



## Design of Curriculum for Woodworking CNC Operators in Turkey

### Meta-Analysis of Education of CNC Operators in Turkey and the European Union

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This report is prepared as the second output (O2) of Erasmus + KA 2 Project with acronym ProCNC and entitled as Design of Curriculum for Woodworking CNC Operators in Turkey

Prepared by:

Middle East Technical University

In collaboration with:

İkooor Mobilya İmalat Koordinasyon Sanat ve Ticaret A.Ş.

Europäisches Bildungswerk für Beruf und Gesellschaft (EBG)

Office Furnitures Industry and Businessmen Association (OMSIAD)

Aris Formazione e Ricerca

Akyurt Nevzat Hüseyin Tiryaki Teknik ve Endüstri Meslek Lisesi



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## Introduction

Advent of computers, blooming of information technologies and use of the social networks force to revise education in general. Moreover, rapidly changing technologies and tremendously accumulating information and knowledge cause expiration of many professions or outdates the skills and competencies easily. In this regard, Bologna Process is an important turning point in EU not only to question higher education but also to promote the idea of life-long learning. Today, this idea has been spreading more and more and implemented in formal and informal education (i.e. on the job trainings) in all levels and in all professions together with revising curricula in schools. In this revision processes and on the job training programs, the competencies outlined by Vocational Qualification Institutes or Professional Competency Board play crucial role in defining the objectives and the outcomes of the education either formal or informal.

Second output of the project aims to survey how CNC education in formal and informal way in EU and in Turkey in detail and compare to determine discrepancies, overlaps, differences to further propose a new schema for such an education. In the survey process, not only objectives of the education and learning outcomes according to the needs of the sector, but also the level of expected knowledge in terms of knowledge and cognitive dimensions are studied based on revised Bloom's Taxonomy. Hence firstly the framework will be explained; followed by the in depth survey of CNC education in EU and Turkey separately in terms of both competencies and conveying the education with respect to the Bloom's taxonomy. Following report is concluded with the comparison of CNC education Turkey and EU.

## The Framework for Evaluation of CNC Education

Learning which is defined as “knowledge or skill acquired by instruction or study<sup>1</sup>” is an act for which profile of the learner (age, background, culture etc.) and the context (subject matter) determine the curricula and the teaching material. In this regard, PROCNC project aiming to provide curricula and a methodology for training of CNC operators in woodworking industry exhibits a high level of complexity due to

- Diversity/indeterminacy of the educational background of CNC operators
- Technology dependent subject matter, which should be applicable to any CNC and to any operator profile.

Present Erasmus+ Project addresses the issue of teaching methodology rather than the content alone in CNC training. In this context, it is important to picture the profiles of CNC

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<sup>1</sup> <http://www.merriam-webster.com/dictionary/learning>



operators in practice regarding their educational background which exhibits considerable differences in terms of their formal education (vocational schools, apprenticeships, short term educations etc.), their experience (indirectly their age).

Yet, as any learning/teaching act, proposed training program should be compatible with learning requirements defined by education experts. In that sense original Bloom's Taxonomy proposed by educational psychologist Dr. Benjamin Bloom in 1956 and the present revised version can be accepted as the guidelines of each step of the training curricula.

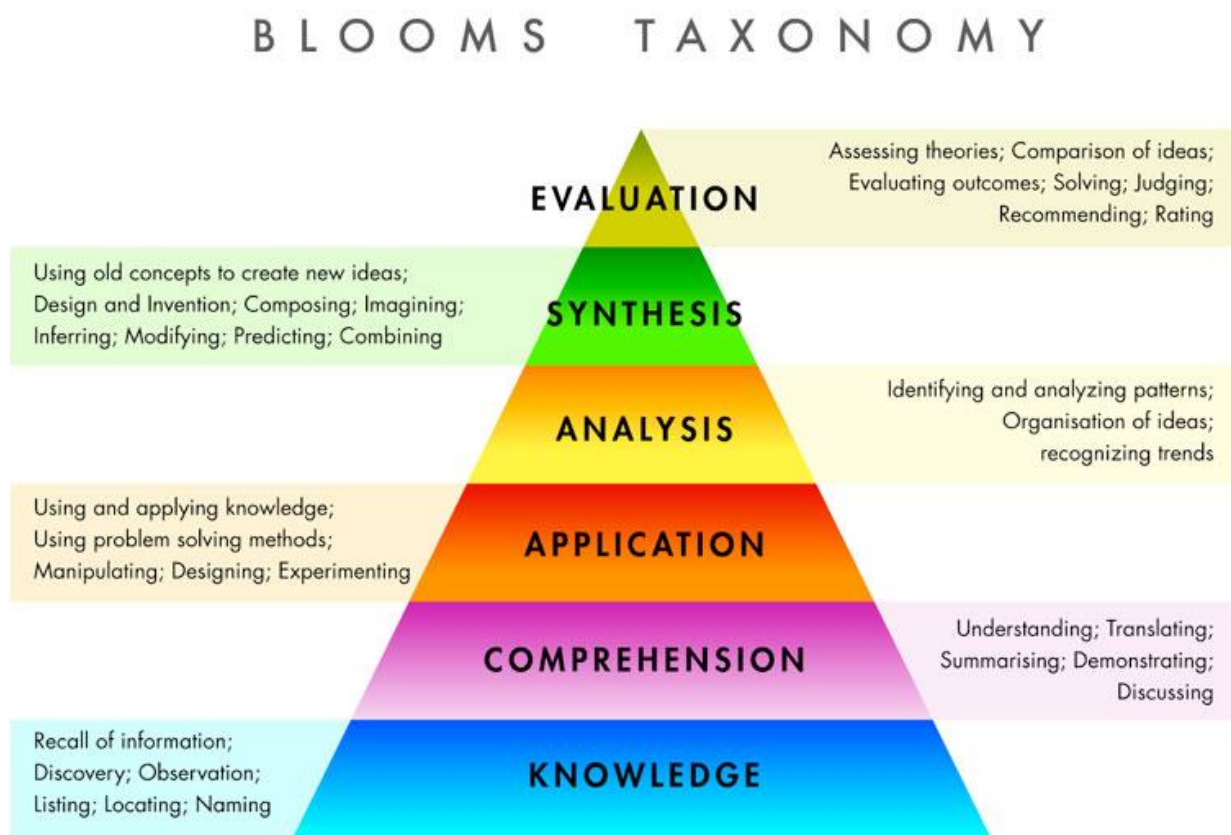


Figure 1: Bloom's Taxonomy  
<http://whitman.syr.edu/wsmhelp/docs/faculty-resources/Blooms%20Taxonomy.jpg>

The revised version of the Bloom's Taxonomy was proposed by Lorin Anderson, one of Bloom's former students in the 1990's where all the nouns were replaced by verbs, i.e. from a more passive state to an active one and learning becomes an active act so does the subject matter i.e. curricula.

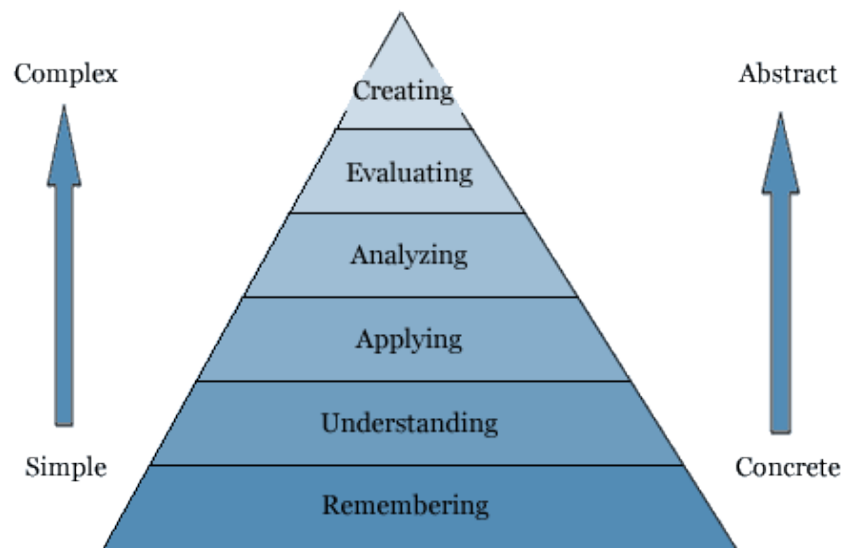


Figure 2: Revised Bloom's Taxonomy ([http://www.ucdenver.edu/faculty\\_staff/faculty/center-for-faculty-development/Documents/Tutorials/Assessment/module2/index.htm](http://www.ucdenver.edu/faculty_staff/faculty/center-for-faculty-development/Documents/Tutorials/Assessment/module2/index.htm))

Where the steps can be defined as follows<sup>2</sup>

- **Remembering:** Retrieving, recognizing, and recalling relevant knowledge from long-term memory.
- **Understanding:** Constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.
- **Applying:** Carrying out or using a procedure through executing, or implementing.
- **Analyzing:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing, and attributing.
- **Evaluating:** Making judgments based on criteria and standards through checking and critiquing.
- **Creating:** Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing.

<sup>2</sup> Anderson, L.W. (Ed.), Krathwohl, D.R.(Ed.), Airasian, P.W., Cruikshank, K.A., Mayer, R.E. Pintrich, P.R., Raths, J., & Wittrock, M.C. (2001). A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of Educational Objectives (Complete edition). New York: Longman.



It is also necessary to point out that, learning has two dimensions: cognitive dimension and knowledge dimension as shown in Table 1 and Table 2.

Table 1: Knowledge Dimension

concrete knowledge			abstract knowledge
factual	conceptual	procedural	metacognitive*
knowledge of terminology knowledge of specific details and elements	knowledge of classifications and categories knowledge of principles and generalizations knowledge of theories, models, and structures	knowledge of subject-specific skills and algorithms knowledge of subject-specific techniques and methods knowledge of criteria for determining when to use appropriate procedures	strategic knowledge knowledge about cognitive tasks, including appropriate contextual and conditional knowledge self-knowledge

Table 2: Cognitive Dimension

lower order thinking skills			higher order thinking skills		
remember	understand	apply	analyze	evaluate	create
recognizing • identifying recalling • retrieving	interpreting • clarifying • paraphrasing • representing • translating exemplifying • illustrating • instantiating classifying • categorizing • subsuming summarizing • abstracting • generalizing inferring • concluding • extrapolating • interpolating • predicting comparing • contrasting • mapping • matching explaining • constructing models	executing • carrying out implementing • using	differentiating • discriminating • distinguishing • focusing • selecting organizing • finding coherence • integrating • outlining • parsing • structuring attributing • deconstructing	checking • coordinating • detecting • monitoring • testing critiquing • judging	generating • hypothesizing planning • designing producing • constructing

Assessment of the contents of any course or training content regarding the objectives and learning outcomes is one of the major requirements in order to evaluate the skills, knowledge and competency of students/learners no matter what the level is or which discipline the content is designed for.

