



## SHVET PROGRAM (Slovenia)

The content in the following document presents an educational HVET program proposal for an "Expert in Building Automation". It was prepared as part of the Erasmus+ project SHVET (Smart development for highly skilled and mobile workforce). The document contains the context of the program proposal, general and specific part of the program and knowledge catalogues for the proposed units (practical training is an integral part of every module included even though there is a separate knowledge catalogue for it):

1. Work management,
2. Electrical and mechanical installations,
3. Building automation systems,
4. Programming and testing smart home installations,
5. Practical training.

### INTRODUCTION

Slovenian companies: ARH electromechanics, Dulc, EMJ Elektroinstalacije, Go4Panda, Selekt elektronštalacije Aleš Skušek, and Elsynt, supported by the Regional Chamber of Crafts and Small Businesses Krško and Higher Vocational School at Novo mesto School Center jointly express the need for upskilling employees in the field of building automation.

Modern technology is integrated in every area of our lives and its role is constantly growing. The use increases our comfort, supports us in saving time, and is a very important factor in energy efficiency. Smart buildings were more or less just single case studies, are on the rise. Terms such as "smart house" and "smart building" has become common in everyday use. Building automation systems included in such buildings are practical and efficient while also becoming more and more affordable.

Smart buildings are included in the Slovenian strategic development and implementation documents as they are considered an important factor in the development of energy and energy efficiency, sustainable tourism, raising competitiveness of the Slovenian economy, etc. Due to the aging of the population, supportive housing for elderly is coming to the fore. As defined in the Smart Specialization Strategy of Slovenia (S4), Smart buildings and wooden homes are one of the prioritised to be (further) developed areas of the (Government of the Republic of Slovenia, S4, p. 12)

Demand for improving buildings with automation system and building smart buildings is growing rapidly. There are currently 579 companies in this sector in Slovenia (there were 490 3 years ago). The companies employ electrical, mechanical and computer experts, and upskill them through internal

trainings mainly offered by equipment manufacturers.

In the SHVET project we took a closer look of the work performed by an expert in building automation. 35 companies active in this field were included in the preliminary survey. The purpose was to identify what tasks and duties define the work of an expert in building automation.

**Knowledge and skills of an expert in building automation are:**

- communicating with a potential client, identifying customer needs, proposing technical solutions for a building automation system;
- communicating with installers;
- proposing and selecting the necessary equipment, examining the technical documentation and installation instructions of the equipment;
- organizing and managing the work of installers with detailed wiring instructions;
- performing final testing, troubleshooting and system start-up;
- providing training and support for end users;
- managing life cycle of building automation system (monitoring performance, organizing maintenance and repair, upgrading).

The necessary competencies could be gained by completing the educational program for continuing vocational education called an Expert in building automation.

**Relation of the new qualification to existing, similar qualifications**

In addition to basic knowledge, an expert in building automation also needs transversal skills that are important for integration and maintenance of smart home installations, and as it was identified by the authors, these skills are not fully included by any of the existing educational programs.

At the post-secondary level (EQF5 ), seven HVET programs which include content related to the key tasks of an expert in building automation have been reviewed. These programs are: Electronics, Electrical Engineering, Energetic, Informatics, Mechatronics, Mechanical Engineering and Telecommunications.

All of these programs include subjects related to the use of computer and information systems and subjects for the acquisition of organizational and communication skills (Computer Science and Informatics, Business Communication and Management, Professional Language Terminology). Three programs include building automation namely Electronics (in Intelligent Installations), Electrical Engineering (in Electrical Installations and Lighting 2, in Energy Management of Buildings), and Telecommunications (in Terminal Devices).

Most of these programs involve the regulatory aspect of electrical and/or mechanical installations, and contents related to the design of installations and their implementation and maintenance, which we present below.

In program **Electronics** the following compulsory and optional/elective subjects are related to building automation: Design (design of classic low-voltage installations and their safety), Intelligent Installations (classic low-voltage installations, lighting, smart home installations) and Process Control Systems and Process Drive and Control (drive and control).

