer are storage or memory, central processing unit, … .
3. Central processing unit coordinates all the actions performed by. .
4. The function of the storage, or memory, is to store information and make it available at … .
5. Memory consists of two main parts: … .
6. An arithmetic-logical unit performs … .
7. Control unit controls and coordinates data movements within … .
8. The visible units of a data processing system are called … .
9. Software programmes are of two types: … .
10. The functions of input-output devices are to insert data into a machine and … .

Exercise 25. Translate the following sentences from Russian into English.

1. Для того чтобы компьютер мог обработать информацию, её необходимо ввести, затем её необходимо обработать и показать результаты этой обработки. 2. Значит, компьютер должен иметь в своем составе устройства ввода, обработки и вывода информации. 3. Самое главное — системный блок. В системном блоке находятся: материнская плата с установленным на ней процессором, ОЗУ, накопитель на жестких магнитных дисках, блок питания. 4. Процессор, его можно назвать «сердцем машины», устанавливается на «материнской плате» и выполняет все операции с информацией, всю работу с аппаратурой и программами. 5. ПЗУ, составляющая часть материнской платы, предназначена для постоянного хранения информации о составных частях и настройках компьютера. 6. ОЗУ, составляющая часть материнской платы, предназначена для кратковременного хранения информации. 7. На-копитель на жестких магнитных дисках, «жесткий диск», — устройство для долговременного хранения информации. 8. В компьютерной терминологии жёсткий диск, установленный в компьютере, именуется как «фиксированный диск», «жёсткий диск» или «винчестер». 9. Кроме этого, для хранения информации используется дополнительное оборудование — устройство чтения (записи) информации на лазерных дисках (CD ROM, DVD-ROM). 10. Центральный процессор состоит из арифметико-логического устройства и устройства управления. 11. К устройствам ввода информации относят клавиатуру, мышь, сканер, цифровую камеру и др. 12. К устройствам вывода информации относят монитор, принтер и др.

ADDITIONAL READING

Exercise 26. Make a summary of the text using the following phrases:

1. The title of the text is.
2. The text is about. The text deals with…
3. The text covers such points as … first …. second …. third ….
4. It should be underlined that ….

5. In conclusion, I may say that ….
6. To my mind (In my opinion) ….

WHAT IS A COMPUTER?

Electronic computers are a comparatively modern invention, although their manual predecessors go back several centuries. Let us consider briefly the history of computers that nowadays we are familiar with. Long ago J. Napier, a Scotsman, devised a mechanical way to multiply and divide that is known as the slide rule. Later Henry Briggs applied Napier's ideas and developed logarithm tables commonly used today. The mathematicians Pascal and Leibnitz developed some of the first primitive calculating machines. As for the first real calculating machines concerned, they appeared in 18th century. In 1830, Charles Babbage suggested to create a problem-solving device that he called "analytical engine". It is a mechanical device incorporating a punched card input memory, calculating section, automatic output and a series of instructions that could control its operation. His ideas were the basis for building modern computers.

In 1930, the first analog computer was built by an American, Vannevar Bush. Many technical developments and progress in electronics made it possible to build the first electronic computer in the early 1940s. It was called ENIAC (the Electronic Numerical Integrator and Calculator). It was used for military and scientific purposes. By the end of the 1960s, commercial models of these computers were mainly used for both scientific computation and business data processing. Initially those devices got input data supplied by punched cards. At the turn of the 1970s punched cards were replaced by keyboard terminals. Since that time scientific advances have resulted in the proliferation of computers that spotted the entire landscape of the Universe!

It is considered that computers have many remarkable powers. However, most computers, whether large or small, have three basic capabilities. First, computers have circuits for performing arithmetic operations such as: addition, subtraction, division, multiplication, and exponentiation. Second, computers have means of communicating with the user. Third, computers have circuits which can make decisions. They can solve a series of problems and make thousands of logical decisions without becoming tired. A computer can replace people in dull, routine tasks, but it works according to the instructions given to it.

