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RETHINKING HIGHER EDUCATION QUALIFICATIONS FROM THE ROMANIAN TECHNICAL FIELD

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Abstract: *Romanian technical higher education is now at a crossroads and must be reset, rethought, rearranged on new directions, on the one hand taking into account the international results obtained by the technical universities and on the other hand the new European requirements. The European single market requires the recognition of qualifications in order to comply with one of the requirements of the Accession Treaty: free market access for services and goods. This requires the Romanian education to adopt measures that translate into its reset, such as primarily: it requires the adoption of ISCED classification, it requires the adoption of skills/ abilities and knowledge from ESCO as well as the transition to learning outcomes as a result of the education process. At the same time, learning outcomes require common assessment and certification systems at the level of the technical system, together with the involvement of market representatives in the process of curriculum design as well as assessment and certification of learning outcomes. Therefore, it is a different kind of school than the one that has existed for the past 25 years, that is one essentially student-centered and focused on efficiency.*

Key words: *learning outcomes ISCO, ESCO, skills, study programs, efficiency*.

1. INTRODUCTION

In this pandemic time, the higher technical education suffers the most along with medical education, because laboratories, applications within projects, the projects themselves, can no longer be realized in the desired parameters.

The future practicing engineer cannot perform all its activity on the internet, before the computer, engineering is an applied field of technology and not everyone can become consultants, experts, specialists overnight.

Globally, there is talk of the great reset, and the authors talked about the reset of education [1], mentioning general aspects of the future of education.

This article discusses the rethinking / resetting of higher education in the technical field.

It is considered that the time has come for its reorganization, it is too vast and not homogenous, leading to financial and occupational inefficiency.

What does this mean? It is simple, money is spent on study programs that end with qualifications for occupations that will no longer exist.

2. THE LEVEL OF QUALIFICATION

The level of qualification is not complied with and there is no difference between the bachelor and the master degree with respect to the labour market, that is of the occupations for which the master or bachelor graduates are qualified, they are all prepared in the end for occupations from major group 2 of COR (Romanian Classification of Occupations).

In reality, Romanian higher education is a mass education, progressing horizontally - bachelor + master and not vertically, as it should be considering the NQF (National Qualifications Framework).

In this context, it is necessary to analyze what qualifications and levels 6 NQF − bachelor and 7 NQF − master means:

A) *qualification* means a formal outcome of an assessment and validation process which is obtained when a competent authority determines that an individual has achieved learning outcomes to given standards [2]

For the many in the education system who are unfamiliar with the terms used in the previous definition, they translate as follows:

1 – *formal outcome*, means in writing, a document

2 – *assessment process*, means evaluation along the way, written examination, theoretical, practical, etc.

3 – *validation* refers to who confirms the results of the assessment process: teacher, commission, etc.; here lies the great responsibility of the teacher who must assess whether or not the student passes the exam / validation of the evaluation. It would be good for the current, half-yearly validations to take place in front of a commission of 2 or 3 people, professor, assistants, doctoral students, everyone who studies.

4 – *competent authority*: the university, unlike the current exams, the validation as an engineer is performed

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by a commission of the competent body, the university; here it should be noted that there is a big difference between the student who passed all the exams over the years and the one who graduated the dissertation exam. Until graduating from the dissertation exam before a dissertation committee appointed by the rector, the sole representative of the competent body, no competent body woud have validated the total training of the engineer but only a competent professor or a committee has validated exams other than the one that validates the whole process.

Therefore, the dissertation exam should bear ECTS credits.

5 – *achieved learning outcomes*: learning outcomes, means that all exams were passed with passing grades on a minimum scale, in our country at least 5. In other words, the competent body - the dissertation examination board finds on this occasion that all the exams of the academic year were passed and after the dissertation, the graduate can be validated as an engineer.

These standard minimum scales for each discipline are missing.

One must keep in mind that there are countries where the professional validation is performed by the professional association, the university offers only the diploma through which the school is validated, at certain standards. In Romania this was the case before '90 when validation as engineer was obtained after internship, upt to that point the graduate was a trainee engineer.

6 – *given standards*: these are the study programs that should have a standard character, so that the employer knows that if he hires a mechanical engineer from wherever he graduated, about 80–90% have the same knowledge validated by the university – the competent body. This is not the case in Romania, as there is not yet the necessary training to teach similarly for the same product.

Engineering speaking, it is desired to validate the same product – the engineer – in different institutes, made according to different standards – that is, which differ 30–40% or more and have different graduation scales.

This is wrong and misunderstood by the technical academic community, it is as if the same Mercedes car made in South America or Africa would be 30–40% different, it would be a joke; of course, there is a 10% difference to take into account the nature, but only that much.

