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Integration of Vocational Schools to Industry 4.0 by Updating Curriculum and Programs+

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Abstract – In recent years, the industry has been trying to meet our sectorial requirements in an innovative, reliable and fast manner. For this reason, Industry 4.0, this is a new industrial reform that has been linked to industrialization studies, initiated high-tech strategy, real-time data processing and cyber-physical systems. The first step is to be taken in the field of education in order for Turkey to develop a qualified workforce, export the values it produces and become a country that has a say in both the region and the international arena. It is seen that most of the unemployment rates in our country are made by college graduates. This demonstrates the necessity of updating appropriate programs and curriculums in developing technology. Especially in the industry, low cost, high quality and fast production oriented approaches are on the agenda, necessitating the use of advanced technologies. Therefore, curriculums need to be refreshed so that they can be integrated into the Philosophy of Industry 4.0 of the Vocational School laboratories. Thus, it is possible that graduates of the programs compliant with the Industry 4.0 curriculum can be employed in the smart factories created in their own field. This work; The aim was to draw attention to the need for the upgrading of higher education programs in order to train the staff to adapt to the industry's reforms.

Keywords – Vocational Training, Industry 4.0, Curriculum, Integration, Innovations

I. INTRODUCTION

Concept 'Industry 4.0' first emerged in Germany in 2011 and has become a rising value in the world due to the economic and social benefits it provides especially in the field of production. The Industry 4.0 revolution refers to the transformation of production structures into digital systems using information technologies [1]. Innovative technologies emerging from industrial revolutions have been the result of some professional groups and have led to the emergence of new business lines. In this context, it is inevitable that Vocational Schools which provide technical education in particular should update the curriculum and laboratory facilities by adapting to Industry 4.0. The first step is to be taken in the field of education in order for Turkey to develop qualified labor force, to export the values it produces, and to become a country with both regional and international talents.

Today's education systems cannot be adapted to the rapid development of working life. For this reason, many employers do not have the technical staff with the application skills they are demanding. For this reason, many employers do not have the technical staff with the application skills they demand. According to a field assessment of McKinsey with employers and newly graduated people, approximately 40% of employers show a lack of skills as the primary reason for not being able to find people suitable for basic jobs [2, 3].

Today, particularly in the fields of information and technology, the developments rapidly change the qualifications of the desired workforce in the period of expansion and contraction of the economy. In order to be able to adapt to this rapid change, especially the vocational training parts of higher education institutions have to train the qualified personnel to meet the needs of the industry. It is only through providing qualified vocational training. Today, the movement of labor as well as capital mobility has increased significantly in the world. Received diplomas and certificates not only on a national scale is inevitable that the worldwide recognition. The need for the development of curriculum for vocational schools has therefore arisen [3].

Curriculums of Vocational Schools need to be re-audited so that they can keep pace with the rapidly changing industry conditions in recent years. Although protocols have been made for the development of laboratories within the scope of industry-university cooperation, the expected yield has not been obtained [4]. Therefore, it is not possible for the graduates of existing programs to be employed in sectors adapted to Industry 4.0. This will require specialized staff especially in areas such as data analysis, software, cyber security, robotic applications, mechatronics, digital business processes. Vocational education curricula developed on the basis of qualified, innovative and competitive foundations not only contribute to the countries applying them but also to the development of countries on a global scale. Technical schools; curriculums of programs such as Mechatronics, Electricity, Electronics, Biomedical Device Technology, Automotive, Machinery, Computer Programming, Logistics should be made compatible with Industry 4.0.