The following matrices based on Bloom's Taxonomy are used to assess the CNC education in both EU and Turkey.



The knowledge and cognitive dimensions are explained below. Here it is important to ask proper questions and corresponding activities specific to CNC woodworking in order to clearly identify the problems/deficiencies etc. in CNC training. This evaluation is to be a benchmarking for the existing situation and it will also be guideline for the development of new curriculum.

*Table 3: Evaluation Matrix With Respect To Bloom's Taxonomy*

	COGNITIVE						
KNOWLEDGE		REMEMBER	UNDERSTAND	APPLY	ANALYZE	EVALUATE	CREATE
<b>FACTUAL</b>							
<b>CONCEPTUAL</b>							
<b>PROCEDURAL</b>							
<b>METACOGNITIVE</b>							

*Table 4: How Bloom's Taxonomy Is interpreted Within the Scope of the Project <sup>3</sup>*

Type of Knowledge	Examples
<b>Factual Knowledge</b> The basic elements must be acquainted with in the discipline or to solve the given problem	Technical vocabulary, reliable teaching materials and/or references, works of others etc...
<b>Conceptual Knowledge</b> The interrelationships among the basic elements within a larger structure that enables them to function together	General principles of fabrication, CAD/CAM technologies, principles of CNC working etc...
<b>Procedural Knowledge</b> How to do something, methods of inquiry and criteria for using skills, algorithms, techniques and methods	Skills to use CNC, skills to understand solid models, methods to machine wood etc...
<b>Metacognitive Knowledge</b> Knowledge of cognition in general as well as awareness and knowledge of one's own cognition	Knowledge of various CNC operations, knowledge of various CNC machines, knowledge on woodworking etc...deeper level of knowledge, knowledge of one's level of knowledge in the area, knowledge of one's motivation for a task

<sup>3</sup> <http://cte.illinois.edu/resources/topics/syllabus/blooms.html>



Table 5: Cognitive Processes and Relevant Verbs, Questions and Potential Activity

Cognitive Process	Verbs	Sample Questions	Potential Activity
<b>Remember</b> Retrieve relevant knowledge from long-term memory	Remember, recognize, identify, recall, retrieve	What happens...How many... what it is..., where.....	Make a list showing... Make a model....
<b>Understand</b> Construct meaning from instructional messages including oral, written and graphic communication	Understand, interpret, clarify, represent, translate, exemplify, match, illustrate, explain, classify, categorize, map, summarize, generalize, abstract, predict, conclude, compare, contrast, interpolate, extrapolate	Explain...., why did..., who do you think..., what do you think..., which method..., what are the examples..., how could you approach...how are they similar....	Write down... Prepare a pseudo algorithm... Write down the steps clearly... Make a model of....
<b>Apply</b> Carry out or use a procedure in a given situation	Apply, execute, carry out, use, implement...	What is the method? Which tools... What are the steps? How do you fix.... etc....	Solve a problem, write a response...make a model, make a dry run...
<b>Analyze</b> Break material into its constituent parts and determine how the parts relate to one another and to an overall structure or purpose	Analyze, differentiate, discriminate, distinguish, focus, select, organize, integrate, outline, structure, attribute, deconstruct, find coherence	What was the most relevant machining? How is ... similar to? Why did ... occur? What is needed to? Can you distinguish between?	Make a simple diagram showing interrelationships... Write a technical brief examining the problems... Construct a graph to show the process...
<b>Evaluate</b> Make judgments based on criteria or standards	Evaluate, check, coordinate, detect, monitor, test, critique, judge	Is there a better solution? What do you think about ... and why? Is ... good and why?	Prepare another solution Write an opinion report Check the quality
<b>Create</b> Put elements together to form a coherent or functional whole; reorganize elements into a new pattern or structure	Create, generate, hypothesize, plan, design, produce, construct	What are possible solutions to? Can you design a... What would happen if...? How many ways can you...?	Design an experiment Create a new product Plan a new process Machine a new part...



Sub-types of knowledge in Revised Bloom's Taxonomy is explained in the figure below<sup>4</sup>:

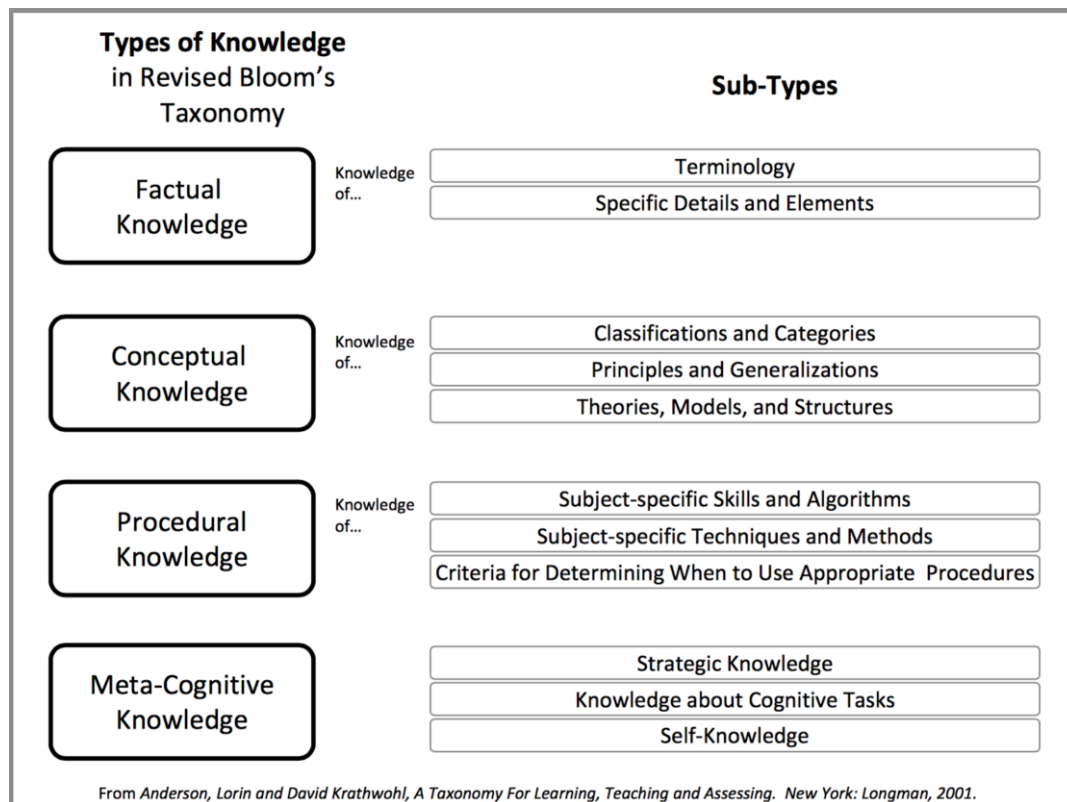


Figure 3: Types of Knowledge in Revised Bloom's Taxonomy

Bloom's Taxonomy is a general guideline for teachers and trainers in preparing the appropriate education material as well as assessment of the learning process and outcomes. As this method is a well-known and well acknowledge method for evaluation and assessment of education, the framework is based on this taxonomy while evaluating and assessing the CNC education in both EU and Turkey.

<sup>4</sup> <http://www.dpi.state.nc.us/docs/acre/standards/rbt-knowledge-chart.pdf>



## CNC Education in Woodworking Industry in EU

In this section, CNC education in EU is surveyed. European Classification of Skills, Competences, Qualifications and Occupations (ESCO) and Qualification Systems in European Union (ECVET) are constructed based on the occupational classifications in ISCO - International Standard Classification of Occupations. In the scope of these definitions<sup>5</sup>, “Woodworking machine tool setters and operators” are acknowledged as an occupation class with its definition, tasks and included and excluded occupants as shown in Table 6.

Table 6: ISCO08 definition of Woodworking Machine Tool Setters and Operators

Title EN	ISCO 08 Code	Definition	Tasks include	Included occupations	Excluded occupations
<b>Woodworking machine tool setters and operators</b>	7523	Woodworking machine tool setters and operators set-up or operate and monitor automatic or semi-automatic woodworking machines, such as precision sawing, shaping, planning, boring, turning and woodcarving machines to fabricate or repair wooden parts.	Tasks include - (a) setting-up, programming, operating and monitoring several types of woodworking machines for sawing, shaping, boring, drilling, planning, pressing, turning, sanding or carving to fabricate or repair wooden parts for furniture, fixtures	Examples of the occupations classified here: - Carving machine operator (wood) - Furniture production machine operator - Precision woodworking sawyer - Wood products machine operator - Wood turner - Woodworking lathe operator - Woodworking machine	Some related occupations classified elsewhere: - Wood and related products assemblers – 8219

The innovation based on the computer numerical control (CNC) of machine tools till the highly automated end-to-end component design using computer-aided design (CAD) and computer-aided manufacturing (CAM) programs it constitutes from several years an issue very relevant in Wood Manufacture as well as in the Furniture Manufacture sub-sectors in European

<sup>5</sup> ILO, International Labor Organization. 2015. ISCO-08 Structure and preliminary correspondence with ISCO-88. Accessed May 11, 2015. <http://www.ilo.org/public/english/bureau/stat/isco/isco08/>.

countries, with a very large impact on companies development and on skills required by the sector (e.g., these aspects were already evidenced in 2008 by the wide survey study at enterprise level “Study of Wood Sector - Research report on skill needs” done by the Lithuanian Methodological Centre for Vocational Education and Training of Vilnius – PMMC, which tried to define the “Future Skills” required by the sector, evidencing in particular the growing connections among skill change with regard to the jobs in the Wood sector and implementation of the new tools in manufacturing, and between productivity of WM and FM and automation level of manufacturing process and modernization of work methods, gaining more importance the qualification of the specialists and workers, and the need of maintenance and programming skills / higher qualification staff to maintain the highly automated production processes).

With specific regard to CNC education and training in woodworking industry at European level, the main EU issues are constituted by the specific references to CNC in wood and furniture contained in the multilingual European classification of skills, competences, qualifications and occupations (**ESCO**, <https://ec.europa.eu/esco/home>), jointly coordinated since 2010 by the DG Employment, Social Affairs and Inclusion and by the DG Education and Culture of the European Commission, with the support of European Centre for the Development of Vocational Training (Cedefop).

The ESCO classification - which is part of the Europe 2020 strategy - identifies and categorizes skills, competences, qualifications and occupations relevant for the EU labor market and education and training, included those relating to Wood and Furniture Manufacture, and to CNC in these production sectors.

The first version of ESCO was published on 23 October 2013. This release marks the beginning of the pilot and testing phase, including the ESCO mapping pilot. Until 2017 the classification will be completely revised and the final product will be launched as ESCO v1. ESCO is structured in three pillars: occupations; skills and competences; qualifications.

