EQF assigned educational key element:

High level Technician in drawing and industrial design from Italy

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Selection of an exemplary curriculum for further consideration

The definition and analysis of the key elements structuring the proposed optimum model have mainly been drawn from the experience of the Italian IFTS system (post-secondary non-academic education and training) representing a recent framework within the Italian scenario offering a high level of education and vocational/professional training but, above all, a fast track to job opportunities.

For Italy, the curriculum selected as an example of outcome-oriented qualification standard concerning the occupational competences and activities related with the mechatronics sector is: "*Tecnico superiore per l'automazione industriale con indirizzo in progettazione e sviluppo di sistemi meccatronici per le energie rinnovabili ed il risparmio energetico e in movimentazione industriale*" (attach extended description – Executive Project).

The proposed methodological model: from competence to training standard

Identification of the learning objectives as a mix of basic, transversal and technical-professional competences

The proposed model make reference to "basic, transversal and technical professionalizing competences" and to the national standards "the standard (...) contains (...) the specification of the profile and the related basic, transversal and technical professionalizing competences (...)".

"The basic competences consist of the fundamental resources necessary to a person in order to access training and work, furthermore for the development of a real individual and professional path in relation to this it should be pointed out that after an appropriate reflection a contribution should be given to the educational and university channel which also offer development related to the professional competences of individuals; a greater visibility and consideration to the basic competences should be given. Basic competences mean therefore the group of knowledge (and their use) which form both the requirement for an access to any further training course, and also the minimum base for access to the working world and professions, thus forming a modern citizenship right. Languages, IT skills, economics, legislation and work rights are only some of the examples of such competences. In this respect the development of a wide range of basic competences is today a joint goal, each one in its own area, education, vocational training and university.

The transversal competences are those competences that (communication, relational, problem solving, etc.) are needed in different working situations and that allow the subject to transform the know-how into an efficient

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working behaviour belonging to a specific context. It is important to underline that all cognitive and methodological resources that education and university experience allows to develop are to be considered transversal competences and therefore becomes part of the stable patrimony of the individual, although often it is declined with different languages.

The technical-professional competences are composed of the know-how and the techniques linked to the practice of the operative activities required by the working processes where reference is made in the different professional environments. To this purpose it is necessary to appeal the specificities that characterise the different contributions that derive from the education system, university and regional vocational training, for the development of technical professional competences".

For the basic competences "requisites for occupation and citizenship" are taken into consideration which are considered essential, in order to favour the access to training and work in the emerging scenarios and to develop an individual and professional path.

For the transversal competences, non working characteristics should not be analysed but rather the working behaviour of the individuals and the variables which can significantly influence its actions. Namely there should be an analysis methodology of the working behaviour of individuals.

For the technical professional competences, instead the concrete operative activities linked to determine functions and working processes should be analysed, through an appropriate methodology of "work analysis" which is capable of "reading" the activities and reconstruct the picture of the competences present in the same operative activities.

From competence to training standard

From the developments in progress at the European level, there is a clear orientation for the definition of standards of competence that would make it possible to group competences into "Competence Units – C.U." viewed as a uniform and coherent set of competences. The C.U., which focuses on results (output/outcomes), is characterized by a level of reference, by a set of competences which refer to activities or tasks, by methods of evaluation and validation.

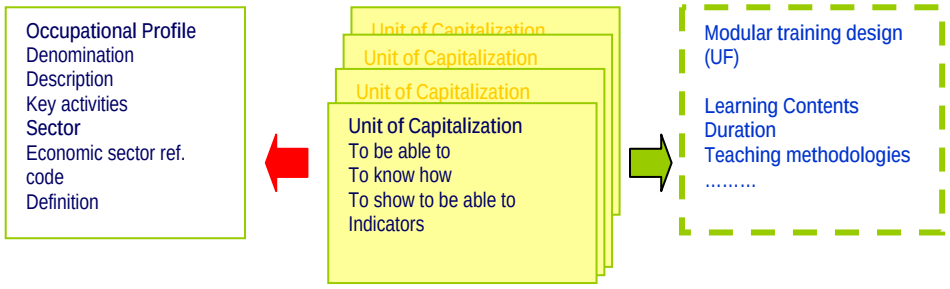

Fig. Standard of competences

As can be seen from the figure reported below, the first part of the C.U. indicates: the complete set of competences, which can easily be drawn from the relative Dictionaries, and the knowledge that is the reference also for the training projects and for certification of acquired competences. In this part, in addition to listing the names of the "aggregate" competences, it is necessary to define the "Know-how" to guarantee the result, the output required by the exercise of the individual competences.

