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## ВВЕДЕНИЕ

Учебно-методическое пособие разработано в соответствии с требованиями программы дисциплины «Иностранный язык» для обучающихся бакалавриата всех технических направлений подготовки.

Учебно-методическое пособие разделено на четыре тематических раздела: “Construction automation. History”, “Robotics in the construction industry”, “Information technologies in automation”, “Construction sustainability”, что соответствует темам, представленным в рабочих программах дисциплины.

Каждый раздел включает учебные тексты, имеющие профессиональное содержание и заимствованные из оригинальных источников, а также комплекс лексических, грамматических, коммуникативных упражнений, которые имеют целью формирование профессиональной иноязычной коммуникативной компетенции обучающихся. В учебно-методическом пособии представлены текстовые упражнения как репродуктивного типа (задания на поиск информации в тексте, заполнение таблиц по материалам текстов, ответы на вопросы по содержанию текстов), так и продуктивного характера, что позволяет развивать умения профессионального общения на иностранном языке.

Материалы учебно-методического пособия могут быть применены для организации как аудиторной, так и самостоятельной работы обучающихся.

## Unit 1. CONSTRUCTION AUTOMATION. HISTORY

**Task 1. Read the text and define the term “construction automation”. Why is the construction industry automated?**

### Construction automation

The term “construction automation” means that the building process involves automated processes, tools, and equipment. In some situations, firstly, the work is done manually and after that some tools are utilized to automate the construction process. And sometimes automated equipment is developed specifically for construction. Automation in construction is applied at various phases of a project. It can be the use of software at a design stage or the utilization of some automated tools and equipment off-site and on-site during the construction process. At the final stage data on the systems and energy use of completed buildings are shared and collected in cloud-based living models.

Industrialized construction (IC) integrates automation and mechanization in a factory production environment to optimise the construction process. It uses precision technology and efficient production methodologies to fabricate building components with high accuracy and quality. Industrialized construction and construction automation are not the same. Today the term “industrialized construction” mostly includes off-site construction, where the manufacturing techniques are applied to the built environment.

Industrialized-construction produces elements of buildings and infrastructure. The elements vary from single parts to components of structures or entire assemblies. IC integrates technologies and strategies usually used in manufacturing processes. Volumetric industrialized construction deals with volumetric modules, for instance, with whole hotel rooms. The rooms are manufactured in a factorylike environment. The completed modules are transported to the construction site. There they are assembled into a complete building.

In automated industrialized construction the use of paper drawings can be canceled, as data from 3D models are collected and transferred into an automated production line for fabrication. Production lines may include industrial robots, assembly lines, or other automated equipment that transform materials into building components and assemblies.

**Task 2. Find in the text words having one of the following meanings.**

Definition	Word
computer programs	
to change a process, so that the work is done by machines	
the things that are needed for a particular purpose or activity	
using something	
making a structure	
the state of being exact or correct	
a high standard	
a unit of a system that has a particular function	

**Task 3. Answer the questions:** What is the difference between construction automation and industrialized construction? What is volumetric industrialized construction used for? What equipment is used to automate the construction industry? What is meant by “off-site construction”?

**Task 4. Read the following statement and decide whether they are true or false according to the text.**

Statements	T/F
Automation in construction is applied only at the design stage	
Data on automated systems is stored in cloud-based models	
Building components are fabricated with high accuracy and quality	
Industrialized construction means only off-site construction	
Paper drawings are automated by special software	
Industrialized-construction produces construction elements of a certain size and shape	

**Task 5. Match antonyms.**

assemble	manufacture	disassemble	destroy
construct	efficient	demolish	useless
connect	manual	disconnect	automatic
increase	on-site	decrease	off-site
efficient	single	useless	numerous

**Task 6. Match synonyms.**

transport	equipment	transfer	design
produce	automated	apparatus	manufacture
build	project	self-operating	erect
utilize	efficient	use	useful
tool	data	equipment	information

