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WirelessUP!

UPraising VET skills for innovation in European electrotechnical sector

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Recommendations for local implementation of smart systems in VET for Industry 4.0

Intellectual Output 1

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Introduction

In the emerging era of Digital Economy and Industry 4.0 the vocational education and training are lacking behind with delivering relevant offer and skills of new VET professionals. The Wireless-UP project aims at delivering new and innovative learning contents in the sector of electrotechnics. The sector is chosen because it is the sector which has cross-cutting influence and covers the field of building, industry and automatization.

Internet and wireless technology are changing the economy of tomorrow, called digital economy. It will revolutionize every commercial sector, disrupt the workings of virtually every industry, bring with it unprecedented new economic opportunities, put millions of people back to work, and create a more sustainable low-carbon society to mitigate climate change. Hand in hand with the process of digitalization emerges Industry 4.0 which refers to the fourth industrial revolution that creates gaps in productivity and changed people's behaviour throughout the world. Industry 4.0 is the transformation of the whole industrial production through the application of digital technology to the traditional industry. One of the key communication aspects in Industry 4.0 and Digital Economy are sensors. Sensors are embedded into every device and appliance, allowing them to communicate with each other and Internet users, providing up to the moment data on the managing, powering, and moving of economic activity in a smart Digital Europe. Already, 14 billion sensors are attached to resource flows, warehouses, road systems, factory production lines, the electricity transmission grid, offices, homes, stores, and vehicles, continually monitoring their status and performance. By 2030, it is estimated there will be more than 100 trillion sensors connecting the human and natural environment in a global distributed intelligent network.

WirelessUP – The Project

The WirelessUP project recognises the shift in the digital economy and Industry 4.0. It thus seeks to develop new vocational module which will contribute to the further strengthening of key competencies in VET curricula in the electrotechnical sector according to the needs of the Industry 4.0 and Digital Economy. Alongside with the module, a new toolkit for VET students and learners will be developed to facilitate the gaining of new skills. The Skills Benchmarking model in form of local and transnational competitions will be developed to assess and compare skills of VET students and learners from different countries learning the same module. Through all the involvement of VET students and learner accent will be put on gaining practical skills, as key skills that are directly applicable and usable in the VET expert labour market.

The WirelessUP! project aims at contributing to :

1. smart growth by closing the gap between the set of traditional competences used to predict performance within VET organizations and the new challenges set by the digital economy. Specifically project will focus on implementation of wireless communication between sensorial technologies within existing VET curricula for smart and sustainable houses and industry.

2. sustainable growth by focusing and developing competencies for energy efficiency solutions in order to turn the digital economy into a knowledge-driven sustainable business, with higher productivity and higher skilled employees. The project aims at upskilling digital competencies and spreading the digital culture.

3. inclusive growth by providing through VET training “a more skilled workforce, capable of contributing and adjusting to technological change with new patterns of work organisation” (Agenda for New Skills and Jobs).

The project has identified some specific needs that refer to its target groups, namely:

1. VET students and learners – New Wireless-UP! training module for wireless technologies among sensors will be implemented to support professional growth, job opportunities and company competitiveness with a double effect: to generate new jobs and change the existing jobs.

2. VET Teachers/trainers – New skills opportunities mean, however, demand for new skilled VET providers, not only among new recruited but also among the present staff.

3. SMEs and Industry - Employers and training providers will have to agree changes to restructure and modernize existing curricula and training pathways as well as to retrain trainers, including professional skills in new technologies as pillars of training courses.

Intellectual Output 1: Recommendations for local implementation of smart systems in VET for industry 4.0

Aim

The *Recommendations for local implementation of smart systems in VET for industry 4.0* have the aim of providing a baseline for implementing of educational framework of the Wireless-UP! training module. The Recommendations provide a first step in the development and implementation of the WirelessUP educational module.

The methodology of the output is set as following:



- The Desk research included existing secondary data already existing to ensure the understanding and future comparison of differed partners’ VET systems and electrotechnical educational sector. The core of the desk research is to share priorities and mechanisms within: 1. policy and standard coherence at vertical and horizontal levels; 2. focus on local development priorities and plans; 3. development of innovative learning model.
- The Interviews with SMEs and Industry include altogether 14 interviews (3 per country with 1 non valid) in order to get feedback of employers about their involvement in Industry 4.0 and the need for specialized employees.
- Identification of existing VET programs where the new WirelessUP educational module could be implemented.

The Recommendations are designed to:

- include main ideas and recommendations for establishing a joint part of innovative learning models with implementation of smart sensorial systems in VET
- be in line with the legal framework of each region and country
- be in line with the European instruments: EQF, ECVET and ESCO
- set up a general educational framework for future steps
- be an open document which can be updated according to the changes and needs.

Desk Research

Methodology of the Desk Research

As one of the methodological pillars of the Recommendations partners have used the desk research method. Desk research is the collection of secondary data from internal sources, the internet, libraries, associations, government agencies, and published reports. As secondary data resources project partners have used EU and national strategies, publications of national governments concerning VET and of CEDEFOP, databases of national bureaus of statistics, databases of employment services, different publications of different stakeholders as well as strategic plan documents.

A desk research methodology was developed in order to collect data about:

- socio-economic base of each partner country;
- overview of VET systems of partner countries;
- best practice example VET electrotechnical sector in each partners' institution.

The data was used to get an overview and insights of each partner country. This makes the baseline for defining the project methodology and further development of the WirelessUP educational Module. In summary, the desk research informs and supports the Recommendations by:

- providing insights in the current status of the VET in the 5 partners' countries;
- highlighting differences and similarities in VET and the education for electrotechnical sector;
- highlighting some best practice examples to be considered in future work.

Results

The partnership consists of five countries reaching from Turkey, Croatia, Slovenia up to Czech Republic and Germany. The countries itself represent the transition from a candidate country (Turkey) over new members (Croatia) up to developed countries as Germany. On the other side there is also a possibility of compare within the partnership also countries that went through the process of transition (Croatia, Slovenia and Czech Republic) and countries that have stabile economies as Germany.

At the socio-economic level partner's countries show significant differences. Germany and Turkey have the highest inhabitants population reaching from 80,69 mil in Turkey to 82,67 mil in Germany.

On the other side smaller countries are Czech Republic with 10,56 mil and Croatia 4,17 mil with Slovenia 2,06 mil.

Differences may be seen also at the level of economic development. Germany, as the leading country in EU, shows the highest macroeconomic figures and is the current largest economy in Europe, the European Union and the Eurozone. In January 2018, the number of unemployed people in Germany was at a level of 5,8%. According to the Job Centre, in Bavaria, 253.501 persons were registered as unemployed, which corresponds to an unemployment rate of 3,5%. In Germany, the current number of employed persons reached a new record high.

According to the World Economic Outlook Report of the World Bank 2017, on the basis of the purchasing power parity (PPP), Turkish economy is the 13th largest in the world and 5th largest in Europe in 2016. However, the biggest problem of its economy is high inflation with 11% in 2017 and an actual inflation rate of 12,15%. European union average is around 2,4% annually. Unemployment and youth unemployment rates are also high hitting 10,60% and 19% respectively (3.354 million unemployed in total).

Although growth is expected to wane in 2018, the GDP growth in Czech Republic will nevertheless remain strong with its government debt being low. Heading into 2018, the unemployment rate reached a record low. Moreover, the number of job vacancies reached a new all-time high. The unemployment rate was in 2017 at 2,9% being one of the lowest in the EU.

Slovenia's economic growth accelerated towards the end of last year, reaching a ten-year high. According to initial estimates from the national Statistical Office, the country's GDP rose by 5% in real terms in 2017. These upward trends were most pronounced in the last quarter of the year, with GDP growing by 6% on the last quarter of 2016. On the other side the percentage of unemployed is constantly decreasing and in 2017 reaching 9%.

Croatia is since 2014 reaching out of the 7 years long recessions. Since 2014 GDP was rising from -0,1 in 2014 to 2,8% in 2017. Still Croatia is economically seen at the bottom of the European Union concerning economic indicators. According to the Croatian Bureau of Statistics, there is a constant decrease of the number of unemployed persons. In 2014 the unemployment rate was 19,6%, whereas in 2017 it was reduced to 12,4%.

VET

A characteristic feature of the **Czech** education system is that all basic school leavers (almost 95%) continue studying after the completion of compulsory education. Most of these students acquire a vocational qualification that is recognised by the labour market as early as at upper secondary level. The responsibility for the development of principal pedagogical documents for public schools rests with the Ministry of Education, Youth and Sports (MoEYS). It assigns this task to the relevant expert institutions, coordinates their work and approves the final documents. Non-formal groups of teachers, teachers' organisations and independent professional associations contribute to the modernisation of the existing, and the design of new, curricula. The autonomy that schools have gained facilitates considerable diversity as to the content of education and the shaping of distinct school profiles which accommodate regional needs and the students' interests. This is also present in the electrotechnical sector and allows constant upgrading of educational contents.

VET plays a major role in **Croatia**. Since the 2013 Act on the Croatian qualifications framework (CROQF), 25 sector skills councils cover general, vocational and higher education. The Human Resource Development Council assesses, validates and coordinates education, employment, and lifelong professional guidance policies, regional policy and CROQF development, aiming to encourage human potential development, stimulate competitiveness and achieve Croatia's strategic goals. All VET programmes combine professional and general competences, to varying degrees; most include mandatory work-based learning (WBL), though duration and type varies.

In **Germany**, education policy lies individually in the hands of the federal states. That means that the different federal states have different kinds of exams, degrees and types of schools. However, the basic idea of the education system is the very same in all the federal states. After eight years of secondary high school, the pupils pass their final high school exams. If the students choose to attend middle school (five years) or secondary school (six years), they have to go to a vocational school or a vocational school within the dual system afterwards. In a vocational school, the students spend the whole vocational training at school. In contrast, if they choose the vocational training in the dual system, the apprentices are employed in a company in first place.

In the **Slovenia**, the education system is organized mainly as a public service rendered by public and private institutions and private providers holding a concession who implement officially recognized or accredited programs. Concerning the governance of public institutions, the state and the local communities have several roles given that they are the regulators, founders, main financiers and supervisors. After completing primary education the pupils can enrol into general upper secondary education, Technical upper secondary education (EQD4/SQF5), Vocational upper secondary education (EQF4/SQF4) or Short vocational upper secondary education (EQF4/SQF4). Formal education is not enough coupled with the economy, so the formal structure of the working force often does not match the needs of the economy. In general, the flexibility of formal education for the needs of the economy is too small, as the needs of the economy are rapidly changing.

In **Turkey**, the education system comprises three main structures: pre-school education, basic education and general secondary education and vocational secondary education. Professional Competency Board carries out the research done by the competency boards in European countries. Within the project for the development of vocational training (MEGEP), 42 occupational fields were determined and modular VET programs were designed for 194 majors. In accordance with the law 3308, these programs were classified according to İSCED 97 and the majors were named similar to the program names in Europe. VET institutions started the implementation of these modular programs with apprenticeship training in 2005-2006. Previously named apprenticeship training centre, these institutions provide education for 110 major fields. There are 378 Vocational Training Centres (MEM) whose aims are to prepare the individuals (who are 14-18 years old and who don’t have formal education) for their profession.

Good practice examples

Each partner has identified a good practice example in their country. The good practice examples are based on the factors or either supporting innovation or in fostering and enhancing competences for the electrotechnical sector. The methodology involved outstanding outcomes and success factors.

These range from support of national authorities, degree of innovation, costs for students, international certification, approaches to cover specific demands of the electrotechnical sector etc.

Croatia

Apart from the VET programmes at the secondary level, Electrical Engineering Vocational School Zagreb also provides additional non-curricula programs for VET students in the fields of electrical engineering and ICT. The good practice example of a program is Cisco Academy Network Technology course. The entire program in the school is realized in the third and fourth grade of the VET school, and it is the only school in Croatia that offers its students the opportunity to master this course with lowest price on the market in addition to the regular VET curriculum. The program's backbone is a practical work, and runs on network communication equipment and personal computers. After completing the program, attendees can access the CCNA (Cisco Certified Network Associate) 640-802 exam. It is an internationally recognized IT certificate which allows students immediate access to the labour market, or qualifies them for additional engineering and study in the field of science.

Czech Republic

Due to the lack of qualified teachers for teaching vocational subjects (around 5,000 teachers are missing for primary and secondary schools) in Czech Republic, Smíchovská střední průmyslová škola therefore integrates graduates in the teaching of vocational subjects. Success factor is the sharing of experience and knowledge. These graduates bring state-of-the-art information in professional areas and work and share experience with educators. Teachers give valuable advice to graduates from the point of view of the form and methods of teaching, classification, organizational forms of teaching. Furthermore graduates give teachers feedback about relevance and state of art on specific curricula during further study. An example of this approach is two school leavers who were actively interested in cyber security during their studies. After following their maturity exam, they have joined a group of experts who created the contents of the new cyber security field. On one side they teach these new subjects and on the other side they are still in further education.

Germany

A good example for the integration of industry 4.0 into the vocational training in the technical sector is the vocational training for mechatronics at the company Krone in Spelle. Here, the main part of the production processes are automated and the production itself is getting more and more digitalised and interconnected. Hence, industry 4.0 is a part of the daily work at the supplier for agricultural machinery. However, not only the production processes are digitalised. Even the produced agricultural machines are interconnected digitally by a complex Farm-Management-System. This does not only concern the controlling of the machines. It also works for the fleet management, the recognition of the agricultural production, data management and invoicing. Therefore, there are many training rooms with simulators that have been developed in the training workshop. It has to be mentioned that even customers are allowed to use these simulators for further training. In these training rooms, the drivers learn how to control the agricultural machines and to master the diverse functions. It is the job of the trainees to equip the models with functions that can perform fault simulations. That way, the correct operation of the control units and touchscreens in case of a malfunction can be trained.