II. HISTORY OF INDUSTRIAL REVOLUTIONS

The steam-powered mechanical systems in the first industrial revolution have been transformed into a structure in which cyber-physical systems take place in a very short time. In the first industrial revolution, mechanical production systems emerged by using water and steam power. In the ongoing process, mass-producing technologies have emerged using electric energy and this is called the second industrial revolution. At the beginning of the 1970s, the automation of production processes, along with the intensive use of

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electronic technology, led to digital transformation, making the production processes in the industry faster. The industrial revolutions can be described as follows: production with the help of machines, serialization of production, automation of production, and finally the 4th industrial revolution, adaptation to the production systems of information and communication technologies. In summary, these processes led to a shift from muscle strength to mechanical strength [5]. We can define the fourth industrial revolution as the digitalization of the industry by communicating all the structures within the production systems. This revolution, which accelerates the production processes by making all the units in the production systems communicate with each other over the internet, promises that intelligent systems will be in all areas.

III. VOCATIONAL AND TECHNICAL EDUCATION

Vocational and Technical Education should provide the students with appropriate information equipment in accordance with the requirements of the advanced age in their general skills. Vocational and Technical Education structuring in our country should have a system that aims to social and economic development of the country, provides a possibility to meet the needs of everyone who wants to be a profession, provides a practical training in laboratories equipped with new technology and cooperates with all common working partners. With a strong vocational training, it will be possible for individuals to acquire new skills, to switch between different disciplines and to acquire them from the source of knowledge. At the same time, increasing the competitiveness in the global world, providing employment in many areas including production and service area, and preventing unemployment will also be through healthy and structured Vocational and Technical Education. Today, the rapid development in knowledge and technology has caused some of the existing professions to disappear and the grounds for the emergence of new professions. At the same time, at the beginning of this century, various economic and social problems emerged under the influence of globalization and rapid change, and states used public resources as grants in order to solve these problems, thus causing large scale financial problems. There is a need for a more active and innovative Vocational and Technical Education system that will address many of these and similar problems, starting with the fact that the various risk areas that come to the square are also making life difficult [6].

In Council of Higher Education (YÖK) legislation; vocational colleges are defined as higher education institutions aiming at raising qualified human resources for certain professions, continuing education for two years and giving degree of associate degree. To students who are entitled to graduate from this school; who graduated from technical programs take the title of "Technician" while graduates of administrative and social sciences take the title of "Professional Staff" bearing the name of the department where they graduated [7].

When assessed according to world standards, the Vocational and Technical Education structure in our country is not in a position to meet the needs of the sector and to follow technological progress closely. It is foreseen that the joint work of all stakeholders in the system necessitates the restructuring of Vocational and Technical Education. Today, as science and technology develops new professions, Higher Education Institutions are needed to meet the qualified human needs of these professions. Therefore, it is inevitable to update the curriculum of theoretical and practical courses in Vocational and Technical Education Institutions.