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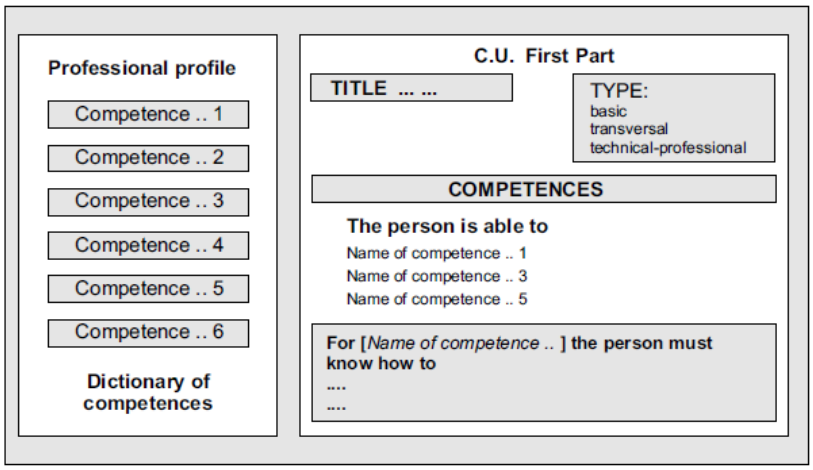
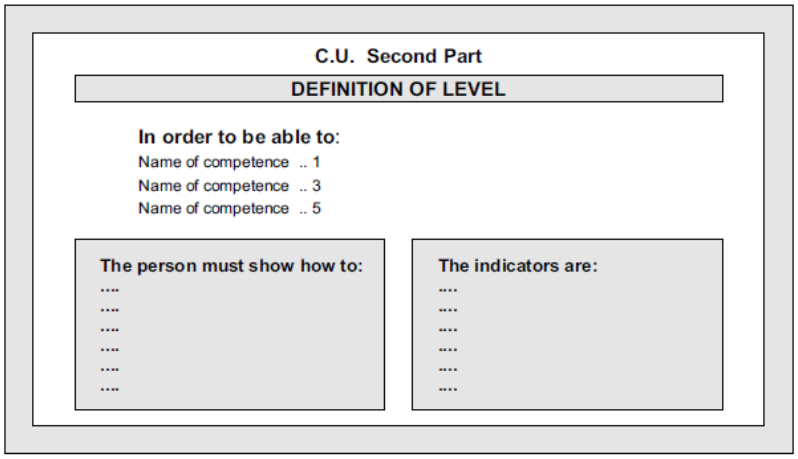


The second part: "definition of level" (see Fig.), lists the results that show whether the person possesses the aggregate competences listed making up the C.U. The second part also identifies the descriptors of the levels of mastery, that is, the situations that illustrate and therefore confirm and make it possible to assess the competences that make up the C.U. In addition, the indicators necessary to express an evaluation of the competences and level of mastery are defined.



The descriptors of the level of mastery (the person must show how to ..) represent the situations that require the competences and therefore make it possible to verify them. In a technical-professional sphere, situations that require a "product" will be privileged, analogous to the definition of the competences indicated within the project.

The product, the output, must be as similar as possible to the output required of real working processes and should be significant of the range of critical aspects that may arise. The indicators should be viewed also as contributions to the formulation of the tests for assessment and/or certification competences however acquired. It is advisable to provide an indicator for every descriptor, taking care to ensure objectivity of verification and the possibility of defining the relative indices that define the threshold values of acceptability. It is easy to see that the contents of the C.U. can be a complete source of structured information that defines sets of standards for competences.