In program **Electrical Engineering**, the following compulsory and optional/elective subjects are related to building automation: Electrical Installations and Lighting (classic low-voltage installations and their safety, lighting, smart home installations), Process Control Systems (process control), Energy Management of Buildings (energy systems and installations, renewable energy, energy management and monitoring of buildings) and Efficient Use of Energy in Buildings (energy indicators of buildings).

In program **Energetics**, the following compulsory and optional/elective subjects are related to building automation: Technical Regulations and Design (energy distribution and their efficient use) and Modern Electrical Installations (classic low-voltage electrical installations and their safety).

In program **Informatics**, the following compulsory and optional/elective subjects are related to building automation: Computer Communications and Networks (communication networks) and Programming (programming logic).

In program **Mechatronics**, the following compulsory and optional/elective subjects are related to building automation: Technical Regulations and Design (regulatory aspect, design of systems combining mechanical and electrical technologies), Communication Technologies and Services (communication networks and services), and Programming in Automation (programming logic).

In program **Mechanical Engineering**, the following optional/elective subjects are related to Building Automation: Automation and Robotics (Principles of System Management), Maintenance of Machines and Devices (System Approach to Maintenance), and Maintenance of Energy Devices (Maintenance of HVAC Systems).

In program **Telecommunications**, the following compulsory and optional/elective subjects are related to the building automation: Design and Documentation (technical regulation, planning of communication networks), Telecommunication Networks (communication networks) and Terminal Devices (terminal equipment, including smart installation equipment).

These findings indicate the need for a new training program, since none of the graduates meets the competence need of an expert in building automation. All graduates lack certain knowledge and skills. In addition, certain Subjects (courses) within the programs are elective and not attended by all students.

Being more specific, graduates of electrical engineering, computer science and informatics programs are not acquainted with the basic knowledge in the field of mechanical installations and vice versa. Graduates of mechanical engineering programs are sufficiently familiar with electrical engineering, but not with low-voltage electrical installations. Graduates of electrical engineering programs are having difficulties reading technological designs and projects for the construction of mechanical installations, and the functional sets of devices for heating, cooling and ventilation are completely foreign to them. They are usually familiar with the main principles, understand the curves by which the control systems of these devices are adjusted, but in the real world they do not recognize the individual functional

assemblies. This has also been confirmed by the company representatives on many occasions (several expert groups, workshops, roundtables, etc.) during the SHVET project activities.

### **Target group and employment opportunities**

Applicants of the continuing training program in higher vocational education called An Expert in Building Automation should have obtained at least a HVET degree (EQF 5) in study programs mentioned above and they wish to upskill their knowledge and competences in the field of building automation. They may be employees of companies or currently unemployed but have at least one year of relevant work experience.

As mentioned above, the demand for smart building installations and smart building construction is increasing. Currently, 579 companies are engaged in this field in Slovenia, compared to 490 3 years ago. According to trends and national development areas, the demand for such personnel is expected to grow.

### **Short description of the qualification**

After finishing the continuing vocational training program, an expert of building automation will be trained to integrate various components of electrical and mechanical installations into a harmonized system that saves energy and increases the comfort level of users. He/she will be able to identify customer needs, select the necessary equipment and organize the work of installers by providing detailed instructions on how to do the wiring and install components. He will be able to test and trial the system, communicate with the end user and manage the smart building by providing customer support and organizing system maintenance.

The professional competences that the candidate will acquire in this program are:

- organize maintenance and periodic inspections of electrical installations in smart buildings,
- organize and supervise the connection of electrical components,
- monitor and control the operation of energy distribution systems,
- manage and organize the installation and maintenance of smart home installations,
- set/parameterize, run, check and diagnose smart home installations,
- update and upgrade smart home installations,
- communicate with clients, educate them for use, and lead a working group.

## **A. GENERAL PART**

### **1. STUDY PROGRAM**

**1.1 Name of the study program for continuing training:** Continuing training program in higher vocational education, An expert in building automation

**1.2 Qualification name:** An expert in building automation

### **2. OBJECTIVES AND COMPETENCES OF THE STUDY PROGRAM**

The basic objectives of the continuing HVET program are to upgrade and advance the knowledge, skills and competences of the participants for:

- organizing and controlling the quality of work in the implementation of smart home installations in existing buildings and in smart buildings under construction;
- communicating with clients, proposing solutions and training end users of smart home installations;
- organizing the work in construction of electrical and mechanical installations;
- setting up and testing components of smart building installation;
- organizing the maintenance of electrical and mechanical installations.