**Task 7. Use negative prefixes to form new words.**

in-; un-; il-; dis-
accuracy; adequate; sufficient; variable; experienced; logical; organized; visible; legal; appropriate; acceptable; convenient; comfortable; appear; agree; interested; frequent; complete; flexible; practical

**Task 8. Fill in the gaps with appropriate words from the task 7.**

- Constructing a building without obtaining proper permits is \_\_\_\_\_ under building regulations.
- The \_\_\_\_\_ seating in the lecture hall made it challenging to concentrate during the engineering seminar.
- The team members strongly \_\_\_\_\_ regarding the most efficient steel beam placement for the structural design.
- Incorporating excessive decorative elements into the building's facade would be \_\_\_\_\_ due to budget constraints.
- The \_\_\_\_\_ cracks in the foundation caused by improper reinforcement pose a significant risk to the stability of the structure.
- The \_\_\_\_\_ drainage system resulted in water accumulation, leading to deterioration of the building's foundation.
- The \_\_\_\_\_ layout of the construction site caused delays in material deliveries and impeded progress.
- Due to the \_\_\_\_\_ measurements taken during the survey, the resulting floor plan did not accurately reflect the building's dimensions.
- The \_\_\_\_\_ design of the steel framework made it challenging to accommodate necessary modifications during the construction process.
- Utilizing low-quality construction materials is \_\_\_\_\_ in building engineering as it compromises the structural integrity of any project.

**Task 9. Use suffixes to form new words.**

-age; -ness; -ment; -ism; -ian; -cy; -ist
legal, align, equip, improve, measure, inadequate, lever, store, use, technical, assess, enlarge, manage, arrange, electrical, mechanical, modern, science, ready, skillful, adjust, physics, achieve, require, thick, useless

**Task 10. Fill in the gaps with appropriate words from the task 9.**

1. The construction team invested in state-of-the-art \_\_\_\_\_ to expedite the building process.
2. The \_\_\_\_\_ in structural design allowed for more efficient use of space in the building.
3. Precise \_\_\_\_\_ is essential in ensuring the accuracy of construction dimensions.
4. Engineers \_\_\_\_\_ their knowledge of materials and techniques to create safe and sturdy buildings.
5. Adequate \_\_\_\_\_ facilities are necessary for housing construction materials on-site.
6. The effective \_\_\_\_\_ of construction resources plays a key role in completing projects on time and within budget.
7. Regular \_\_\_\_\_ of the building's structural integrity is crucial to identify potential risks or weaknesses.
8. Efficient \_\_\_\_\_ of construction projects requires excellent organizational and communication skills.
9. Continuous \_\_\_\_\_ of construction plans is needed to accommodate unforeseen challenges or changes.
10. \_\_\_\_\_ in executing complex engineering tasks is essential for achieving high-quality building results.

**Task 11. Fill in the gaps with appropriate word forms derived from the words given in the right column. Pay attention to parts of speech.**

The _____ of the new bridge will begin next month	Construct Use Develop Build Industry Produce Equip Design Fabricate Complex Material
The _____ project requires skilled engineers	
The proper _____ of these tools is essential for safety	
The _____ instructions helped me assemble the furniture	
The _____ of a new software application is in progress	
They discussed the _____ features of the upcoming product	
The team is working hard to _____ the project quickly	
The _____ of the skyscraper took several years	
The _____ structure withstood the earthquake	
They decided to _____ the house slowly and steadily	
The region is known for its thriving agricultural _____	
_____ standards are crucial for economic growth	
The farm increased its _____ of organic vegetables	
_____ goods are in high demand in the market	
The factory can _____ efficiently with its new machinery	
The soldiers were provided with the latest _____	
The well-_____ laboratory facilitated groundbreaking research	
The team was thoroughly _____ for the challenging mission	
The _____ of the new website is visually appealing	
The _____ elements were carefully chosen	
The project was _____ to meet the client's specific needs	
The _____ of custom-made furniture requires skill	
The _____ components were assembled flawlessly	
The parts were _____ to precise specifications	
Understanding the _____ of the human brain is a scientific challenge	
The instructions were _____ written, causing confusion	
The _____ properties of the substance make it suitable for construction	
They decided to _____ the dress with lace for added elegance	