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From the standard of competence to the training standard

A third key element characterizing the proposed model has to do with training standards (Training Units – T.U.) coherent with the "competence based" method to be adopted and tested to produce the Competence Units.

The technical structure of the T.U. (training standard) requires demonstration of:

- the learning goals, defined according to the knowledge, ability and behaviour involved ("elements" which are listed in the dictionaries of competences). It should be noted that the methods of testing and describing the competences makes it possible, also, to dispose of the elements of competence in an organic manner, as verified also in the working world and sufficiently stable in time;
- the learning situations, preferably divided into general categories: assisted learning (in the classroom, workshop, etc.), individual study, experience of real work (internships, apprenticeships, etc.);
- the timing (workload for the participants) assigned to the various training situations;
- the criteria for assigning the training credits and relative quantification;
- the types of tests, instruments, subjects and methods of testing and assessment.

The Training Units (training standards) and the Competence Units (standards of competence) are the standards "of the system": that make it possible to share among countries, areas, educational subsystems, vocational training and actual jobs the "reference points" of the learning paths (formal, not formal, informal). The developers of learning programs for the training organizations that wish to offer standard training plans can define all details of the training program, based on univocal references.

Structure of the learning programmes

BUILDING UNITS OF COMPETENCES (U.C.)

The pathway of U.C. building coincides essentially with the drafting of the format and consists in:

- The aggregation in homogeneous areas of competences, identified in the dictionary of competences for each professional figure, and in their description in terms of knowledge necessary to their implementation (Part A of U.C.);
- The definition of level declination, namely in the representation of outcome, showing that the individual has the competences pertaining to U.C. (Part B of U.C.)

"PART A" OF U.C.

Aggregation of competences in homogeneous areas

The necessary step for U.C. building consists in aggregating in homogeneous areas competences identified in the dictionary of competences for a given professional figure.

In fact, the U.C. – as previously indicated – indicates an area of homogeneous competences in terms of mental and behavioural activity derived from the contextualised action, and may refer to activity areas, phases of direct work processes, service lines. The U.C. becomes therefore and aggregate of competences needed to perform a

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set of activities producing an observable and assessable result, relevant per se, and recognisable by the labour world as belonging to specific professionalism.

A useful and "objective" criterion for the detection of homogeneous competence areas may be the exploration of activities correlated to the competences. In view of their "objectivity", activities may in fact be easily aggregated in "activity areas".

These may be defined as follows: an activity area corresponds to a relevant set of specific activities, recognised as correlated by the labour world, identifiable within processes, according to criteria of functional finalisation, self-consistency-autonomy and homogeneity. These specific activities present features of homogeneity, both for procedures to be applied, and for results to attain, and finally for the level of complexities of required competences to produce related output/outcome.

Often an activity area "incorporates" activities referring to relevant segments of a single process, especially when this is particularly complex. An activity area may also "incorporate" mutually homogeneous activities referring to several correlated processes.

According to this definition, we should underline that activities areas:

- Constitute in work organisation a circumscribed, visible and recognised set of activities;
- Produce results and carry out a function differentiating them in a relevant way;
- Are performed, managed and controlled with techniques and procedures specifically characterised within the ones relating to the process in its entirety;
- Require a specific corpus of competences in connexion with specificities of activity-related techniques and procedures.

On average, from 8 to 10 homogeneous competence areas may be identified for a given professional figure, and each of them may incorporate 4-5 competences.

Definition of U.C. heading

Once having identified activity areas, corresponding to homogeneous competence areas, the definition of the title/heading of each U.C. becomes possible, with respect to the given professional figure: each U.C., in fact, corresponds to a competence area.

Heading of U.C.:

- on the one hand, one part must briefly express the area of competence and therefore the area of activities referring to U.C.;
- on the other hand, it should clearly communicate that the named object is precisely a unit of "competences".

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Drafting of "part A" of U.C.

Part A, in its turn subdivided into two mutually complementary **sections**, formalises (1) the homogeneous set of **competences**, and (2) **applied knowledge** constituting the reference for certifications (but also for the design of *competence based* learning pathways).