The participant acquires the following professional competences:

- arranging maintenance and inspection of electrical and mechanical installations;
- organizing and supervising the connection of electricity consumers;
- monitoring and controlling the operation of energy systems;
- selecting, organizing and managing the implementation and maintenance of a smart installation;
- setting up/parameterize, running, checking and diagnosing smart home installations,
- updating and upgrading smart home installations;
- communicating with clients, training them for use, and managing the teamwork.

### **3. PROGRAM DURATION AND EVALUATION WITH CREDIT POINTS**

#### **3.1. Program duration**

The program lasts 420 hours.

#### **3.2. ECTS credit assessment (ECTS)**

The program is credited with 22 ECTS credits.

#### **4. ENTRY CONDITIONS AND SELECTION CRITERIA WITH LIMITATION OF ENTRY**

##### **4.1. Enrolment requirements:**

Enrolment is open to anyone who has:

1. a degree (EQF 5) in (at least) higher vocational education program in the fields of electronics, electrical engineering, energetic, informatics, mechatronics, mechanical engineering or telecommunications;

and has

- a) at least 1 year of electrical or mechanical installation work experience and a practical training contract,  
OR
- b) full time working contract at a company implementing smart installation and a written agreement for practical training.

##### **4.2. Entry selection criteria:**

Not Specified.

#### **5. RECOGNITION OF KNOWLEDGE AND COMPETENCES OBTAINED BEFORE THE ENTRY**

A graduate of the higher vocational education program in Mechanical Engineering, who has completed the elective module Maintenance is partially credited with obligations according to the subject Electrical and mechanical installations - all obligations in the field of electrical installations must be fulfilled.

A graduate of the higher vocational education program in Electronics or Electrical Engineering is partially credited with obligations according to the subject of Electrical and Mechanical Installations - all obligations in the field of mechanical installations must be fulfilled.

A graduate of the higher vocational education program in Electrical Engineering who has completed the elective module Energy Management of Buildings is credited with obligations according to the subject of Electrical and Mechanical Installation.

The recognition process is carried out in accordance with the Rules on the recognition of previously acquired knowledge.

Despite what is written above, the school may recognize the knowledge in accordance with the Rules on the Recognition of Previously Acquired Knowledge in higher vocational education.

## COMPULSORY METHODS OF KNOWLEDGE ASSESSMENT

Label	Subject or other ingredient	Oral exam	Written exam	Product or service and defence
<b>M1</b>	Process management			
S1	Work management	X		
S2	Electrical and mechanical installations		X	
P1	Practical training - work management			X
<b>M2</b>	Implementing smart home installations			
S3	Building automation systems			X
P2	Practical training - Implementing Smart home Installations			X
<b>M3</b>	Parameterization of smart home installations			
S4	Programming and testing smart home installations			X
P3	Practical training - parameterization of smart home installations			X

## 7. METHODS AND FORMS OF STUDIES

The continuing program is implemented at school and at companies. The company provides 240 hours (6 weeks) of practical training.

## 8. PARTS OF THE PROGRAM WHERE PRESENCE IS MANDATORY

Parts of the program where student presence is mandatory are determined by the school. In seminars and laboratory exercises the presence limit should not be less than 80% of the contact hours determined by the course.

## **9. REQUIREMENTS FOR PROGRESSION AND COMPLETION OF STUDIES**

### **9.1. Requirements for progression**

Not determined.

### **9.2. Requirements for completion**

In order to finish the continuing program, the participant must complete all obligations as follows:

- all modules in the scope of 22 credits:
  - Work management (8 credits),
  - Implementation of smart home installations (6 credits),
  - Parameterization of smart home installations (8 credits) and
- final exam.

Final exam consists of preparation and defence of a project assignment (service or a product). The project assignment must include all work processes included the catalogue of practical training.

## **10. TRANSFER REQUIREMENTS BETWEEN STUDY PROGRAMS**

The program does not include this data.

## **11. CONDITIONS FOR COMPLETION OF INDIVIDUAL PART OF THE STUDY PROGRAM**

The program is uniform.