Slovenia

Because of the presence of the Krško Nuclear Power Plant in the domestic environment, the idea for a closer cooperation of the school with the mentioned company was born in order to get to know the

technologies and processes used, which are necessary for efficient, and above all, safe operation of the power plant. At the initiative and support of the Nuclear Power Plant, the Radioactive Waste Agency, the Nuclear Decommissioning Plant and the GEN Energija, a professional Module of Basic Nuclear Knowledge was developed at the school. The module is optional in the open curriculum in the SSI Electro Technician Program and it is compulsory in the PTI Electro Technician. For the needs of the technical module at the school a wide range of simulation models, which clearly illustrate the operation of individual sets of devices, were built in the special classroom. The module is unique not only in Slovenia but also in Europe, since the students implement the practical part of the module in the Nuclear Power Plant itself on a simulator under the guidance of an instructor who trains future power plant operators. Furthermore a technical event of "Tehnogenij" (Technological Genius) is held each year, which aims to bring the technology closer to young people and to encourage them to innovate.

Turkey

As profession becomes very important in vocational and technical education, Turkey ministry of education decided to build thematic vocational and technical schools in different regions of Turkey. Within this scope pilot regions were selected based on the economic and social features of the regions in 2017. Selected cities were Ankara, Adana, Erzurum, Sivas, Sakarya, Kocaeli, Istanbul, Izmir Konya and Samsun. Every city has different profession based on the economic activity in their regions. For example in Sakarya where the automobile industry is developed, the Motor Vehicle technology vocational and technical high school was established and built. In the sector of electrotechnics, the Erzurum Electronics technology vocational and Technical high school provides vocational and technical education to meet the need of qualified workforce. The School provides 3-years vocational and technical education in the departments of Coil Winding, Office Machinery Technical services, Electrical Installations and Panel Mounting, Household Electrical Appliances Technical Services, Electromechanics Conveyor Maintenance, Industrial maintenance, Video and Audio-visual systems, Security Systems, Telecommunication Systems, Automation Systems and High Voltage Systems. More important is that the educators are selected based on the experience in electrotechnical sector. In practical part of the education, qualified workers in electrotechnical sector are engaged in order to provide students with relevant and up-to-date competences.

Questionnaires and Interviews

Methodology

Partners have prepared a questionnaire which measures the perception of sectoral representatives and SMEs toward industry 4.0 in electrotechnical sector. This questionnaire form (Annex II) was applied to sectoral representatives in each country. Each partner country conducted three interviews. However one of the interviews from Czech partner was missing due to insufficient answer and extracted from the sample and total of 14 interviews were collected.

The questionnaire was divided into three sections:

1. **General information** – In order to obtain data about the respondents and their main features, partners have prepared a general part where information about the size, number of employees, sector, production system and employee distribution have been collected.

2. **Quantitative research** – In order to generate numerical data or data that can be transformed into usable statistics, partners have used Likert-type questions as a method. Likert scale survey questions are essential in measuring a respondent's opinion or attitude towards a given subject. The answers of 14 questionnaires were put in SPSS 23.0 statistical programme in order to see the relationship between answers.
3. **Qualitative research** – In order gain an understanding of underlying reasons, opinions and motivations in the electrotechnical sector, partners have used an Interview as a method. It provides insights into the problem and/or helps to develop ideas or hypotheses of the current and future trends in the electrotechnical sector.

The collected answers with a detailed analysis can be found in Annex I.

Results

The partners have collected questionnaires from different sectoral representatives. Participating companies are either production or service companies which provide professional ERP solutions. At sectoral level, 3 companies are operating in professional and industrial devices sector, 3 companies in maintenance services, 2 companies in telecommunication devices sector, 2 companies in Electronic Components sector, 1 company in Software, Industrial Automation, Computer electronics and Automative Industry sector. Additionally 4 companies are providing Planning, Development and Integration services and become number one sector in our sample. Automation, IoT and machine learning are the services that they offer. The majority of the participating companies are medium size companies in terms number of employees with 42% of all companies, 36% of the companies can be considered as small companies and 2% of the companies are considered as micro companies.

Although the participating companies vary in the offer, size, market and sector, they mostly share the same status towards industry 4.0 and the importance of implementing it into VET systems of the participating countries. The conclusion of the questionnaire is that the companies and employees are still not fully implementing or are not prepared to fully implement the Industry 4.0. Companies still complain about a lack of qualified workforce with up-to-date skills and competences. Relevant skills would increase their employment opportunities. Companies are asking for more specific and especially practical education in technical and vocational schools. This would enable the employers to directly engage workers in the process and lower the need for prior in-house training due to the lack of necessary competences.

Concerning the electrotechnical sector IoT is a fundamental basis for new skills and competences. The questionnaire showed that knowledge of wireless technologies and their system mechanisms are also highly demanded in the sector. At the level of VET schools and the competences they offer in the electrotechnical sector, conclusions based on the questionnaire are:

- Vocational education must be in line with digital transformation.
- Vocational school students need to improve their qualifications because competency based hiring is very popular for industry 4.0.
- Sectoral representatives believe that digital transformation will bring new job opportunities therefore technical and vocational schools need to be proactive to see niches and paradigm shift at the industry and open more specific departments to prepare highly focused and competent individuals.

- Most of the sectoral representatives believe that current employees are not aware of industry 4.0. This is a new concept and technical and vocational schools must foresee upcoming trends at the industries to design their education curriculum.

At the level of companies and the workforce in the electrotechnical sector following conclusions based on the questionnaire can be made:

- Both companies and workers are not ready or not fully aware of industry 4.0.
- Part of the sectoral representatives is not fully aware of digital transformation.
- Knowledge of technical staff is critical for industry 4.0.
- Current skills and competencies of the technical staff are insufficient and need to be improved.
- Industry-university and industry-VET relationships must be improved with a specific focus on updating the curricula.
- New and specific courses should be provided to VET students and workers.

The new shifts in the sector offer great possibilities both for VET providers and adult education providers. Industry 4.0 is still developing, however educational providers should follow the change. Especially important is the transfer of relevant skills and competences though modernised curricula. This should be done in close cooperation with the sectoral representatives which are already implementing the principles of Industry 4.0 in their process. The adult education providers should prepare new programs in order to be able to offer further education to the existing workforce.

Concerning the specific topic and aim of the project, there is a common view. Wireless technologies and mesh networks are critical for further improvement in data transmission technology. Wireless technologies are base for the sensor technologies and automation as well. Therefore companies find wireless technologies as fundamental for the products and services they offer. VET offer should implement the wireless technologies in the electrotechnical sector. The VET students will be prepared for the entry into the labour market and have relevant and ready-to-use competences specific for Industry 4.0.

Implementation Possibilities of WirelessUP Training Module

Partners have conducted an analysis of each partner country's VET offer in the electrotechnical sector. The goal was to identify in which present vocational education and training programs the new WirelessUP! training module could be implemented. In order to be comparable the partners had to follow a methodology with following content at the level of a VET occupation:

1. EQF and NQF level of the qualification/program
2. Date of the program's foundation
3. Qualification(s) achieved at the end of the program
4. Duration of education and time of delivery (time/semesters/modules/years)
5. Key competences of the whole educational program.

At the level of the program, partners have identified courses/subjects in which the WirelessUP training module can be implemented. The methodology encompassed the following content:

1. obligatory/elective subject

2. basic/advanced
3. semester/module/year
4. learning outcomes

Following the above explained methodology, partners have identified altogether 28 occupations and 39 courses/subjects within the occupations in 5 partner countries which are suitable for implementing the new WirelessUP! training module. The following table shows the identified occupations and courses. Detailed description for each partner country can be found in Annex III. The listed courses generally exist in more than one program/occupation and vary in their electiveness.

Croatia	
Educational Program	1. Technician for Electrical Engineering 2. Technician for Computing 3. Technician for Electrical Machines with Applied Computing 4. Technician for Mechatronics 5. Technician for Electronics 6. Fitter for Regulating Systems in Smart Houses (adult education)
Courses	a. Microcontrollers b. Computer Embedded Systems c. Automatic Process Control d. Configuring Computer Network e. Security of Information Systems f. Installations of Smart Houses (adult education)
Czech Republic	
Educational Program	1. Information Technology 2. Technical Lyceum 3. Electronics 4. Electrotechnical and Machine Assembling work 5. Electrician 6. Computer Networks
Courses	a. Computer Networks b. Hardware c. Robotics d. IoT (Internet of Things)
Germany	
Educational Program	1. Industrial Electronics Technician 2. Electronics Technician for Building and Infrastructural Systems 3. Electronics Technician for Automation Technology 4. Mechatronics Technician 5. Electrical System Fitter
Courses	a. Analysing and Checking Devices and Assemblies b. Programming Realising Controls of Plants c. Customized Realisation of Building Technology Plants d. Integrating Systems and Assigning External Service e. Choosing and Integrating Drive Systems f. Realisation of Mechatronic Subsystems g. Activation, Troubleshooting and Maintenance
Slovenia	
Educational Program	1. Electrician 2. Industrial Mechanic

	3. Computer Operator 4. Electro Technician 5. Computer Technician 6. Electronic Communications Technician 7. Technician of Mechatronic
Courses	a. Making of Electrical and Communication Installations b. Use of Control Devices c. Covering and treatment of processed sizes d. Mechatronic Systems e. Use of microprocessor devices f. Planning automated units g. Management of ICT systems h. IT hardware maintenance i. Making electrical and communication installations j. Managing programmable devices k. Programming of devices l. Making of electrical and communication installations m. Diagnostics and troubleshooting n. Telecommunications network installation o. Set-up of local telecommunications and computer networks p. System measurement techniques q. Capture and processing of process variables r. Electro engine drive and regulation s. Use of microprocessor devices t. Transmission and recording of information u. Design of electrical installations v. Automation planning w. Digital technique x. Industrial controllers y. Industrial networks z. Intelligent house aa. Control systems
Turkey	
Educational Program	1. Mechatronics 2. Computer Programming 3. Machinery 4. Electricity
Courses	a. Computer Aided Drawing b. Microcontrollers c. Sensors and Transducers d. Programmable Logic Controllers e. System Analysis and Design, Analog Electronics f. Industrial Robots g. Electric Motors h. Scada Systems

Annex 1 Analysis of the Questionnaire with Interview

General Questions

The participating companies in the questionnaire are either production or service companies which provide professional ERP solutions. At sectoral level, 3 companies are operating in professional and industrial devices sector, 3 companies in maintenance services, 2 companies in telecommunication devices sector, 2 companies in Electronic Components sector, 1 company in Software, Industrial Automation, Computer electronics and Automative Industry sector. Additionally 4 companies are providing Planning, Development and Integration services and become number one sector in our sample. Automation, IoT and machine learning are the services that they offer. Size of the enterprises are also considered in this study and 6 companies have more than 50 employees, 5 companies between 10-30 employees and remaining 3 companies have 1-10 employees. So it can be said that majority of the companies are medium size companies in terms number of employees with 42% of all companies, 36% of the companies can be considered as small companies and 2% of the companies are considered as micro companies. When production systems of the companies are viewed, 6 companies have stated that they are using order based production (42%), 4 companies flexible production (29%), 3 companies Just in Time (JIT), Computer Integrated Manufacturing, Computer Aided Design and Mass production (21%), 2 companies Lean production (14%) and 4 companies answered as not applicable (29%). This means 4 companies out of 14 are only providing services like planning, integration, development and maintenance. However other 10 companies are both providing services and production. Further comparison of the countries can be seen in table 2 below.

Table 1: Comparison of countries

Country	Company	Sectoral Information	Number of Employees	Production Systems
Turkey	T1	Software	50+	Order Based Production, JIT, Computer Integrated Manufacturing
	T2	Industrial Automation	10-30	Order Based Production, Computer Integrated Manufacturing
	T3	Computer Electronics, Professional and Industrial Devices	1-10	Computer Integrated Manufacturing, Computer Aided Design, Flexible Production
Croatia	CR1	Telecommunication Devices	50+	Order based Production, Lean Production, Flexible Production
	CR2	Telecommunication Devices, Electronics Components	1-10	Computer Aided Design
	CR3	Maintenance	10-30	Not Applicable
Czech Republic	CZ1	Planning, Development,	50+	Order Based Production

		Integration		
	CZ2	Planning, Development and Integration	1-10	Not Applicable
Germany	G1	Automative Industry	50+	Mass Production, JIT, Lean Production, Flexible Production
	G2	Electronics Components	50+	Mass Production
	G3	Planning, Development, Integration, Maintenance	10-30	Not Applicable
Slovenia	S1	Planning, Development, Integration, Maintenance	10-30	Not Applicable
	S2	Professional and Industrial Devices	10-30	Mass Production, Order Based Production, Computer Aided Design
	S3	Professional and Industrial Devices	50+	Order Based Production, JIT, Flexible Production

Even though SMEs are focused on electrotechnical sector, it can be observed that many niche sectors exist. Some of the companies like in Germany are focused on sensor technologies in construction sector on the other hand some of others such as software programmer service companies which are providing tailor made solutions for bigger companies in order to integrate into industry 4.0.