In order for this to be possible, it is good to work according to standards, as stated by the European Commission, a pyramid model of standard competences was proposed [3].

B) *Levels of qualification* means a volume and a special advancement of the learning outcomes (what the graduate actually knows), thus:

1 – Level 6 – Bachelor, implies: *advanced knowledge of a field of work or study, involving a critical understanding of theories and principles, advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study, manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts, take responsibility for managing professional development of individuals and groups* [2]

How many teachers understand what a graduate needs to know and undertake today, how to prepare him for control, innovation, unpredictable work situations, project management, etc.? Does the school do something like this today or is it just happy to offer knowledge?

The following question should be asked: why do they want to talk about rethinking / resetting the university technical field? It is simple: to follow European standards and make the graduate compatible with European requirements.

New curricula are needed to include all of the above in the form of learning outcomes and later as skills and competencies.

2 – Level 7 – master: *highly specialised knowledge*, some of which is at the *forefront* of knowledge in a field of work or study, as the basis for original thinking and/or research, *critical awareness* of knowledge issues in a field and at the interface between different fields, *specialised* problem-solving *skills* required in *research and/or innovation* in order to develop new knowledge and procedures and to integrate knowledge from different fields, *manage and transform work* or study *contexts* that are *complex*, *unpredictable* and require new strategic approaches, take responsibility for contributing to professional knowledge and practice and/or for *reviewing the strategic performance of teams* [2].

There are many words here that have nothing to do with today's master's degree: the very specialized expression makes sense if advanced knowledge has been acquired at the bachelor's degree, otherwise there is no basis; critical awareness in a field is a doctoral topic; you can only have specialized research-innovation skills if you go higher up in a field in which you have the background; situation management, strategies, taking responsibility or team performance are new areas that are not found in our study programs – general and transversal competencies are missing, so our master's degree is not a master's degree but rather a related license degree in the same field or a borderline one. Without a true master's degree, research is far away, even innovation.

As it can be seen in both definitions of qualification levels, it is talked about the labor market, here in recent years by introducing RNCIS (the National Register of Qualifications in Higher Education) it has been possible to link curricula to outputs of the labor market: the occupations listed in COR (the Romanian Classification of Occupations), there are practically no more study programs that do not end with a reference to an occupation, but is it enough? Has anyone in the labor

market looked at these contents of the study programs? Has the field or specialty disciplines confirmed them? Not at all. Those who validates them are also teachers from Romanian Agency for Quality Assurance in Higher Education (ARACIS) and universities, who have written the standards for the fields of work, but without asking the labor market.

It was not the same at European level. Here, ESCO (European Skills, Competences, Qualifications and Occupations) was created, which includes recognized occupations at European level, skills, knowledge and related skills / abilities, realized by labor market representatives.

It remained for the education-labour tandem to establish the learning outcomes and a standard model for their evaluation and validation.

It is desirable that the reset of technical education in Romanian higher education should start from adopting ESCO with its knowledge, skills / abilities, competencies and the addition at national level of local demands from the labor market at national and local level.

Thus, a future study program would include 70% disciplines related to ESCO competencies, 20% national and 10% local, this new way of thinking will lead to the automatic recognition of qualifications in the European Space, with a huge gain for the Romanian student and engineering school.

There are two more barriers to overcome:

- Solving the correlation with ISCED (International Standard Classification of Education) or even its adoption and
- Adapting to ISCO-08 occupations, respectively ESCO, which are different from COR, being fewer in number as well.

Efforts are still being made to remove these two barriers that still hold away the international academic environment, in which ISCED has been recognized and implemented for decades, and so has ISCO-08.

2.1. Correlation with ISCED

What does ISCED mean for engineers? Basically, it means starting to organize ourselves according to the international domains and not according to the local ones designed before ‘90 or ‘60.

It is understood that it was difficult for the older generations to accept and make an organizational change, and that is why there is hope in the new generations and in the new government that they will align with international standards.

What does this mean? In essence, fewer commissions, heads of departments, secretariat, paperwork, etc.

When this is stated, the data in the analysis shall be taken into account, as follows:

1) The *correlation* between the categories from ISCED and the provisions of GD no. 299/2020, as further amended and supplemented, took into account the ISCED detailed fields with the branch of science from the Nomenclature of fields and specializations / university study programs within Annex no. 1 to the Government Decision no. 299/2020, as further amended and supplemented.

The challenges in performing the correlation were due to the fact that to the bachelor fields it woud correspond the specializations in ISCED, and to the branches of science both the narrow and the detailed ISCED fields, given that in GD no. 299/2020 there are 3 levels of hierarchy (fundamental field, branch of science and bachelor field), while in ISCED there are 4 levels (broad, narrow, detailed and specialization field).