## **12. INFORMATION ABOUT THE INTERNATIONAL COMPARABILITY OF THE STUDY PROGRAM**

Not specified.

## **13. DATA ON LIABILITY TO OTHER SCHOOL PROGRAMS IN THE COMMON EUROPEAN HIGHER EDUCATION AREA**

Not specified.



## B. MAIN PART

### 1. SUBJECT

Label	Object or other ingredient	Compulsory / optional	Number of contact hours				No. hours of independent work	Total no. hours of participant's work	Credit points
			Lectures	Seminar exercises	Laboratory exercises	Total			
<b>M1</b>	Process management	compulsory							<b>8</b>
S1	Work management		20	20		40	50	90	3
S2	Electrical and mechanical installations		20		20	40	50	90	3
P1	Practical education - process management							60	2
<b>M2</b>	Implementing smart home installations	compulsory							<b>6</b>
S3	Building automation systems		15	5	20	40	50	90	3
P2	Practical Training - Implementing Smart home Installations							90	3
<b>M3</b>	Parameterization of smart home installations	compulsory							<b>8</b>
S4	Programming and testing smart home installations		15	5	40	60	90	150	5
P3	Practical training - parameterization of smart home installations							90	3
<b>Together</b>			<b>70</b>	<b>30</b>	<b>80</b>	<b>180</b>	<b>240</b>	<b>660</b>	<b>22</b>
Number of hours of school work							180		14
Number of hours of practical training							240		8
<b>Total number of hours</b>							<b>420</b>		<b>22</b>

Notes:

*M - module, S - subject, P - other component of the study program (practical training)*

*Knowledge catalogues are prepared for subjects (S) and other parts of the study program (P).*

## 2. LECTURER

Notation	Subject	Lecturer/instructor	Field of expertise
S1	Work management	lecturer	A degree in (at least) higher education in the following programs: communications, economics, organization, management, psychology, educational sciences or sociology
S2	Electrical and mechanical installations	lecturer	A degree in (at least) higher education in the following programs: electrical engineering, energetic, mechatronics, mechanical engineering
		instructor	A degree in (at least) higher education in the following programs: electrical engineering, energetic, mechatronics, mechanical engineering
S3	Building automation systems	lecturer	A degree in (at least) higher education in the following programs: electrical engineering, telecommunications, energetic, computer science, informatics, mechanical engineering
		instructor	A degree in (at least) higher education in the following programs: electrical engineering, telecommunications, energetic, computer science, informatics, mechanical engineering
S4	Parameterization of smart home installations	lecturer	A degree in (at least) higher education in the following programs: electrical engineering, telecommunications, energetic, computer science, informatics, mechanical engineering
		instructor	A degree in (at least) higher education in the following programs: electrical engineering, telecommunications, energetic, computer science, informatics, mechanical engineering
P1-3	Practical training	lecturer	A degree in (at least) higher education in the following programs: as defined in any subject of this program

### 3. CATALOGS OF KNOWLEDGE

#### 3.1. Knowledge catalogue for particular subjects

<b>S1</b>	<b>Subject title: Work management</b>
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#### General objectives of the subject

The general objectives of the subject are to advance the knowledge, skills and competences of the participants for:

- developing good interpersonal and business communication skills,
- independent planning and organizing,
- leading teamwork and
- work management.

#### Professional competences with expected learning outcomes

Professional competences:

- human resources management and motivation of employees;
- organizing and managing group processes,
- communicating with participants in the process.

#### Expected learning outcomes:

Professional competences	Informative objectives	Formative objectives
Managing human resources and motivating employees	<p>Describes the importance of human resources management;</p> <p>presents approaches to effectively organize work and timing;</p> <p>describes tools and methods for monitoring and determining work performance;</p> <p>describes the types of individual needs in the work group or team and their importance;</p> <p>explains the relation between motivation and the achievement of the goals of the work group or team and organization.</p>	<p>Plans and delegates work assignments according to plan;</p> <p>selects effective tools for motivating colleagues;</p> <p>assesses the motivation of colleagues in the work environment;</p> <p>monitors and determines employees' work performance.</p>