**The ESCO occupations** pillar contains occupation groups and occupations. In ESCO v0, ISCO-08 serves as hierarchical structure of the occupations pillar. In ESCO v1, sectorial Reference Groups create a new hierarchical structure for the occupations pillar. The grouping of occupations according to ISCO-08 will be maintained as an additional mapping. In ESCO, an occupation is a grouping of jobs involving similar tasks and which require a similar skills set. Occupations should not be confused with jobs or job titles. While a job is bound to a specific work context and executed by one person, occupations group jobs by common characteristics. E.g., being the "project manager for the development of the ventilation system of the Superfly 900 aircraft" is a job. "Project manager", "aircraft engineer" or "ventilation engineer" could be occupations, i.e. groups of jobs, to which this job belongs. Occupations can be used as job titles. An employer recruiting for the above mentioned position might title the vacancy notice

with the name of an occupation, e.g. "project manager". ESCO contains occupations, not jobs. Occupations in ESCO cover all types of labor market activities including unpaid activities, voluntary work, self-employment and political mandates (if the mandate is an occupation itself). The size of the business or activity is not important, as long as the occupations are relevant for the European labor market. The ESCO occupations pillar does not only contain occupations, but also occupation groups. An occupation group clusters occupations or occupation groups with common characteristics in a hierarchical way. ESCO v0 contains 4 761 occupation concepts. In ESCO v0, each occupation comes with a basic occupational profile. For each occupation this occupational profile indicates skills, competences and qualifications that are relevant for the occupation on the European labor market. In ESCO v0 an occupation concept contains a preferred term and sometimes non-preferred term in each ESCO language.

**The ESCO skills and competences** pillar contains skills, competences, knowledge as well as skills and competence group concepts. The pillar makes a distinction between occupation-specific skills and competences and cross-sector skills and competences. In ESCO, a broad definition of skills and competences is applied. The skills and competence pillar includes also cross-sector skills and competences. It also contains other concept that are frequently used to describe occupational profiles on the labor market, such as knowledge, tools, materials, hardware, software and work contexts. The skills and competences pillar in ESCO v0 contains around 5 000 concepts. They are divided into occupation-specific skills and competences and cross-sector skills and competences. All concepts are grouped in a flat hierarchical structure. In ESCO v0 each concept in the skills and competences pillar contains a preferred term and sometimes non-preferred term in each ESCO language. They are related to occupations in order to illustrate which knowledge, skills and competences are typically required in an occupation. With the development of ESCO v1 all contents of the skills and competences pillar will be reviewed. Their level of detail will enable qualitative competence-based job matching at European level across languages. In addition, it will allow using the vocabulary for describing or annotating individual CVs, job vacancies, and learning outcomes. Each skill, competence and knowledge will come with a scope note describing in short the meaning of the concept and a definition for concepts that might be misunderstood.

**The ESCO qualifications** pillar contains qualification groups and qualifications. The hierarchically structured qualification groups are based on the ISCED Fields of Education and Training 2013. ESCO is based on the qualification definition of the European Qualifications Framework (EQF): a qualification is the formal outcome of an assessment and validation process which is obtained when a competent body determines that an individual has achieved learning outcomes to given standards.

Each qualification concept contains:

1. Exact title of qualification: qualifications titles are not translated. Translations will only be included
  - 1.1. where official translations exist (as is the case for qualifications covered by Directive 2005/36) or
  - 1.2. When they are made available by authorities and institutions of the country/language concerned.
2. Awarding body
3. Expiry date (if applicable)
4. EQF level (if applicable)
5. Relationship to one or more ESCO occupations
6. Relationship to one or more knowledge, skills and competences
7. Definitions (optional)
8. Scope note (optional)

During the development of ESCO, a distinction is made between four types of qualifications. Three of them are directly included in ESCO:

- Qualifications awarded at national level but regulated at European level,
- (International) qualifications, certificates and licenses linked to tasks, technologies;
- (International) qualifications and certificates linked to occupations and sectors.

In the fourth category, national qualifications, ESCO will exclusively integrate information that is being collected during the work on national qualification databases and the European Qualification Framework (EQF). National qualifications are considered with particular care as ESCO will build on the work already being carried out under the EQF Recommendation, in particular through the development of national qualifications frameworks and the interconnection of national databases with the EQF portal.

About the relationships between the three pillars, in ESCO v0, the pillars are interrelated through associative relationships ("is related to"). The associative relationships carry the label "undefined". As of ESCO v0.1, the relationships between the three pillars will be developed further.

The relationship between knowledge, skills and competences and occupation, it is an associative relationship ("is related to") defined as "essential" or "optional". "Essential" are those knowledge, skills and competences that are usually required when working in an occupation, independent of the work context or the employer. "Optional" refers to knowledge, skills and competences that may be required or occur when working in an occupation depending on the employer, on the working context or on the country.



The relationship between qualifications and occupations is an associative relationship ("is related to") which describes how a particular qualification or certificate is linked to occupations. Although the nature of this relationship is still under development, it most likely will indicate when a qualification is legally required on a European level for a specific occupation.

The relationship between knowledge, skills and competences and qualifications is an associative relationship ("is related to"). The exact nature of this relationship is still to be defined.

Furthermore, ESCO systematically shows the relationships between different "concepts", also introducing the relations with associated "terms". A concept is a thing, idea or shared understanding of something. Concepts are not language dependent. Terms are language-dependent. A term refers to the linguistic description of a concept, while a concept is the actual meaning of a term. E.g.: the idea or shared understanding of a person baking bread, pastries, etc. and selling it to customers is a concept, while terms that are frequently used to refer to the concept are for example "Baker" in English language, "Bäcker/in" in German language, and "Fornaio" in Italian language.

More in detail, in ESCO, each concept will be associated with at least one term in all ESCO languages (currently, the ESCO project covers Icelandic and the official languages of the European Union, except Irish). In many cases, a language contains more than one term to refer to the same or a very similar concept. ESCO can thus contain several terms per concept. Therefore, in ESCO v1 each concept will not only be associated with one "preferred term" but also with as many "non-preferred terms" as relevant for each ESCO language. Within the ESCO data model each term is a separate element in the ESCO data structure.

Terms in ESCO always have a relationship with a concept. This is illustrated with the following chart showing a concept-term relationship for eight EU languages:



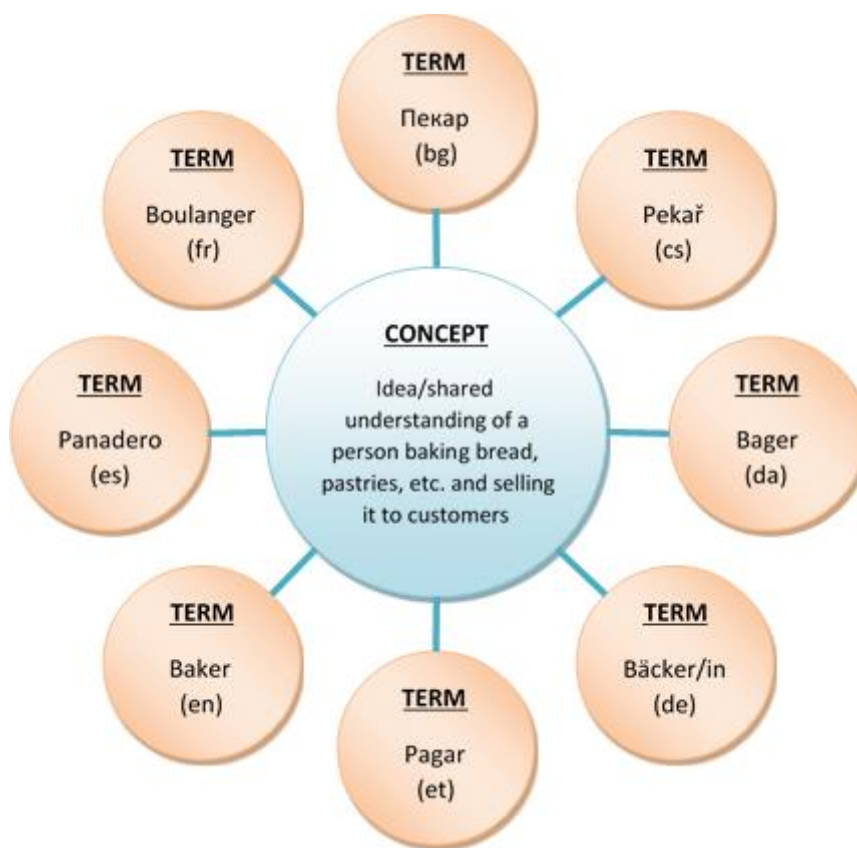


Figure 4: Concept-Term Relationship for Eight EU Languages

About the distinction between “preferred terms” (PT) and “non-preferred terms” (NPT), ESCO associate to each concept a designated, unique preferred name per ESCO language. It is called the preferred term and can be a single-word term or a multi-word term. The preferred term is used to represent a concept in ESCO in a specific language. Out of a group of terms with similar meaning, the one that best represents the concept is chosen to be the preferred term. The preferred term of a given concept is unique per language. Non-preferred terms can be synonyms (words with similar or same meanings) but can also be spelling variants, declensions, abbreviations, etc. They are regularly used by the target group (jobseekers, employers, education institutions) to refer to concepts that are described in ESCO with the preferred term.

Within ESCO, there are currently 90 concepts articulated in 54 Occupations, 36 skills with specific references to wood and CNC; 38 concepts articulated in 14 occupations, 24 skills with specific reference to furniture and CNC which can be accessed from Appendix 2: Concepts, Occupations and Skills In ESCO Related With Wood, Furniture and CNC.

ESCO v0 doesn’t contain classified “Qualifications” for Furniture and CNC, also because the qualifications pillar in ESCO v0 contains a small sample list of qualifications regulated at

European level, international qualifications and certificates and licenses linked to tasks, technologies, occupations or sectors. The list will be further developed in the next releases of ESCO. In addition, National Qualifications databases developed by the Member States and referenced to the European Qualifications Framework (EQF) will, in the future, feed into the development of ESCO.

It seems interesting to remark that, within the European literature on CNC education and training in wood and furniture industry, there aren't specific references to qualifications or systems of competences established on a voluntary basis at EU level by means of the application of European principles and tools for transparency and recognition of competences and qualifications, in particular through a Memorandum of Understanding - MoU ECVET, i.e. a formal agreement between, public institutions competent in VET, sectorial social partners and VET providers at national/regional/local level, establishing the European correspondence for assessment, transfer, and accumulation of learning outcomes achieved in formal, informal and non-formal contexts (units, unit parts, related ECVET credit points).