Table 1. Electrical Program Course Plan

I. Semester Course Plan					
Course unit code	**Course unit title**	**Lecture**	**Recitation**	**Local Credits**	**ECTS**
MAT011	Mathematics-I	4	0	4	4
BIK011	Computer Applications	2	0	3	3
TBI011	Scientific Principles of Technology	2	0	3	3
EEO011	Electric And Electronic Measurements	3	1	6	6
DDA011	Direct Current Circuit Analysis	3	1	4	4
TUR011	Turkish Language-I	2	0	2	2
ATI011	P. of Ataturk and His. of Turkish Rv-I	2	0	2	2
MYD	Foreign Language-I	2	0	2	2
ENY	Energy Management	1	1	2	2
TES011-4	Complem. Electric Serv. And Systems	1	1	2	2
TOTAL		**22**	**4**	**30**	**30**
II. Semester Course Plan					
Course unit code	**Course unit title**	**Lecture**	**Recitation**	**Local Credits**	**ECTS**
MAT011-B	Mathematics-II	2	0	2	2
BDT011-B	Computer Aided Design-I	1	1	2	2
ADA011-B	Alternative Current Circuit Analysis	3	1	3	3
AEL011-B	Analog Electronic	3	1	3	3
EST011-B	Electric Network Installations	1	1	2	2
LM011-B	Electric Machines-I	3	1	3	3
TUR011-B	Turkish Language-II	2	0	2	2
MYD	Foreign Language II	2	0	2	2
ATI011-B	P. of Ataturk and His. of Turkish Rv-II	2	0	2	2
OTT011-4	Special Installation Techniques	3	1	3	3
STJ011-B	Summer Practice-I	0	7	6	6
TOTAL		**22**	**13**	**30**	**30**
III. Semester Course Plan					
Course unit code	**Course unit title**	**Lecture**	**Recitation**	**Local Credits**	**ECTS**
BDT011-3	Computer Assisted Design-II	1	1	2	2
SAE011-3	Digital Electronic	3	1	5	5
ELM011-3	Electric Machines-II	3	1	4	4
EBA011-3	Electric Maintenance And Troubles.	1	1	2	2
SAT011-3	System Analysis And Design-I	1	1	3	3
EUD011-3	Pro.Tran. and Distr. of Elect. Energy	3	1	4	4
YGT011-4	High Voltage Techniques	1	1	2	2
TOTAL		**13**	**7**	**22**	**22**
	Elective Course				
EKS011-3	The Systems of Electromec. Rem. Con.	3	1	4	4
SRT011-3	Winding Technique	3	1	4	4
TT011-3	Telecomunication Technology	3	1	4	4
TOTAL		**21**	**10**	**30**	**30**
IV. Semester Course Plan					
Course unit code	**Course unit title**	**Lecture**	**Recitation**	**Local Credits**	**ECTS**
GUE011-4	Power Electronics	3	1	4	4
ETP011-4	Electricity Installation Plans	3	1	4	4
PLD011-4	Programmable Controllers	3	1	4	4
SAT011-4	System Analysis And Design-II	1	1	2	2
SKP011-4	Agreement, Inspection And Plan	3	1	3	3
FIT011-4	Factory Manufacture Techniques	1	1	2	2
STJ011-4	Summer Practice-II	0	7	6	6
TOTAL		**14**	**13**	**25**	**25**
	Elective Course				
Course unit code	**Course unit title**	**Lecture**	**Recitation**	**Local Credits**	**ECTS**
EKE011-4	Industrial Control And Elements	1	1	2	2
ISU011-4	Advanced Digital Practices	3	1	3	3
TOTAL		**18**	**15**	**30**	**30**

IV. RECOMMENDED COURSES FOR INDUSTRY 4.0

With the fourth industrial revolution, labor qualifications in the primarily service and production sectors are expected to change. In particular, vocational training institutions should re-examine their course content, course descriptions, curricula and program outputs, focusing on trained human resources that Industry 4.0 already needs. Industry 4.0's workforce expectations are technology use, knowledge competence, motivation for learning, problem solving, cooperation, team work, easy adaptation of change, agility etc. Therefore, we have to raise skills-based, software-driven, coding-aware, production-minded, creative, entrepreneurial young people. The factories of your future are now looking for more outcome-focused employees who know how to make assessments and solve problems.

Under normal conditions, some of the features sought in engineers now need to be found in intermediate stages. It will not be possible to operate the factory of the future with untrained and unskilled labor. It should also be noted that 68% of the total workforce in our country is in general high school and under high school. The training of 68% of those who have profession today does not comply with Industry 4.0. In addition, the remaining 32% of the profession is not suitable for the future. In this case, we must first question our vocational education and higher education system [8].

Erciyes University Kayseri Vocational School Electrical and Energy Department Electrical Education Program 2017/2018 Education Course Plan is given in Table 1. As you can see from this table, our department has been teaching two years and four semesters of formal education. The same curriculum is applied to primary and secondary education students. In order to graduate from our department, a student must take a total of 120 ECTS credits and give it successfully. At the end of the four semesters, the average grade of a student must be at least two to graduate. In addition, our students are required to do internship for 20 days at the end of the second and fourth semesters as industrial application training. The students who graduated by providing the necessary conditions get the title of Electrical Technician. Graduates of electrical program have the opportunity to find jobs in many different sectors.