<p>Organizing and managing group processes</p>	<p>Describes the characteristics of effective leadership;</p> <p>explains the importance, strengths and weaknesses of individual and team work;</p> <p>presents elements of the formation and development of the team;</p> <p>describes the decision-making process;</p> <p>presents different decision-making methods;</p> <p>explains the need for change, improvement and progress in the group or organization.</p>	<p>Selects members of a working group or a team;</p> <p>chooses individual or team work;</p> <p>organizes the work of a group or a team;</p> <p>leads a working group or a team;</p> <p>introduces improvements to the work of the team.</p>
<p>Communicating with participants in the process</p>	<p>Presents the impact of various factors on communication performance;</p> <p>lists the elements of verbal and non-verbal communication;</p> <p>describes the basic skills of successful communication;</p> <p>presents the rules of business ethics in spoken and written business communication;</p> <p>explains the relationship between communication and organizational performance and the impact on relationships.</p>	<p>Communicates with participants;</p> <p>explains instructions for use of the equipment;</p> <p>plans and implements user education;</p> <p>provides support to participants;</p> <p>chooses the appropriate way and method of communication in the business context;</p> <p>uses different tools of persuasive communication.</p>

<b>S2</b>	<b>Subject name: Electrical and mechanical installations</b>
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**General objectives of the subject**

The general objectives of the subject are advancing the knowledge, skills and competences of the participants for:

- mastering safety and environmental protection procedures;
- developing an attitude towards energy saving;
- possessing knowledge of components of energy distribution systems (mechanical installations);
- possessing knowledge of components of electrical installations.

**Professional competences with expected learning outcomes**

Professional competences:

- ensuring safe work and environmental protection;
- monitoring and controlling the installation of energy distribution systems;
- maintenance and inspection of electrical installations.

**Expected learning outcomes:**

Professional competences	Informative objectives	Formative objectives
Ensuring safe operation and protection of the environment	<p>Lists regulations on safe work and health; explains the measures for safe work on low-voltage installations;</p> <p>lists fundamental and operational objectives of environmental protection;</p> <p>lists regulations on handling hazardous substances;</p> <p>explains the labelling of hazardous substances.</p>	<p>Recognizes individual hazards in the work process and takes steps to prevent them;</p> <p>plans measures for safe operation;</p> <p>plans and implements waste separation and disposal measures.</p>

<p>Monitoring and controlling operation of energy systems</p>	<p>Lists comfort parameters of the living environment;</p> <p>describes components of energy systems in buildings and understands their operation;</p> <p>explains time delays in the building's internal climate caused by outer weather conditions;</p> <p>describes responsiveness of individual energy systems in the facility;</p> <p>lists individual parameters of the heating/cooling components of energy systems;</p> <p>lists and explains regulations related to energy systems, machines or devices.</p>	<p>Explains parameters of living environment (temperature, humidity, air speed and quality, brightness, colours ...);</p> <p>monitors connection between energy source, distribution elements and heaters/heat sinks;</p> <p>recognises individual elements of the energy system in the facility and by reading technical drawings;</p> <p>plans delays of effects of external conditions on indoor parameters and relates them to responsiveness of individual energy systems;</p> <p>uses anticipated modes of operation of individual components of energy systems in the facility;</p> <p>complies with legal restrictions and recommended standards in the field of energy systems in buildings;</p> <p>maintains relevant technical documentation.</p>
<p>Maintaining and monitoring electrical installations</p>	<p>Defines protection measures when working with electrical appliances;</p> <p>lists and explains regulation and guidelines in the field of low-voltage electrical installations;</p> <p>lists types of electrical connections and elements of the remote control;</p> <p>explains the graphic symbols of switchgear and electrical devices.</p>	<p>Takes precautionary measures when working with electrical devices;</p> <p>assesses the application of technical guidelines, standards and regulations;</p> <p>uses design and technical documentation;</p> <p>organizes and controls the connection of devices to the electrical distribution system.</p>

<b>S3</b>	<b>Subject name: Building automation systems</b>
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### **General objectives of the subject**

General objectives of the subject are to advance the knowledge, skills and competences of the participants for:

- becoming familiar with standard systems of smart home installations, materials and components for their implementation;
- becoming familiar with basic functions of smart buildings;
- choosing components for building automation systems;
- planning and organizing the implementation and maintenance of building automation systems.

