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ESCO information note: options for modelling granularity

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1. PURPOSE OF THIS DOCUMENT

The purpose of this document is to provide conceptual clarity on the top-level definitions of the skills pillar and outline a strategy for improving the granularity of the classification.

2. DEFINITIONS FOR TOP LEVEL CONCEPTS IN ESCO

2.1. Methodology for analysing definitions

An in-depth analysis of the definitions was carried out on the top level ESCO concepts: skill, knowledge, competences, etc. This analysis drew upon literature coming from multiple domains:

- Psychology and labour market literature: sources for understanding how domain experts conceptualize these terms in practice. This literature included the current ESCO definitions, and the research carried out by the Joint Research Centre[1] among other sources. The outcome of this research was a set of non-ontological clarifications of the current definitions for some of these concepts.

- Philosophical literature: to explore the ontological dimensions of these definitions and ensure conceptual clarity. The outcome of this research was a set of ontological definitions for all these concepts. These definitions were reviewed by ontology domain experts from the Basic Formal Ontology working group.

The objective of this analysis was to provide further clarifications of the existing ESCO definitions, and to add a complementary ontological understanding to each of these concepts. This enabled a thorough understanding of their roles and interrelations within the ESCO taxonomy. With the ontological foundations in place, it became possible to explore multiple modelling approaches for ESCO that better support practical implementation and stakeholder needs.

2.2. Skill

Current ESCO definition:

The ability to apply knowledge and use know-how to complete tasks and solve problems. Skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments).

Clarification to current definition (based on JRC analysis):

Skill is an acquired ability that an individual has in order to perform well an activity and solve problems. Thus, a skill is an attribute of individuals which necessarily actualizes in specific activities. In the context of the labour market, individuals actualize their skills while carrying out occupational activities. Skills are described as cognitive (involving the use of logical,

[1] Rodrigues, M., Fernández-Macías, E., & Sostero, M. (2021). A unified conceptual framework of tasks, skills and competences. JRC Working Papers Series on Labour, Education and Technology, 2021/02.

intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments).

2.3. Knowledge

Current ESCO definition:

The body of facts, principles, theories and practices that is related to a field of work or study. Knowledge is described as theoretical and / or factual and is the outcome of the assimilation of information through learning.

Clarification to current definition (based on JRC analysis):

Knowledge is the cognitive outcome of an assimilation of the body of facts, principles, theories, and practices that is related to a field of work or study. ESCO models descriptive knowledge (knowledge -that) as the outcome of the assimilation of information (facts and propositions) through learning. Procedural knowledge (knowledge-how), which is the practical knowledge on how to perform an activity, is not a part of the ESCO taxonomy, due to its overlap with skills.

2.4. Competence

Current ESCO definition:

The proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations, and in a professional and personal development. However, for simplicity reasons, the ESCO classification currently do not distinguish between skills and competence concepts.

Clarification to current definition (based on JRC analysis):

The proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations, and in a professional and personal development. Competence is the general ability to do well in a particular area of the labour market (which is a cluster of occupational activities).

Competences are constituted by three components: 'a set of key skills for the domain'; 'a general knowledge of the domain, that enables an understanding of the object and transformation processes of the activities involved'; and 'a particular set of attitudes which are beneficial for performance in the domain and to act when confronted with uncertainty in the domain'[2] .

2.5. Occupational activity

New definition (based on JRC analysis, no current ESCO definition):

An occupational activity is a work activity that contributes to the production of economic output; these activities are a part of the process of transforming inputs into outputs which have

[2] Rodrigues, M., Fernández-Macías, E., & Sostero, M. (2021). A unified conceptual framework of tasks, skills and competences. JRC Working Papers Series on Labour, Education and Technology, 2021/02, page 12.

economic value. Occupational activities are carried out by individuals who are applying their competencies in a professional context.

2.6. Tasks

New definition (includes analysis from JRC, no current ESCO definition):

JRC defines tasks as 'units of work activity that produce actual output'. A task is therefore a granular conceptualization of an occupational activity.

Tasks differ from occupation activities because occupation activities can have several levels of granularity, whilst a task is necessarily a granular occupational activity. For example, the act of writing a report can be considered both as an occupational activity and as a task, but the act of writing in general can only be considered as an occupational activity.

2.7. Occupations

Current ESCO definition:

Occupations are not the same as jobs (which are not covered in ESCO). Their distinction is based on the following definitions:

- Occupation: a 'set of jobs whose main tasks and duties are characterised by a high degree of similarity';
- Job: a 'set of tasks and duties carried out, or meant to be carried out, by one person for a particular employer, including self-employment'.