Following the verification of the correlation of the detailed fields from ISCED 2013 with the branch of science from GD no. 299/2020, a series of non-correlations could be found, highlighted quantitatively in the following table (Table 1).

Like any reorganization, it is scary, and if those who should do it do not even know the tasks, then conservatorism appears, the familiar "it's better this way" as Romanians often do, meaning nothing new is happening.

2) In detail, *ISCED reorganizes education in general and higher education in particular*, according to Table 2 [4].

Table 1

Correlation of detailed fields with the branch of science

	Number provided in ISCED 2013	**Number provided in GD no. 299/2020**	**Remarks**
Broad field/ Fundamental field	12	6	There are broad areas of ISCED that have no corresponde nt within the fundamental areas of GD no. 299/2020.
Narrow field / branch of science	26	34	There are detailed areas of ISCED without coverage in the studies proposed in the branches of science within GD no. 299/2020
Detailed field / bachelor	80 (77+3)	78	

Table 2

ISCED Structure

Broad field	Narrow field	Detailed field
00 Generic programmes and qualifications	001 Basic programmes and qualifications 002 Literacy and numeracy 003 Personal skills and development	0011 Basic programmes and qualifications 0021 Literacy and numeracy 0031 Personal skills and development
01 Education	011 Education	0111 Education science 0112 Training for pre-school teachers 0113 Teacher training without subject specialisation 0114 Teacher training with subject specialisation
02 Arts and humanities	021 Arts	0211 Audio-visual techniques and media production 0212 Fashion, interior and industrial design 0213 Fine arts 0214 Handicrafts 0215 Music and performing arts
	022 Humanities (except languages)	0221 Religion and theology 0222 History and archaeology 0223 Philosophy and ethics
	023 Languages	0231 Language acquisition 0232 Literature and linguistics
03 Social sciences, journalism and information	031 Social and behavioural sciences	0311 Economics 0312 Political sciences and civics 0313 Psychology 0314 Sociology and cultural studies
	032 Journalism and information	0321 Journalism and reporting 0322 Library, information and archival studies
04 Business, administration and law	041 Business and administration	0411 Accounting and taxation 0412 Finance, banking and insurance 0413 Management and administration 0414 Marketing and advertising 0415 Secretarial and office work 0416 Wholesale and retail sales 0417 Work skills
	042 Law	0421 Law
05 Natural sciences, mathematics and statistics	051 Biological and related sciences	0511 Biology 0512 Biochemistry
	052 Environment	0521 Environmental sciences 0522 Natural environments and wildlife
	053 Physical sciences	0531 Chemistry 0532 Earth sciences 0533 Physics
	054 Mathematics and statistics	0541 Mathematics 0542 Statistics
06 Information and Communication Technologies (ICTs)	061 Information and Communication Technologies (ICTs)	0611 Computer use 0612 Database and network design and administration 0613 Software and applications development and analysis
07 Engineering, manufacturing and construction	071 Engineering and engineering trades	0711 Chemical engineering and processes 0712 Environmental protection technology 0713 Electricity and energy 0714 Electronics and automation 0715 Mechanics and metal trades 0716 Motor vehicles, ships and aircraft

	072 Manufacturing and processing	0721 Food processing 0722 Materials (glass, paper, plastic and wood) 0723 Textiles (clothes, footwear and leather) 0724 Mining and extraction
	073 Architecture and construction	0731 Architecture and town planning 0732 Building and civil engineering
08 Agriculture, forestry, fisheries and veterinary	081 Agriculture	0811 Crop and livestock production 0812 Horticulture
	082 Forestry	0821 Forestry
	083 Fisheries	0831 Fisheries
	084 Veterinary	0841 Veterinary
09 Health and welfare medicine and therapy	091 Health	0911 Dental studies 0912 Medicine 0913 Nursing and midwifery 0914 Medical diagnostic and treatment technology 0915 Therapy and rehabilitation 0916 Pharmacy 0917 Traditional and complementary
	092 Welfare	0921 Care of the elderly and of disabled adults 0922 Child care and youth services 0923 Social work and counselling
10 Services	101 Personal services	1011 Domestic services 1012 Hair and beauty services 1013 Hotel, restaurants and catering 1014 Sports 1015 Travel, tourism and leisure
	102 Hygiene and occupational health services	1021 Community sanitation 1022 Occupational health and safety
	103 Security services	1031 Military and defence 1032 Protection of persons and property
	104 Transport services	1041 Transport services

Table 3

ISCED in figures

Broad field	Narrow field	Detailed field
00	3	3
01	1	4
02	3	10
03	2	6
04	2	8
05	4	9
06	1	3
07	3	12
08	4	5
09	2	10
10	4	10
99	1	1

Table 4

ISCED 2013 vs 1997

07 Engineering, manufacturing and construction	5 Engineering, manufacturing and construction (plus most of 85 Environmental protection field)
071 Engineering and engineering trades	52 Engineering and engineering trades (plus most of 85 Environmental protection field)
072 Manufacturing and processing	54 Manufacturing and processing
073 Architecture and construction	58 Architecture and building

As one can see, the great transformation takes place in the field of Engineering and Services, where Transport is included together with Defense and Security, which today are included in Engineering in our system.