### **Professional competences with expected learning outcomes**

Professional competences:

- selecting materials and components to implement smart home installations;
- planning, organizing and supervising the implementation of smart home installations;
- organization inspection and maintenance of smart home installations;
- managing project documentation for integration and maintenance of smart home installations.

**Expected learning outcomes:**

Professional competences	Informative objectives	Formative objectives
<p>Choosing components for smart home installations</p>	<p>Describes the basic features of smart home installations;</p> <p>defines the classic and smart implementation of functions in electrical and smart home installations;</p> <p>lists basic functions of smart buildings;</p> <p>explains the limitations of different building automation systems;</p> <p>describes the topology of the various building automation systems;</p> <p>lists electrical characteristics of the guides in the various building automation systems;</p> <p>explains the benefits of different building automation systems;</p> <p>lists the interfaces between the various building automation systems;</p> <p>describes the operation of the components of smart home installations;</p> <p>lists and describes materials for wiring smart home installations.</p>	<p>Estimates the benefits of smart home installations over classic ones;</p> <p>examines key features of the planned system;</p> <p>assesses the optimality of the proposed building automation system;</p> <p>proposes changes to the building automation system;</p> <p>recognizes the topology in the building automation system;</p> <p>selects a building automation system according to the specifics of the project;</p> <p>determines interfaces between different building automation systems;</p> <p>uses the technical documentation of the components of smart home installations;</p> <p>selects the basic components to build a smart installation;</p> <p>applies marginal criteria in the preparation of proposals or solutions.</p>



<p>Designing, organizing and monitoring the implementation of smart home installations</p>	<p>Explains the operation of the building automation system in its design;</p> <p>presents the content of the technical report;</p> <p>lists basic parameters of lighting devices;</p> <p>describes the comfort parameters of living and work areas;</p> <p>describes the basic settings of the smart installation components.</p>	<p>Plans location of smart installation components;</p> <p>follows suggestions of smart installation users;</p> <p>uses smart installation designs;</p> <p>provides components of smart home installations;</p> <p>checks components of smart home installations;</p> <p>organizes installation of smart home installations;</p> <p>controls the implementation of smart home installations.</p>
<p>Organizing check-up and maintenance of smart installation</p>	<p>Explains the process of connecting a smart installation to a power source;</p> <p>describes the importance of maintenance and its impact on the reliability of the building automation system;</p> <p>presents the difference between the types of maintenance of smart home installations;</p> <p>lists the legislation on the maintenance of smart home installations;</p> <p>describes options for upgrading the building automation system.</p>	<p>Arranges connection of smart installation power source;</p> <p>plans a smart installation check-up;</p> <p>performs a smart installation check-up;</p> <p>prepares a smart installation review report;</p> <p>maintains and services smart installation;</p> <p>upgrades the building automation system according to user requirements and suggestions.</p>
<p>Maintaining project documentation for the construction and maintenance of smart home installations</p>	<p>Describes smart installation documentation;</p> <p>present differences between types of project documentation;</p> <p>describes the technical documentation of the smart installation components;</p> <p>explains the process of making modifications in project documentation.</p>	<p>Maintains operation and maintenance log;</p> <p>documents modifications in project documentation.</p>

<b>S4</b>	<b>Subject name: Programming and testing smart home installations</b>
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**General objectives of the subject**

The general objectives of the subject are to advance the knowledge, skills and competences of the participants for:

- being familiar with communication models used in a standard building automation system;
- being familiar with the process of setting the parameters of the components and the design of the smart installation;
- connectivity of different systems;
- maintenance of smart installation software.

**Professional competences with expected learning outcomes**

Professional competences:

- defining the logic of operation of systems in smart installation;
- commissioning the components and starting the system;
- planning and implementation of scenarios in building automation systems;
- building automation systems software maintenance.

Expected learning outcomes:

Professional competences	Informative objectives	Formative objectives
Determining the logic behind the operation of systems in a smart installation	Defines a communication model in various building automation systems; describes the ISO/OSI reference model; presents rules for programming smart home installations; explains the programming logic behind smart installation programming; lists and describes various communication models; presents different parameters of data transmission; describes connectivity between building automation systems.	Uses different communication protocols; determines network bandwidth; assesses options for connecting to other building automation systems.