FIRST SECTION: "THE SUBJECT IS CAPABLE OF/ABLE TO:…"

In the first section, U.C. competences are stated, and introduced – as in the dictionary of competences - by the expression *"The subject is capable of/able to:"*, followed by a verb of action.

For instance:

A – COMPETENCES
The subject is capable of/able to: 1. acquire the methods of integration of electronic devices, with particular reference to circuits for digital and analog signals processing on the basis of their applications in industrial automation; 2. develop control algorithms driven to software systems synthesis; 3. analyze problems related to the implementation of mechatronic systems with particular reference to operating principles, performance and application domains; 4. understand and analyze the properties of reliability and maintenance of processes and systems 5. develop supporting technical documentation

SECOND SECTION "THE SUBJECT SHOULD KNOW HOW :…"

Knowing how to mobilise and dynamically structure appropriate resources (knowledge, skills, behaviours, etc.) to explicitly show his/her mastery of each competence.

In other words, the description should make explicit and articulate "applied knowledge" through which the "dedicated" mix of resources is dynamically implemented, thus enabling the attainment of professional output/outcome resulting from a given activity.

In the declination of "applied knowledge", which is necessary for an effective and efficient support to activities, what counts here is making transparent both *whom* the subject should relate *to*, and *which decisions* should he/she take and *how*, as well as the *controls* to be performed.

Conventionally, "applied knowledge" is presumed to be the matrix (condition of possibility) of different operations which may comprise the activity. It should be again stressed that only competences, indicated via a brief and converging denomination, are capable of *assuring the attainment of an outcome, recognised and recognisable as adequate and valid with respect to an activity required within an exchange-based relation*.

Articulations describing a given competence (applied knowledge), and individually and autonomously considered, do not express this property: only their integration and convergence, by constructing "*that*" mix of resources and applied knowledge, which is necessary for the acquisition and exercise of "*that*" competence, is capable of assuring "*that*" socially required, expected, recognised and recognisable outcome.

The syntactical structure adopted to describe competences is intentionally homogeneous with the one adopted for their denomination, and is indicated below:

KNOWING HOW	OPERATIVE VERB	OBJECT	SPECIFICATION
	OPERATIVE VERB	OBJECT	SPECIFICATION
	…	…	…

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The expression «*Knowing how …*» may be considered the "symbolic contraction" of a more articulated phrase, of the kind: «*In order to actuate the competence illustrated in the description – by dynamically mobilising and structuring a set of resources of different nature, in a pertinent and effective way –, knowing how …. [should be necessary]…*».

The verb specifies the operation that the subject should "*know how* to perform" in order to "*be capable of/able to …*".).

The object circumscribes the essential semantic and operative field the operation expressed by the verb would refer to. Together with the operative verb, it indicates exactly "what" (and possibly by also explicitly indicating by which attributes/features) the subject should activate/implement in order to support a given operation.

Whenever deemed feasible, the specification should indicate (by using expressions, such as "*by having available …*", "*with the support of …*", "*by using …*", "*by choosing …*", "*in view of …*", "by *interacting with …*" etc.) conditions dictated by the context, where the operation expressed by the verb is exercised: tools which may be used, the setting, the support which may be given, existing environmental and interactive features, etc.

EXAMPLE OF STRUCTURE DESCRIPTION OF U.C. COMPETENCES

Professional figure: High level Technician in drawing and industrial design

Capitalised Unit: Mechanic design

A – COMPETENCES
The subject is capable of/able to: 1. Translating the client's needs in the specific language of mechanic design. 2. Developing the drawing of the mechanical component to be produced, by using the most suitable software tool. 3. Developing the executive project for the production of the mechanical component. 4. Performing a simulation on the PC in the effective utilisation conditions for the designed mechanical component. 5. Making the prototype of the mechanical component.