Analysis of the Likert-type questions

The answers of 14 questionnaires were put in SPSS 23.0 statistical programme in order to see the relationship between answers. The following tables show the frequency, percentage and cumulative percentage per questions and answer.

Table 2: Question 1

I believe that digital transformation at the industry will influence the vocational education.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	9	64,3	64,3	64,3
	Rather Agree	5	35,7	35,7	100,0
	Total	14	100,0	100,0	

For the first question, 9 out of 14 respondents strongly agree with the statement and 5 of them rather agree. Respondent companies believe that digital transformation will influence the vocational education.

Table 3: Question 2

I believe that qualification of the vocational students have influence on the production process.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	5	35,7	35,7	35,7
	Rather Agree	7	50,0	50,0	85,7
	Not Sure	1	7,1	7,1	92,9
	Rather Disagree	1	7,1	7,1	100,0
	Total	14	100,0	100,0	

For the second question 12 of 14 respondent companies either rather agree or strongly on the statement that qualifications of the vocational students have influence on production process. So most of the firms believe that qualified workforce is essential for the efficiency in production.

Table 4: Question 3

I believe that the sector I work in will need digital transformation within the scope of Industry 4.0.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	5	35,7	35,7	35,7
	Rather Agree	6	42,9	42,9	78,6
	Not Sure	2	14,3	14,3	92,9
	Rather Disagree	1	7,1	7,1	100,0
	Total	14	100,0	100,0	

The third question aims to investigate the awareness of the respondent companies toward the sector they work in. Out of 14 respondent companies 11 (78,6%) stated that they believe the sector they work in needs digital transformation. However two of them are not sure whether the digital transformation is needed or not and 1 respondent stated that digital transformation is not needed. Considering these answers it can be said that most of companies in our sample haven't completely integrated the Industry 4.0.

Table 5: Question 4

I have knowledge on how to implement digital transformation process at my organization.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	4	28,6	28,6	28,6
	Rather Agree	6	42,9	42,9	71,4
	Not Sure	4	28,6	28,6	100,0
	Total	14	100,0	100,0	

This question aims to find out knowledge of respondent companies towards industry 4.0. Only 4 of the respondent companies completely rely on their knowledge on digital transformation, whereas 6 of them rather agree and 4 of the respondent companies are not sure about their knowledge on digital transformation. Considering these numbers it can be said that even sectoral representatives have some ambiguity about what the digital transformation is and how to implement it.

Table 6: Question 5

I believe that vocational school students' skills toward Industry 4.0 need to be improved.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	7	50,0	50,0	50,0
	Rather Agree	6	42,9	42,9	92,9
	Not Sure	1	7,1	7,1	100,0
	Total	14	100,0	100,0	

The knowledge and technical skills of the vocational school students are highly criticised by the sectoral representatives. Here it can be seen that 13 out 14 respondents agree that skills of the vocational school students are insufficient and their skills and technical knowledge needs to be improved in order to adapt changing job patterns within the scope of Industry 4.0.

Table 7: Question 6

I believe that digital transformation (industry 4.0) will bring new job opportunities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	8	57,1	57,1	57,1
	Rather Agree	4	28,6	28,6	85,7
	Not Sure	2	14,3	14,3	100,0
	Total	14	100,0	100,0	

Shifting human power to the machines and changing the qualifications of the workforce within industry brings new opportunities for job seekers. The electrotechnical sector opens new entry possibilities for highly skilled workforce. In our study 12 out of 14 respondent companies believe that Industry 4.0 will bring new job opportunities. The production will be fully automated and human power will be used less while technical knowledge will be more important and demanding.

Table 8: Question 7

I believe that digital transformation (Industry 4.0) will increase overall efficiency at the sectors.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	5	35,7	35,7	35,7
	Rather Agree	7	50,0	50,0	85,7
	Not Sure	2	14,3	14,3	100,0
	Total	14	100,0	100,0	

Efficiency is the one critical factor that all companies are aiming to achieve. However it is generally the main reason why most of the companies fail. In electrotechnical sector efficiency is even more important because, thanks to Industry 4.0, production processes become fully integrated and automated. Industry 4.0 unarguably increases the efficiency and in our study 12 out of 14 respondent companies agree with this statement.

Table 9: Question 8

I believe that security infrastructure needs to follow digital transformation (Industry 4.0).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	8	57,1	57,1	57,1
	Rather Agree	5	35,7	35,7	92,9
	Not Sure	1	7,1	7,1	100,0
	Total	14	100,0	100,0	

Security becomes one of the most important concerns in digital transformation. Therefore the question aims to find out the awareness of the respondent companies towards security infrastructure. It is critical that the security infrastructure is in line with the digital transformation and it should be fully integrated within all systems of a company. Out of 14 respondent companies 13 out agree the security infrastructure should follow digital transformation while only 1 respondent is indecisive regarding the statement.

Table 10: Question 9

I believe that the need for qualified technical staff will increase with Industry 4.0.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	9	64,3	64,3	64,3
	Rather Agree	5	35,7	35,7	100,0
	Total	14	100,0	100,0	

This questions aims to find out the demand toward technical staff. All respondent companies agree on the statement above and they believe that new job opportunities created by Industry 4.0 will focus on highly qualified technical staff.

Table 11: Question 10

I believe that companies are ready for Industry 4.0 (digital transformation).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Rather Agree	2	14,3	14,3	14,3
	Not Sure	8	57,1	57,1	71,4
	Rather Disagree	2	14,3	14,3	85,7
	Strongly Disagree	2	14,3	14,3	100,0
	Total	14	100,0	100,0	

As Industry 4.0 is a relatively new concept most of the companies are either not aware or still do not implement its principles. Therefore this question intends to obtain feedback from electrotechnical sector representatives about their current status of digital transformation. Here the answers are very important. Only 2 out of 14 respondent companies agree on the statement, whereas 8 of them are

not sure, and 4 of them somehow disagree with the statement. This is a very important indicator for the electrotechnical sector. It can be abstracted that companies are not ready for industry 4.0 so far. They must first create a basis and then gradually implement industry 4.0.

Table 12: Question 11

I believe that employees are aware of Industry 4.0.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Rather Agree	1	7,1	7,1	7,1
	Not Sure	8	57,1	57,1	64,3
	Rather Disagree	4	28,6	28,6	92,9
	Strongly Disagree	1	7,1	7,1	100,0
	Total	14	100,0	100,0	

This question has a positive correlation with previous question which is measuring the readiness of the companies for industry 4.0. Again 13 out of 14 respondent companies either not sure or disagree about the statement given. This means that most of employees are not aware of the industry 4.0 in the electrotechnical sector.

Table 13: Question 12

I believe that jobs will be more integrated with Industry 4.0.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	7,1	7,1	7,1
	Agree	8	57,1	57,1	64,3
	Not sure	5	35,7	35,7	100,0
	Total	14	100,0	100,0	

Industry 4.0 combines different job processes and make jobs dependent and integrated with each other. Especially with sensor technologies one process does not start without the signal of the previous process. The aim of this question is to measure the awareness of the respondent companies on job processes in Industry 4.0. The answers show that 9 out of 14 respondent companies somehow agree on the job integration and industry 4.0 relationships. However 5 respondent companies are not sure about this.

Table 14: Question 13

I believe that Industry 4.0 is well understood by companies.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Rather Agree	3	21,4	21,4	21,4
	Not Sure	6	42,9	42,9	64,3
	Rather Disagree	5	35,7	35,7	100,0
	Total	14	100,0	100,0	

This question also measures the companies' top management understanding the shift towards Industry 4.0. As it is in correlation with previous answers, only 3 respondent companies agree with

the statement and 11 out of 14 are either not sure or disagree on the statement. This means that there are some problems for understanding the Industry 4.0. Therefore firstly companies must know what the Industry 4.0 is and then explain this to their employees and arrange job processes accordingly. Industry 4.0 is a wide concept which changes job processes, production processes and employee demand.

Table 15: Question 14

I believe that universities have key roles in transition to Industry 4.0.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	5	35,7	35,7	35,7
	Rather Agree	6	42,9	42,9	78,6
	Not Sure	3	21,4	21,4	100,0
	Total	14	100,0	100,0	

Industry-university relationship is very critical for right education and R&D. Especially for technical and vocational schools this relationship is even more important. In this question it is aimed to measure the role of universities for transition towards Industry 4.0. Of 14 respondent companies 11 somehow agree on the key role of universities in transition to Industry 4.0. Universities and companies in the electrotechnical sector should have interacting relationships especially in R&D and in providing relevant education.

Table 16: Question 15

I believe that EU projects may have important contribution for transition towards Industry 4.0.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	5	35,7	35,7	35,7
	Rather Agree	6	42,9	42,9	78,6
	Not Sure	2	14,3	14,3	92,9
	Rather Disagree	1	7,1	7,1	100,0
	Total	14	100,0	100,0	

The last question in the Likert type part of the questionnaire was about EU projects and their contribution for Industry 4.0. Out of 14 respondent companies 11 believe that EU projects have important contribution toward Industry 4.0. This is also in line with the EU and member states investments and design of calls for proposals. Especially important is the joint effort in designing new processes, R&D contributions and preparing the workforce for Industry 4.0.

Interview Analysis

In the interview three questions were asked to each representative:

1. How do you prepare or already implement elements of Industry 4.0?
2. In your opinion, on which skills should VET providers focus on in order to train VET students ready for Industry 4.0 within the sector of electrotechnics?
3. Please explain the importance of wireless technologies in the automation process of buildings and/or industrial processes.

The answers of each country are put in three separate tables in order to understand and compare the answers of each country.

Table 17: Recognition of Industry 4.0

Country	How do you prepare or already implement elements of Industry 4.0?
Croatia	**A1:** We are doing a lot with process automation, applying IoT, machine learning and AI. **A2:** I am implementing KNX system for more than 15 years and during my career I took several courses from basic to advance to get more knowledge since industry is developing very fast. **A3:** We, ASSET+, are doing a lot with system automatization in 80% of ours systems. Like SCADA for example, through it we can manage: Chillers – their job is to make cold water for fan coils in buildings. Air conditioning chambers- their job is to handle air from buildings, use is for intake/output fresh/warm air. Central control unit – managing a building, from lights, air condition, escalators, elevators, parking systems, alarm systems and much more.
Czech Republic	**A1:** We're implementing the cloud computing mechanisms and IoT. **A2:** IQRF Alliance is a team of cooperating companies and institutions building up an ecosystem of IQRF-interoperable devices and related gateways, software, clouds, mobile apps, integration platforms etc. IQRF Alliance members are closely cooperating on building up an ecosystem of IQRF-interoperable end-devices, gateways, software, clouds, mobiles apps and integration platforms. IQRF Alliance supports them by providing them an effective communication platform, IQRF Interoperability Standard and promotion support. IQRF technology is wireless mesh technology used in hundreds of projects in the field of Smart City, Smart Building, Industry 4.0 and other IoT applications.
Turkey	**A1:** We provide project based solutions to industrial companies. We offer services which are fully adapted to 4.0 and especially create base for it. Based on the customer need we to offer solutions for digital transformation. **A2:** We have completely passed to industry 4.0 with our 25 years of experience. This shift has been achieved gradually. We used and improved the existing industrial robotic and automation technologies and applied them in marble sector. As the design of

	automaton varies in marble sector we offer customized tailor made solutions for each company. With industry 4.0 we increased the quality of workforce, security, product quality, efficiency and profitability. **A3:** Joint projects with customers make industry 4.0 inevitable for us.
Germany	**A1:** During the vocational training, we work with 3D-printers and the acquisition of sensor data. **A2:** Agile developments play an important role for our development and our company. This is why digitalization is highly important for faster progresses for projects and production and the integration of our co-workers in the process. Workplace design and the equipment of the workplaces are particularly important, as well as providing our co-workers the access to the new world of work. In order to achieve this, we have several pilot programs running in our company that focus on these challenges. The results are being discussed on the highest ranks. The time needed for the realization and continuation cannot be estimated at the moment. **A3:** At our construction sights and in our projects we implement visualizations that can be monitored for maintenance purposes by our clients and Hörburger AG either locally or remotely, via Real VNC and Microsoft Remote Desktop. We use solutions that safe cloud based data.
Slovenia	**A1:** The use of technology that enables integration into industry 4.0, development with software tools supporting industry 4.0, introduction of new technological processes adapted to industry 4.0 **A2:** We present customers with the use and possibilities of integrating wireless measuring instruments, We provide customers with the use and ability to capture and transfer data to the computer and into the cloud **A3:** I have already attended a few lectures on this subject.

Table 18: the Roles of VET providers toward achieving Industry 4.0

Country	**In your opinion, on which skills should VET providers focus on in order to train VET students ready for Industry 4.0 within the sector of electrotechnics?**
Croatia	**A1:** Return to enforce basic knowledge of mathematics (statistics), concepts of programming and communication – to well understand and be possible to apply knowledge on the real problems – problem-oriented teaching based on the basic concepts **A2:** Except theoretical basics in electrotechnics field student definitely should take even more practical knowledge at least to recognize some equipment when they show in the office for the first time.