**Task 12. Complete the following sentences by choosing the correct verb tense.**

1. The construction crew \_\_\_\_\_ (lay/laid/lays) the foundation last week.
2. By next month, the workers \_\_\_\_\_ (have finish/will have finished/finishing) installing the plumbing.
3. The architect \_\_\_\_\_ (designs/designed/is designing) the blueprint for the building.
4. The electricians \_\_\_\_\_ (wire/wired/wires) the entire building yesterday.
5. The project manager \_\_\_\_\_ (supervise/supervised/supervises) the construction progress every day.
6. Next week, the workers \_\_\_\_\_ (will pour/will pouring/have poured) the concrete for the second floor.
7. The construction company \_\_\_\_\_ (have complete/has completed/completed) the project on time.
8. By the end of this year, the engineers \_\_\_\_\_ (will construct/will have constructed/will be constructing) a new bridge.
9. The workers \_\_\_\_\_ (install/installed/are installing) the windows last month.
10. The inspector \_\_\_\_\_ (check/checking/checks) the building's safety standards regularly.

**Task 13. Rewrite the following sentences, changing the verb tense to match the given instructions.**

Present Simple: The workers (build) the scaffolding. Past Simple: The architect (draw) the floor plans. Future Simple: The construction crew (install) the HVAC system next week. Present Continuous: The workers (pour) the concrete for the foundation. Past Continuous: The engineers (inspect) the structural integrity of the building. Future Continuous: The workers (lay) the bricks throughout the day tomorrow. Present Perfect: The construction company (complete) several projects this year. Past Perfect: The electricians (wire) the building before the drywall was installed. Future Perfect: By next month, the workers (finish) the roofing. Present Perfect Continuous: The project manager (monitor) the construction progress for the past six months. Present Continuous: The new stadium (build) by the construction company. Present Perfect: The new railway line (complete) by the engineering team. Future Simple: The new expressway (plan) by the transportation department. Past Perfect: The prototype (test) by the research and development team before production began. Present Perfect Continuous: The new power plant (work) on by the engineering team for the past few months. Future Continuous: By next year, the new dam (construct) by the engineering firm. Past Continuous: The wind turbines (install) by the technicians while the storm was brewing.

**Task 14. Rewrite the following sentences in the passive voice.**

The engineer designs the bridge. The technician calibrates the instruments. The team constructed the building. The mechanic repairs the engine. The team will install the solar panels. The technician should maintain the equipment regularly. The engineer must design the system according to the specifications. The contractor has completed the construction of the bridge. The supplier will deliver the materials tomorrow. The operator should operate the machine with caution. The architect has drafted the blueprints for the building. The programmer needs to debug the software. The surveyor will measure the site before construction begins. The scientist is conducting experiments in the laboratory.

**Task 15. Fill in the gaps with appropriate verbs in Passive voice.**

approve, check, train, hire, set, erect, pour, install, deliver, cover, design, issue, lift, complete, bring, lay

1. The construction plans \_\_\_\_\_ by the building department.
2. The building materials \_\_\_\_\_ for quality before use.
3. The workers \_\_\_\_\_ with new safety procedures before starting the project.
4. The construction company \_\_\_\_\_ for the new commercial building.
5. The safety barriers \_\_\_\_\_ up around the construction area.
6. The scaffolding \_\_\_\_\_ by the workers before the renovation project began.
7. The concrete foundation \_\_\_\_\_ in place by the construction team last week.
8. The wiring and plumbing \_\_\_\_\_ by the skilled labourers to meet safety standards.
9. The steel beams \_\_\_\_\_ at the construction site yesterday.
10. The walls \_\_\_\_\_ with a fresh coat of paint by the decorators.
11. The blueprints \_\_\_\_\_ by the architect last month.
12. The permits \_\_\_\_\_ by the local authorities before the project could proceed.
13. The roofing materials \_\_\_\_\_ to the top floor by the crane.
14. The electrical wiring \_\_\_\_\_ by the electricians last week.
15. The building \_\_\_\_\_ to code by the construction company.
16. The bricks \_\_\_\_\_ on-site by the masons.