1. In order to **translate the client's needs in the specific language of mechanical design** the *subject should know how*:

PHRASES	VERB OF ACTION	OBJECT	SPECIFICATION
Work preparation	Analysing	Request by the client	By making specific reference to needs and constraints, including costs, contractually defined.
Work performance and monitoring	Transforming	outcome of analysis	In the specific language of mechanical design, in compliance with laws and regulations
	Identifying	Possible techniques	To be used to produce the mechanical component to be designed
	Identifying	Materials possibly in use	For the production of the mechanical component

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"PART B" OF U.C.

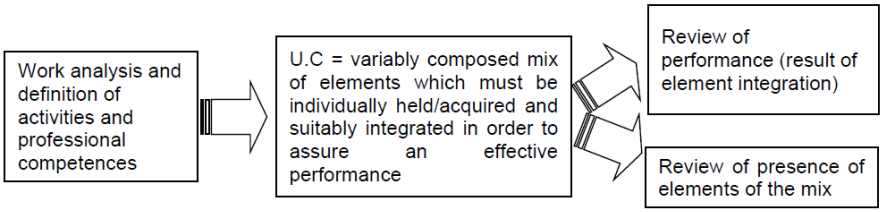
This section provides operative indications and examples for the definition of the **level declination** (Part B of U.C).

Part B, subdivided in its turn in two **sections** mutually complementary, illustrates what are the results showing that the subject has the competences described in part A.

B – LEVEL DECLINATION
In order to be capable of/able to: 1. [indicate competence 1] 2. [indicate competence 2]

The subject should demonstrate	Indicators are:
• ……	• ……
• ……	• ……

The U.C. model enables to maintain some basic principles linked to the set of technical options characterising it. In fact, by starting from the methodology of work analysis, the same process of U.C. construction envisages a specific centrality of the concept of "competence in action". However, the proposed model does not configure itself as a strictly *work-based* approach, as it makes a step forward, by *conceiving competences as a mix resulting from the integration of heterogeneous elements (knowledge, skills, behaviours, etc.) all functional to the expression of an effective work performance.*



FIRST SECTION: "THE SUBJECT SHOULD DEMONSTRATE:…"

In the first section ("*…The subject should demonstrate: …*"), **descriptors** should be formulated – at least for every competence indicated in Part A of U.C. ("*…The subject is capable of: …*") – for situations which should make explicit, and therefore verifiable and assessable, U.C. competences.

What counts here is that situations such as these are considered suitable also as "review test" in a training setting.

A particularly effective situation for the activation of technical-professional competences – responding well to the requisite of a description "*in unitary and concise form*" – is the one where the subject is requested a **product**:

- As much as possible similar to actual work processes (same technologies, same procedures, same input, etc.), better if implemented in the same technical and social contexts of the work place;
- As much as possible significant and representative of the range of critical aspects, and pertinent to processes of actual work setting.

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SECOND SECTION: "…INDICATORS ARE:"

In the second section **indicators** are formulated, which are necessary to express the evaluation of competences and their level of in-depth.

Several guidelines are explored below for the definition of indicators.

Guidelines for the formulation of indicators

Also **indicators** must be conceived as usable also for "review tests" in a training setting.

It is advisable to limit the number of indicators defined for each descriptor, by taking into consideration a criteria of feasibility of reviews: chosen indicators should be more relevant, and predictive of the actual mastery of the competence.

At this regard, the following should be mentioned, as already partially indicated:

- each U.C. should not necessarily be a review unit; summative tests could be envisaged to ascertain (by grouping, summarising, etc.) competences (and related situations and indicators) for more than one U.C.
- similarly to the review of a single U.C., it may verify (by grouping, summarising, etc.) more competences (and related situations and indicators) of the same U.C.

The precision in the definition of indicators should therefore be considered an opportunity, a help provided to evaluators, and does not entail the obligation to carry out review tests specific for each indicator.

Formulating indicators by using a descriptive mode

A modality considered intuitive and friendly for the formulation of indicators consists in the simple description of factors and attributes which, in given situations ("…the subject should demonstrate…") are taken into consideration to express the evaluation of competences and their level of in-depth.

Parts of U.C. to be referred to, for the identification of descriptors, are:

- part A, introduced by the formula ("…the subject should know how…);
- part B, introduced by the formula ("…the subject should demonstrate…").