Briefly, summarized in figures, the ISCED domains look like in Table 3.

A correlation between the ISCED domains and GD no. 299 / 2020 can be found on the ANC website in the Library section under the name "Decision on approving the Recommendation for correlating the fields of study in the Nomenclature of fields and specializations / university study programs with those in ISCED F – 2013".

3) ISCED is a flexible standard adapted to current requirements, this can be notices by comparison between the latest versions: 97 vs 2013, example for the field of Engineering may be found in Table 4.

4) ISCED includes a wide range of specializations but also indicates the place of specializations in the

international context, see Annex 1. These correlations between specializations and fields are not always approved by those who have worked in other systems including the current one, which have been created at national level.

Extending the current system, barriers are being created for our graduates in personal assertion and for our engineering school.

Stubbornness in preserving something of ours, locally, in the context of the globalization of education and the labor market is a mistake that affects future generation, they will not be able to fight on an equal ground with colleagues from other countries for European jobs.

The Engineering field, similarly to the Medical, Service or Business fields and different from many other fields in the higher education system, such as Education, Social Sciences or Law, is fighting for "jobs" on the foreign labor market and therefore has to prepare by field and in the same manner.

5) The big problem of adopting ISCED in the higher education system is presented below; it is about reducing the number of ARACIS commissions from 12 to 11, but by renaming them and with new contents (the gratest difficulty is not here), while at CNATDCU (National Council for Attestation of University Degrees, Diplomas and Certificates) the number of commissions is reduced from 34 to 26, which is the number of new education areas. Below, Table 5 presents the new areas and commissions, according to ISCED (this is a problem).

It is clear that such a change requires political will, correlation, desire for European integration and as long as education is not integrated into the system, everything remains at a declarative stage.

Table 5

The new organization of CNATDCU and ARACIS in the technical field

	ISCED Code	CNATDCU	GD Fields	ARACIS Commissions – new
7	Engineering, manufacturing and construction	6. Civil engineering and management 7. Materials engineering 8. Chemical engineering, medical engineering, materials science and nanomaterials C9: Electrical engineering C10: Energy engineering C11: Electronics, telecommunications and nanotechnology C12: Geological engineering, geodetic engineering, mines, oil and gas C13: Aerospace engineering, motor vehicles and transport C16: Industrial engineering and management C17: Mechanical, mechatronic and robotic engineering C18: Environmental engineering C33: Architecture and urbanism (and can be reduced to 7 commissions: C6 + C12, C7 + C8 + C18, C9 + C10, C11, C13 + C16, C18, C33,)	Chemical engineering Civil engineering and installations Electrical engineering Energy engineering Electronic engineering, telecommunications and information technology Geological engineering Geodetic engineering Mines, oil and gas Aerospace engineering Vehicle engineering Transport engineering Forestry engineering Systems engineering Mechanical engineering Industrial engineering Naval engineering and navigation Applied engineering sciences Naval architecture Mechatronics and robotics Materials engineering Environmental Engineering Engineering and management Genetic engineering, Engineering of armaments, missiles and ammunition	
			Food engineering	C8 – Architecture and construction production
			Architecture Urbanism	C8– Production of architecture and constructions

Table 6

ISCED – NACE - COR / ISCO correlation

Standard	Broad Field	Narrow Field	Detailed Field	Specialised field	Remarks
ISCED	10	26	80 (77+3)	1057	
	SECTION	DIVISION	GROUP (3 DIGITS)		
NACE	21	99	272		
	MAJOR GROUP	SUB-MAJOR GROUPS	MINOR GROUP	UNIT GROUPS	OCCUPATION
ISCO/ COR	9	40	127	438	4304

Table 7

Number of occupations with higher education level

Classification	Occupations with higher education study level
COR	
Group 1 – Members of the legislature, the executive, senior government officials, senior executives and officials	554*
Group 2 Professionals in various fields of activity	1398
Total	**1952**
ISCO	
Group 1 – Managers	512*
Group 2 – Professionals	1415
Total	**1927**

* *total number of occupations in major group 1 (not only those with higher education are selected, they are otherwise regulated) should be largely accessible to master's degree graduates in professional research or doctorate.*

Table 8

COR unit groups related to the ISCED field of Engineering

07 Engineering, manufacturing and construction	2141 Technological and production engineers 2142 Construction engineers 2143 Environmental engineers 2144 Mechanical engineers 2145 Chemical engineers 2146 Mining, petroleum, metallurgical and similar engineers 2149 Engineers and assimilated unclassified in previous core groups 2151 Electrical engineers 2152 Electronic engineers 2153 Telecommunications engineers 2161 Building architects 2162 Landscape architects 2163 Designers products and clothing 2164 Designers in the field of urbanism and traffic systematization 2165 Cartographers and printers 2166 Graphic and multimedia designers

6) The correlation with ISCED also solves the second big problem: the correlation with ISCO and NACE (Classification of Economic Activities in Romania).