**Task 16. Read the text and make a summary of it. What is the theme of the text? What is the main idea of the whole text? What is the main idea of each paragraph?**

### **A history of construction automation**

Ideas of mechanized automated construction have been developing for a long time. More than 2,000 years ago first examples of the off-site construction were used in the prefabrication techniques applied to build the Terracotta Army in China.

However, modern construction automation using robotics appeared when industrial robots were invented in the 1950s and they were applied by the automotive industry in 1960s. Factory automation started to spread. Construction robotics began to be used in the 1960s and 1970s. The first innovative construction automation appeared in Japan at that time due to a construction-labor shortage. The country faced the problem of an aging population and younger employees were disinterested in the work. Japanese architecture and engineering companies created robots and remote-controlled machines for earthworks, placing and finishing concrete, placing fixture, fireproofing, and other construction on-site activities.

During the next 10 years Japanese construction firms created on-site automated processes for high-rise construction. Systems such as automated construction parts' tracking and material processing, robotic connection and assembly, and centralized control had been progressing.

At the same time in Europe researchers were developing large-size masonry robots (brick laying, assembly) for residential and industrial building construction.

The construction industry was adopting automated processes slowly. Today, however, construction automation is being developed rapidly, assisted by collaboration among businesses, state governments, and scientific institutions.

Nowadays construction is digitalized and manufacturing techniques are being united. Building information modeling including complex architectural design and data managements and artificial intelligence's generative design approaches are being combined with rapidly advancing robotics and Internet of things.

**Task 17. Answer the questions:** Where was modern construction automation developed? What automation equipment was introduced in the first part of the twentieth century? Why was constructed industry being automated slowly? What is the current state of the construction industry?

**Task 18. Translate the following word expressions from the text into English.**

Строительство развивается, работы изобретены, нехватка рабочей силы, стареющее население, машины с дистанционным управлением, роботы-укладчики кирпичей, страна столкнулась с проблемой, высотное строительство, обработка материалов, жилое домостроение, сложный проект, быстро развивающаяся робототехника, работники не заинтересованы, управление данными, автоматизация распространялась.

**Task 19. Fill in the gaps with appropriate word forms derived from the roots given in the right column. Pay attention to parts of speech.**

What is your level of _____ in building engineering	Interest Automate Site Place Search Short Employ Act Robot
I am _____ in learning more about building engineering	
She has a keen _____ in sustainable building practices	
The _____ of construction processes has revolutionized the industry	
We need to _____ the assembly line to increase productivity	
The _____ system ensures efficient construction practices	
The construction process was _____, resulting in faster completion	
The construction _____ was carefully selected for its accessibility	
They will _____ the new building near the existing structure	
The _____ manager oversees all construction activities	
The workers are working diligently on the _____	
The _____ where the foundation will be laid has been prepared	
They will _____ the steel beams on the foundation	
The workers carefully _____ the bricks one by one	
The _____ for sustainable building materials is ongoing	
They will _____ for the best suppliers of construction materials	
The _____ process can be time-consuming but necessary	
They _____ extensively for eco-friendly construction options	
The _____ span trusses provide structural support	
They will _____ the length of the trusses for better stability	
The trusses were cut _____ to fit the available space	
The company _____ skilled engineers for their projects	
The _____ engineers have extensive experience	
The _____ of reinforcing concrete ensures structural strength	
They will _____ quickly to reinforce the weakened structure	
Their _____ prevented further damage	
The _____ assists in the construction of prefabricated components	
They will _____ the assembly line for increased efficiency	
The _____ arm is used for precise construction tasks	
What is your level of _____ in building engineering	
I am _____ in learning more about building engineering	
She has a keen _____ in sustainable building practices	



**Task 20. In pairs discuss the question:** What are perspectives of the construction automation in the nearest future?

**Task 21. Answer the questions:** What automated construction equipment do you know? What equipment is used on the construction site?