Turkey has adopted 8 reference levels from the European Qualifications Framework (EQF) for the NQF and for the National Occupational Standards regarding the CNC operators, only Level 3, Level 4 and Level 5 are included. The 8 levels of EQF<sup>6</sup> are stated above:

Table 7: Levels of European Qualifications Framework (EQF)

EQF Level	Knowledge	Skills	Competence
	In the context of EQF, knowledge is described as <i>theoretical and/or factual</i> .	In the context of EQF, skills are described as <i>cognitive</i> (involving the use of logical, intuitive and creative thinking), and <i>practical</i> (involving manual dexterity and the use of methods, materials, tools and instruments)	In the context of EQF, competence is described in terms of <i>responsibility and autonomy</i> .
<b>Level 1</b>	Basic general knowledge	Basic skills required to carry out simple tasks	Work or study under direct supervision in a structured context
<b>Level 2</b>	Basic factual knowledge of a field of work or study	Basic cognitive and practical skills required to use relevant information in order to carry out tasks and to solve routine problems using simple rules and tools	Work or study under supervision with some autonomy

<sup>6</sup> Commission, European. 2015. Descriptors defining levels in the European Qualifications Framework (EQF). Accessed May 13, 2015. <https://ec.europa.eu/ploteus/content/descriptors-page>.



<b>Level 3</b>	Knowledge of facts, principles, processes and general concepts, in a field of work or study	A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information	Take responsibility for completion of tasks in work or study; adapt own behavior to circumstances in solving problems
<b>Level 4</b>	Factual and theoretical knowledge in broad contexts within a field of work or study	A range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	Exercise self-management within the guidelines of work or study contexts that are usually predictable, but are subject to change; supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities
<b>Level 5<sup>[1]</sup></b>	Comprehensive, specialized, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge	A comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems	Exercise management and supervision in contexts of work or study activities where there is unpredictable change; review and develop performance of self and others
<b>Level 6<sup>[2]</sup></b>	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 specialized 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
<b>Level 7<sup>[3]</sup></b>	Highly specialized 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	Specialized 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



<b>Level 8<sup>[4]</sup></b>	Knowledge at the most advanced frontier of a field of work or study and at the interface between fields	The most advanced and specialized skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or innovation and to extend and redefine existing knowledge or professional practice	Demonstrate substantial authority, innovation, autonomy, scholarly and professional integrity and sustained commitment to the development of new ideas or processes at the forefront of work or study contexts including research
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Esco v0 doesn't contain classified "Qualifications" for Furniture and CNC yet this kind of classification system is necessary to construct new curricula. Since there is an uncertainty in this situation, and there will be till Esco v1 is released. Even though qualifications and competencies are regulated and defined by EU, the curricula and how it is conveyed varies from country to country. So an in depth analysis of all practices in EU region is neither feasible nor possible. In this regard, German and Italian VET and education systems are selected as an example of best practice and as a similar system to Turkey's system. In addition, there are several EU projects regarding how VET should be conveyed which can be accessed from Appendix 1:

General Education Programs.

## CNC Education in Woodworking Industry in Turkey

In this chapter, CNC education system in Turkey is analyzed in relation with the CNC education system in EU. For this purpose, both competency system and curricula used in Turkey are evaluated with respect to the framework explained in the previous chapter. In addition, interviews with teachers and private companies are made and evaluated to have insight regarding the conveying of this system.

In the report provided by IKOOR, demand and analysis of problems from the sector's point of view regarding CNC education can be summarized as below:

In developed countries, CNC operators are expected to have competencies to conduct the operations listed below:

- To be able to recognize the machine, to be able to conduct routine maintenance operations of the machine, troubleshooting and repair,
- To render the project, which technical and visual design is completed, machinable and enabling the processing of the work in time and quality (programming, optimization, manufacturing),
- To improve skills regarding problem solving in long term,
- To be able to code CNC at parameter and macro level

CNC machine operators employed in Turkey's wood sector, showed notable progress with their experience in the last ten year period. Qualified staff are trained with the increase of CNC machine usage. However, most of the CNC operators employed in this sector in Turkey are employed only in manufacturing phase, in other words, in the phase of processing the work piece after the programming and optimization phases despite the competencies mentioned above. Yet, it is known that the number of CNC operators having the skills which the sector requires are not sufficient.

This situation is caused by the factors listed below:

- Being unable to get technical and applied trainings at adequate level
- Training programs not being designed for the need,
- Foreign language problems of operators,
- Short training durations provided by producer/distributor companies,
- Companies which do not accept to pay training fees.

In addition, CNC operators in Turkey having insufficient computer and software knowledge, not being able to recognize systems in the machine, prevents the active and effective usage of the machine. An operator who is not able to recognize the machine s/he uses, remains ineligible in maintenance tasks and foreseeing and troubleshooting possible problems.



With the information provided by the sector representatives, competency system and education system are inspected thoroughly to pin point the exact problems within the system.

### Professional Competency Board (Mesleki Yeterlik Kurumu-MYK)

It is evident that education in any field should meet not only the present requirements of the day, but it should provide basis for learners to cope with future technologies and to be able to adopt themselves to novelties and changes. In this sense, learning can be considered in two folds; learning a profession and learning “self-learning”. Hence, it is important how the content of education is prepared and how this content is to be conveyed to learners. In defining the curricula, the competencies expected in practice are important guidelines, which are well specified by Vocational Qualification Institutes or Professional Competency Boards.

As explained in the scope of ECVET and as one of the targets in Bologna Process, it is essential to adapt a National Qualification Framework. Vocational Qualifications Authority - Turkey (Mesleki Yeterlilik Kurumu) is authorized<sup>7</sup>. In order to increase the transparency, recognition and mobility, European Aid project named “Strengthening Vocational Qualifications Authority (VQA) and National Qualifications System (NQS) in Turkey Project” (UYEP) is completed in 2013 by Vocational Qualifications Authority. In the scope of grant projects in UYEP, National Qualification Framework and Vocational Education and Training in Turkey is developed according to ECVET system<sup>8</sup>.

Professional Competency Board in Turkey (Mesleki Yeterlikler Kurumu - MYK) is a national institution having duties regarding documentation, examination and standardization of national professional competency. Even though all vocational fields are in the scope of MYK, standardization of competency is initiated not by MYK itself but other institutions and organizations such as non-governmental organizations and professional chambers. Hence, every professional field in every level is not documented.

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<sup>7</sup> UYEP. 2013. Strengthening VQA and NQS in Turkey Project. June 24. Accessed May 11, 2015. <http://www.uyep.net/web/en-us/uyep.aspx>.

<sup>8</sup> Altin, Recep, and Osman Yalçın. 2011. "VET reform in Turkey: the key of ECVET." Edited by Liliane Volozinskis. ECVET Mag Magazine 19-22. Accessed May 11, 2015. [www.ecvet.team.eu](http://www.ecvet.team.eu).

There are several professional competency requirement documents published by Professional Competency Board (MYK) regarding wood industry and CNC operators. The list of these documents are given in the table below;

*Table 8: List of National Vocational Standards Regarding Woodworking and CNC*

<b>National Vocational Standard Name</b>	<b>Level</b>
<b>Wood Cutting and Stringer Operator</b>	Level 3
<b>Wood Processing Machine Operator</b>	Level 3
<b>Wood Processing Machine Operator</b>	Level 4
<b>Joiner</b>	Level 3
<b>Wood Furniture Manufacturer</b>	Level 3
<b>Wood Furniture Manufacturer</b>	Level 4
<b>Wood Furniture Manufacturer</b>	Level 5
<b>Wood Turner</b>	Level 3
<b>Frame House Manufacturer</b>	Level 3
<b>Frame House Manufacturer</b>	Level 4
<b>Frame House Manufacturer</b>	Level 5
<b>CNC Programmer</b>	Level 4
<b>CNC Programmer</b>	Level 5
<b>Milling Machine Operator</b>	Level 3
<b>Milling Machine Operator</b>	Level 4
<b>NC/CNC Machine Worker</b>	Level 3
<b>NC/CNC Machine Worker</b>	Level 4
<b>CNC Machine Tools Application and Serviceman</b>	Level 5

National Occupational Standards are documented in a predetermined template consisting the chapter titles as below:

1. Introduction
2. Occupation Definition
  - 2.1. Occupation definition
  - 2.2. Position of the occupation among the international classification system
  - 2.3. Regulations regarding health, safety and environment
  - 2.4. Other legislations about the occupation
  - 2.5. Work environment and conditions
  - 2.6. Other requirement concerning occupation





3. Occupation Profile
  - 3.1. Duties, operations and performance index
  - 3.2. Tools, instruments and equipment used
  - 3.3. Knowledge and skills
  - 3.4. Manner and behavior
4. Measurement, assessment and documentation

As such documents are not for educational purposes but for assessment of competency and documentation, it is not possible to inspect such documents with Bloom's taxonomy. Yet, it is possible to match performance indices of occupation profiles with the categories defined in Bloom's taxonomy.

In the scope of the present project, the qualifications of the operators are pre-evaluated based on the categories defined in Bloom's taxonomy as shown in Table 9.

Table 9: Knowledge Dimension vs. MYK National Occupational Standards

Knowledge Dimension	NC/CNC Machine Worker L3	NC/CNC Machine Worker L4	Wood Turner L3	CNC Programmer L4	CNC Programmer L5	Milling Machine Operator L3	Milling Machine Operator L4
<b>Factual Knowledge</b>							
<b>Knowledge of terminology</b>	A,B,C,D, E, G,H,I	A,B,C,D, E, F,G,H,I,J	A,B,C,D, E	A,B,C,D, E, F,G,H,I	A,B,C,D, E, F,G,H,I,J	A,B,C,D, E, F,G,H,I	A,B,C,D, E,F,G,H,I
<b>Knowledge of specific details and elements</b>	A,B,C,D, E, F,G,H,I	A,B,C,D, E, F,G,H,I,J	A,B,C,D, E	A,B,C,D, E, F,G,H,I	A,B,C,D, E, F,G,H,I,J	A,B,C,D, E, F,G,H,I	A,B,C,D, E,F,G,H,I
<b>Conceptual Knowledge</b>							
<b>Knowledge of classifications and categories</b>	B,D,F,G, H	B,D,F,G, H,I,J	B,D	B,E,F,G,I	B,D,E,F, G,H,I,J	B,D,F,G, H,I	B,D,F,G, H,I
<b>Knowledge of principles and generalizations</b>	D,F,G,H	D,E,F,G, H,I, J	D,E	D,E,F,G, H,I	D,E,F,G, H,I,J	D,E,F,G, H,I	D,E,F,G, H,I
<b>Knowledge of theories, models and structures</b>	-	-	-	-	-	-	-



Knowledge Dimension	NC/CNC Machine Worker L3	NC/CNC Machine Worker L4	Wood Turner L3	CNC Programmer L4	CNC Programmer L5	Milling Machine Operator L3	Milling Machine Operator L4
<b>Procedural Knowledge</b>							
Knowledge of subject-specific skills and algorithms	A,F,G,H	A,F,G,H,I,J	A,E	A,D,E,F,G,H,I	A,D,E,F,G,H,I,J	A,F,G,H,I	A,F,G,H,I
Knowledge of subject-specific techniques and methods	A,F,G,H	A,F,G,H,I,J	A,E	A,D,E,F,G,H,I	A,D,E,F,G,H,I,J	A,F,G,H,I	A,F,G,H,I
Knowledge of criteria for determining when to use appropriate procedures	A,H	A,E,F,H,I,J	A	A,F,G,I	A,D,E,J	A	A,E,F,G,H,I
<b>Metacognitive Knowledge</b>							
Strategic knowledge	A,J	A,K	A,F	A,G,H,J	A,F,K	A,J	A,J
Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge	-	K	-	J	K	-	-
Self-knowledge	A, J	A,K	A,F	A,J	A,K	A,J	A,J

\*Letters denote task groups for each occupation standard. Letters denoting task groups may vary among standards

Occupation profile is defined with measurable criteria in subchapter tasks, operations and performance indices and given as table. First three titles are templates regarding occupational safety, environmental protection legislation and being able to work in accordance with the quality management system documents. These chapters are formulated with respect to concerning legislations with reference and related directly to occupation itself. However, subsequent titles are defined and formulated directly regarding the occupation requirements yet these titles are defined and explained for purely operational concerns and gives direct instructions about the tasks (i.e. being able place work piece to bench clamps for milling machine operator). Furthermore, it is observed that tasks and requirements defined with respect to specific to occupation embodies all steps of the revised Bloom's taxonomy. Weighting of these steps varies with the level of competency. For example, NC/CNC Machine Worker Level 3 competency document is mainly based on up to 3<sup>rd</sup> level of Bloom's revised



taxonomy whereas NC/CNC Machine Worker Level 4 competency document contains more tasks regarding higher steps.