Clarification to current definition (based on JRC analysis):

Occupations are a 'set of jobs whose main tasks and duties are characterised by a high degree of similarity'. This similarity manifests itself 'in terms of the competences they require and their hierarchical position within organisations.' Jobs are 'consistent bundle of 'occupational activities 'that is associated with a specific position within an economic organisation, for some level of task consistency'.

2.8. Transversal skills

Current ESCO definition:

Transversal skills are learned and proven abilities which are commonly seen as necessary or valuable for effective action in virtually any kind of work, learning or life activity. They are 'transversal' because they are not exclusively related to any particular context (job, occupation, academic discipline, civic or community engagement, occupational sector, group of occupational sectors, etc).

2.9. General occupational skills

New definition (no current ESCO definition):

General occupational skills are skills that are broadly applicable across workplaces, but not necessarily universal to all people or contexts. They reflect abilities many workers are expected

to possess in order to function effectively in professional environments, such as adhering to schedules, following workplace safety rules, or completing standard reporting procedures.

2.10. Technical skills

New definition (based on JRC analysis, no current ESCO definition):

Technical skills are specialized skills that are actualized in occupational activities that are specific to certain sectors. These skills are not limited to technology or engineering but also include expertise in areas such as auditing, healthcare, finance, and more.

For example, an auditor's technical skills might involve proficiency in financial analysis, understanding regulatory standards, and using auditing software. Similarly, a healthcare professional's technical skills could include patient assessment, medical procedures, and the use of diagnostic equipment. Technical skills should exclude general skills because they are actualized in activities that are specific to three or less industries.

2.11. Green skills

Current ESCO definition:

Green skills consist in the knowledge, values and attitudes needed to live in, develop and support a society which reduces the impact of human activity on the environment.

2.12. Digital skill

Current ESCO definition:

Digital competence involves the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society. It includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property related questions, problem solving and critical thinking.

3. GRANULARITY: GENERAL OCCUPATIONAL SKILLS, GENERAL TECHNICAL SKILLS, GRANULAR TECHNICAL SKILLS (TASKS)

In this document granularity is defined as what separates a general occupational skill, general technical skill and a granular technical skill .

This document will not address:

Criteria for establishing which concepts are too granular to appear in ESCO.	This will be the object of future research.
Criteria for creating concepts with the correct level of granularity.	This has already been addressed the 25th MSWG, on the documentation for the ESCO heuristics, the chapter on creating concepts with coherent levels of abstraction.

3.1. Criteria for defining granularity: general occupational skills

3.1.1. Criteria 1: Golden Rule

If a concept applies to everyone in the labour market, then this concept should be considered a general occupational skill, even if the following criteria 2 and 3 apply. This golden rule always has precedence over criteria 2 and 3. Examples are provided below.

3.1.2. Criteria 2: Relevance of concepts to industry

As a rule, a general occupational skill should be applicable to more than three industries. However, there are exceptions to this. Concepts such business support activities (marketing, accounting, management, administrative support) can be applied to a wide range of industries, but they are carried out by professionals in a specific field, and therefore these concepts will be considered as technical skills. Table 1 below shows some examples of technical skills, and the explanation of why they are not general occupational skills according to the criteria of relevance to industries:

Technical skill	Explanation according to relevance to less than three industries criteria
Organize homecare for patients	Concept applicable to the health sector only.
Operate digging construction equipment	Concept applicable to the construction sector only
Connect music fragments	Concept applicable to the music sector only.
Raisin grapes	Concept applicable to three sectors: agriculture, food and beverage manufacturing and food and beverage services.
Accounting department processes	Exception: although businesses across a wide range of industries hire accountants, this skill belongs to a specific professional area that supports business operations.
Manage a team	Exception: although businesses across a wide range of industries hire managers, this skill belongs to a specific professional area that supports business operations.

Table 1: Technical skills according to relevance to industry

The table below shows some examples of general occupational skills, and an explanation of why they are general according to the criteria of relevance to industries:

General occupational skill	Explanation according to relevance to less than three industries criteria
Analyze own performance (cross-sector)	General skill applicable to all industries.
Apply social distancing protocols (sector-specific)	General skill applicable to all industries.
Focus on service (cross-sector)	General skill applicable to all industries.
Have emotional intelligence (sector-specific)	General skill applicable to all industries.
Personal reflection techniques based on feedback (cross-sector)	General skill applicable to all industries.
Maintain personal hygiene standards (cross-sector)	General skill applicable to all industries.