**Task 22. Read the text. What is the classification of construction automation?**

### **Types of construction automation**

#### *Off-site construction automation*

Off-site construction automation includes prefabrication, volumetric and panelized modular construction, and precast. These practices move construction processes into factories.

Off-site automation in the building industry is more common than automated on-site operations, despite the fact that the construction of buildings, roads, and bridges includes assemblies of manufactured elements. The elements are diverse in materials, sizes and other characteristics. Therefore, the configuration of automated equipment in a production line, and the production line must be adjustable to respond to variation.

Factory automation saves time, money, and improves quality control and provides safety. The automation makes work more comfortable for workers as many of the repetitive tasks associated with typical construction processes are eliminated. Factory-based construction helps to save environment, creating less waste; using less water; reducing operational energy; and optimizing material use, and recycling.

#### *On-site construction automation*

Factory-based automation in construction is a manufacturing technology allowing automated tooling to produce building elements rather than whole products. On-site construction automation, however, requires new equipment and processes. It should support variations across units while also using standardized elements. For instance, automated equipment placing concrete reinforcement eliminates repetitive tasks on the jobsite. It allows variability in rebar placement. And, by placing the reinforcement precisely where it is needed, the equipment reduces construction waste.

Automated construction equipment allows the industry to consider the jobsite a factory in the field. Therefore, there is a need to move along the field. Construction-automation machinery must be portable to travel to construction sites, then set up, while being used, and taken down to move to the next job. Today semiautonomous and autonomous construction vehicles are becoming widespread. One operator can control several machines simultaneously. For example, load-carriers, excavators, dozers, and haul trucks can be operated at the same time by only one human. Another example of a construction vehicle is a rover. The rovers follow workers around on the construction site carrying tools and materials.

Autonomous vehicles are operated by means of special equipment. Sensors are used to detect obstacles in the surroundings. Inertial measurement units (IMUs) and global positioning system (GPS) locate the vehicles on the construction site. And control systems limit the movement of the machines outside the site. The vehicles on-site are often connected to each other, allowing for coordinated actions.

Currently wheeled machines are being replaced by walking robots; as legs offer more benefits than wheels. The main advantages of the walking robots are their adaptability and maneuverability. They are light enough to operate on soft soil. The devices provide higher mobility, lower energy consumption, and stability. There are several types of walking robots depending on the number of legs. The most spread types are bipeds (humanoids), four-legged (quadrupeds), and six-legged. For example, “Boston Dynamics”, four-legged walking robots. They can inspect a site and collect data safely, accurately, and frequently. The robot travels across the site and records the map. The path through an environment will be remembered and can be repeated autonomously without a human control.

**Task 23. Decide whether the statements are true or false according to the text.**

Statements	T/F
On-site construction automation includes prefabrication	
On-site automation is more common than off-site prefabrication	
Factory automation improves quality of products	
The automation makes work more comfortable for workers	
The automation makes employees work harder	
Factory-based construction saves environment.	
Factory-based automation produces whole building units	
Construction-automation machinery is stationary	
Autonomous construction vehicles are operated manually	
Wheeled machines are being replaced by walking robots	
Walking robots are adaptable to the environment	
Robots cannot collect data	

**Task 24. Answer the questions:** What types of robots are mentioned in the text? Why are walking robots better than wheeled machines? What vehicles are used on-site? What is the difference between off-site and on-site construction automation? What does off-site automation include?

**Task 25. Fill in the table with the information from the text. Using the complete table give a 2-minutes talk on the types of construction automation.**

Off-site construction automation	On-site construction automation
Main features	Main features
...	...

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