Module 2
FLEXIBLE MANUFACTURING SYSTEMS

KEY VOCABULARY
Exercise 1. Read and guess the meanings of the new words.
1) *flexible manufacturing system (FMS).* FMS is a manufacturing technology.
2) *to incorporate.* FMS incorporates a system view of manufacturing.
3) *to evolve.* The concept of FMSs went on evolving at that time.
4) *to succeed in.* Computerized numerical controls succeeded in bringing a controlled environment to the factory floor.
5) *numerically controlled, direct-numerically-controlled machines.* They managed to control the manufacture using numerically-controlled and direct-numerically-controlled machines.
6) *sophisticated material-handling systems.* Early FMSs contained sophisticated material-handling systems.
7) *incredibly.* Early FMSs were controlled by incredibly complex software.
8) *flexible cell.* The trend in FMS is towards small versions of the traditional FMS called flexible manufacturing cells (FMC).
9) *to introduce a wide scale automation.* The progress of computing machines allowed introducing a wide scale automation of all branches of industry.
10) *independent development.* The progress of computing machines led to independent development of automation process.

11) *computer-aided designing (CAD).* Automated data processing includes automated control systems and computer-aided designing.
12) *computer-aided manufacturing (CAM).* Automation of production technology includes numerically-controlled equipment, computer- aided manufacturing, and industrial robots.
13) *to be interconnected.* The various cells for machining are interconnected by an automated transport system.
14) *loading, unloading stations.* The various machining cells are interconnected via loading or unloading stations by an automated transport system.
15) *possibility.* This prospect of automation and flexibility presents the possibility of producing non-standard parts.
16) *competitive advantage.* They employ different competitive advantages to maintain a lead in this industry.
17) *to approach.* The general objectives of FMS are to approach the efficiencies and economies of mass production.
18) *small- and medium-lot-size production.* FMS maintains the flexibility required for small- and medium-lot-size production of variety of parts.
19) *to fall within.* Two kinds of systems for manufacturing fall within the FMS spectrum.
20) *generic.* A generic FMS consists of some components.
21) *set-up time, change-over.* A set of stations do not require significant set-up time or change-over between successive jobs.
22) *milling, boring, drilling.* These machines perform operations of milling, boring, drilling, etc.
23) *routing.* Computers direct the routing of jobs through the system.
24) *to be capable of.* Computers are capable of performing complex tasks.
25) *to track.* Computers track the status of all jobs in progress.
26) *to ensure.* A network of supervisory computers and microprocessors is to ensure that the right tools are available for the job.
27) *to provide the monitoring.* Computers provide the monitoring of correct performance of operations.
28) *to require attention.* Computers signal problems requiring attention.
29) *to make customizations.* Machines can be used to assemble different parts and to make customizations.
30) *to implement.* Several companies decided to implement flexible manufacturing systems.
31) *agility.* The common word for today's manufacturer is agility.

Exercise 2. Read the words following the rules of reading.
Incorporate, numerically-controlled, system, via, speed, succeed, routine, customer, track, handling, cell, process, incredibly, scale, control, flexible, complex, enhance, machine, change, approach, technology, equipment, nutshell, sophisticated, within, loading, milling, boring, drilling.

Exercise 3. Look at the following pairs of words and think if the underlined letters are pronounced in the same way, or if they are pronounced differently.
Final — machine, cells — control, numerically-controlled — customer, speed — succeed, could — without, human — under, manufacturing — computer, much — produce, incredibly — complex, scale — consider, process — computer.

Exercise 4. Read the international words, mind the stress.
Computer, control, technology, philosophy, concept, system, version, machine, group, product, problem, central, component, operation, result, cooperation, material, final, automation, complex, instruction, signal.

Exercise 5. Try to enrich your vocabulary:
a) *analyse the following words with different suffixes and divide them into two groups — nouns and adjectives:*
numerical, technological, automation, operation, flexibility, possibility, arrangement, conversion, requirement, different, flexible, numerical, environment, expensive, version, traditional, development, industrial, various, famous, production, significant, computer, instruction, station, performance.

Exercise 6. Divide the following words into two groups, those which belong to a) automated data processing; b) automation of production technology.
Computer-aided manufacturing, industrial robots, automated control systems, CAM, computer-aided design, numerically-controlled equipment, CAD.