	A3: They have to put much more effort to provide more quality knowledge of math, programming and computer science.
Czech Republic	**A1:** Students should be able to understand the main theory of IoT, cloud computing and digital economy. They must also know how to create basic IoT devices mesh, and how to configure it. They should know the risks of potential cyber threats. **A2:** Students should be able to build the basic IQRF mesh network, they should understand how it works, what are its benefits and limits, they should be able to decide for which IoT applications is it well usable, they should be able to connect the IQRF network through gateways to TCP/IP network. Students should be able to send basic DPA commands for network control and for obtaining sensoric and status data from devices.
Turkey	**A1:** Vocational education schools should focus on "technical drawing programs" which are used in the sector. 3D drawing labs should be provided to students so that they can use their imaginations to create something unique. Students should have sufficient infrastructure to apply what they have learned theoretically. **A2:** Firstly these education institutions should attract qualified individuals. Then these people should take technical education and be prepared for industry 4.0. So basically specific and practical education should be given. **A3:** Collaboration between industry and ministry of national education, Support or incentive to the schools which provides vocational or technical education for this purpose, Job Guarantee to the individuals who has received this education
Germany	**A1:** Wireless data transmission, Evaluating big data and deriving reactions, Combination of smartphones and tablets with conventional controlling systems **A2:** Particularly integrative skills for the challenges of the digital transformation. We must overcome generation borders as there is a different openness towards digital transformation. Channelled motivation because of the increasing complexity of the interconnection in the world of work. Teaching of personal resilience in the face of an increasing complexity in the world of work. Teaching of personal perspectives in terms of forms of cooperation (e.g. agile team work, "Kanban", etc.) **A3:** It can be recognized that not only private persons but also construction companies that build or renovate buildings seem to notice home automation systems. It might be good if students learn how to handle technologies that use transmission technologies like WiFi because in the future, devices that use IoT might be applied in the industry and trade. For making visualizations that can be shown by a browser, profound knowledge of HTML and CSS can be useful. There should be a certain curiosity for programming languages.
Slovenia	**A1:** introduction of new technologies and instrumentation, capture and transmission of data, signal processing, Data processing with software, knowledge of automation and

	robotics building blocks **A2:** simple presentation of industry 4.0, simple examples of everyday use of wireless technologies, basics of data processing. **A3:** VET providers should focus on providing practical work skills.

Table 19: Importance of Wireless Technologies

Country	Please explain the importance of wireless technologies in the automation process of buildings and/or industrial processes.
Croatia	**A1:** It's essential technology that enable connection of different needed devices for data collection and provide relevant actuation according to needs – it's impossible without communication where the wireless communication starts to be fundamental **A2:** WiFi as add-on for wired technology is good improvement in quick and easy access and monitoring of system I would say especially in maintenance service but also in usual day work as long as security access is maintain. **A3:** Wireless technology is very important in the automation process, for collecting data in electricity, heating, cooling, for example managing sprinkler systems (protection against fire), video and camera systems and many more. In case of fire alarm on business buildings, we can do everything with help of wireless technology, like manage elevators to put them in base position, opening the garage and all building doors for exits and many more.
Czech Republic	**A1:** Too risky I am afraid. We can never ensure real security in big wireless solutions on the base city / company levels to prevent the cyber threats. Cables are cables. **A2:** Some devices don't allow using cables for data transfer, some buildings have limits to use new cables for device control and obtaining data. Using cables is often very expensive. Using a reliable wireless mesh network usually solves these problems. IQRF Technology is a reliable wireless technology which works well in also harsh environments where other wireless technologies have problems in data delivery.
Turkey	**A1:** Process included units should be integrated and work together. Therefore communication protocols and their networks and integrity has critical importance. ın our projects we use distance I/O systems however we follow the wireless systems which provides efficient results. **A2:** It directly influenced. In marble sector image processing traditionally made by human eye and it was creating some errors. But with fully automated image processing device we have developed, errors were decreased to almost 0 and time spent on this activity is decreased dramatically. **A3:** Flexible and location free job opportunity. Fast, easy and terminal using flexibility.

	Infrastructure, Cost, Maintenance and Management
Germany	**A1:** Only by using wireless communication it is possible to use sensors and actuators in the planned number. **A2:** Wireless technologies are the key to the transmission of information to human beings and machines. They are the only way of synchronizing industrial processes in a more and more flexible and agile working environment. They represent a bridge between the planning and the fulfilment of tasks, quality assurance for products and monitoring. **A3:** Via wireless technologies, it is possible to query and control sensors and actuators with the smallest amount of effort. Especially for the reconstruction of a building, this is very good as only a very small number of data cables can be laid. Wireless devices are compact, they can be placed almost everywhere and they almost always have their own power supply in form of a battery. Of course, these need to be replaced from time to time. At the moment, we are only using Dydteme which uses common remote controls and frequencies. They don't work with the OSI-Model as does Wi-Fi for example.
Slovenia	**A1:** easier integration into the measuring system, Wi-Fi communication allows connecting peripheral equipment into smart grid, control and management **A2:** reduced use of wired/guided transmission media, simplified use and handling, easy data entry and transfer to the cloud. **A3:** The use of wireless technology can assist the industry to overcome the limitations of wired networks and benefits from the mobility and design freedom it offers. When considering the introduction of wireless technology into industrial process, different aspects must be considered: wireless means mobility: you can move around industrial process without disrupting connectivity. Intuitively a wireless solution is more efficient if it allows for an worease of the member of users connected to the same device, number of active networks.

Annex II Questionnaire Form

Introduction

Together with partners in different countries our organization is cooperating in a two-year-project selected by the European Union within the Erasmus+ Program. The project *WirelessUP!* is about implementing wireless communication in sensor technology within the existing vocational curricula for smart and sustainable housing and industry. We are in a first phase of creating common understanding and identifying good or promising practice within Croatia, Czech Republic, Germany, Slovenia and Turkey.

This questionnaire is aimed to find out SMEs and industry representatives' view toward digitalization and industry 4.0. The data gathered in this study will be used in creation of a new education *WirelessUP!* module. Therefore your contribution is so valuable in this study.

1. General information

1) Name		
2) Address		
3) Number of Employees		☐ 1-10 ☐ 10-30 ☐ 30-50 ☐ 50 and above
4) Sector	☐ Production	☐ Customer Electronics ☐ Telecommunication devices ☐ Computer Electronics ☐ Professional and Industrial Devices ☐ Electronics Components ☐ Defense Electronics (Military) ☐ Other _____
	☐ Services (within automation and digitalization)	☐ Planning ☐ Development ☐ Integration ☐ Maintenance ☐ Other _____
5) Which production system do you have at your organization/sector?		☐ Mass production ☐ Order based production ☐ Just in Time Production (JIT) ☐ Computer Integrated Manufacturing (CIM)

	☐ Computer Aided Design (CAD) ☐ Lean Production ☐ Flexible Production ☐ Not applicable
6) Employee Distribution	☐ Manager (……) ☐ Administrative Staff (……) ☐ Technical Staff (……..) ☐ Base line worker (……..)

2. Needs and trends in Industry 4.0

		STRONGLY AGREE	RATHER AGREE	NOT SURE	RATHER DİSAGRE	STRONGLY DİSAGREE
1.	I believe that digital transformation at the industry will influence the vocational education.					
2.	I believe that qualification of the vocational students have influence on the production process.					
3.	I believe that the sector I work in will need digital transformation within the scope of Industry 4.0.					
4.	I have a knowledge on how to implement digital transformation process at my organization.					
5.	I believe that vocational school students' skills toward industry 4.0 need to be improved.					
6.	I believe that digital transformation (industry 4.0) will bring new job opportunities.					
7.	I believe that digital transformation (industry 4.0) will increase overall efficiency at the sectors.					
8.	I believe that security infrastructure needs to follow digital transformation (industry 4.0).					
9.	I believe that the need for qualified technical staff will increase with industry 4.0.					
10.	I believe that companies are ready for industry 4.0 (digital transformation).					
11.	I believe that employees are aware of industry 4.0.					
12.	I believe that jobs will be more integrated with industry 4.0.					

13.	I believe that industry 4.0 is well understood by companies.					
14.	I believe that universities have key roles in transition to industry 4.0.					
15.	I believe that EU projects may have important contribution for transition towards industry 4.0.					

3. Specifics in electrotechnical sector

1. How do you prepare or already implement elements of Industry 4.0?
2. In your opinion, on which skills should VET providers focus on in order to train VET students ready for Industry 4.0 within the sector of electrotechnics?
3. Please explain, the importance of wireless technologies in the automation process of buildings and/or industrial processes.

Thank you for your time and contribution!

Annex III Detailed description of Implementation Possibilities of WirelessUP! Module

Croatia

The identified VET programs where the new educational WirelessUP module could be implemented share the same identified subjects. They can vary in the electiveness – in some programs they are obligatory and in the other elective.

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Technician for Electrical Engineering Elektrotehničar
EQF level	4
NQF level	4.2
Date of the program's foundation	1996
Qualification(s) achieved at the end of the programme	Technician for Electrical Engineering
Duration of education and time of delivery (time/semesters/modules/years)	4 years
Key competences of the whole educational programme	Technical design, production and control of various electrical engineering products, preparation of developmental technological and operational documentation of products in various telecommunication companies, electro-industry. With the help of other experts, he/she draws schemas, compiles technical calculations and parts drawing of an electrical engineering devices; he/she determines the way, the necessary materials and the appropriate tools and machines for making a particular product; constructs and assembles complex equipment and performs tests and control of electrical products and their parts. He/she can also work on maintenance of electrical power machines, devices and equipment; planning, construction and monitoring of electrical network construction and testing and maintenance of electric generators, energy transformers and aggregates. He/she works includes repair of defective devices and electrical appliances.

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Technician for Computing Tehničar za računalstvo
EQF level	4
NQF level	4.2

Date of the program's foundation	2013
Qualification(s) achieved at the end of the programme	Technician for Computing
Duration of education and time of delivery (time/semesters/modules/years)	4 years
Key competences of the whole educational programme	Compiles, services and maintaines hardware or computer hardware and installs complete programs in the computer. He/she draws, adds equipment and expands the work of the computer. There is a need for expert knowledge in electrical engineering and other technical areas - technical drawing and documentation, electrical engineering, electrical engineering and components, electrical engineering and fine engineering.

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Technician for Electrical Machines with Applied Computing Tehničar za elektične strojeve s primijenjenim računalstvom
EQF level	4
NQF level	4.2
Date of the program's foundation	2005
Qualification(s) achieved at the end of the programme	Technician for Electrical Machines with Applied Computing
Duration of education and time of delivery (time/semesters/modules/years)	4 years
Key competences of the whole educational programme	He/she works on computer engineering and programming of electrical machines, design, construction, testing, data processing and documentation. He/she also carries out the supervision of materials, semi-products and products, manages the production workgroup, works on operational and technological preparation of electrical machinery and equipment, prepares technological documentation, material planning and procurement, construction of electrical machinery parts and their standardization. He/she works in state-of-the-art electrical and industrial computers, as well as industry in general. He/she possesses basic knowledge of electrical engineering, automation, automated computer management, industrial computers, all the way to robotics.

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Technician for Mechatronics Tehničar za mehatroniku
EQF level	4

NQF level	4.2
Date of the program's foundation	2013
Qualification(s) achieved at the end of the programme	Technician for Mechatronics
Duration of education and time of delivery (time/semesters/modules/years)	4 years
Key competences of the whole educational programme	He/she designs, upgrades and maintains mechatronic systems - machines, tools and devices that consist of - Electronic, Mechanical, Optical, Automated and Computerized Circuits. More recently, there are more and more mechatronic products: for example, various robots, digitally controlled machines, automated vehicles, electronic cameras, fax machines, photocopiers, airplanes, etc. He/she deals with the design of automatic machines, devices and tools and, if necessary, upgrades these devices. He/she creates technological documentation for some device with the help of specialized computer programs (CAD / CAM, SOLID, -EDGE, CATIA). He/she also monitors the handling of complex processes in mechatronic devices.

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Technician for Electronics Tehničar za elektroniku
EQF level	4
NQF level	4.2
Date of the program's foundation	2013
Qualification(s) achieved at the end of the programme	Technician for Electronics
Duration of education and time of delivery (time/semesters/modules/years)	4 years
Key competences of the whole educational programme	He/she designs, manufactures and services electronic or electronic controlled devices. Preparation of technological procedures, conducting inter-test and control measurements, production line management, determination of the quality of manufacturing processes and the quality of the products themselves. He/she can work on product testing in special measuring laboratories where product conformity is complied with standards requirements and technical regulations. He/she can also perform assembly, servicing and maintenance of electronic devices and machines.

Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject	**Practical Skills (Radioničke Vježbe)**
a. obligatory/elective subject	obligatory in all occupations except in Technician

	for Computing
b. basic/advanced	basic
c. semester/module/year	in the fourth year
d. learning outcomes	• use of ARDUINO platform for controlling electrical devices (transformers, asynchronous motors and synchronous generators) remotely over a wireless network • measure the current and speed of rotation through the ARDUINO platform sensor • use the ARDUINO platform when setting up video surveillance • use the ARDUINO platform for lighting management • use the ARDUINO platform when measuring current power consumption at home appliances
Subject	**Microcontrollers**
a. obligatory/elective subject	obligatory in occupations Technician for Computing, Technician for Mechatronics, Technician for Electronics
b. basic/advanced	basic
c. semester/module/year	in the third year
d. learning outcomes	• define and describe the basic terms of a microcontroller • define and describe the framework and structure of the Arduino IDE program • analyze Arduino platform and Atmega 328P microcontroller • define and describe the purpose and method of using electronic components in the exercises (resistors, capacitors, potentiometers, transistors, relays, sensors, actuators) • define and describe the electrical scheme of the microcontroller connection with the associated electronic components • analyze the Arduino IDE program code • use the Arduino platform to solve the examples from the worksheet • use the Fritzing program to produce electrical diagrams • use the Arduino IDE program to program a microcontroller
Subject	**Computer embedded systems**
a. obligatory/elective subject	obligatory in occupations Technician for Computing
b. basic/advanced	basic
c. semester/module/year	in the fourth year
d. learning outcomes	• identify the basic ways of connecting microcontrollers to the physical world

	• illustrate the connection of the microprocessor interface with conventional electronic circuits (connection with resistive, capacitive and inductive loads with overvoltage protection) • use interface features for digital input and output signals • examine sampling principles and analogue-to-digital (AD) and digital to analogue (DA) conversion and interface for analogue input and output signals • create simple program slots for receiving input values, performing simple management tasks, and performing outbound operations • demonstrate how to measure time and generate time signals • compare the difference between direct programming of the microcontroller (without OS and programming by using OS's for real-time operation (RTOS) • define and describe the structure of the embedded computer system - model, definition • analyze a simple URS • describe the performance of the URS control part • define and describe the characteristics and application of sensors (shift, liquid level, temperature, movement, pressure) • analyze executive elements (actuators, interfaces) • analyze Display Elements (LED, Display) • analyze AD and DA transceivers • analyze serial communication • define and describe the control system using microcontrollers • define and describe the regulation (bi-directional, proportional, sequential)
Subject	**Automatic Process Control (AVP)**
a. obligatory/elective subject	obligatory in occupations Technician for Electrical Engineering, Technician for Electrical Machines with Applied Computing, Technician for Mechatronics, Technician for Electronics
b. basic/advanced	basic
c. semester/module/year	in the fourth year
d. learning outcomes	• provide basic theoretical knowledge on measurements of process and other non-electric sizes • adopt basic knowledge of the structure and mode of operation of the regulator

	• adopt the basic theoretical knowledge of automated control circuits • understand the principles of performance measurement systems and automated process management • know the performance and the ways in which devices and systems for remote measurement and control are operated • provide basic practical knowledge of measurements of process and other non-electric sizes • apply the basic practical knowledge of automatic control circuits • know the performance and the ways in which devices and systems for remote measurement and control are operated • connect, test, approve and enable simpler metering devices and automatic control devices
Subject	**Configuring computer network**
a. obligatory/elective subject	obligatory in occupations Technician for Computing, Technician for Electronics
b. basic/advanced	basic
c. semester/module/year	in the fourth year
d. learning outcomes	• set optimum router configuration • set the basic security settings on the switch and the router • configure simple routing protocols • connect two local networks using routers • configure a simple wireless connection • configure network devices to perform basic network services • configure a wireless connection between multiple LANs • configure a small home or office network with Internet access • apply Virtual Computers and Network Devices • connect video monitoring equipment and VoiP to a multi-service network
Subject	**Security of information systems**
a. obligatory/elective subject	obligatory in occupations Technician for Computing
b. basic/advanced	basic
c. semester/module/year	in the fourth year
d. learning outcomes	• described multilayer model of information security • protect your computer data • protect your computer's operating systems • protect Network Devices by Specification

	• explain basic approach to building an information system security policy • use tools to track network traffic

In Croatia there is no register of all verified adult education programmes by the Agency for Vocational Education and Training and Adult Education. Therefor it is not possible to list all programs in the educational sector where the new educational content of WirelessUP could be implemented. It is only possible to use the program which the institutions have, and in this case it is the Craft College as partner.

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Fitter for Regulating Systems in Smart Houses (Monter/ka za regulacijske sustave u pametnim kućama)
EQF level	EQF 4
NQF level	NQF 4
Date of the program's foundation	2016
Qualification(s) achieved at the end of the programme	Certificate of Up-skilling for Fitter for Regulating Systems in Smart Houses (Uvjerenje o usavršavanju za poslove montera/ke za regulacijske sustave u pametnim kućama)
Duration of education and time of delivery (time/semesters/modules/years)	300 hours
Key competences of the whole educational programme	1. Set building electrical installation according to the principle of smart installation. 2. Apply software tools to program smart home components and run installations. 3. Test the integrity of all components integrated into the intelligent system of a building. 4. Perform the service and repair of the required components of smart homes and apply IT technology in business. 5. Apply standards, norms and protocols used in automation of smart homes. 6. Develop and update technical and technological documentation for smart homes in a timely manner. 7. Apply business communication with co-workers and clients. 8. Apply legal protection measures at work and environmental protection.
Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject	Installations of Smart Houses (Instalacije pametnih kuća)
e. obligatory/elective subject	obligatory
f. basic/advanced	/
g. semester/module/year	20 hours of theoretical part, 80 hours of exercises
h. learning outcomes	Topic: Communication

	• Present the basics of the operation of a small bus installation • Explain the structure of the physical and group address of bus devices • Describe communication facilities for bus installations • Describe standardized data type • Describe the function blocks-control of shadows and damping • Explain symmetric data transfer • Illustrate the connection of the power supply unit to the bus installation • Specify the required length of cable between the individual bus components <u>Topic: Topology</u> • Explain the structure of the complete bus network • Describe the connection of the physical address of the bus device to its position in the topology • Describe ways of transmitting information inside a line, between lines and between areas <u>Topic: Data</u> • Explain the original and the target address of the information sent <u>Topic: Bus devices</u> • Describe the types of input, output, and system units • Explain the parts of the bus devices • Demonstrate the internal structure of the bus coupler unit • Specify the functions of the transmitter module <u>Topic: Bus installations</u> • Apply low voltage supply power • Specify the requirements when installing the bus units in the distribution cabinet • Indicate and apply protection measures against thunder • Describe the method for testing the resistance of the bus devices according to the disturbances <u>Topic: Checking the bus installation</u> • Perform check of connection of bus devices <u>Topic: Programming of bus devices</u> • Set up collector topology • Structure physical and group addresses • Perform parameter setting for bus devices • Conduct the connection of the

	communication facilities of the input and output bus devices
Subject b	Practical
a. obligatory/elective subject	obligatory
b. basic/advanced	/
c. semester/module/year	140 hours
d. learning outcomes	Topic: Configuring of smart home installations • Perform the external lighting management of smart homes • Perform internal lighting management of smart homes • Implement the management of smart homes • Perform centralized management of smart homes • Perform heating of smart homes • Activate or deactivate the alarm and supervisory functions via the bus installation • Implement a project for lighting, rolling, heating and central operation (off light / rollers above)

Czech Republic

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Information Technology/ Informační technologie
EQF level	4
NQF level	18-20-M/01
Date of the program's foundation	2008
Qualification(s) achieved at the end of the programme	Maturita exam
Duration of education and time of delivery (time/semesters/modules/years)	4 years
Key competences of the whole educational programme	• Design, build and maintain HW • Work with basic software • Work with application software • Design, implement and manage computer networks • Program and develop a user database, and web solution • Take care of work safety and health at work • Work for the highest quality of your work, products or services • To act economically and according to the sustainable development strategy

Identification of VET occupation for implementation of the Wireless UP Module

Occupation English/national language	Technical Lyceum/ Technické lyceum
EQF level	4
NQF level	78-42-M/01
Date of the program's foundation	2007
Qualification(s) achieved at the end of the programme	Maturita exam
Duration of education and time of delivery (time/semesters/modules/years)	4 years
Key competences of the whole educational programme	• To know the importance of education for their successful career and to understand the need for self-education and lifelong learning • Gain insight into technical issues, have a realistic picture of the content and complexity of the university studies under consideration and, especially in the technical fields, and the possibilities of their application after graduation • Controlled the basic methods of scientific work and solving technical problems • Applied mathematical and natural sciences and spatial imagination in solving technical problems, able to justify and defend the chosen solution; • Able to process and interpret data obtained through observations, experiments, and measurements • Have created the right idea and idea of the technical feasibility of a particular project • Take care of work safety and health at work • Work for the highest quality of your work, products or services • To act economically and according to the sustainable development strategy

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Electrotechnics/ Elektrotechnika
EQF level	4
NQF level	26-41-M/01
Date of the program's foundation	2007
Qualification(s) achieved at the end of the programme	Maturita exam
Duration of education and time of delivery (time/semesters/modules/years)	4 years
Key competences of the whole educational programme	• Apply standardization principles, follow valid technical standards and graphically communicate • Perform electrotechnical calculations and apply graphical methods for solving problems using basic electrotechnical laws, relationships and rules

	• Perform assembly and wiring work, design, connect and assemble simple electronic circuits, design and fabricate printed circuit boards and perform manual and basic machining of different materials • Measure electrotechnical quantities • Take care of work safety and health at work • Work for the highest quality of your work, products or services • To act economically and according to the sustainable development strategy

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Electrotechnical and machine-assembling work/ Elektrotechnické a strojně montážní práce
EQF level	3
NQF level	26-51-E/01
Date of the program's foundation	2010
Qualification(s) achieved at the end of the programme	Vocational certificate
Duration of education and time of delivery (time/semesters/modules/years)	3 years
Key competences of the whole educational programme	• Use technical documentation at work • Work with electrotechnics and engineering materials and components • Mount and disassemble simple electromechanical products and equipment, performing service and maintenance activities at the appropriate qualification level • Take care of work safety and health at work • Work for the highest quality of your work, products or services • To act economically and according to the sustainable development strategy

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Electrician/ Elektrikář
EQF level	3
NQF level	26-51-H/01
Date of the program's foundation	2007
Qualification(s) achieved at the end of the programme	Vocational certificate
Duration of education and time of delivery (time/semesters/modules/years)	3 years
Key competences of the whole educational programme	• Perform installation, repair and maintenance work on electrical equipment under professional supervision in accordance with OSH requirements and Electrotechnical Decree

	• Perform electrotechnical measurements and evaluate the measured results • Use technical documentation • Take care of work safety and health at work • Work for the highest quality of your work, products or services • Act economically and according to the sustainable development strategy

Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject a	Computer networks/ Počítačové sítě
i. obligatory/elective subject	Obligatory
j. basic/advanced	Advanced
k. semester/module/year	1 year
l. learning outcomes	• Learn how to distinguish individual network topologies, understand the principles of network communication, design and implement a simple computer network using active and passive elements • Is able to classify networks according to the chosen criterion, eg physical, logical, geographic etc., knows the basic principles of network communication, uses OSI reference model to describe network communication, can realize a simple network using passive and active elements • It is able to distinguish the types of cable lines and their parameters, to choose their use according to given conditions, to distinguish network elements such as hub, switch, router, knows basic functions of these devices, can configure basic parameters such as IP address, passwords, routing protocols etc. It can configure network parameters for the network (IP address, mask, DHCP, DNS), and use the network services of the operating system • It is orientated in different ways to connect to the Internet and can set parameters for Internet connection • It can orientate itself in IP addresses of computer networks, can configure and use DHCP services, know the principle of NAT function. Can classify wireless devices and configure their parameters. It focuses on routing between networks • He knows basic ways of attacking the network and can protect it by appropriate means. Can identify network failure, consult technical support issues, and troubleshoot

	common problems • Know how to use an IQRF platforms for controlling electrical devices in computer networks (control of active components of a computer network such as routers, repeaters, hubs and switches, remote account management and remote computer maintenance)
Subject b	Hardware
e. obligatory/elective subject	Obligatory
f. basic/advanced	Basic
g. semester/module/year	1 year
h. learning outcomes	• Knows basic computer components and their properties, compares them, designs, selects and compiles a computer of suitable parameters according to the user's needs • Know how to use an IQRF platforms for controlling electrical devices in hardware subject (control of lighting, temperature and power measurement, control and adjustment of ventilation or water cooling, switching on or off of individual components or the whole devices, remote license installation and volume licensing, and computer maintenance)
Subject c	Robotics/ Robotika
m. obligatory/elective subject	Elective
n. basic/advanced	Advanced
o. semester/module/year	1 year
p. learning outcomes	• Knowledge of the basis of robotic systems, their classification, internal structure and basic components of which these systems are composed (control unit, HMI, drives, sensors, mechanical components) • Control of SW environment, device abstraction and data acquisition, applications for algorithm calculations - structures, procedures, templates, sensor control - calibration, signal control, error reporting and detection, remote control - feedback, stability, decision making, planning and searching • Know how to use an IQRF platform for controlling electrical devices in robotics
Subject d	IoT/ Internet věcí
i. obligatory/elective subject	Elective
j. basic/advanced	Advance
k. semester/module/year	1 year
l. learning outcomes	• It explains how the general Internet and the Internet of things work • understand the limitations and possibilities of

	wireless and mobile networks for the Internet of Things • Using basic measurement tools, real-time packet network performance monitors • It analyzes compromises in interconnected wireless embedded sensor networks

Germany

In the 10th grade, in all the electric and electronic professions, almost the same basic contents are being taught. Among them are the following:

- Behaviour and characteristic quantities of exemplary components and functional units
- Measurement methods, functional checks, troubleshooting
- Block diagram, IPO-model, sensors, actuators, interfaces
- Functional chain, functional descriptions
- Hard-wired programmed and stored-program signal processing
- Logic basic interconnections, memory function
- Standards, regulations and rules
- Technical documentations

The above-mentioned topics offer the possibility to include the basics of wireless sensors and wireless signal transmission and signal processing in class (on a quite abstract and not too high level). Thus, the basics of "wireless technology" can be implemented in all electrotechnical professions. This basic knowledge can be taken up and repeated in higher grades. Moreover, it can be intensified according to the demands of the profession.