It needs to be changed in the current curriculum to meet Industry 4.0 expectations. Topics that will be the basis for Industry 4.0 are smart factories, sensors, renewable energy sources, digital data analysis, digital electronics, energy management, data security, internet traffic, internet of objects. When we review our course plan under industry 4.0, many courses from our plan do not fit industry 4.0. From our current curriculum; Courses such as Energy Management, Computer Aided Design, Digital Electronics, Power Electronics, Programmable Controllers, Telecommunication Technology can be based on Industry 4.0 and its contents are being updated in this scope to make this cycle more suitable. In addition, within the scope of the fourth industrial revolution, the curriculum should be expanded. Lessons that can be added to the curriculum include lectures such as Network Technologies, Data Analysis, Data Security, Robot Technology, Intelligent Factory Systems, Smart Home Systems, Cloud Computing, Virtual Reality, Next Generation Control Systems, Custom Designed Electric Machines, Scada Systems. At the same time, with an innovative approach, modeling and simulation-based laboratories have to be established in all sectors, especially in the production and service sectors of Industry 4.0 technologies. In summary, Vocational and Technical Education has evolved in line with the needs and standards of Industry 4.0, and some workforce with some new features has emerged. As vocational colleges, we have also introduced the need to add curricula to some of the new courses in order to train people with these qualities and to update the appropriate courses that have already been integrated into the Industry 4.0.

V. CONCLUSION

In this study, it is aimed to train electric technicians who know and apply the concept of Industry 4.0 by implementing new curriculum programs that will be prepared in the framework of the fourth industrial revolution rationale. In sectors that have been adapted to Industry 4.0, it is not possible for graduates from existing programs to be employed. In this context, the need for equipped staff will arise especially in areas such as data analysis, software, cyber security, robotic applications, mechatronics, digital business processes. Technical schools; It is foreseen that curriculums of programs such as Mechatronics, Control and Automation, Biomedical Device Technology, Electricity, Electronics, Automotive, Machinery, Computer Programming, Logistics should be adapted to Industry 4.0 as well as curriculums must be updated in Health Science, Social Sciences and Law. The Vocational and Technical Education curricula, based on qualified, innovative and competitive foundations, contribute not only to the countries that apply them but also to the development of countries on a global scale. It is thought that the cultivation of human resources is as important as the intelligent devices and systems for the conversion of the industry 4.0.

REFERENCES

[1] (2017) Tübitak Bilim, Teknoloji ve Yenilik Politikaları Daire Başkanlığı website. [Online]. Available: http://www.tubitak.gov.tr/sites/default/files/akilli_uretim_sistemleri_tyh_v2-03ocak2017.pdf

[2] (2016) McKinsey Global Institute website. [Online] Available: http://www.mckinsey.com/global-themes/employment-and growth/technology-jobs-and-the-future-of-work

[3] (2017) Eğitimde Dönüşüm Vakfı Sanayi 4.0 Ve Mesleki Eğitim. website. [Online]. Available: http://www.egitimdedonusumvakfi.org/upload/files/mesleki-egitim-raporu.pdf

[4] (2017) Erciyes Üniversitesi Kayseri Meslek Yüksekokulu website. [Online]. Available: https://kmy.erciyes.edu.tr

[5] (2017) Türkiye'nin Endüstri 4.0 Platformu website. [Online]. Available: http://www.endustri40.com/dorduncu-endustri-devrimi sanayinin-dijitallesmesi

[6] Türkiye Mesleki ve Teknik Eğitim Strateji Belgesi ve Eylem Planı 2014-2018. Available: http://abdigm.meb.gov.tr/projeler/ois/017.pdf

[7] E. Ekşioğlu and B. Kurt, "Türkiye'de Mesleki Eğitimde Gelinen Nokta," in Proc. MESTEK 2017, 2017, pp 293-307.

[8] (2017) Mesleki ve Teknik Eğitim Sendikası website. [Online]. Available: http://www.metesen.org/endustri4-0meleki-egitim