Table 6 shows a link that exists between these three international regulations, thus linking those mentioned in the definition of qualification levels by "working conditions" with the reality of study programs. It is necessary to know what the market wants in order to provide the desired training staff, but this means knowing where and to whom the address is made.

How many occupations are found can be seen in Table 7, to which the qualification levels are connected, when talking about NQF level 6 or 7.

In Romania, people still want to operate according to Romanian principles and change is not accepted, and this will have repercussions, making it increasingly difficult for Romanian graduates to enter the international labor market.

The non-acceptance of standards and norms is understood in the light of the country's history, but the time has come to align with other countries, otherwise the distance from them will increase and this will affect the future of young people.

2.2. Adapting the occupations to ISCO and ESCO

1) It is necessary to mention that at the level of 4-digits unit groups, COR is compatible with ISCO-08, ie the Ministry of Labor has solved its problem and connected to the international system.

2) Next, a correlation between the ISCED Engineering field and the major technical groups to which the study programs must refer to, is presented in Table 8.

One can notice that for engineers there are two minor groups 214 and 215, in other words only the occupations in these two groups can be referred to when establishing the occupations related to each study program.

Here again there are many problems that will affect us in the future, in COR there are a number of occupations distributed as follows:

- Industrial production – 41,
- Constructions – 38,
- Environment – 11,
- Mechanics – 93,
- Chemistry – 36,
- Oil, mines – 57,
- Not classified elsewhere – 56,
- Electrical – 63,
- Electronics – 42,
- Telecommuncations – 16.

Thus, there are a total of 453 engineering occupations, without specifying how many are NQF level 6, 7 or 8.

This triggers an alarm signal, if each study program has at the end one or more occupations, it results that the maximum possible would be *453 undergraduate and master's degree programs*, but there have a number of *1519 bachelor's and master's degree programs registered* in RNCIS, provided in various forms and languages of teaching, out of which *200 are unique*. It is an anomaly of Romanian higher education that needs to be reset.

2.3. Correlation with ESCO

As mentioned above, ESCO is the gateway to Europe and the recognition of qualifications, in the sense that programs developed according to ESCO will benefit from automatic recognition in the future.

The problem arises when analyzing the occupations listed in ESCO and COR, so in ESCO there are:

- Industrial production –15,
- Constructions – 11,
- Environment – 6,
- Mechanics – 23,
- Chemistry – 10,
- Oil, mines – 11,
- Not classified elsewhere – 25, out of which 6 under Enregetics and 6 under Applyed Research/ Decelopment,
- Electrical – 6,
- Electronics – 10,
- Telecommunications – 1.

In total, there are 118 engineering occupations of EQF level 6, 7, and 8 to which the 453 occupations from Romanian classification must be mupped, in other words only a maximum of 118 study programs can be automatically recognized, another 100 may be close, but, in fact, it seems that approximately 50% of the engineering study programs in Romania are only at national level and do not address the European or global labor market, it is not even known if they are national.

This must be a strong signal for the reset of our higher technical school, curricula should be revised and programs should be created to meet the European requirements, the skills and knowledge required by these occupations, which even if they have the same name as those in our national classification, they have a different content, adapted to this beginning of the century.

In this regard, are presented from ESCO the knowledge, skills and abilities of engineers recognized as a name on any continent: the field of Mechanical Engineering - Mechanical Engineers. (www. https://ec.europa.eu/esco/portal/occupation/2144.1)

If you look at this portal, you can see something that could have been inferred a long time ago, the mechanical engineer is a starting point for specializations through horizontal postgraduate programs for lifelong optional occupations or for vertical masters.

By comparison, the Romanian system creates graduates for horizontal occupations by master's degree, which makes no sense and is at the expense of the state budget.

It is desired to finance horizontal continuing education courses, all right, but they can be short, postgraduate, not master's programs.

With a master's program, 4 - 5 postgraduate programs can be funded at a high-quality level and much more useful to engineers due to the short time required of about three months.

The situation is similar in all ten major engineering occupational fields. This forces the rethinking of undergraduate programs for the respective ten fields, master's programs to be designed only to raise the level of qualification, not the diversification of knowledge and skills, in conjunction with the development of adult training through specialized, dedicated postgraduate programs.