Exercise 7. Think over the definitions of the words which appear in the texts and dialogues and then:
a) *agree or disagree with the following definitions*
1. *FMS (flexible manufacturing system)* is a manufacturing system in which there is some amount of flexibility that allows the system to react in the case of changes, whether predicted or unpredicted.
2. *CNC (computer numerical control)* is the method of controlling machines by the application of digital electronic computers and circuitry (design or detailed plan for an electric circuit).
3. *Agile manufacturing* is the manufacturing that has created the processes, tools, to respond quickly to customers' needs and market changes while still controlling costs and quality.
4. *Flexible* means able to make changes or to deal with the situation that is changing.
5. *A network* is a set of computers that are connected to each other so that each computer can send and receive information to and from other computers.
b) *match each word with its correct definition*
                    scale, system, manufacture, robot, component
1. A machine that can do work by itself.
2. One of the different parts that a machine or piece of equipment consists of.
3. A set of connected things that work together for a particular purpose.
4. The size of something, especially when it is big.
5. The process of making goods in large quantities in a factory.

EXPLORING GRAMMAR
Exercise 8. Read the sentences, point out the gerund. Give the Russian equivalents.
1. By changing the speed of machining they significantly increased the performance. 2. We apply different technologies for performing two or more functions simultaneously. 3. They have to analyse manufacturing of automobiles. 4. You may use these technologies for maximizing the performance of the machines. 5. We are interested in producing non-standard parts. 6. It is worth installing new machinery. 7. On checking the set of work stations we found the reason of their failure. 8. Providing monitoring of operations we identified the problems requiring special attention. 9. They are thinking of saving huge amounts of money by switching to flexible manufacturing systems. 10. They missed the opportunity of producing low quality products.

Exercise 9. Make up your own sentences according to the models.
Model A:
They designed that model. They did not use the computer.
They designed that model without using the computer.

1. They assembled the car parts. They did not use FMS. 2. They improved the processes. They did not increase the price. 3. They performed different operations. They did not make production more flexible. 4. They controlled the production. They did not apply incredibly complex software. 5. They tried to attach doors to the car. They did not use special equipment.

Model B:
When they introduced wide scale automation, independent automation processes began to develop.
On introducing wide scale automation, independent automation processes began to develop.

1. When we came to the plant, we installed new machinery. 2. When they returned to the workshop, they installed the necessary equipment. 3. When the idea of FMS was proposed, computerized numerical controls succeeded in bringing a controlled environment to the factory floor. 4. When they started to use FMS, they increased the number of units produced per hour. 5. When they completed the manufacturing, they faced many problems.

READING

Exercise 10. Read the text, try to focus on its essential facts and choose the most suitable heading given below for each paragraph.

1) FMS Is an Automated Production System
2) Early FMSs
3) Modern FMSs
4) Generic FMS Components

FLEXIBLE MANUFACTURING SYSTEM

Flexible Manufacturing System (FMS) is famous for being both a manufacturing technology and a philosophy. "System" is the key word for a flexible manufacturing system. FMS incorporates a system view of manufacturing. The FMS idea was proposed in England (1960s) under the name "System 24". It was a flexible machining system that could operate without human operators 24 hours a day but being controlled by a computer.

The concept of flexible manufacturing systems went on evolving at that time when robots, programmable controllers, and computerized numerical controls succeeded in bringing a controlled environment to the factory floor in the form of numerically-controlled and direct-numerically-controlled machines. Early FMSs were large and very complex, consisting of dozens of Computer Numerical Controlled machines (CNC) and sophisticated material-handling systems. They were too expensive and they were controlled by incredibly complex software.

Currently, the trend in FMS is towards small versions of the traditional FMS, called flexible manufacturing cells (FMC). Today two or more CNC machines are considered a flexible cell and two or more cells — a flexible manufacturing system. The progress of computing machines allowed to introduce a wide scale automation of all branches of industry and led to independent development of automation processes:

— Automated Data Processing: the appearance of Automated Control Systems and Computer-Aided Designing (CAD);