Descriptions should be formulated with reference both to the product, and to subjects, for the evaluation of those elements of competence which, although non assessable in the product per se, may be assessable through other modalities.

The subject should demonstrate:	Indicators are:
3. To know how to use different techniques for developing and assembling simple automatisms characterized by the integration of computer and mechanics electronics; To know how to describe the characteristics and application fields of most commonly used electric motors in the field of automatic machines; To know how to describe the properties of simple production lines based on industrial robots and	The application of regulations and project methodologies; The development of solutions with different technologies technically viable The application of techniques for the classification and analysis of industrial production lines based on robot and numerical control machines

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numerical control machines	The application of laws of mechanics and motion relating to the most typical applications of industrial automation

BUILDING CAPITALISABLE TRAINING UNITS (C.T.U.)

The Training Unit

In consolidated practice, the Capitalisable Training Unit has been considered the "minimum training standard", incorporating both the objective standard related to competences and the standard related to the minimum requisites of the training response.

The C.T.U can be interpreted as a technical standard, useful for training design, representing that which training provides to the trainee to permit him to acquire the skills aggregated in one C.T.U., at the level envisaged by the indicators (minimum threshold) identified therein.

At the technical level, we can affirm that the construction of the C.T.U.s is necessary, because a non-generic definition of the training credits associated with a C.T.U. seems to be an indispensable reference for the transparency of the certifications; that is, to be able to evaluate the "content" of a certification and make comparisons between different certifications.

U.T. FORMALISATION MODULE

The "Module of formalisation of the CAPITALISABLE TRAINING UNIT (C.T.U.) is presented in the following pages.

TITLE OF THE CAPITALISABLE TRAINING UNIT (C.T.U.)	
[insert title]	
Type:	❒ basic ❒ transversal ❒ technical-professional

PART ONE - "ELEMENTS" SUBJECT TO TRAINING

KNOWLEDGE
To acquire the necessary proficiency for putting into practice the competences of the U.C. of reference, the trainee must learn the following knowledge: 1. [insert notion] 2. …

PRACTICAL SKILLS
To acquire the necessary proficiency for putting into practice the competences of the U.C. of reference, the trainee must learn the following practical skills: 1. [insert practical skill] 2. …

BEHAVIOURS
To acquire the necessary proficiency for putting into practice the competences of the U.C. of reference, the trainee must learn the following behaviours: 1. [insert behaviour] 2. …

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PART TWO - PREREQUISITES

Work experience
•
•

Educational qualifications
•
•

Work experience	
Title	Type
1. ……..	❒ basic ❒ transversal ❒ technical-professional
……	❒ basic ❒ transversal ❒ technical-professional

PART THREE – ASSESSMENT METHODS

Type of test		Mandatory indications	Breakdown of test type	Optional indications
Written tests	Close questions		❒ Multiple choice	
			❒ Completion (with choice between the options provided)	
			❒ Fill in the gap (with choice between the options provided)	
			❒ Mini-case study (with multiple choice ❒ Questions)	
			❒ Matching	
	Open questions		❒ Discussion questions	
			❒ Completion (with free formulation)	
			❒ Fill-in the black (with free formulation)	
			❒ Mini-case study (with open questions)	
	Case solutions		❒ With open questions	
			❒ With close questions	
	"Traditional" tests		❒ Essays	
			❒ Problems	
			❒ Exercises	
Oral tests	Interviews		❒ Structured	
			❒ Semi-structured	
			❒ Unstructured	
Practical tests	Observation checklist		❒ Process	
			❒ Product	
	Technical reports			
Performance in simulation	Observation checklist		❒ Process	
			❒ Product	
	Technical reports			

DEFINITION OF THE C.T.U.

A C.T.U. corresponds to a U.C. The C.T.U. must therefore lead to the same qualification as the related U.C.

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Elements of the training

The elements of the training are the knowledge (declarative and procedural), practical skills, and behaviours considered indispensable for learning and practicing the knowledge identified as necessary for achieving the outcomes in which the skills aggregated in the U.C. of reference are shown.