When these documents are thoroughly inspected, what is problematic is not the definition of occupational profile and subsequently definition of tasks, duties and performance indices but the measurement, assessment and documentation. Text in the 4<sup>th</sup> chapter (Measurement, assessment and documentation) is also a template text and refers to regulations regarding Professional Competency Board Occupational Competency Examination and Documentation. The content and methodology of assessment of competency and content of the exams are available from the MYK website. However, most of the standards listed in the table do not have a corresponding examination document. List of National Vocational Competency documents regarding woodworking and CNC can be seen in Table 10.

*Table 10: List of National Vocational Competency Documents Regarding Woodworking and CNC*

<b>National Vocational Standard Name</b>	<b>Level</b>
<b>CNC Programmer</b>	Level 4
<b>CNC Programmer</b>	Level 5
<b>Milling Machine Operator</b>	Level 3
<b>Milling Machine Operator</b>	Level 4
<b>NC/CNC Machine Worker</b>	Level 3
<b>NC/CNC Machine Worker</b>	Level 4
<b>CNC Machine Tools Application and Serviceman</b>	Level 5

As a result, templates constructed for standardization and assessment of professional competency are not problematic in terms of conformity with Bloom’s revised taxonomy but in terms of execution. As standards and examination are initiated by non-governmental organizations and professional chambers, standards for professions are obliged to remain missing if an organization does not apply for the national profession competency. In addition, concurrent fields are also missing. For example, NC/CNC Machine Worker Occupational Standard is generated by Turkey Metal Industrialists Union and validated by Metal Sector Committee which neglects woodworking NC/CNC Machine Worker.

### Current Situation Analysis of MEB Curricula

Furniture and Interior Design branch is present in 420 schools in 79 cities in Turkey. Specifically in Ankara, there are 153 instructor in 29 schools which means there is one instructor per 10-12 students. These numbers are not efficient for practical training schools; moreover, not all of these institutions has CNC education within their curriculum. In Turkey, the students of “Furniture Interior Draftsmanship” branch of Furniture and Interior Design Area which are located in 79 schools are educated for CNC.

Apart from schools, on-the-job trainings given by the manufacturers teach the employees to use the machine although they are not allowed to give certificate accredited by MEB. On the other hand, Public Education Centers (Halk Eğitim Merkezleri) are accredited to train the workers with MEB curriculum. This curriculum is thoroughly analyzed in the scope of this report.

In Turkey, curricula of the vocational schools are proposed, determined and prepared by the Directorate General for Vocational and Technical Education of Ministry of National Education. In the scope of “Strengthening Vocational Qualifications Authority”, weekly course schedules are determined and published. Present education program is consist of modules for each branch.

According to the report prepared by Altin and Yalçın<sup>9</sup>, the basic elements of the ECVET approach that are adapted to the Turkish VET context are:

- Learning outcomes are credited based on total learning time.
- Learning outcomes which lead to qualifications of similar scope, content, complexity and duration are allocated the same amount of credits.
- Learning outcomes gained through one-to-one learning of up to 20 hours are equivalent to 1 ECVET credit.
- One full educational year of VET education is equivalent to 60 credits.
- 240 credits can be gained upon completion of 4 years of secondary formal VET education.

Courses covering general concepts and processes related to CNC and CAD/CAM are offered as programs in Technical High Schools, Vocational High Schools, Anatolian Technical High Schools and Anatolian Vocational High Schools.

Guidelines for the curricula and execution of the courses are revealed by the Ministry of National Education. Some common requirements and rules regarding the execution of vocational courses can be summarized in four headings as trainers, assessment, certification, teaching technics and methodology.

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<sup>9</sup> Altin, Recep, and Osman Yalçın. 2011. "VET reform in Turkey: the key of ECVET." Edited by Liliane Volozinskis. ECVET Mag Magazine 19-22. Accessed May 11, 2015. [www.ecvet.team.eu](http://www.ecvet.team.eu).

**Trainers;**

- Trainers' higher education background should be related with the content of the courses.
- If required, qualified instructors, technicians and members of the related profession with sufficient sectorial experience can be employed for the conduction of the course.

**Assessment;**

Assessment of the students in accordance with Ministry of National Education's Regulations for Pass-Fail and Examinations of Secondary Education Institutions is essential. Hence;

- Proficiencies gained during the teaching of each module should be assessed according to the criteria mentioned in the related regulations.
- Success of the students should be assessed in terms of the learning activities conducted in school and during internships as well as student's self-learning activities.

**Certification;**

- Graduates of the vocational schools are awarded with a diploma indicating the field and branch
- All the courses and modules taken during the education are indicated in the diploma supplement.
- For a vocational certification, proficiencies gained during education are assessed independently.

**Teaching Technics and Methodology;**

- Students are guided by the teachers.
- Students are encouraged for self-learning.
- Students are encouraged for being active during the teaching activities.
- Students are motivated for research.
- Students can assess themselves.
- Appropriate methods and technics are applied for gaining required proficiency.

On the other hand, CNC and CAD/CAM related programs have different weekly workload for different kind of schools and grades. Detailed workload distribution can be found in Table 11.



Table 11: Workload Distributions of CNC Related Courses for Different Kinds of Schools

PROGRAMS	EDUCATIONAL INSTITUTION	Courses	9th Grade	10th Grade	11th Grade	12th Grade
<b>INDUSTRIAL AUTOMATION TECHNOLOGY (Mechatronics)</b>	Anatolian Vocational High School	Must Courses	-	-	22	28
		Elective Courses	3	-	5	4
	Anatolian Technical High School	Must Courses	-	-	15	19
		Elective Courses	3	3	-	1
<b>MACHINERY TECHNOLOGY (CAM, Industrial Mold, CAD, Machinery Maintenance and Repair, Marble Processing and Computer Aided Industrial Modelling)</b>	Vocational High School	Must Courses	-	-	22	28
		Elective Courses	6	-	4	4
	Anatolian Vocational High School	Must Courses	-	-	22	28
		Elective Courses	3	-	5	4
	Technical High School	Must Courses	-	-	15	19
		Elective Courses	6	3	-	1
	Anatolian Technical High School	Must Courses	-	-	15	19
		Elective Courses	3	3	-	1

Mechatronics sub branch of “Industrial Automation Technology” programs offered in Anatolian Technical High Schools and Anatolian Vocational High Schools, which aims educating highly qualified technicians with sufficient scientific and technical background for the industrial automation technologies sector, has a special emphasis on maintenance, programming and production of automatic manufacturing machines.

Similarly, Computer Aided Manufacturing, Industrial Molding, Computer Aided Drawing, Machine Maintenance and Repair, Marble Processing, Computer Aided Industrial Modelling branches of Machine Technology Programs offered in all vocational schools has a special emphasis on CAD/CAM, molding, simulation, maintenance, programming and production of automatic manufacturing machines.

Mechatronics sub branch of Industrial Automation Technology program necessitates successful completion of two CNC related courses; Factory Automation and Automatic Manufacturing namely. Explanation of each course, included modules, duration and learning outcomes are presented in Table 12.



Table 12: Detailed Information On CNC Related Course Offered In Industrial Automation Technology Program.

Course	Explanation	Module	Duration	Learning Outcomes
<b>Factory Automation</b>	Control and operation of automation systems in a factory is taught in the course.	Factory Automation CNC Unit	40/32	Operating Factory Automation CNC Unit
<b>Automated Manufacturing</b>	Manufacturing work pieces in CNC with CAM programming, flexible manufacturing cell monitoring are taught in this course.	Programming Robots	40/32	Programming Robots
		Programming CNC Milling	40/32	Operating CNC Milling
		Programming CNC Lathe	40/32	Operating CNC Lathe
		CAM	40/32	Manufacturing work piece with CAM Programming
		Communication between PLC and CNC Robot	40/32	Communicating CNC Robot with PLC

In the scope of Machinery Technology Programs offered in all vocational schools types, two courses are specified in the field of CAD/CAM and CNC. Explanation of each course, included modules, duration and learning outcomes are presented in Table 13.

Table 13: Detailed Information On CNC Related Course Offered In Machinery Technology Program.

Course	Explanation	Module	Duration	Learning Outcomes
<b>Manufacturing With CNC</b>	Course covers programming CNC Milling and Turning Machines, Operational sequencing, Simulation and Processing of Critical Works. Main goal of the course is gaining proficiency for using CNC machines in manufacturing processes and manufacturing using advancing programming technics.	CNC Lathes	40/32	Operating CNC Lathe
		Programming CNC Lathes	40/24	Programming CNC Lathes
		CNC Turning Operations 1	40/24	Operations via CNC Lathe
		CNC Turning Operations 2	40/24	Boring, drilling, grooving, turning with CNC Lathe and Programming
		CNC Turning Conversions	40/24	Programming CNC Turning Conversions
		Sub-programming in CNC Lathes and Exporting	40/16	Operating Various Tasks in CNC Lathe
		CNC Milling Machines	40/32	CNC Milling Machines

		Programming CNC Milling Machines	40/24	Programming CNC Milling
		CNC Milling Operations 1	40/24	CNC Milling Machines
		CNC Milling Operations 2	40/24	CNC Milling Machines
		CNC Milling Conversions	40/24	Programming Conversions in CNC Milling Machine
		Sub-programming in CNC Milling Machines and Exporting	40/16	Operating Various Tasks in CNC Milling Machine
<b>Computer Aided Drawing and Manufacturing</b>	Content of the course includes manufacturing of work pieces designed using CAD and CAM software. Main goal of the course is gaining proficiency for drawing the part to be manufactured, making necessary planning for machining with a CNC milling and turning machine, making the simulation of manufacturing and obtaining manufacturing codes to be used in CNC machines.	2D Drawing with CAM Software	40/16	Utilizing CAD/CAM Software
		3D Drawing with CAM Software	40/24	Utilizing CAD/CAM Software
		CAM Turning with 2 Axis	40/16	CAM Turning
		CAM Turning with C Axis	40/24	CAM Turning
		CAM Milling with 2.5 Axis	40/16	CAM Milling
		CAM Milling with 3 and 5 Axis	40/24	CAM Milling

CNC related courses are offered in other programs as elective courses. Elective courses are offered by the school management in accordance and in compliance with the requests of coordinator teachers, students and sectorial requirements.