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English / **national language** (school-specific abbreviation)	industrial electronics technician – **Elektroniker für Betriebstechnik (EBT)**
EQF level	4
NQF level	4
Date of the program's foundation	16.05.2003
Qualification(s) achieved at the end of the programme	skilled workers certificate
Duration of education and time of delivery (time/semesters/modules/years)	3.5 years
Key competences of the whole educational programme	The trainees install, maintain and repair electric operational, production and processing plants, reaching from switch and control installations to installations for energy supply and communication and lighting technology.
Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject **(Learning area 6): Analysing and checking devices and assemblies**	
a. obligatory/elective subject	obligatory
b. basic/advanced	basic
c. semester/module/year	module (2. year, learning area 6)
d. learning outcomes	• plan and organise engineering change orders and maintenance orders on devices and

	systems due to the customers' demands • determine the work steps • analyse devices, modules and the effects between the components of a system • use technical literature, datasheets and instructions (also in English) • determine the function and performance of the elements of a system.
Subject **(Learning area 7): Programming and realising controls for plants**	
a. obligatory/elective subject	obligatory
b. basic/advanced	basic
c. semester/module/year	module (2. year, learning area 7)
d. learning outcomes	• plan the control of systems and analyse the control of existing systems and adapt them to customers' demands. • understand and analyse controls and use tools for programme development, configure and parameterise the necessary software and hardware components • choose the notation in compliance with the norms and regulations • activate systems on their own and monitor their function.

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English / **national language** (school-specific abbreviation)	electronics technician for building and infrastrucual systems – **Elektroniker für Gebäude- und Infrastruktursysteme (EGI)**
EQF level	4
NQF level	4
Date of the program's foundation	05.2005
Qualification(s) achieved at the end of the programme	skilled workers certificate
Duration of education and time of delivery (time/semesters/modules/years)	3.5 years
Key competences of the whole educational programme	The trainees maintain, monitor, control and improve the infrastructures for building technology, e.g. ventilation systems, heating, electric and security systems, diagnose errors and correct malfunctions.
Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject **(learning area): Customised realisation of building technology plants**	
a. obligatory/elective subject	obligatory
b. basic/advanced	basic
c. semester/module/year	module (2. year, learning area)
d. learning outcomes	• configure a complete system due to customers' demands • choose the components and integrate them in the existing systems and parameterise the components and their functions

	• adjust the functions of components to the specific demands. • Specific contents are: Sensors and actuators, central and decentralised controlling, as well as regulations, bus systems and transmission media.
Subject **(learning area):** Integrating systems and assigning external service	
a. obligatory/elective subject	obligatory
b. basic/advanced	advanced
c. semester/module/year	module (3. and 4. year, learning area)
d. learning outcomes	• develop customised proposals for the integration of communication systems in building and infrastructural systems. • develop concepts for the realisation of bus systems and security technology • configure subsystems, check the functionality of the components and replace the defect ones • use technical documentations in English.

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English / **national language** (school-specific abbreviation)	electronics technician for automation technology – **Elektroniker für Automatisierungstechnik (EAT)**
EQF level	4
NQF level	4
Date of the program's foundation	05.2004
Qualification(s) achieved at the end of the programme	skilled workers certificate
Duration of education and time of delivery (time/semesters/modules/years)	3.5 years
Key competences of the whole educational programme	The trainees install highly complex and computer controlled industrial plants. They make sure that the individual modules form one automatically working system. Therefore, they programme and test the plants, activate them and maintain them.
Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject **(learning area): Programming and realising controls for plants**	
a. obligatory/elective subject	obligatory
b. basic/advanced	basic
c. semester/module/year	module (2. year, learning area)
d. learning outcomes	• plan system controls, develop solutions and choose the right modules, building systems, sensors and actuators • create complex programmes, make the necessary arrangements, define the handover points and add parts of the programme • use English software surfaces and realise controls, present them to the companies and give instructions to their use • Specific contents are: Compact, modular and

	computer based controls, assemblies and digital as well as analogue signal processing.
Subject **(learning area): Choosing and integrating drive systems**	
a. obligatory/elective subject	obligatory
b. basic/advanced	advanced
c. semester/module/year	module (2. year, learning area)
d. learning outcomes	• integrate drive systems in controls and regulations and realise the necessary parameterisation • Specific contents are: Analogue and digital programmable sensors.

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English / **national language** (school-specific abbreviation)	mechatronics technician – **Mechatroniker (TEM)**
EQF level	4
NQF level	4
Date of the program's foundation	07.2002
Qualification(s) achieved at the end of the programme	skilled workers certificate
Duration of education and time of delivery (time/semesters/modules/years)	3.5 years
Key competences of the whole educational programme	The trainees build mechanical, electrical and electronic components, assemble them to complex systems, install controlling software and maintain the systems.
Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject **(learning area): Realisation of mechatronic subsystems**	
a. obligatory/elective subject	obligatory
b. basic/advanced	basic
c. semester/module/year	module (2. year, learning area)
d. learning outcomes	• describe the structures of mechatronic subsystems • explain the functions of sensors and converters, adjust sensors and apply their knowledge on controlling and regulations in order to affect the way and directions. • design fundamental circuits and describe the function (also in English) • master simple programming techniques. • Specific contents are: Mode of action and signal behaviour of sensors and converters, programming of simple motion sequences and control functions as well as the design of circuits.
Subject **(learning area): Activation, trouble shooting and maintenance**	
a. obligatory/elective subject	obligatory
b. basic/advanced	advanced
c. semester/module/year	module (3. and 4. year, learning area)
d. learning outcomes	• explain the procedure of the activation of

	mechatronic systems and determine the procedure for the activation of a complete system • adjust sensors and actuators, check the system parameters and adjust them • document the results and communicate in English • Specific contents are: Checking and adjustment of sensors and actuators, system parameters, bus parameterisation and software installation.

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English / **national language** (school-specific abbreviation)	electrical systems fitter – **Elektroanlagenmonteur (EAM)**
EQF level	4
NQF level	4
Date of the program's foundation	25. April 1997
Qualification(s) achieved at the end of the programme	skilled workers certificate
Duration of education and time of delivery (time/semesters/modules/years)	3 years
Key competences of the whole educational programme	The trainees mount, install, maintain and repair plants for energy supply technology, for control and regulation technology, for electronic signalling technology, for security technology and lighting technology.
Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject**: Working on plants with automation equipment**	
a. obligatory/elective subject	obligatory
b. basic/advanced	basic
c. semester/module/year	module (3. year)
d. learning outcomes	• analyse production and process technology systems and recognise the link between plants, components and devices. • install and activate devices and parts of a plant according to the corresponding plans • Specific contents are: Equipment for controlling, regulating, measuring and monitoring, active and passive sensors, BUS systems, interfaces, as well as wired and storage programmed processing of sensory data.

Slovenia

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Electrician /elektrikar
EQF level	4
NQF level	4
Date of the program's foundation	1.9.2008
Qualification(s) achieved at the end of the programme	Secondary vocational education European classification ISCED 3C National classification KLASIUS-SRV: 14001 KLAISUS-P: 5222
Duration of education and time of delivery (time/semesters/modules/years)	3
Key competences of the whole educational programme	The holder of the certificate is qualified to: • employ IT for design, preparation and archiving of basic documents and documentation in line with requisite instructions • calculate parameters and make, set and conduct measurements of basic electrical assemblies • connect users, provide protection, carry out measurements and basic maintenance works of electrical appliances, communication installations and equipment • carry out, connect and set parameters as well as repair programmes in control and relay modules.
Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject**: Making of electrical and communication installations (6 credits)**	
a. obligatory/elective subject	obligatory
b. basic/advanced	basic
c. semester/module/year	module
d. learning outcomes	• implement basic maintenance work on electrical and communication installations • implement basic measurements on electrical and communication installations and equipment • networking of computer systems in local networks and the Internet-implements wired LAN networks in buildings • connect the basic active elements of the computer network,-distinguish between the access point, the router and the client on the wireless network • configure typical wireless network blocks
Subject**: Use of control devices (6 credits**)	
a. obligatory/elective subject	obligatory

b. basic/advanced	basic
c. semester/module/year	module
d. learning outcomes	• connect and adjustment of the steering circle elements • implement of wiring diagrams of control systems • implement and install of simple, applications with control technology elements • assemble of a simple program in control relay modules • set parameters and correct programs in control relay modules • monitor the parameters of production machines
Subject**: Covering and treatment of processed sizes (6 credits)**	
e. obligatory/elective subject	elective
f. basic/advanced	basic
g. semester/module/year	module
h. learning outcomes	• prepare and implement measurement in laboratory and industrial environments • test and check the suitability of electrical appliances • measure electromagnetic radiation, interference, power supply devices • wire assembly and connect sensors and implement of the adjustments • capture, store, process and display the captured process quantities • select and install wiring sensors and measuring transducers • make a measuring station using a computer application

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	INDUSTRIAL MECHANIC / Mehatronik operater
EQF level	4
NQF level	4
Date of the program's foundation	1.9.2008
Qualification(s) achieved at the end of the programme	Secondary vocational education European classification ISCED 3C National classification KLASIUS-SRV: 14001 KLAISUS-P: 5200
Duration of education and time of delivery (time/semesters/modules/years)	3 years
Key competences of the whole educational programme	The holder of the certificate is qualified to: • carry out supervisory and control functions on the machine or production line

	• manage and set process, electrical and mechanic sizes and parameters • control more complex work process parameters, and chain the machine controller by way of synoptic diagrams and entry exit control elements • identify the load of machine elements and their function in the machine • monitor and record complex measuring parameters of the machine or line and identify basic control elements of the machine • prepare a machine for start-up, detect and localise faults in a machine, repair damage to a machine and replace damaged components with original spare parts • monitor machine functioning, fix and insert material in the machine, control work process, repair the machine in the event of a simple standstill in the work process, perform basic maintenance work • examine a general condition of the machine and energy sources, carry out basic maintenance work (machine cleaning and lubrication) • use computer applications, evaluate costs and ensure a well-regulated working environment • use standards, comply with rules and regulations on health and safety at work and environment protection • elaborate technical documentation and technical instructions by employing ICT technologies.
Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject**:** Use of control devices (6 credits)	
e. obligatory/elective subject	obligatory
f. basic/advanced	basic
g. semester/module/year	module
h. learning outcomes	• connect and adjust the steering circle elements • implement wiring diagrams of control systems • implement and install simple applications with control technology elements • assembly of a simple program in control relay modules • set parameters and correct programs in control relay modules • monitor the parameters of production machines

Subject: Mechatronic systems (6credits)	
i. obligatory/elective subject	obligatory
j. basic/advanced	basic
k. semester/module/year	module
l. learning outcomes	• assembly and disassembly of simple mechatronic systems; • maintain and repair of mechatronic systems

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	COMPUTER OPERATOR / RAČUNALNIKAR
EQF level	4
NQF level	4
Date of the program's foundation	1.9.2008
Qualification(s) achieved at the end of the programme	Vocational upper secondary education Secondary vocational education European classification ISCED 3C National classification KLASIUS-SRV: 14001 KLAISUS-P: 4811
Duration of education and time of delivery (time/semesters/modules/years)	3
Key competences of the whole educational programme	The holder of the certificate is qualified to: • employ computer software for design, preparation and archiving of basic documents and documentation in line with requisite instructions • perform basic maintenance works of electrical and communication installations • set up and check the functioning of operation systems and peripheral devices • set up, test and update standard software in line with instructions; archive and protect databases
Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject: Programming of devices (8 credits)	
a. obligatory/elective subject	obligatory
b. basic/advanced	basic
c. semester/module/year	Module/3
d. learning outcomes	• algorithmic Problem Solving • design and elaborate a simple programme • use of well-known solutions in new cases • program simple applications on programmable devices • make simple logical circuit • program of programmable relays • program relay mounting and wiring (PLC)
Subject: Making of electrical and communication installations (6 credits)	
a. obligatory/elective subject	obligatory

b. basic/advanced	advanced
c. semester/module/year	Module/ 3
d. learning outcomes	• implement basic maintenance work on electrical and communication installations • implement basic measurements on electrical and communication installations and equipment • networking of computer systems in local networks and the Internet-implements wired LAN networks in buildings • connect the basic active elements of the computer network • distinguish between the access point, the router and the client on the wireless network • configures typical wireless network blocks

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Electro technician / Elektrotehnik
EQF level	4
NQF level	5
Date of the program's foundation	1.9.2008
Qualification(s) achieved at the end of the programme	Upper secondary technical education Technical secondary education European classification ISCED 3 National classification 1 KLASIUS-SRV: 15001 KLAISUS-P: 5220
Duration of education and time of delivery (time/semesters/modules/years)	4 years
Key competences of the whole educational programme	• read, plan, elaborate, monitor and amend technical documentation in line with requisite instructions and by employing ICT • programme simple applications on programmable devices as well as programme, assemble and wire programmable relays • lay and wire different forms of electric and communication installations, connect users and carry out basic maintenance works • connect electric installation elements in switching, distribution and outlet-coupling devices as well as select and connect electrical protection • perform basic measurements and maintenance works of electrical and communication installations, interpret results and identify errors • set up necessary operating system settings and provide basic support to users when employing user software