<p>Setting parameters of components and system start-up</p>	<p>Describes the importance of addressing the components of smart home installations;</p> <p>presents open source programming solutions for smart components;</p> <p>describes the functionality of central control systems;</p> <p>presents a hierarchy of smart installation components;</p> <p>explains database management systems.</p>	<p>Addresses the components of smart home installations;</p> <p>commissions components of smart home installations;</p> <p>configures the central control system;</p> <p>starts and tests the system;</p> <p>recognizes and corrects malfunctions.</p>
<p>Planning and designing a series of events in smart systems installations</p>	<p>Describes the differences between event types;</p> <p>presents ways of program planning.</p>	<p>Plans a sequence of events;</p> <p>designs a sequence of smart building features;</p> <p>verifies the sequence of events;</p> <p>upgrades the sequence of events.</p>
<p>Maintaining software of building automation systems</p>	<p>Describes rules for maintaining smart home installations;</p> <p>explains the importance of maintaining smart home installations;</p> <p>presents the different types of maintenance.</p>	<p>Plans functionality testing of the building automation system;</p> <p>checks functioning of the building automation system periodically;</p> <p>customizes, updates, and upgrades software on components of smart installation;</p> <p>documents software upgrades of building automation systems.</p>

### 3.2. Knowledge catalogue for practical training

The general objectives of practical training are:

- get to know the work environment and
- extend the knowledge, skills and competences for:
  - communicating and working with all participants in the process;
  - work management;
  - comparing, analyzing and selecting the components of a smart installation;
  - the use of information and communication technology and software tools to produce a technical report, program the smart installation and monitor its operation;
  - arranging check-up of installations;
  - setting interfaces between different networks;
  - setting up, modifying, and upgrading the operation of a smart installation.

#### Work processes and operational learning objectives

In practical training, the student engages in the following work processes:

Work processes	Operational learning objectives
<b>P1 PRACTICAL EDUCATION - MANAGING PROCESSES</b>	
Managing group processes	Student: <ul style="list-style-type: none"> <li>• documents the needs of the client and proposes solutions,</li> <li>• monitors teamwork for smart system installation,</li> <li>• conducts end-user training.</li> </ul>
Implementation of installations	<ul style="list-style-type: none"> <li>• Based on the electrical installation design, monitors the connection of the elements and checks the execution of the mechanical installations.</li> </ul>
<b>P2 PRACTICAL EDUCATION - IMPLEMENTATION OF SMART HOME INSTALLATIONS</b>	
Choosing the components of a smart installation	Student: <ul style="list-style-type: none"> <li>• analyzes the components of the selected building automation system, selects them for the chosen purpose and places them into the floor plan of the building,</li> <li>• compares interfaces between different smart installation networks,</li> <li>• checks the equipment for shading, cooling, heating and air ventilation and identifies its functionalities,</li> <li>• determines the purpose of the system components,</li> <li>• draws a functional design of mechanical and electrical parts of the system.</li> </ul>
Implementation	<ul style="list-style-type: none"> <li>• Collaborates with the designer in the preparation of pre-implementation and</li> </ul>

and inspection of smart installation	<p>post-implementation designs</p> <ul style="list-style-type: none"> <li>• coordinates the implementation with the subcontractors and the client, and monitors it until its completion,</li> <li>• documents all stages of smart installation implementation (final designs, statements, certificates of conformity, instructions for use and maintenance)</li> <li>• checks-up a smart installation.</li> </ul>
<b>P3 PRACTICAL EDUCATION - PARAMETERING OF SMART HOME INSTALLATIONS</b>	
Setting up a smart installation	<p>Student:</p> <ul style="list-style-type: none"> <li>• sets up the interfaces between different networks,</li> <li>• analyzes possible ways of managing equipment,</li> <li>• develops event sequences (scenarios) for managing lightning, shading, cooling, heating and ventilation systems,</li> <li>• uses software to program smart installation and monitor its operation (SCADA).</li> </ul>
Smart installation performance overview	<ul style="list-style-type: none"> <li>• inspects the operation of the smart installation,</li> <li>• modifies and upgrades the operation of smart installation according to user requirements.</li> </ul>

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