Table 14: List of Modules Used In CNC Related Courses of Vocational High Schools

No	Module	Availability
1	CAM Turning with 2 Axis	Ready
2	CAM Milling with 2.5 Axis	Ready
3	CAM Milling with 3 and 5 Axis	Ready
4	CAM Turning with C Axis	Ready
5	2D Drawing with CAM Software	Ready
6	3D Drawing with CAM Software	Ready
7	Sub-programming in CNC Milling Machines and Exporting	Ready
8	CNC Milling Conversions	In Progress
9	CNC Milling Operations 1	Ready
10	CNC Milling Operations 2	Ready
11	Programming CNC Milling Machines	Ready
12	CNC Milling Machines	Ready
13	CNC Turning Conversions	In Progress
14	CNC Turning Operations 1	Ready
15	CNC Turning Operations 2	Ready
16	CNC Lathes	Ready
17	Programming CNC Lathes	Ready
*18	Factory Automation CNC Unit	Ready
*19	Programming Robots	Ready
*20	CAM	Ready
*21	Communication between PLC and CNC Robot	In Progress

As it can be seen that the curriculum in Vocational Schools in Turkey aims to provide the essential knowledge and skills for CNC operators as expected by the sectors. However, it is also important how these contents are conveyed to learners i.e. the second fold of education should be studied. Revised Bloom's Taxonomy which will be explained in details in the following report of the project is employed in this assessment process.

Bloom's taxonomy, which is described in detail, aims to assess how contents are conveyed to learners starting from basic knowledge to meta-cognition which is necessary to develop self-learning skills and to use the previous knowledge to get new ones. The evaluation of the CNC related courses in Vocational High Schools in terms of knowledge dimension is given in Table 15.



Table 15: Evaluation of Modules Used In CNC Related Courses of Vocational High Schools Based On Knowledge Dimension

Knowledge Dimension	Industrial Automation technologies (Mechatronics)
Factual Knowledge	
Knowledge of terminology	1,2,3,4,5,6,7,8,11,12,13,16,17
Knowledge of specific details and elements	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17
Conceptual Knowledge	
Knowledge of classifications and categories	1,2,3,4,5,6,7,8,11,12,13,16,17
Knowledge of principles and generalizations	11,17
Knowledge of theories, models and structures	11,17
Procedural Knowledge	
Knowledge of subject-specific skills and algorithms	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17
Knowledge of subject-specific techniques and methods	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17
Knowledge of criteria for determining when to use appropriate procedures	-
Metacognitive Knowledge	
Strategic knowledge	-
Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge	-
Self-knowledge	-

It is seen that the present curriculum satisfies the essential requirements defined by MYK, yet there appears to be deficient in fulfilling to develop procedural and metacognitive knowledge which are the most important goals of education.

After the survey conducted with vocational school instructors, it is seen that following aspects are found to be the reason of unmet levels of Bloom's taxonomy and the relevant evaluation matrix can be found in Table 16 ;



1. Institutional Aspects
  - 1.1. Lack of technology in schools
  - 1.2. Lack of self-development of the instructors.
  - 1.3. People developing the modules in the curriculum are ineligible, thus modules are insufficient. These people are not trained, hence they developed the curriculum based on limited literature survey.
2. Aspects based on Student Profile
  - 2.1. Attendance problem of the students
  - 2.2. Lack of mathematical background and intelligence of the students.
  - 2.3. Lack of interest
3. Aspects based on Parents
  - 3.1. Lack of attendance in school-parent meeting
  - 3.2. Lack of interest in their children

Table 16: Evaluation Matrix for MEB Curricula Evaluated by Vocational School Instructors

Learning Objectives		COGNITIVE						
	KNOWLEDGE		REMEMBER	UNDERSTAND	APPLY	ANALYZE	EVALUATE	CREATE
<b>1<sup>st</sup> semester</b>	<b>FACTUAL</b>		+	+				
	<b>CONCEPTUAL</b>		+	+				
	<b>PROCEDURAL</b>		+					
	<b>METACOGNITIVE</b>		+					
<b>2<sup>nd</sup> semester</b>	<b>FACTUAL</b>		+	+	+			
	<b>CONCEPTUAL</b>		+	+	+			
	<b>PROCEDURAL</b>		+	+				
	<b>METACOGNITIVE</b>		+					

Lack of technological equipment in schools are tried to be fulfilled with theoretical information, then these students graduates from vocational schools without any practical experience about the machine. Yet, the only opportunity is the internship during the education which is a must on 12<sup>th</sup> grade for 3 days in a week and to be controlled by an instructor. Furniture factories are willingly hire these students as interns, even current number of students does not meet the demand.

In furtherance, when the results of university entrance exam and relevant choices of students are inspected through years, it is seen that university, academy and vocational high schools for furniture education is preferred as last choice or to not to remain uncovered when applicants choices are inspected in the last ten years. Both engineering formation and sector knowledge of students, who are graduated from present schools giving furniture education, remain insufficient and hence qualified labor force required by the sector is not trained.

Furniture and Decoration Departments in Technical Education Faculties were shut down by the Council of Higher Education (Yüksek Öğretim Kurumu / YÖK) and replaced by Woodworking Industry Engineering fields. This situation caused related departments to go under side disciplines which are not directly representing furniture sector. On the other hand, it is required to include furniture education in the curricula of departments giving industrial design education.

Vocational education including knowledge required for manufacturing and design is considered significant to be given in both vocational high schools and at university level in special departments aimed at furniture sector. It is required to establish Furniture Engineering, Furniture Design Department in the areas which the furniture manufacturing is focused on; to intensify academic researches on furniture industry in the frame of university - industry collaboration, and to establish plans and programs regarding the utilization of knowledge and labor force accumulated in this field like the developed country universities. It is considered that the making furniture vocational education attractive will provide benefit in the resolution of fundamental problems and improvement of the sector.

On the other hand, it can be concluded that the present schools, which are giving furniture education and being expected to provide qualified labor force to sector, remain incapable to satisfy the expectancy of the sector in terms of both quality and quantity. What is to be done immediately is the renewal of technologies, establishment of active university - industry collaboration, enhancement of both teaching staff and student qualities, renewal of programs with respect to application and latest technology, and making the sector attractive. In addition, teaching staff in the schools should be enabled to do internship in big enterprises in order to obtain information on contemporary technology. Moreover, sending teaching staff to international fairs to enable them follow the recent developments by means of some promotions will be beneficial for both the sector and vocational education. Sector representatives being in touch with Ministry of National Education and Council of Higher Education respecting the expectancy of the sector has a vital importance on the resolution of furniture vocational education problems.

Sector employees are required to be informed on contemporary topics for efficient and effective manufacturing. It is important to monitor advances in technology and application fields, making up for possible lack of experience and dissemination of vocational education trainings for the fields requiring proficiency for the enhancement of knowledge and skills and the use of promotions like Educational Assistance. Establishing projects with development agencies, activating public education centers, increasing in-house education services are the factors contributing to the formation of qualified labor force and making up for lack of experience. Supporting enterprises in the sector on education of self-labor force also enables building up of qualified labor force in long term. Vocational Education Centers in Organized Industrial Sites must take active role in the rehabilitation of current employees.



## Comparison of CNC Education in EU and Turkey

CNC educations in EU and in Turkey in terms of contents are similar, but how the curricula is structured and conveyed, how it is assessed differ depending on the countries. For the comparison of CNC education in terms of how the curricula is conveyed, practices in two EU countries as Germany and Italy are inspected and compared with the practice in Turkey broadly. In depth investigation of curricula is present under O3 report of this project. Yet, general findings and remarks on how the system works are summarized in the scope of this chapter.

CNC education in Italy and Turkey is similar to each other especially in terms of occupational competencies as they are both based on Esco and ECVET as it is explained in detail in previous chapters. Germany VET system and CNC education in particular are also compatible with Esco and ECVET. However, the levels of competencies are more transient and education/training materials are prepared to melt levels of competencies in a pot so that lower level CNC operators also have skills required for higher levels. Qualification requirements of skilled operators in Germany is described as follows.

Woodworking machine operators perform some or all of the following duties:

- Set up, program and operate one or more computer numerically controlled (CNC) or manual woodworking machines such as saws, molders, lathes, routers, planers, edgers, pressing machines, shapers, drills and sanders to fabricate or repair wooden parts for furniture, fixtures and other wood products,
- Operate gluing machines to glue pieces of wood together or press and affix wood veneer to wood surfaces,
- Operate preset special-purpose woodworking machines to fabricate wood products such as coat hangers, mop handles, clothes pins, cabinet doors, ornate carvings, and other products,
- Read and interpret specifications or follow verbal instructions,
- May clean and lubricate equipment, and replace parts as necessary.

Table 17: Qualification Requirements for Skilled Woodworkers

Qualification requirements for skilled woodworkers		
Basic qualification skills	Advanced qualification skills	Positive skills
General		
Understanding and implementing technical drawings	Dealing with CAD	Spatial perception
Knowledge of the material and knowledge of machine work	EDV-Knowledge	Willingness for further qualification Understanding of manufacturing process Foresighted and planning oriented thinking and acting
Concerning machines		
Setting up, calibrating, setting the machine options Work piece maintenance and repair	Correction and optimization of existing programs taking into account the economy	Self-reliant action creativity quality consciousness

On the other hand, for VET and CNC education systems in both Turkey and Italy, the qualification requirements are limited and strictly based on Esco and ECVET. Hence, for the lower level qualification skills, it is not expected to conduct maintenance and reparation operations in Turkey/Italy cases whereas in German case troubleshooting and relevant reparation and maintenance operations are inherent part of the education which covers higher levels of Bloom's taxonomy (i.e. apply, analyze, and evaluate phases).