— Automation of Production Technology: the appearance of Numerically-Controlled Equipment, Computer-Aided Manufacturing (CAM) and Industrial Robots.
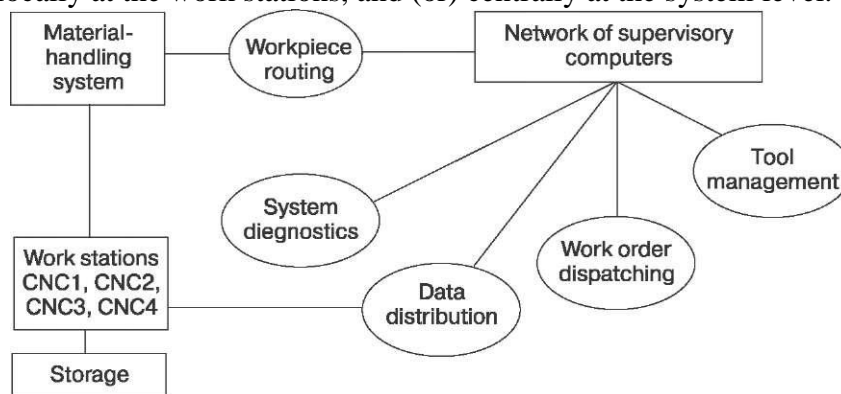
Thus, a flexible manufacturing system is a group of numerically-controlled machine tools, interconnected by a central control system. The various cells for machining are interconnected via loading and unloading stations by an automated transport system. Simply defined, it is an automated production system that produces one or more families of parts in a flexible manner. Today, this prospect of automation and flexibility presents the possibility of producing non-standard parts to create a competitive advantage. Stated formally, the general objectives of FMS are to approach the efficiencies and economies of mass production, and to maintain the flexibility required for small- and medium-lot-size production of a variety of parts. Two kinds of systems for manufacturing fall within the FMS spectrum: assembly systems for assembling components into final products and systems of forming, which actually form components or final products.
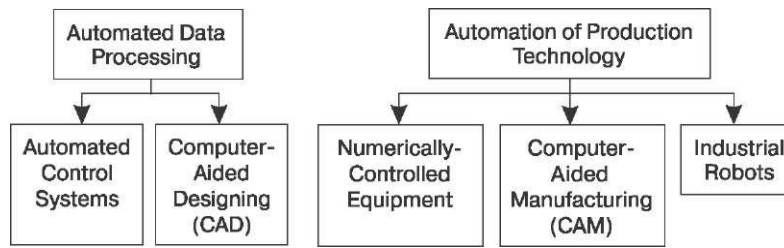
General trends of automation

A generic FMS consists of the following components:

— a set of work stations which contain machine tools that do not require significant set-up time or change-over between successive jobs; typically, these machines perform operations of milling, boring, drilling, etc.;

— a material-handling system allowing to move between any pair of machines so that any job routing can be followed;

— a network of supervisory computers and microprocessors which are capable of performing some or all of the following tasks: directing the routing of jobs through the system; tracking the status of all jobs in progress so it is known where each job is to go next; passing instructions for the processing of the operation to the station; ensuring that the right tools are available for the job; and providing the monitoring of correct performance of operations and signaling problems requiring attention;

— a storage, locally at the work stations, and (or) centrally at the system level.

Generic FMS

Exercise 11. Agree or disagree with the following statements.
1. FMS is both a manufacturing process and a philosophy. 2. Early FMSs were small with several CNC machines. 3. Today two or more CNC machines are thought of being a flexible cell and two or more cells make up a flexible manufacturing system. 4. FMS is a group of numerically-controlled machine tools interconnected by a central control system. 5. The main components of FMS are: a set of workstations with machine tools, a material-handling system, a network of supervisory computers and storage.

KEY VOCABULARY DEVELOPMENT
Exercise 12. Match the words in column A with the words in column B to form meaningful phrases and then identify them at the sentence level in the text.

1) controlled	a) software
2) various	b) system
3) sophisticated	c) scale
4) wide	d) environment
5) flexible	e) controllers
6) programmable	f) robots
7) human	g) controls
8) numerical	h) operator
9) manufacturing	i) technology
10) industrial	j) cells

Exercise 13. Decide which of the verbs on the left collocate with the nouns on the right

1) to incorporate	a) system
2) to propose	b) changes
3) to assemble	c) tools
4) to require	d) functions
5) to perform	e) change-over
6) to interconnect	f) idea
7) to respond to	g) parts
8) to present	h) components
9) to provide	i) environment
10) to produce	j) possibility