3. CONCLUSIONS

Resetting technical higher education means:

- observance of professional training on qualification levels with the specific characteristics of each level, respectively of the learning outcomes expressed through: knowledge, skills, responsibility and autonomy, values and attitudes.
- recognition of qualifications in the Romanian school through their inclusion in ISCED and ESCO in order to be able to further ascend to Europass, a portfolio of skills and jobs in the European market.
- undergraduate programs mainly focused on large groups in ISCO and ESCO, respectively: Mechanical Engineering, Chemical Engineering, Environmental Engineering, Construction Engineering, Mining, Oil and Gas, Production – Technology (Food, Textiles, Materials, Engines), Electrical Engineering and Energy Engineering, Electronic Engineering, Telecommunications.
- master's degrees in research and innovation development in each field listed above, in which students have at least two years of practical experience in the field.
- current master's degrees (poly–qualification), should renamed to: *postgraduate programs of continuing education*, training/ specialization/ qualification, carried out with own funds or from the budget, specialized on occupations listed in ESCO mainly and COR as appropriate; and "masters" of specialization: several such postgraduate programs may form, at some point, as a volume and content but not as a level of qualification, such a program.
- study programs to incorporate through the subjects taught the essential knowledge and skills from ESCO for each occupation and, where appropriate, the optional ones.
- programs to be carried out in compliance with the provisions in force on ECTS (transferable credits), so as to facilitate the recognition of qualifications and in the future their automatic recognition, this will also lead to a decrease in the number of disciplines, the recommendation would be one discipline per day.
- preparing teachers for the change, awareness of the situation outside the European labor market area, even if some universities are part of European university consortia it does not mean that our

graduate is recognized on the foreign labor market as the graduate of some partners is not recognized on the foreign market.

The reset must be done at system level but also at the level of university, faculty and program.

It is mainly the task of each field and specialized department to create its environment and professional recognition.

It is necessary to reduce the number of bachelor's degree programs, but also to create programs strongly anchored in today's and tomorrow's realities to create a base for the engineer in the chosen field, from which he can go futher to specializations in the chosen field or related engineering fields.

This means respecting the pyramid model of disciplines, created by ANC specialists after the American model, which allows different approaches in life, depending on opportunities and situations.

The most important thing after creating new programs is to establish the way of assessment and certification for the recognition of learning outcomes.

This must be transparent but unequivocal for quality, regardless of the form of formal or informal training.

Establishing clear evaluation criteria will further lead to the recognition of the previous experience that tomorrow's Europe requires.

The following article will cover the design of modern curricula based on learning outcomes and ESCOs, including an example for one of the mentioned fields.

The reset is urgent, new curricula should be completed in two years and new study programs should be offerred in 3–4 years, all against a background of digitization development, distance learning, digital credentials and implementations of European documents.

The mentality of the last 20–25 years must be replaced by a new one in which the quality, specialization, recognition at European level of our qualifications and lifelong learning are priorities.

Synergy with other portals, such as Eures, EPSO, Euraxess must become a norm.

ANNEX 1 - ENGINEERING FIELD IN ISCED

07 Engineering, Manufacturing and Construction
071 Engineering and engineering trades
0711 Chemical engineering and processes

Chemical engineering and processes is the study of planning, designing, and developing products and processes where chemical and physical changes occur. It includes designing chemical plants and control systems.

Programmes and qualifications with the following main content are classified here:

- Chemical engineering;
- Chemical process engineering;
- Laboratory technology;
- Oil/gas/petrochemicals processing;
- Plant and machine operation (processing);
- Process technology;

Inclusions:

Laboratory technology is included here if emphasis is not given to a specific application.

Exclusions:

Laboratory technology is excluded from this detailed field if emphasis is given to a specific application (biological, medical, etc.) and is included under the appropriate detailed field (0914 etc). Biotechnology is excluded from this detailed field and included in detailed field 0512 'Biochemistry'.

Programmes and qualifications with emphasis on the production of a specific material are excluded from this detailed field (e.g. studies with emphasis on paper processing should be included in detailed field 0722 'Materials (glass, paper, plastic, wood)'.

0712 Environmental protection technology

Environmental protection technology is the study of processes in order to minimise discharge and waste and avoid pollution. It includes programmes dealing with control of water, air, soil etc.

Programmes and qualifications with the following main content are classified here:

- Air pollution control;
- Ecological technology;
- Energy efficiency;
- Environmental engineering;
- Industrial discharge control;
- Noise pollution control;
- Recycling;
- Water pollution control.

*Exclusion*s:

Programmes and qualifications dealing with hygienic standards in food, water etc. are excluded from this detailed field and included in detailed field 1021 'Community sanitation'.