One of the major differences in VET and CNC education of Germany and Turkey/Italy is the integration of application to respective trainings. Vocational training in the Federal Republic of Germany is provided on the job and in vocational training schools. Based on what is referred to as the dual system, practical vocational training is given at work, backed up by theoretical training and general education provided in vocational training schools which are generally attended on one or two days a week. The characteristic feature of this system is that the provision of knowledge and skills is linked to acquiring the necessary job experience. This ensures that training will proceed under the same conditions that the trainee will encounter when practicing his chosen occupation. Only on the job, a trainee is able to learn to cope with the constantly-changing demands of the job and to appreciate the variety of social relationships that exist in the work environment. In addition, learning by doing gives a sense of achievement and provides a special source of motivation for the trainee. It promotes independence and a sense of responsibility, which are indispensable qualities in a developed industrial country, because by tackling concrete tasks under real working conditions the trainee can show evidence of the knowledge and skills he has acquired and can himself/herself

experience the success of his efforts. This shows that training on the job is more than just a process of institutionalized and organized learning. On the other hand, in Turkey and Italy the education is more dependent on in class trainings with the absence of or partial application on CNC machine. Hence, a disconnection between lectures and application is observed in these systems.

While VET and CNC education system in Italy and Turkey is similar to each other, the supervising and implementing systems are different from each other. In Italy, the curricula and competencies are delegated to provinces by the ministry. As a result, some differences in the application and conveying of the curricula, and even the curricula itself may change from region to region with the condition of conforming the Esco and ECVET standards. Turkey's system is more similar to Germany's system in terms of having a central system. Yet, it can be concluded that the collaboration between industry and institutions are more well-structured enabling trainees to have experience during their education. The gap between industry and education institutions are significant in Italy and Turkey examples.

## Conclusion

As it is seen, the basic knowledge dimensions targeted in CNC education is similar in formal and informal education both in EU and in Turkey. However, how such an education is conveyed, how it should be structured and standardized have differences. It is also seen that education strategies in EU considers the age groups of learners so pedagogical and androgogical principles in these strategies are taken into account in organizing short or long term trainings. In German case, such training is also well structured and organized aiming to achieve a common knowledge level among the operators.

In Turkish case, although the content of the curriculum in vocational schools is very similar, how it is applied and how the objectives and learning outcomes are assessed is not as clear as in German case. Another important difference appeared to be in informal education as short term trainings which are organized by different institutions and by Ministry of National Education. How the contents, durations and learning objectives of such trainings are determined and evaluated is not as structured as in German Case which can be a problem in the expected competencies of operators.

As a result of the analysis made in the previous chapters it is found out that there is no concrete gap between EU and Turkey in terms of competencies as Esco v0 also remains to define all occupational competencies and both Turkey's system and EU system are based on the same framework. It is also not possible to directly compare how the curriculum is constructed and conveyed. However, how these curricula are implemented in formal and informal education is varying from country to country even in EU region. It is also observed that in the implementation of the curriculum, the major problem is related with by whom or by which institution this curriculum is to be taught and how the overall training is to be assessed in order to ensure compatible skills among the operators who may take such trainings. The diversity of the responsible organizations, institutions and vocational schools and the diversity of the directives and major controlling bodies in EU and in Turkey makes difficult to evaluate outcomes and thus the success of education. In this sense, German system can be considered as one of the good examples where a top down educational system and quality control are successfully realized. The curricula of German and Italian VET systems and CNC education are inspected in depth in O3 report of this project.



## References

- University of Illinois at Urban-Champaign, Center for Innovation in Teaching & Learning. 2015. Bloom's Taxonomy Of Educational Objectives (Revised), Accessed May 10, 2015. <http://cte.illinois.edu/resources/topics/syllabus/blooms.html>
- Public Schools of North Carolina, Department of Public Instructions. 2015. Types of Knowledge in Revised Bloom's Taxonomy <http://www.dpi.state.nc.us/docs/acre/standards/rbt-knowledge-chart.pdf>
- Altin, Recep, and Osman Yalçın. 2011. "VET reform in Turkey: the key of ECVET." Edited by Liliane Volozinskis. ECVET Mag Magazine 19-22. Accessed May 11, 2015. [www.ecvet.team.eu](http://www.ecvet.team.eu).
- ILO, International Labor Organization. 2015. ISCO-08 Structure and preliminary correspondence with ISCO-88. Accessed May 11, 2015. <http://www.ilo.org/public/english/bureau/stat/isco/isco08/>.
- UYEP. 2013. Strengthening VQA and NQS in Turkey Project. June 24. Accessed May 11, 2015. <http://www.uyep.net/web/en-us/uyep.aspx>.
- Commission, European. 2015. Descriptors defining levels in the European Qualifications Framework (EQF). Accessed May 13, 2015. <https://ec.europa.eu/ploteus/content/descriptors-page>.
- Regione Umbria. 2015. Sistema regionale standard professionali, formativi, di certificazione, riconoscimento dei crediti. Accessed May, 2015. <http://www.regione.umbria.it/lavoro-formazione/sistema-regionale-standard-professionali-formativi-di-certificazione-riconoscimento-dei-crediti>
- Osservatorio Nazionale Distretti Italiani. 2015. [www.osservatoriodistretti.org/category/settore/arredo-casa](http://www.osservatoriodistretti.org/category/settore/arredo-casa)
- European Commision. ESCO : European Skills, Competences, Qualifications and Occupations. Accessed in May 2015 <https://ec.europa.eu/esco/home>
- Methodological Centre for Vocational Education and Training (www.pmmc.lt)
- Regione Umbria (www.regione.umbria.it)
- Osservatorio Nazionale Distretti Italiani ([www.osservatoriodistretti.org](http://www.osservatoriodistretti.org))
- European Association of Institutes for Vocational Training. Accessed in May 2015. [www.evbb.de](http://www.evbb.de)

## Appendices

## Appendix 1: General Education Programs

Acronym	Name	Website	Type	Description	Outcomes
smart	SMART Project's (Supporting dynamic Matching for Regional development)	<a href="http://www.openeductioneuropa.eu/en/project/smart">http://www.openeductioneuropa.eu/en/project/smart</a>	project	<i>Skill matching</i> Main goal is to create a model to identify the real training needs in different professional sectors, and to adapt the existing training offer to that identified needs, improving the employability of the users of that tools, using online personalized training paths.	e-training tool (http://www.smart-project.org/) report and scientific publication
evet2edu	Supporting Vocational Teachers and Trainers in e-Learning	<a href="http://www.openeductioneuropa.eu/en/project/evet2edu">http://www.openeductioneuropa.eu/en/project/evet2edu</a>	project	The general aim of the project is to support trainers and teachers from the vocational education and training (VET) sector in the implementation of dynamic, open and innovative methods by adapting and transferring validated e-learning course for vocational schools and training sector.	e-training tool (http://evet2edu.eu/moodle/course/view.php?id=22)
peal	EPALE: platform for Adult Learning in Europe	<a href="http://ec.europa.eu/epale/">ec.europa.eu/epale/</a>	portal	EPALE is a multilingual open membership community for teachers, trainers, researchers, academics, policy makers and anyone else with a professional role in adult learning across Europe. Community is at the heart of EPALE. It is set up around the sharing of content related to adult learning, including news, blog posts, resources, and events and courses.	electronic database
clohe	Building transversal key competences with animated toys	<a href="http://www.openeductioneuropa.eu/en/project/clohe-1">http://www.openeductioneuropa.eu/en/project/clohe-1</a>	project	<i>automata</i> The European CLOHE educational project is an innovative project that is using mechanical moving toys (Automata) as a learning tool for primary students to build transversal key competences. CLOHE will motivate primary children to use multidimensional, cognitive resources to achieve learning outcomes. The CLOHE project outcomes will allow teachers and students to build their own Automata. The resources the project will produce will include everything that will allow a teacher to make automata with their students. An online virtual museum will be created where students will be able to show their results to their peers.	hands on learning: international workshops for children based on toy based learning online virtual museum
tell me	Technology Enhanced Learning Livinglab for Manufacturing Environments	<a href="http://www.openeductioneuropa.eu/en/project/tell-me">http://www.openeductioneuropa.eu/en/project/tell-me</a>	project	<i>learning manufacturing</i> Project aims to develop and trial in authentic contexts (SME-driven human-centric and service-oriented manufacturing workplaces) an innovative cross-enterprise methodology and IT platforms for continuous education and training in heterogeneous business ecosystems, blending Precision Teaching (PT) lifelong learning and Living Lab (LL) participative co-creation aspects in ways that can address more business needs than traditional training.	e-learning platform conferences dissemination
convet	European Credit System for Vocational Education and Training (ECVET) for recognition of qualifications in construction sector	<a href="http://con-vet.eu/en/">http://con-vet.eu/en/</a>	project	<i>construction workers</i> The main objective of the project is the development and testing of an European Credit System for Vocational Education and Training (ECVET) and to improve the mobility of workers in the construction sector by engaging them to create innovative content and structure of a web application with built-in qualifications comparison tool based on the transferred cascade training methodology and PALS tools.	web-based application containing a module that is used to compare existing qualifications with the content of ECVET training
diva	Good Practices for Dissemination and Valorization of Educational Projects	<a href="http://www.openeductioneuropa.eu/en/project/diva">http://www.openeductioneuropa.eu/en/project/diva</a>	project	<i>dissemination and valorization</i> The DiVa consortium will carry out European studies about successful educational projects in its members countries /AT, BG, PT, IT, FI, NL/ as well as all over Europe. It will define criteria for evaluation of successful educational projects and will elaborate a best-practice catalogue.	database: catalogue of successful education projects
vimims	Virtual Institute for Modelling of Industrial Manufacturing Systems	<a href="http://www.openeductioneuropa.eu/en/project/vimims">http://www.openeductioneuropa.eu/en/project/vimims</a>	project	Its objective is to establish a virtual institute for knowledge sharing and integration of competencies about modelling and design of manufacturing systems. The VIMIMS environment is not created to completely replace "face-to-face" learning, but to support it with specific distance learning components, with adjunctive contents and the support of collaborative on-line services. The project intends also to promote an active and participatory role of students by involving them directly in concrete project works based on real industrial case studies (provided by two industrial external partners of the consortium).	e-learning platform