Exercise 14. Try to enrich your vocabulary:
a) *find words in the text which have the same meanings as the following words:*
main, to continue, to develop, complex, nowadays, adaptable, information, different, manufacture, purpose, type, to include, to fulfil, through, work, considerable;

b) *find words in the text whose meanings are opposite to the meanings of the following words:*
unknown, indirect, modern, simple, cheap, less, standard, beyond, disadvantage;

c) replace the words in italics with the words with similar meanings:
1. We are to install a set of work stations containing machine tools which do not require *considerable* set-up time or change-over between successive jobs. 2. They were automated, too expensive and controlled by incredibly *complex* software. 3. They *continue* installing the equipment. 4. There are *different* tools in the workshop. 5. The system *includes* some components.

Exercise 15. Complete the sentences: change the word in capitals at the end of each sentence to form a word that fits suitably in the blank space.
1. The general objectives of FMS are to approach the ... and economies of mass production and to maintain the flexibility required for small- and medium-lot-size production of a variety of parts EFFICIENT.
2. It provides essential monitoring of correct ... of operations and signals problems which require attention PERFORM.
3. It led to ... development of automation processes DEPEND.
4. FMS is an automated ... system PRODUCT.
5. It led to the ... of automated control systems APPEAR.

Exercise 16. Insert the words at the sentence level: fill in the blanks with the missing words (the first letter of each word is given).

1. Early FMSs were large and very complex, consisting of dozens of C... N. C. machines (CNC) and s… material-handling systems. 2. A material- handling system is automated and f… . 3. Supervisory computers and microprocessors p... different tasks. 4. FMS i….. a system view of manufacturing. 5. The concept of FMS went on e.... . 6. Computerized numerical controls s... in bringing a controlled environment to the factory floor. 7. Early FMSs were controlled by i... complex software. 8. The progress of computing machines allowed introducing a wide s... automation of all branches of industry. 9. Flexibility presents the p... of producing non-standard parts. 10. Two kinds of systems for manufacturing fall w... the FMS spectrum.

GRAMMAR DEVELOPMENT

Exercise 17. Point out the sentences with the gerund in the text and provide the Russian equivalents.

Exercise 18. Fill in the blanks to streamline the use of the gerund.

1. The microprocessors are capable of ... several functions (to perform). 2. FMS is famous for ... a manufacturing technology (to be). 3. FMS incorporates a system view of . (to manufacture). 4. The concept of FMS continued ... (to evolve). 5. ... the monitoring of operations is very important (to provide).

Exercise 19. Make up sentences according to the model to practise the use of the gerund.

Model: Прочитав эти данные, они рассмотрели вопрос о совершенствовании системы.

After reading these data they decided to upgrade this system.

1. Изучив данные о применении нового оборудования, производители решили установить новые станки с числовым управлением на все производственные линии. 2. Прочитав информацию о ГАП (гибкое автоматизированное производство), они изменили свое решение. 3. После того как идея ГАП была представлена, она продолжала развиваться. 4. После того как производители изучили все недостатки и преимущества этой системы, они были готовы поддержать новый проект. 5. После того как он рассмотрел схему, он мог назвать компоненты этой системы.

SPEAKING

Exercise 21. Share your vision of FMS using the following phrases: to my mind, in my opinion, if I am not mistaken, as far as I remember, it seems to me, etc.

1. What is FMS?
2. When did the idea of FMS appear?
3. What kind of machines were the first FMSs?
4. What is a flexible cell?
5. How are the various machining cells interconnected?
6. What is the prospect for the automation and flexibility if any?
7. What are the goals of FMS?
8. What are the main components of a generic FMS?

Exercise 22. Make up general and disjunctive questions, and answer them according to the models to enhance your speaking skills.

Model A: FMS incorporates a system view of manufacturing.

Does FMS incorporate a system view of manufacturing? — Yes, it does.

FMS incorporates a system view of manufacturing, doesn't it? — Yes, it does.

1. FMS consists of several CNC machines and material handling systems. 2. FMS incorporates two or more cells. 3. Central control system interconnects a group of numerically-controlled machine tools. 4. Automated production system produces one or more families of parts in a flexible manner. 5. The prospect presents the possibility of producing non-standard parts.

Model B: FMSs create a competitive advantage.

Do FMSs create a competitive advantage? — Yes, they do.
FMSs create a competitive advantage, don't they? — Yes, they do.