	• adhere to measures for safe work with electrical appliances
Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject**:** Automation planning (8 credits)	
a. obligatory/elective subject	elective
b. basic/advanced	advanced
c. semester/module/year	module3
d. learning outcomes	• manufacture and maintain simple pneumatic, electro-pneumatic and hydraulic controls • program, install, start up, monitor and control the functioning of simple, automated multi-device units and video, carry out measurements and repair faults
Subject**:** Use of regulations (8 credits)	
a. obligatory/elective subject	elective
b. basic/advanced	advanced
c. semester/module/year	module/3
d. learning outcomes	• perform wiring, connecting, programming and setting up of parameters of primitives in control and regulation systems and carry out regulations • know the elements of the steering and regulation systems • know the individual elements of automated installations • connect the elements of the steering/regulatory circle • perform the necessary measurements on regulation systems • make a simple regulatory system, monitor and control the operation of steering systems • understand the importance of control systems and different signalling • produce simple SCADA programs • correctly select sensor and measuring peripherals, • connect sensors and measuring transducers
Subject**:** Managing programmable devices (8 credits)	
a. obligatory/elective subject	obligatory
b. basic/advanced	basic
c. semester/module/year	module/2
d. learning outcomes	• algorithmic Problem Solving • design and elaboration of a simple programme • use of well-known solutions in new cases • program simple applications on programmable devices • make simple logical circuit • program of programmable relays • Programmable relay mounting and wiring

	(PLC)
Subject**:** Making electrical and communication installations (6 credits)	
e. obligatory/elective subject	obligatory
f. basic/advanced	basic
g. semester/module/year	module/3
h. learning outcomes	• use sensors for electric power consumers • make simple electrical circuits that contain elements of intelligent installations and perform simulations of intelligent installations • know the functioning and importance of sensors in electrical installation systems

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Electro technician / Elektrotehnik
EQF level	4
NQF level	5
Date of the program's foundation	1.9.2008
Qualification(s) achieved at the end of the programme	Vocational-technical education European classification ISCED 3B National classification KLASIUS-SRV: 15001 KLAISUS-P: 5221
Duration of education and time of delivery (time/semesters/modules/years)	2 years
Key competences of the whole educational programme	• read, plan, elaborate, monitor and amend technical documentation in line with requisite instructions and by employing ICT • programme simple applications on programmable devices as well as programme, assemble and wire programmable relays • lay and wire different forms of electric and communication installations, connect users and carry out basic maintenance works • connect electric installation elements in switching, distribution and outlet-coupling devices as well as select and connect electrical protection • perform basic measurements and maintenance works of electrical and communication installations, interpret results and identify errors • set up necessary operating system settings and provide basic support to users when employing user software • adhere to measures for safe work with electrical appliances
Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject**:** Electro engine drive and regulation (8 credits)	
a. obligatory/elective subject	elective
b. basic/advanced	advanced

c. semester/module/year	module/2
d. learning outcomes	• perform wiring, connecting, programming and setting up of parameters of primitives in control and regulation systems and carry out regulations • know the elements of the steering and regulation systems • know the individual elements of automated installations • connect the elements of the steering/regulatory circle • can perform the necessary measurements on regulation systems, • can make a simple regulatory system, monitor and control the operation of steering systems • understand the importance of control systems and different signalling • know the principles of measuring the process- in the industry • produce simple SCADA programs and principles of operation Measuring transducers • correctly select sensor and measuring peripherals • connect sensors and measuring transducers
Subject**:** Use of microprocessor devices (8credits)	
a. obligatory/elective subject	elective
b. basic/advanced	advanced
c. semester/module/year	module/2
d. learning outcomes	• plan and program microprocessor boards • control, capture and regulate microprocessor boards, connect sensors and actuators to a simple microprocessor system, • know the structure, operation and use of microprocessor circuits • use the development environment of the microprocessor (IDE) and programs • acquire data from different sources of information • design of a microprocessor circuit • program a microprocessor circuit • perform control, capturing and controlling with microprocessor circuits • introduce input-output units (A/D converter, timer, communication interface) • learn programming in a higher programming language • use a development environment for a microprocessor (microcontroller) • connect the sensors to a microprocessor

	• capture input signals (analogue and digital) • connect elements for controlling high power consumers (transistor, relay, thyristor, triac, optocouplers) • depending on the needs of the application, select the appropriate microcontroller • perform measurements of digital signals in microprocessor circuits • connect sensors and consumers to a simple microprocessor system

The Electro technician / Elektrotehnik of 2 and 4 years duration share the following ellective subjects:

Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject**:** Capture and processing of process variables (8 credits)	
a. obligatory/elective subject	elective
b. basic/advanced	advanced
c. semester/module/year	module/1
d. learning outcomes	• select, install, assemble and wire sensors and measurement transducers • capture, store, process and display captured process variables in laboratory and industrial environments using computer applications
Subject**:** Use of microprocessor devices (8credits)	
a. obligatory/elective subject	elective
b. basic/advanced	advanced
c. semester/module/year	module/2
d. learning outcomes	• plan and program microprocessor boards • control, capture and regulate microprocessor boards, connect sensors and actuators to a simple microprocessor system, • know the structure, operation and use of microprocessor circuits • use the development environment of the microprocessor (IDE) and programs • acquire data from different sources of information • design of a microprocessor circuit • program a microprocessor circuit • perform control, capturing and controlling with microprocessor circuits • introduce input-output units (A/D converter, timer, communication interface) • learn programming in a higher programming language • use a development environment for a microprocessor (microcontroller) • connect the sensors to a microprocessor • capture input signals (analogue and digital)

	• connect elements for controlling high power consumers (transistor, relay, thyristor, triac, optocouplers) • depending on the needs of the application, select the appropriate microcontroller • perform measurements of digital signals in microprocessor circuits • connect sensors and consumers to a simple microprocessor system
Subject: Transmission and recording of information (8 credits)	
a. obligatory/elective subject	elective
b. basic/advanced	advanced
c. semester/module/year	module/2
d. learning outcomes	• select, assemble, set up, manage and repair audio and video system components • set up local HF networks and install aerial devices • explain the composition, characteristics (signals) and (physical) implementation of computer networks (Ethernet, IP...), • distinguish the basic characteristics of electromagnetic wave propagation (EMV) • understand the principle and structure of wireless communication systems (radio, TV, satellite communications, GSM / UMTS, Bluetooth, WiFi ...) • measure the properties of wired connections (pairs, UTP, coaxial cable) and compare properties • explain the principle of transmission over a fibre optic cable • perform simple EMV propagation tests (polarization, directional characteristics, power transmission) • perform (wired and wireless) connection between two computers, or between a computer and network equipment (hub, switch, router) • set up communication parameters, observes online activities (the corresponding software package) • examine, document and analyse the composition of the computer network (one level, different levels, flows, settings) • understand the principle of packet data transmission • explain the principle of IP data transmission • know the composition, characteristics (signals) and (physical) execution of computer

	networks (Ethernet, IP ...).
Subject: Design of electrical installations (8credits)	
a. obligatory/elective subject	elective
b. basic/advanced	advanced
c. semester/module/year	module/1
d. learning outcomes	• use sensors for connecting electrical devices • manufacture, assembly and connection of control and distribution cabinets and devices • perform device connection with remote control elements • manufacture simple electrical circuits that contain elements of intelligent installations and conducts simulations of intelligent installations • distinguish different systems of intelligent installations

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Computer Technician / tehnik računalništva
EQF level	4
NQF level	5
Date of the program's foundation	1.9.2008
Qualification(s) achieved at the end of the programme	Technical secondary education European classification ISCED 3 National classification KLASIUS-SRV: 15001 KLAISUS-P: 4812
Duration of education and time of delivery (time/semesters/modules/years)	2 years
Key competences of the whole educational programme	• read, plan, elaborate, monitor and amend technical documentation in line with requisite instructions and by employing ICT • use of organization of work concepts and economics in a professional area • programme simple applications on programmable devices as well as programme, assemble and wire programmable relays • set up necessary operating system settings and provide basic support to users when employing user software • compile, maintain, rectify errors and service computer hardware • lay and wire different forms of electric and communication installations, connect users and carry out basic maintenance works • connect electric installation elements in switching, distribution and outlet-coupling devices as well as select and connect electrical protection

	• set up, maintain, protect and provide the restoration of network services

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Computer Technician / tehnik računalništva
EQF level	4
NQF level	5
Date of the program's foundation	1.9.2008
Qualification(s) achieved at the end of the programme	Technical secondary education European classification ISCED 3 National classification KLASIUS-SRV: 15001 KLAISUS-P: 4812
Duration of education and time of delivery (time/semesters/modules/years)	4 years
Key competences of the whole educational programme	• read, plan, elaborate, monitor and amend technical documentation in line with requisite instructions and by employing ICT • use of organization of work concepts and economics in a professional area • programme simple applications on programmable devices as well as programme, assemble and wire programmable relays • set up necessary operating system settings and provide basic support to users when employing user software • compile, maintain, rectify errors and service computer hardware • lay and wire different forms of electric and communication installations, connect users and carry out basic maintenance works • connect electric installation elements in switching, distribution and outlet-coupling devices as well as select and connect electrical protection • set up, maintain, protect and provide the restoration of network services
Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject**:** IT hardware maintenance (7 credits)	
a. obligatory/elective subject	obligatory
b. basic/advanced	basic
c. semester/module/year	module/1
d. learning outcomes	• make and maintain simple pneumatic, pneumatic-electric and hydraulic controls • programme, assemble, set up, monitor and control the operation, carry out measurements and repair errors in simple automated units.
Subject**:** Making electrical and communication installations (6 credits)	

a. obligatory/elective subject	obligatory
b. basic/advanced	basic
c. semester/module/year	module /1
d. learning outcomes	• implement basic maintenance work on electrical and communication installations • implement basic measurements on electrical and communication installations and equipment • networking of computer systems in local networks and the Internet • implement wired LAN networks in buildings • connect the basic active elements of the computer network • distinguish between the access point, the router and the client on the wireless network • configure typical wireless network blocks
Subject**:** Managing programmable devices (8 credits)	
a. obligatory/elective subject	obligatory
b. basic/advanced	basic
c. semester/module/year	module/2
d. learning outcomes	• algorithmic Problem Solving • design and elaborate of a simple programme • use of well-known solutions in new cases • program of simple applications on programmable devices • make simple logical circuit • program of programmable relays • programmable relay mounting and wiring (PLC)

The Computer Technician / tehnik računalništva in duration of 2 and 4 years share the following subjects:

Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject**:** Use of microprocessor devices (8 credits)	
a. obligatory/elective subject	elective
b. basic/advanced	basic
c. semester/module/year	module/2
d. learning outcomes	• structure, operate and use of microprocessor circuits • use the development environment of the microprocessor (IDE) and programs • acquire data from different sources of information • design of a microprocessor circuit • program a microprocessor circuit • perform control, capture and control with microprocessor circuits • introduce input-output units (A/D converter,

	timer, communication interface) • learn programming in a higher programming language • use a development environment for a microprocessor (microcontroller) • connect the sensors to a microprocessor • capture input signals (analogue and digital) • at the output of a microprocessor, connect elements for controlling high power consumers (transistor, relay, thyristor, triac, optocouplers) • depending on the needs of the application, select the appropriate microcontroller • perform measurements of digital signals in microprocessor circuits • connect sensors and consumers to a simple microprocessor system
Subject: Planning automated units (8 credits)	
a. obligatory/elective subject	elective
b. basic/advanced	advanced
c. semester/module/year	module/3
d. learning outcomes	• plan and programme microprocessor wiring • conduct control, capture and regulation by way of microprocessor wiring • make and maintain simple pneumatic, electro-pneumatic and hydraulic controls • program, install, start up, monitor and control the functioning of simple, automated multi-device units • carry out measurements and repair faults
Subject: Management of ICT systems (8 credits)	
a. obligatory/elective subject	elective
b. basic/advanced	basic
c. semester/module/year	module/3
d. learning outcomes	• advise on the use of e-certificates and signature • protect IC systems against unauthorised access and dangerous programmes; • set up, maintain, protect and provide the restoration of network services

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Electronic Communications Technician / tehnik elektronskih komunikacij
EQF level	4
NQF level	5
Date of the program's foundation	1.9.2008
Qualification(s) achieved at the end of the programme	Technical secondary education European classification ISCED 3

	National classification KLASIUS-SRV: 15001 KLAISUS-P: 5233
Duration of education and time of delivery (time/semesters/modules/years)	4
Key competences of the whole educational programme	The holder of the certificate is qualified to: • read, plan, draft, monitor and amend technical documentation in accordance with prescribed instructions and through the use of ICT • apply concepts regarding the organisation of work and economics in a technical field • carry out assembly, testing, set-up and start-up of servers and connect computer systems to local networks and online network • make required settings to an operating system • program simple applications on programmable devices • set up the necessary settings in an operation system • program simple applications on programmable devices • build a simple logic circuit and control system • assemble, wire and program programmable relays (PLCs) • set up the parameters for optimum signal reception • incorporate and set up parameters for decoding systems; carry out highly demanding RA and TV broadcasts • configure terminal equipment, program base stations and portable devices in mobile networks and manage mobile communications and control systems • lay, wire and carry out basic measurements and maintenance work in various types of electrical and communications installations • select and connect electrical protection systems: fuses, installation circuit breakers, RCD switches and safety switches;
Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject**:** Diagnostics and troubleshooting (8 credits)	
a. obligatory/elective subject	elective
b. basic/advanced	advanced
c. semester/module/year	module/n.a.
d. learning outcomes	• configure and test equipment, supervise functioning and analyse faults in telecommunications installations and cable conductors • connect, disconnect, test, supervise the

	functioning of and troubleshoot base stations and transmission systems in the field under supervision
Subject: Telecommunications network installation (8 credits)	
a. obligatory/elective subject	elective
b. basic/advanced	advanced
c. semester/module/year	module/n.a.
d. learning outcomes	• assemble antennas and installations in antenna systems, base stations, cable conductors, power supplies and transmission systems
Subject: Set-up of local telecommunications and computer networks (8 credits)	
a. obligatory/elective subject	elective
b. basic/advanced	advanced
c. semester/module/year	module/n.a.
d. learning outcomes	• configure computer networks and telecommunications networks
Subject: System measurement techniques (8 credits)	
a. obligatory/elective subject	elective
b. basic/advanced	advanced
c. semester/module/year	module/n.a.
d. learning outcomes	• implement, analyse and evaluate measurement results on telecommunications equipment