Construction related to waste and water management is excluded from this detailed field and included in detailed field 0732 'Building and civil engineering'.

0713 Electricity and energy

Electricity and energy is the study of installing, maintaining, repairing and diagnosing faults in electrical wiring and related equipment in domestic, commercial and industrial establishments. Installation and maintenance of overhead and underground electrical power distribution networks is included. Energy is the study of energy generation.

Programmes and qualifications with the following main content are classified here:

- Air-conditioning trades;
- Climate engineering;
- Electrical appliances repairing;
- Electrical engineering;
- Electrical fitting;
- Electrical power generation;
- Electrical trades;
- Energy studies;
- Gas distribution;
- Heating trades;
- Nuclear, hydraulic and thermal energy;
- Power line installation and maintenance;
- Power production;
- Refrigeration;

- Solar power;
- Wind turbines.

Inclusions:

The study of installing, diagnosing faults in and repairing heating, air-conditioning and refrigeration equipment is included here.

Exclusions:

Study of vehicle electrical systems is excluded from this detailed field and included in detailed field 0716 'Motor vehicles, ships and aircraft'.

0714 Electronics and automation

Electronics and automation is the study of planning, designing, developing maintaining and monitoring electronic equipment, machinery and systems. It includes designing computers and equipment for communication.

Programmes and qualifications with the following main content are classified here:

- Broadcasting electronics;
- Communication systems;
- Communications equipment installation;
- Communications equipment maintenance;
- Computer engineering;
- Computer repairing;
- Control engineering;
- Data processing technology;
- Digital technology;
- Electronic engineering;
- Electronic equipment servicing;
- Network technology;
- Robotics;
- Telecommunications technology;
- Television and radio repairing.

Exclusions:

Computer science (Software and applications development) is excluded from this detailed field and included under 0613 'Software and applications development and analysis'.

0715 Mechanics and metal trades

Mechanics and metal trades is the study of planning, designing, developing, producing, maintaining and monitoring machines, mechanical plants and systems and metal products. It includes designing and maintaining machines which produce goods and services. The focus of study in this detailed field is machines, mechanical systems and metal products.

Programmes and qualifications with the following main content are classified here:

- Gunsmithing;
- Hydraulics;
- Locksmithing and safe repairing;
- Mechanical engineering;
- Mechanical trades;
- Metal casting and patternmaking;
- Metal fitting, turning and machining;
- Metallurgical engineering;
- Precision mechanics;
- Sheet metal working;
- Steel production;
- Tool and die making;
- Welding.

Exclusions:

The study of motor vehicle mechanics and engineering is excluded from this detailed field and included in detailed field 0716 'Motor vehicles, ships and aircraft'.

0716 Motor vehicles, ships and aircraft

Motor vehicles, ships and aircraft is the study of designing, developing, producing, maintaining, diagnosing faults in, repairing and servicing motor vehicles, including earth moving equipment and agriculture machines, ships, trains and aircraft. Typical is the combination of studies in both metal structures and motors.

Programmes and qualifications with the following main content are classified here:

- Aerospace engineering;
- Aircraft engineering;
- Aircraft maintenance;
- Automotive electrical systems;
- Automotive engineering;
- Avionics;
- Coachwork;
- Marine engineering;
- Motorcycle engineering;
- Panel beating;
- Shipbuilding;
- Train repair and maintenance;
- Vehicle building and repairing;
- Vehicle varnishing/spraying.

Inclusions:

Study of vehicle electrical systems is included here.

Exclusions:

Study of producing and repairing non-motorised vehicles is excluded from this detailed field and included in 0715 'Mechanics and metal work' (e.g. bicycles) or 0722 'Materials (glass, paper, plastic, wood)' (e.g. non-motor boats).

0719 Engineering and engineering trades not elsewhere classified

Engineering studies not covered by other detailed fields are classified here:

- Nanotechnology

072 Manufacturing and processing

0721 Food processing

Food processing is the study of processing and packaging of food and beverages, and the equipment and procedures used in the production and distribution of foods.

Programmes and qualifications with the following main content are classified here:

- Baking;
- Beer brewing;
- Butchery;
- Confectionery;
- Dairy foods;

- Food and drink processing;
- Food preservation;
- Food science and technology;
- Meat processing;
- Pastry cooking;
- Tobacco processing;
- Wine production.

Inclusions:

Study of food handling and food hygiene is included here.

Exclusions:

Restaurant and catering are excluded from this detailed field and included in detailed field 1013 'Hotel, restaurant and catering'.

Nutrition science is excluded from this detailed field and included in narrow field 051 'Biological and related sciences'.

0722 Materials (glass, paper, plastic and wood)

Materials is the study of the manufacturing of products in glass, paper, plastic, wood or other materials like stone, clay, artificial materials etc. Programmes and qualifications included in this detailed field have more to do with a specific material than general technical knowledge.