1. Flexible machining systems operate without being controlled by a person. 2. FMSs approach efficiencies and economies of mass production. FMSs maintain the flexibility required for small-size production. 4. Work stations contain machine tools, performing such operations as milling, boring, drilling, etc. 5. Computers and microprocessors perform several tasks.

Exercise 23. Make up special questions according to the models, and answer them to streamline your speaking skills.

Model A: *FMS allows the system to react in case of changes.*
What does FMS allow?

1. Agile manufacturing creates the processes and tools, responding to customers' needs and market changes. 2. FMS adapts manufacturing with relative ease. 3. Company estimates risks before attempting to use a new approach for their operations. 4. This system minimizes labour costs. 5. The new approach calls for changing the corporate culture.

Model B: *One of the main benefits of FMS is to adapt the processes to new requirements.*
What is one of the main benefits of FMS?

1. The common word for today's manufacture is "agility". 2. Agile manufacturing is the fastest on the market. 3. FMS is simply one of the ways to achieve this agility. 4. FMS is a right option. 5. The final result is efficient operation.

Exercise 24. Ask questions and use the words in italics in your answers.

1. *FMS* is a *manufacturing* technology (what, what kind of). 2. *The idea of FMS* was proposed *in England in 1960s* (what, where, when). 3. *Supervisory computers* and microprocessors correct performance of operations and signal *about problems* (what, what kind of, what about). 4. These *systems* assemble *components* into *final* products (what, what, what kind of). 5. *Computers* track *the status* of *all* jobs in process (what, what, what kind of).

Exercise 25. Read the following dialogue, sum up the information and act out a similar dialogue.
FMS APPLICATION

A. : Today we hear about flexible manufacturing systems more and more often. Could you, mr Smith, clear up the situation about this system, please!

B. : With great pleasure! As you know, our company is doing its best to streamline the manufacturing processes. One of the potential to do is to make production more flexible.

A. : What does it mean? What do you mean saying "to make production more flexible?" How can you make it more flexible?

B. : Well, em. In short, our equipment can be used for more than one purpose, though they may be somewhat related. The equipment is often used to make customized parts, or make different parts for different models of product.

A.: Really? If I've got it right, in some cases, the machines may not only be used to produce or assemble different parts for different models, but to make customizations.

B.: Yes, that's it! And in terms of automobile industry potential savings are incredibly huge! Just some facts if you don't mind!

A. : Sure! It'll be super!

B. : Ford's decision to implement flexible manufacturing systems in 2004 helped them avoid a financial crisis. Ford didn't need any federal help.

A. : I guess that more and more automobile makers are likely to switch to flexible manufacturing technology, as any other type of industry is likely to do that can use it.

B. : You are quite right! Moreover any significant amount of money could be saved in the manufacturing process, and it would likely result in more job security for our citizens.

— : Thanks a lot, Mr Smith! I'm pretty sure this information will be of great help for everyone who deals with manufacturing processes.
— : Thank you for your greatest concern about the production sector. Nice to meet you! Good-bye!

Exercise 26. Role-play the following situations.

I.   You are at the International scientific conference for the first time. Ask about main automation processes implemented in different industrial fields.

II.   You meet a famous Australian scientist and discuss with him why the manufactures are interested in developing FMSs.

WRITING

Exercise 27. Complete the following sentences in a logical way.

1. FMS is a manufacturing system famous for…
2. FMS is a philosophy the key word of which is…
3. FMS incorporates a system view of…
4. The idea of FMS was proposed under the name...
5. Early FMSs were large and very complex, consisting of…
6. A flexible cell consists of two or…
7. FMS is a group of numerically-controlled machine tools, interconnected by…
8. The machining cells are interconnected via stations of loading and . by…
9. The prospect of automation and flexibility presents the possibility of producing…
10. The general objectives of FMS are to approach the efficiencies and economies of mass production and to maintain…
11. FMS consists of the following components: ...
12. A set of work stations contains machine tools that…
13. A material-handling system allows to move between…
14. Supervisory computers and microprocessors are capable of performing such tasks as…
15. One of the most common examples of FMS can be seen in…

Exercise 28. Translate the following sentences from Russian into English.