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	*TECHNICIAN OF MECHATRONIC /TEHNIK MEHATRONIKE*
EQF level	4
NQF level	5
Date of the program's foundation	1.9.2008
Qualification(s) achieved at the end of the programme	Technical secondary education European classification ISCED 3 National classification KLASIUS-SRV: 15001 KLAISUS-P: 5200
Duration of education and time of delivery (time/semesters/modules/years)	4
Key competences of the whole educational programme	The holder of the certificate is qualified to: • use and understand technical plans • use information systems in technological processes • provide for automation of technological processes for maintaining technological systems • determine lifting and load capacity of construction elements • use hydraulic and mechanical elements or systems, and electrical machines or

	appliances • construct mechatronic systems and plan assembly and disassembly of mechatronic systems • diagnose errors and perform simple repairs of mechatronic systems • programme less complex applications in different programme languages • integrate the information system with production process • maintain equipment and applications by integrating information system with production processes • design controls and regulations, and plan pneumatic and hydraulic controls • use and plan digital wiring, microcontroller, PLC control and sensory elements;
Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject**:** Digital technique (6 credits)	
a. obligatory/elective subject	obligatory
b. basic/advanced	basic
c. semester/module/year	module/3
d. learning outcomes	• use measuring transducers • connect and replace the elements of the sensors and the executive members • know the basic structure of microcontrollers • build simple circuits using a microcontrollers • check the operation of circuits with microcontrollers • write simple microcontroller programs
Subject**:** Industrial controllers (7 credits)	
a. obligatory/elective subject	obligatory
b. basic/advanced	basic
c. semester/module/year	module/3
d. learning outcomes	• know the basics of approaches in designing controls • use freely programmable systems - PLK • analyse the PLK program and monitors its implementation • connect and replace sensor elements • know the basics of SCADA systems
Subject**:** Industrial networks	
a. obligatory/elective subject	obligatory
b. basic/advanced	advanced
c. semester/module/year	module/n.a.
d. learning outcomes	• use of information technology in automated processes • use specialized information and communication tools and equipment • use software and hardware for data

	acquisition and processing • take appropriate action and correct the errors as soon as possible • connect communication equipment with peripheral units of the automated process
Subject: Intelligent house (6 credits)	
a. obligatory/elective subject	elective
b. basic/advanced	advanced
c. semester/module/year	module/4
d. learning outcomes	• separate between standard installation and intelligent installation • know sensors and actuators in intelligent installations • know how to manage and control in intelligent installations • know network protocols in intelligent installations • recognize occupational hazards, observes safety instructions and uses safety devices and protective devices

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	*TECHNICIAN OF MECHATRONIC /TEHNIK MEHATRONIKE*
EQF level	4
NQF level	5
Date of the program's foundation	1.9.2008
Qualification(s) achieved at the end of the programme	Technical secondary education European classification ISCED 3 National classification KLASIUS-SRV: 15001 KLAISUS-P: 5200
Duration of education and time of delivery (time/semesters/modules/years)	2 years
Key competences of the whole educational programme	The holder of the certificate is qualified to: • use and understand technical plans • use information systems in technological processes • provide for automation of technological processes for maintaining technological systems • determine lifting and load capacity of construction elements • use hydraulic and mechanical elements or systems, and electrical machines or appliances • construct mechatronic systems and plan assembly and disassembly of mechatronic systems • diagnose errors and perform simple repairs

	of mechatronic systems • programme less complex applications in different programme languages • integrate the information system with production process • maintain equipment and applications by integrating information system with production processes • design controls and regulations, and plan pneumatic and hydraulic controls • use and plan digital wiring, microcontroller, PLC control and sensory elements
Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject**:** Information systems (6 credits)	
a. obligatory/elective subject	obligatory
b. basic/advanced	basic
c. semester/module/year	module/n.a.
d. learning outcomes	• fundamentals of programming languages • maintenance of equipment and applications at the level of the information system connection with production processes,
Subject**:** Control systems (9 credits)	
a. obligatory/elective subject	obligatory
b. basic/advanced	advanced
c. semester/module/year	module/2
d. learning outcomes	• design and elaboration of a simple programme • of well-known solutions in new cases • programming of simple applications on programmable devices • simple logical circuit making • programming of programmable relays • programmable relay mounting and wiring (PLC)
Subject**:** Mechatronics (11 credits)	
a. obligatory/elective subject	obligatory
b. basic/advanced	basic
c. semester/module/year	module/n.a.
d. learning outcomes	• knowledge of the structure and operation of elements of the electric circuit, electronic elements and electronic assemblies • determination of load and load capacity of structural elements, operation of electrical machines devices • construction of mechatronic systems and planning of assembly and dismantling of mechatronic systems • diagnosing errors and repairing mechatronic systems • basics of robotic systems

Turkey

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Mechatronics Mekatronik
EQF level	4
NQF level	4
Date of the program's foundation	2009
Qualification(s) achieved at the end of the programme	Mechatronich Technician, Associate Degree
Duration of education and time of delivery (time/semesters/modules/years)	2 years
Key competences of the whole educational programme	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose. (Realistic constraints and conditions may include factors such as economic and environmental issues, sustainability, manufacturability, ethics, health, safety issues, and social and political issues, according to the nature of the design.) Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself. Mechatronics Program aims to meet the skilled labor demand of the sector with via training about mechatronic system components, mechanical systems and their design, electronic systems, automation systems, information systems, process systems, mechatronic systems and their design.

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Computer Programming Bilgisayar Programcılığı
EQF level	4
NQF level	4
Date of the program's foundation	1992
Qualification(s) achieved at the end of the programme	Computer Programming Technician
Duration of education and time of delivery (time/semesters/modules/years)	2 years
Key competences of the whole educational programme	With the rapid development in the field of computer technology in recent years, computers are widely used in the bussiness and home lifes. Computer Programming is related with the areas of computer usage, software development (for PC, network and internet), hardware, maintanance and repairment, computer network

	installation and management. The students of this department are trained as persons who have sufficient knowledge in all areas of computer science, equipped with the ability to practice their knowledge at high levels and can develop themselves according to technological advancements.

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Machinery Makine
EQF level	4
NQF level	4
Date of the program's foundation	1980
Qualification(s) achieved at the end of the programme	Machine Technician
Duration of education and time of delivery (time/semesters/modules/years)	2 years
Key competences of the whole educational programme	Machine Programme aims to meet the skilled labor demand of the sector with via training about machine system components, mechanical systems and their design, electronic systems, automation systems, information systems, process systems, machine systems and their design. Machine Program objective is to follow the technological developments in cooperation with industry, to communicate to students, who need the program to create the CNC and laboratories, the vertical migration of graduates and graduate students to complete without an examination to ensure a greater number of passes, post-graduate students by providing guidance to follow up unemployed graduates entering employment by not to be working with the industry to meet the need for technical staff with community service and a leading national and international level Vocational School Program is to be respected.

Identification of VET occupation for implementation of the Wireless UP Module	
Occupation English/national language	Electricity Elektrik
EQF level	4
NQF level	4
Date of the program's foundation	1977
Qualification(s) achieved at the end of the programme	Electricity Technician
Duration of education and time of delivery (time/semesters/modules/years)	2 years
Key competences of the whole educational programme	Program of Electrical Technology aims to raise qualified labor force, which has adequate

	knowledge about the basic Electrical , is acquainted with electronics systems and equipments used in the industry and applies their knowledge to the industrial system and equipments. The goal of this program is to raise our students, who graduate at the end of the two-year degree education and become technician, as individuals who are acquainted with Electrical systems and equipments used in official and private sector, as well as industrial plants and who apply their knowledge to the industrial system and equipments. Our students who graduate as technician are raised in such a way to follow the developments in the advanced information technologies.

Identification of subjects within the VET occupation for implementation of the Wireless UP Module	
Subject	**Computer Aided Drawing**
a. obligatory/elective subject	obligatory in all occupations except in Computer Programming
b. basic/advanced	basic
c. semester/module/year	in the second year
d. learning outcomes	After passing the course, the student will know the different techniques of graphical representation for simple parts and assemblies: sketching, dihedral system, topographic maps, axonometric and cavalier perspective and CAD. He or she will also be able to interpret the key information contained in different plans for activities within the engineering and defence sector, learning and applying correctly the current technical drawing rules
Subject	**Microcontrollers**
a. obligatory/elective subject	obligatory in occupation of Mechatronic
b. basic/advanced	basic
c. semester/module/year	in the second year
d. learning outcomes	• choose useful microcontroller • load program into the microcontroller • create Algorithm and flow diagram for solving a problem • use microcontroller registers • use command of microcontroller • write basic input-output program with microcontroller • compile program and eliminate errors • make application of button and LED with microcontroller • set up 7 segment display circuit • set up the keypad circuit with microcontroller • set up the LCD circuit with microcontroller

Subject	**Sensors and Transducers**
a. obligatory/elective subject	obligatory in Mechatronics and electricity and elective in computer programming
b. basic/advanced	basic
c. semester/module/year	in the second year
d. learning outcomes	• motion detectors, light, radiation, electromagnetic field, recognition and use of security and fire detectors • force, strain, pressure, flow, temperature, chemical processes used to select and use sensors • position, level, the displacement, velocity, acceleration sensors • recognize and understand the working principles of sensors and transducers
Subject	**Programmables Logic Controllers**
a. obligatory/elective subject	obligatory in mechatronics and electricity
b. basic/advanced	basic
c. semester/module/year	in the second year
d. learning outcomes	• foundations and structures of PLC, • PLC programming techniques • design and implementation of industrial applications with the ability to teach PLC • recognize the control elements • apply the techniques of control • recognize PLC and peripherals • program the PLC • perform physical connections to PLCs
Subject	**System Analysis and Design**
a. obligatory/elective subject	obligatory in all occupations but elective in computer programming
b. basic/advanced	basic
c. semester/module/year	in the second year
d. learning outcomes	• define and describe the five phases of the system development life cycle • state at least five expected benefits from systems projects • explain at least three ways in which information systems support business requirements • describe how systems analysts interact with users, management, and other information systems professionals • develop data flow diagrams and decision tables • perform a feasibility study • evaluate systems development alternatives • solve realistic systems analysis problems • determine methods for evaluating the effectiveness and efficiency of a system

	• work as an effective team member on assigned projects
Subject	**Computer Programming**
a. obligatory/elective subject	obligatory in mechatronics and computer programming
b. basic/advanced	basic
c. semester/module/year	in the second year
d. learning outcomes	• analyze technical problems as related to customer requirements • design a logical plan for the development of a software solution • implement software solutions including documentation Evaluate software problems, plans, and solutions for correctness and appropriateness • communicate effectively with technical and non-technical audiences
Subject	**Analog Electronics**
a. obligatory/elective subject	Obligatory in mechatronics
b. basic/advanced	basic
c. semester/module/year	In the first year
d. learning outcomes	• acquire a basic knowledge in solid state electronics including diodes, MOSFET, BJT, and operational amplifier • develop the ability to analyze and design analog electronic circuits using discrete components • observe the amplitude and frequency responses of common amplification circuits • design, construct, and take measurement of various analog circuits to compare experimental results in the laboratory with theoretical analysis
Subject	**Industrial Robots**
a. obligatory/elective subject	Obligatory in mechatronics
b. basic/advanced	basic
c. semester/module/year	In the second year
d. learning outcomes	• analyze the manipulator design including actuator, drive and sensor issues • calculate the forward kinematics, inverse kinematics and Jacobian for serial and parallel robots • identify different types of end effectors and sensors required for specific applications • develop programming principles and languages for a robot control system • discuss various applications of industrial robot systems
Subject	**Electric Motors**
a. obligatory/elective subject	Obligatory in machinery and mechatronics

b. basic/advanced	basic
c. semester/module/year	Second year
d. learning outcomes	• design, analyze, install, and repair alternating current motors, motor starters, and control circuits • use industry specific terminology to explain or discuss motor operations with industry professionals • demonstrate safe working conditions in accordance with state and regional regulations
Subject	**Scada Systems**
a. obligatory/elective subject	Obligatory in electrity program
b. basic/advanced	basic
c. semester/module/year	In the second year
d. learning outcomes	• interpret a control narrative for a typical WTP/WWTP • differentiate between the different components of a control system (e.g. PLC, instruments, HMI, SCADA) within a typical WTP/WWTP • explain the purpose of the different components within a typical WTP/WWTP control system • describe the control system troubleshooting steps appropriate for use in a typical WTP/WWTP • identify the appropriate steps to use for given operational issues within a typical WTP/WTPP • recommend appropriate solutions to operational issues within a typical WTP/WTPP • contribute to the design/upgrading of control systems within WTPs/WTPPs

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