eucam	EUCAM	<a href="http://www.openeducationeuropa.eu/en/node/39346">http://www.openeducationeuropa.eu/en/node/39346</a>	project	EUCAM is directed at establishing an infrastructure for life-long learning of production workers at a European level. EUCAM is a work-process oriented multilingual learning system for workers in the industrial sector which aims at ensuring life-long learning and knowledge management in the production industry.	integrated qualification tool
novtec	European Profile of CAD/CAM Technicians in Production Technologies in the Footwear Industry.	<a href="http://www.openeducationeuropa.eu/en/project/novtec">http://www.openeducationeuropa.eu/en/project/novtec</a>	project	The project will define the European Profile of a Computer Aided Design/Computer Aided Manufacturing Technician working in the design and creation of footwear production machinery. A training package will then be created to support the development of this new job profile.	proposal of a new training package
metrolearn	European e-Learning in Manufacturing Metrology	<a href="http://www.openeducationeuropa.eu/en/project/metrolearn">http://www.openeducationeuropa.eu/en/project/metrolearn</a>	project	To develop and implement a coherent learning chain from introductory e-courses in initial manufacturing engineering studies towards higher-level vocational training.	e-learning tool
The European HTEC Network	The European Haas Technical Education Center (HTEC) Network	<a href="http://www.htecnetwork.eu">http://www.htecnetwork.eu</a>	network	<i>CNC education</i> The HTEC concept is a unique industry initiative that enables technical schools to teach advanced manufacturing technologies and provide local employers with highly trained and capable employees, fully prepared for careers in the 21st century hi-tech manufacturing industries.	education network for a specific machine
CNC Machining	HAAS CNC Machining Magazine	<a href="http://www.haascnc.com/magazine.asp#gsc.tab=0">http://www.haascnc.com/magazine.asp#gsc.tab=0</a>	journal	CNC Machining is distributed through a worldwide network of Haas Automation Distributors, and by individual subscription request.	journal for the manufacturers using a specific machine
Amatrol	AMATROL CNC Machine Operator	<a href="http://www.amatrol.com/program/cnc-machine-operator/">http://www.amatrol.com/program/cnc-machine-operator/</a>	web page	<i>CNC Machine Operator Program</i> Amatrol's CNC Machine Operator Program focuses exclusively on the modern CNC machine operator, including such tasks as maintaining machines and recording SPC (Statistical Process Control) data. It covers all the skills operators' need, from operating the CNC machine to set-up of tooling and fixtures to quality inspection.	virtual hands on learning with simulators
<a href="http://thomasnet.com">thomasnet.com</a>	Getting an Education in CNC	<a href="http://www.thomasnet.com/articles/custom-manufacturing-fabricating/cnc-education">http://www.thomasnet.com/articles/custom-manufacturing-fabricating/cnc-education</a>	web page	<i>CNC Education</i>	CNC machine education program
conestoga	Practical CNC Machining (Part-time)	<a href="http://www.conestogac.on.ca/parttime/1304.jsp">http://www.conestogac.on.ca/parttime/1304.jsp</a>	web page	The intent of the Practical CNC Machining program is to address the practical machining skills needed by students who are studying CNC programming. This part-time program will be approximately 142 hours in duration and encompass a mixture of theoretical and practical knowledge with a focus on practical applications in the CNC machining environment.	CNC machining certificate program



COMENIUS GRANT	CNC-Technology standards in Europe - Handicraft and Science for a sustainable Technical and Vocational Education	<a href="http://ec.europa.eu/education/trainingdatabases/index.cfm?fuseaction=DisplayCoursePrint&amp;cid=35634">http://ec.europa.eu/education/trainingdatabases/index.cfm?fuseaction=DisplayCoursePrint&amp;cid=35634</a>	project	For preparation the organizer is going to develop a website for the training course. These website will be contain information and documents especially for the thematic field (especially CNC-technology). On this website also a competition for CNC-programming and processing for vocational schools will be announced. The award winners will be selected by the participants of the training course. Furthermore the website will include also an e-learning course and teaching materials for CNC technology.	e-learning platform
ET-PETRA 1	Pre-vocational and vocational training for young people with poor educational background	<a href="http://cordis.europa.eu/project/rcn/19427_en.html">http://cordis.europa.eu/project/rcn/19427_en.html</a>	project	To develop tailor-made training directed towards the acquisition of practical and theoretical skills, to be achieved by manual activity. Target group: Young people between 16-25 who have dropped out of school, and young people of foreign origin. Activities: Practical masonry work, woodwork, and tiling. General training in building work through work experience. Activities to promote creativeness and manual skills.	training course
CFAO DU MEUBLE	CAM training module for the furniture industry	<a href="http://cordis.europa.eu/project/rcn/50642_en.html">http://cordis.europa.eu/project/rcn/50642_en.html</a>	project	The major objective will be to optimize the use of CAD software designed to modify existing drawings quickly rather than drawing new objects. The extensive codifying of objects in this sector is making CAD/CAM liaison essential.	Short training courses on CAM training Distance Video cassette
Training of Trainers	Training of Trainers	<a href="http://cordis.europa.eu/project/rcn/19356_en.html">http://cordis.europa.eu/project/rcn/19356_en.html</a>	project	To improve the quality of vocational education and training, in collaboration with the social partners and sectorial training institutions. Target group: Trainers and instructors in firms, responsible for the training of young people with low educational background (aged 16-21). Technical and vocational education teachers.	training for trainers
COMPETENCES BOIS	Skills accreditation software for the wood sector	<a href="http://www.2020-horizon.com/COMPETE_NCES-BOIS-Skills-accreditation-software-for-the-wood-sector(COMPETENCES-BOIS)-s53059.html">http://www.2020-horizon.com/COMPETE_NCES-BOIS-Skills-accreditation-software-for-the-wood-sector(COMPETENCES-BOIS)-s53059.html</a>	project	This pilot project will enable a Europe-wide skills accreditation software package to be developed which deals with woodwork, not only from the traditional perspective but from a modern context too, with all the new technologies that are available. It will also permit greater transparency of skills between member states, insofar as wood is an easily identifiable link between all those who work it, be they cabinet makers, sawyers or carpenters. Finally, it will enable a new skills accreditation tool to be made available to schools and universities, so that they may develop their own methods of qualification.	accreditation software package

## Appendix 2:

Concepts, Occupations and Skills In ESCO Related With Wood, Furniture and CNC

WOOD and CNC: 90 “Concepts”, articulated in 54 “Occupations”:

- [Wood gilder](#)
- [Stainer \(wood\)](#)
- [Artisan \(wood\)](#)
- [Crosscutter \(wood\)](#)
- [Polisher \(wood\)](#)
- [Assembler \(wood\)](#)
- [Planer \(wood\)](#)
- [Mold presser \(laminated wood\)](#)
- [Machine operator \(wood finishing\)](#)
- [Graphic artist \(wood\)](#)
- [Wax polisher \(wood\)](#)
- [Boat hull builder \(wood\)](#)
- [Wood molding maker](#)
- [Assembler \(wood products\)](#)
- [Wood sculptor \(artist\)](#)
- [Wood molding worker](#)
- [Surface finisher \(wood\)](#)
- [Sculptor \(wood cabinet makers and related workers\)](#)
- [Sculptor \(wood sculptors, painters and related artists\)](#)
- [Supervisor \(manufacture of textile/wood products\)](#)
- [Designer \(textiles/wood products, etc.\)](#)
- [Quality engineer \(textile/wood products\)](#)
- [Inspection engineer \(textiles/wood products etc.\)](#)
- [Production engineer \(textile/wood production, etc.\)](#)
- [CNC driller](#)
- [CNC miller](#)
- [CNC operator](#)
- [CNC turner](#)
- [Wood turner](#)
- [Wood treaters](#)
- [Wood sculptor](#)
- [Wood measurer](#)
- [Wood impregnation worker](#)
- [Wood wool worker](#)
- [Wood processing plant operators](#)
- [Wood industry worker](#)
- [Laminated wood worker](#)
- [Machine operator \(wood\)](#)
- [Construction wood worker](#)
- [Wood processing and papermaking plant operators](#)
- [Draftsman, textile/wood products, etc.](#)
- [Handicraft workers in wood, basketry and related materials](#)
- [Wood treaters, cabinet-makers and related trades workers](#)
- [Veneer maker \(wood-processing-plant operators\)](#)
- [Veneer maker \(woodworking-machine setters and setter-operators, wood-products machine operators, wood treaters\)](#)
- [Woodworker](#)
- [Craftsman/craftswoman \(woodwork\)](#)
- [Woodcarver](#)
- [Food processing, wood working, garment and other craft and related trades workers](#)
- [Woodwork teacher](#)
- [Teacher of woodwork and metalwork](#)
- [Woodworking machine operator](#)
- [Teacher of textile craft and woodwork](#)
- [Furniture restorer \(handicraft workers in textile, leather and related materials and in wood and related materials\)](#)

36 “Skills / Competences”:

- [Drilling \(CNC\)](#)
- [Planing \(CNC\)](#)
- [Grinding \(CNC\)](#)
- [Milling \(CNC\)](#)





- [Sawing \(CNC\)](#)
- [Turning \(CNC\)](#)
- [CNC programming](#)
- [Pressing \(CNC\)](#)
- [Punching \(CNC\)](#)
- [Bending \(CNC\)](#)
- [Boring \(CNC\)](#)
- [CNC systems \(maintenance\)](#)
- [Spark cutting \(CNC\)](#)
- [Wood sorting](#)
- [Wood engraving](#)
- [Wood drying](#)
- [Wood measurement](#)
- [Wood knowledge](#)
- [Assembly \(wood\)](#)
- [Wood carving](#)
- [Wood sculpture](#)
- [CNC machining Centre](#)
- [Wood tapping \(conventional machine\)](#)
- [Wood technology \(sales\)](#)
- [Wood technology engineering](#)
- [Industrial wood \(teaching\)](#)
- [Gilding wood surfaces](#)
- [Treatment of wood surfaces](#)
- [Wood and metal work \(teaching\)](#)
- [Machine operation \(wood and paper industry\)](#)
- [Edging \(wood\)](#)
- [Woodwork](#)
- [Veneering](#)
- [Forestry machines \(repairing\)](#)
- [Forestry machines](#)
- [Stoves](#)

ESCO don't contains classified "Qualifications" for Wood and CNC.

FURNITURE and CNC: 38 "Concepts", articulated in 14 "Occupations":

- [Furniture painter](#)
- [Furniture restorer \(cabinet-makers\)](#)
- [Salesperson \(furniture, household items\)](#)
- [Furniture restorer \(handicraft workers in textile, leather and related materials and in wood and related materials\)](#)
- [CNC driller](#)
- [Furniture stuffer](#)
- [CNC miller](#)
- [Furniture reconditioner](#)
- [CNC operator](#)
- [Furniture washer](#)
- [Furniture assembler](#)
- [CNC turner](#)
- [Wicker furniture maker](#)
- [Upholstery worker](#)

24 "Skills / Competences":

- [Furniture](#)
- [Furniture conservation](#)
- [Furniture valuation](#)
- [Furniture renovation](#)
- [Drilling \(CNC\)](#)
- [Planing \(CNC\)](#)
- [Grinding \(CNC\)](#)
- [Milling \(CNC\)](#)
- [Sawing \(CNC\)](#)
- [Turning \(CNC\)](#)
- [Furniture upholstery](#)
- [CNC programming](#)
- [Furniture assembly](#)
- [Pressing \(CNC\)](#)
- [Punching \(CNC\)](#)
- [Bending \(CNC\)](#)
- [Boring \(CNC\)](#)
- [Furniture upholstery \(providing training\)](#)
- [CNC systems \(maintenance\)](#)
- [Spark cutting \(CNC\)](#)
- [CNC machining Centre](#)
- [Furniture cleaning](#)
- [Furniture design](#)
- [Furnishing \(fitting\)](#)