Knowledge, practical skills, and behaviours can be considered the "elements" brought into play/mobilised by the trainee to substantiate the learning ("the trainee must be capable of") formalised in the second section of Part A of the U.C..

Prerequisites

The prerequisites must be defined in terms of:

- work experience
- educational qualifications
- other C.T.U. considered to be preparatory.

Assessment Methods

Formalises the types of tests considered appropriate for assessing the learning of the "elements" involved in the C.T.U. and, above all, of the level of mastery of the competences defined in the U.C. of reference.

List of references:

- MINISTERO DELLA PUBBLICA ISTRUZIONE Direzione Generale per l'istruzione post-secondaria degli adulti e per i percorsi integrati e ISFOL Area Metodologie per la Formazione, *Guida metodologica alla progettazione per UFC nella Formazione Integrata Superiore*, Maggio 2002
- http://www.indire.it/ifts/
- http://www.indire.it/eda_2003/biblioteca/materiale/percorsi_didattici/05_ufc.pdf
- http://www.nrpitalia.it/documenti/TSautomazioneind.pdf
- http://archivio.pubblica.istruzione.it/dg_post_secondaria/allegati/industria/automazione.pdf - Tecnico Superiore per l'Automazione Industriale – Standard minimi delle competenze tecnico-professionali
- Certiskills Project "From skills to competive credits: creation of models and tools for the development of common professional standards shared by the education-training-work system" financed in the framework of LLP Leonardo da Vinci Grant Agreement n. 2003 I/03/B/F/PP-154191

For further information on the project please consult:

www.project-predict.eu

For further information on the paper please contact:

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CAPITALISED UNITS
U.C. Heading

A – COMPETENCES
The subject is capable of/able to: 1. [competence 1] 2. [competence 2]

1. For [indicate competence 1] the subject should know how: ❒…

2. For [indicate competence 2] the subject should know how: ❒…

B – LEVEL DECLINATION
In order to be capable of/able to: 1. [indicate competence 1] 2. [indicate competence 2]

The subject should demonstrate	Indicators are:
• ……	• ……
• ……	• ……

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TITLE OF THE CAPITALISABLE TRAINING UNIT (C.T.U.)	
15 – TO INTEGRATE THE PRINCIPLES OF ELECTRONICS, COMPUTER SCIENCE AND MECHANICS IN THE MAIN APPLICATIONS USING AUTOMATIC MACHINES	
Type:	❒ basic ❒ transversal ☒ technical-professional

A – COMPETENCES

The subject is capable of/able to:

1. acquire the methods of integration of electronic devices, with particular reference to circuits for digital and analog signals processing on the basis of their applications in industrial automation;
2. develop control algorithms driven to software systems synthesis;
3. analyze problems related to the implementation of mechatronic systems with particular reference to operating principles, performance and application domains;
4. understand and analyze the properties of reliability and maintenance of processes and systems
5. develop supporting technical documentation

1. To acquire the methods of integration of electronic devices, with particular reference to the circuits for analog and digital signal processing based on their applications in the field of industrial automation, the subject should know how:
   - ❒ to identify the principles of functioning, technical data and the design of the electronic components, applying management techniques and power control;
   - ❒ to know how to use the main types of sensors for data acquisition;
   - ❒ to classify the components according to the functioning principles;
   - ❒ to set up schemes using simple automatisms using microprocessor and microcontrollers. systems

2. To develop control algorithms driven to the synthesis of software systems, the subject should know how:
   - ❒ to use the modelling software tools driven to the analysis of the automated systems;
   - ❒ to use the techniques of object-oriented programming;
   - ❒ to use the Labview programming language

3. To analyze the problems related to the implementation of mechatronic systems with particular reference to the principles of functioning, performance and application fields, the subject should know how:
   - ❒ to classify the characteristics of the most common sensors and transducers on the basis of the specific fields of application
   - ❒ to set up motion generation systems through the use of electronic motors and drivers and motions control;
   - ❒ to describe the generators of motion laws: electronic cams and servo

4. To understand and analyze the properties of reliability and maintenance of processes and systems, the subject should know how:
   - ❒ to access to the applicable technical regulations and understand the mode of application;
   - ❒ to interpret the type of reliability information;
   - ❒ to manage the key issues related to the preventive, corrective, ameliorative maintenance.