1.   Гибкая производственная система (ГПС) — это интегрированный комплекс станков с числовым программным управлением (ЧПУ). 2. ГПС состоит из разных сочетаний гибких производственных модулей и (или) гибких производственных ячеек. 3. Гибкая производственная ячейка является совокупностью нескольких гибких производственных модулей, управляемых средствами вычислительной техники. 4. Гибкая производственная ячейка (ГПЯ) способна работать автономно. 5. Основной характеристикой ГПЯ является то, что она способна работать не только автономно, но и в составе ГПС. 6. В состав ГПС входят ГПЯ, автоматическая складская и транспортная система, система автоматизированного управления. 7. Система обладает свойством автоматизированной переналадки при изменении программы производства изделий. 8. ГПС может изготавливать мелкосерийные и среднесерийные единичные изделия. 9. Эта система нацелена на удовлетворение нужд конкретного потребителя. 10. ГПС быстро реагирует на изменения на рынке. 11. Внедрение ГПС на начальном этапе обходится дороже, чем установка обычного оборудования. 12. Общеизвестный факт, что конечной целью производителя является снижение затрат. 13. ГПС нацелена на экономию средств производителя и направлена на конкретного потребителя. 14. Применение ГПС может ускорить производственные процессы. 15. Использование ГПС позволяет снизить цену на изделие.

Exercise 29. Make up your own story about FMS according to the following points of the plan. The words and phrases are supposed to make your story logical and interesting.

1.   What Is FMS?

FMS is …

Early FMSs were ….

The trend is ……

2.   The Definition of FMS

FMS is…

Simply defined, it is….

The prospect of automation and flexibility presents ….

The general objectives of FMS are ….

3. *The Main Components of FMS*

A set of work stations contains ….

A material-handling system does not require …

A network of supervisory computers is capable of ….

Storage is performed …..

ADDITIONAL READING

Exercise 32. Make a summary of the text using the following phrases:

1. The title of the text is….
2. The text is about…. The text deals with….
3. The text covers such points as…. first…. second…. third…..
4. It should be underlined that…..
5. In conclusion, I may say that…..
6. To my mind….. In my opinion…..

FMS BENEFITS AND DRAWBACKS

A flexible manufacturing system (FMS) is an approach to arranging the production effort of a business so that it is possible to change or adapt manufacturing policies and procedures with relative ease. The idea behind this type of flexibility is often to allow the business to anticipate and shift priorities depending on innovations in technology or shifts in demand for the company's products. There are some benefits and liabilities associated with a flexible manufacturing system that should be considered before attempting to use this approach for company operations.

One of the main benefits of a flexible manufacturing system is the change to adapt the operation to meet emerging demands for certain products by customers. Doing so can aid the business in capturing a significant market share and enjoying increased revenues for as long as the demand for those products remains in place. For example, a textile plant that operates with a flexible manufacturing system may be able to adapt quickly carding and spinning machinery to accommodate the production of corduroy instead of terry cloth, if the general public begins to demand more clothing made with corduroy, then shift back to the production of terry cloth once the trend has subsided. Another advantage of a flexible manufacturing system is the chance to minimize labour costs during seasonal downturns, and then to increase the labour force during busy seasons. This approach can be achieved by cross training employees who can take on additional responsibilities during lean seasons, and then turn a portion of those responsibilities over to part-time personnel during busy seasons. The end result is efficient operation that still helps keep the cost of production for each unit produced under a certain level.

While there are some benefits of a flexible manufacturing system, there are also a few potential drawbacks that should be taken into consideration. Converting to this type of arrangement often has a significant up-front cost, since machinery may have to be modified to allow for an easier conversion of goods produced. This approach also often calls for changing the corporate culture, a process that can take a lot of time and result in some loss of efficiency in the short-term.

Technological barriers may also slow the efforts to be more adaptable, requiring additional planning to overcome those obstacles and creating additional expense for the company. Before deciding that a flexible manufacturing system is the right option, company owners should weigh the benefits against the liabilities and decide if the effort will ultimately be in the best interests of the company.

The common word for today's manufacturer is "agility". An agile manufacturer is one who is the fastest on the market, operates with the lowest total cost and has the greatest ability to "delight" its customers. FMS is simply one of the ways for manufacturers to achieve this agility.