Programmes and qualifications with the following main content are classified here:

- Boat building (non-motor);
- Cabinet making;
- Carpentry (furniture);
- Ceramics (industrial);
- Furniture making;
- Glass working (industrial);
- Industrial diamond production;
- Paper manufacturing and processing;
- Plastic manufacturing;
- Rubber processing;
- Timber technology;
- Wood machining and turning;
- Woodwork trades.

Exclusions:

Study of metal work is excluded from this detailed field and included in detailed field 0715 'Mechanics and metal trades'.

Study of building carpentry and joinery is excluded from this detailed field and included in detailed field 0732 'Building and civil engineering'.

Study of chemical processing in general is excluded from this detailed field and included in detailed field 0711 'Chemical engineering and processes'.

Study of printing and bookbinding is excluded from this detailed field and included in detailed field 0211 'Audio-visual techniques and media production'.

Handicrafts programmes (glass arts and crafts, woodcarving etc) are excluded from this detailed field and included in detailed field 0214 'Handicrafts'.

0723 Textiles (clothes, footwear and leather)

Textiles (clothes, footwear and leather) is the study of the manufacture of textiles, textile and leather products, clothing and related items, shoes and other forms of footwear.

Programmes and qualifications with the following main content are classified here:

- Clothing trades;
- Dressmaking;
- Footwear making;
- Fur making;
- Garment production;
- Leather processing;
- Saddlery;
- Shoemaking;
- Skins and leather production;
- Spinning;
- Tailoring;
- Textile trades;
- Upholstery;
- Weaving (industrial);
- Wool science.

Exclusions:

Handicrafts studies (weaving, embroidery etc.) are excluded from this detailed field and included in detailed field 0214 'Handicrafts'.

0724 Mining and extraction

Mining and extraction is the study of assessing, planning, developing, and directing the extraction of minerals, oil and gas from the earth.

Programmes and qualifications with the following main content are classified here:

- Coal mining
- Mineral technology;
- Mining of minerals;
- Oil and gas drilling;
- Oil and gas extraction;
- Raw material extraction.

Exclusions:

Study of metallurgical engineering is excluded from this detailed field and included in 0715 'Mechanics and metal trades'

Study of geology is excluded from this detailed field and included in detailed field 0532 'Earth sciences'.

073 Architecture and construction

0731 Architecture and town planning

Architecture is the study of the art, science and techniques of building design. It encompasses both utilitarian ends – such as the soundness of the structure and the functional and economic efficiency of the building – and aesthetic considerations. Town planning is the study of the regulated growth and improvement of towns in both functional and aesthetical points of view.

Programmes and qualifications with the following main content are classified here:

- Architectural urban design and planning;
- Architecture;
- Building design;
- Cartography/Land surveying;
- City planning;

- Community development;
- Landscape architecture;
- Structural architecture;
- Surveying;
- Town and country planning;
- Urban planning.

Exclusions:

Study of interior design is excluded from this detailed field and included in detailed field 0212 'Fashion, interior and industrial design'. Geomatics is excluded from this detailed field and included in detailed field 0532 'Earth science'.

The laying out and construction of parks and gardens is excluded from this detailed field and included in detailed field 0812 'Horticulture'.

0732 Building and civil engineering

Building is the study of the science, technology and techniques of assembling, erecting and maintaining public, commercial, industrial and residential structures and their fittings. Civil engineering is the study of planning, designing, testing and directing the construction of large scale buildings and structures, including systems for transport, water supply, sewage etc.

Programmes and qualifications with the following main content are classified here:

- Bricklaying;
- Bridge construction;
- Building construction;
- Building engineering;
- Building technology;
- Carpentry and joinery (building);
- Civil engineering;
- Construction equipment;
- Constructional metalwork (building);
- Dock and harbour engineering;
- Floor and wall tiling;
- Floor covering;
- House building;
- Industrial abseiling (commercial);
- Masonry and tile setting;
- Painting and wall covering;
- Plastering;
- Plumbing and pipefitting;
- Road building;
- Water engineering and technology;
- Water supply and sewerage engineering;
- Ventilation.

Exclusions:

Installation of electricity is excluded from this detailed field and included in detailed field 0713 'Electricity and energy'. Similarly, installing and repairing of heating, air-conditioning and refrigeration equipment is excluded from this detailed field and included in detailed field 0713 'Electricity and energy'.

078 Inter-disciplinary programmes and qualifications involving engineering, manufacturing and construction

0788 Inter-disciplinary programmes and qualifications involving engineering, manufacturing and construction

Inter-disciplinary or broad programmes and qualifications to which the greatest intended learning time is devoted to engineering, manufacturing and construction are classified here.

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