5. To develop supporting technical documentation, the subject should know how:
   - ❒ to describe the operational sequences and procedures used for the construction of the electromechanical system

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B – LEVEL DECLINATION
In order to be capable of/able to: 1. acquire the methods of integration of electronic devices, with particular reference to circuits for digital and analog signals processing on the basis of their applications in industrial automation; 2. develop control algorithms driven to software systems synthesis; 3. analyze problems related to the implementation of mechatronic systems with particular reference to operating principles, performance and application domains; 4. understand and analyze the properties of reliability and maintenance of processes and systems 5. develop supporting technical documentation

The subject should demonstrate:	Indicators are:
1. To know how to describe the parameters of electronic components used in industrial automation based on their functional characteristics; To know how to implement simple systems based on sensors and transducers useful for industrial applications; To know how analyze and implement simple networks within industrial context	The identification o the functioning principles The determination of technical and construction characteristics of components to be used for different application fields; The choice of the sensor type and the creation of simple signal conditioning of circuits from sensors The ability to analyze performance and to design simple networks within the iundustrial context Measurements
2. To know how to choose the software components suitable for the application to be implemented; To be able to identify the different techniques of software modeling To know how to interpret and create simple programs in Labview	The application of the programming methods to objects using specific development environments; The use of abstract modelling languages The use of Labview for writing simple programmes
3. To know how to use different techniques for developing and assembling simple automatisms characterized by the integration of computer and mechanics electronics; To know how to describe the characteristics and application fields of most commonly used electric motors in the field of automatic machines; To know how to describe the properties of simple production lines based on industrial robots and numerical control machines	The application of regulations and project methodologies; The development of solutions with different technologies technically viable The application of techniques for the classification and analysis of industrial production lines based on robot and numerical control machines The application of laws of mechanics and motion relating to the most typical applications of industrial automation
4. To know how to use different techniques for reliable data analysis and relating to the maintenance of systems and components	The application of technical regulations The reliability analysis of simple circuits and systems The correct management of maintenance aspects of a plant/component
5. To know how to describe the modalities for the preparation of the technical documentation and the relating procedures	The editing of the documentation according to the defined procedures

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A further proposal for the implementation of the model: how to describe learning outcomes in EQF terms

Taking into account the IFTS model and its key elements characterising a process based on the definition of the Learning outcomes, further steps are proposed for implementing the selected model.

STEP 1:

- Break down the occupational profile into 4-6 macro-activities, each of which will be characterized by a high degree of autonomy.
- Sequence the macro-activities following a chronological order (i.e. according to the logic of the sequence of training activities provided within the training programme) or as an index of complexity (from simple to complex).

STEP 2:

- Break down each activity into tasks arranged chronologically.

STEP 3:

- Describe each task using the infinitive verb.

STEP 4:

- Articulate each task in Knowledge (results of the assimilation of information through learning).

STEP 5:

- Articulate each task in Skills (i.e. abilities to apply knowledge and to use know-how to perform tasks and solve problems) using the infinitive verb.

STEP 6:

- Associate to each task the Capitalizable Training Units of reference.

STEP 7:

- Articulate for each activity a competence highlighting the degree of autonomy and responsibility

STEP 8:

- Describe the expected outcomes be assessed (one for each activity or subdivided for each task) referred to the learning programme.

The template reported below provides a graphical representation of the process.

Activity (1)	
1. ……..	
2. ……..	
3. ……..	
4. ……..	
5. ……..	
6. ……..	

Activity 4: ……						
Tasks (2)	**Description (3)**	**Knowledge (4)**	**Skills (5)**	**Competence (7)**	**Expected outcomes (9)**	**C.U. (8)**
Task 4A						
Task 4B						
Task 4C						
Task 4D						
Task 4E						
Task 4F						

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