Table 2: General occupational skills according to relevance to industry

3.1.3. Criteria 3: Meaning of concept

In general, a concept that follows **one** of the following elements is a technical skill:

Element indicating granularity	Definition
Physical objects	A physical object is any *unified* material entity that has a definite shape and occupies space. It is something that can be perceived by the senses, such as sight or touch. Physical objects can be made from different parts / components. They can also be either man-made or natural. Examples include tools, machines, vehicles, fruit, an organism, a disease.
Immaterial objects	An immaterial object refers to something that does not have a physical presence or material form by itself and is dependent on a bearer to be realized. For example: music (needs a piece of material support to be written on, or a performer to play it), a piece of information such as departmental process (needs a material support to be written on), a recipe (needs a material support to be written on, or an agent to cook the recipe).
Digital objects	A digital object is any item that exists in a digital form and can be stored, retrieved, and manipulated by electronic devices. Examples include software, moving images stored in digital format, texts stored in digital format, music

	stored in digital format, information stored inside a database.
Physical spaces	A physical space refers to a tangible, three-dimensional area that can be occupied by objects and people. It has measurable dimensions such as length, width, and height, and can be perceived through the senses. It can include both natural spaces (forest, sea) and man-made spaces (hospital, water treatment plant, school).
Events (occurrences that provide context)	The general definition for an event is an occurrence that takes place at a specific time and location. In the context of the ESCO taxonomy, an event is necessarily contextual: it provides context to the occupational activity, to the skill that is being performed, or to the knowledge where it occurs. Examples include 'health emergency', 'pollution', 'disaster events'.
Groups of people	A group of people refers to a collection of individuals who come together, interact, or share a common purpose, interest, or characteristic. Example: a team, a department in an organization, patients in a hospital, social service users.
Materials	The matter / substance from which a thing is or can be made.

Table 3: Types of elements that indicate granularity

The table below shows some examples of technical skills, and the explanation of why they are more granular than a general occupational skill according to the criteria of the meaning of the concept:

Technical skill	Explanation according to meaning of the concept criteria
Organize homecare for patients	Concept refers to a group of people (patients).
Operate digging construction equipment	Concept refers to a physical object (digging construction equipment)
Connect music fragments	Concept refers to an immaterial object (music)
Raisin grapes	Concept refers to a physical object (grapes)
Accounting department processes	Concept refers to an immaterial object (department processes)
Manage a team	Concept refers to a group of people (teams)

Table 5: Technical skills according to meaning of concept criteria

The table below shows some examples of general skills, and the explanation of why they are general according to the criteria of the meaning of the concept:

General occupational skill	Explanation according to meaning of the concept criteria
Analyze own performance (cross-sector)	No mention of any of the elements listed in this criterion, it refers to an attitude that a person has.
Apply social distancing protocols (sector-specific)	This concept mentions an immaterial object (distancing protocols), however this is an immaterial object that is applicable to all industries.
Focus on service (cross-sector)	No mention of any of the elements listed in this criterion, it refers to an attitude that a person has.
Have emotional intelligence (sector-specific)	No mention of any of the elements listed in this criterion, it refers to an attitude that a person has.
Personal reflection techniques based on feedback (cross-sector)	No mention of any of the elements listed in this criterion, it refers to an attitude that a person has.
Maintain personal hygiene standards (cross-sector)	No mention of any of the elements listed in this criterion, it refers to an attitude that a person has.

Table 6: General occupational skills according to meaning of concept criteria

3.2. Criteria for defining granularity: general vs granular technical skills

The following section will explore the differences between two types of technical skills: general technical skills and granular technical skills. The purpose of this section is to open more room for modelling ESCO in such a way that separates skills concepts that are very granular from skills that may not be general occupational concepts but have a medium level of granularity.

One of the main challenges faced by the ESCO implementers is the extensive number of skills concepts within the taxonomy, which can make it difficult to distinguish between those with medium granularity and those that are very granular. There is a clear need for criteria that help navigate this complexity. However, developing such criteria is not straightforward, due to two main limitations:

- ESCO currently includes relatively few concepts with a medium level of granularity. The structure of the skills pillar has largely been built around a two-tiered approach: very general concepts at the top level of the hierarchy (either ISCED-F or skills groups), and long lists of very granular concepts mapped to them.
- Measuring medium levels of granularity is extremely difficult, particularly when dealing with abstract concepts. Achieving this for industry specific concepts with the

objective of separating skills from tasks is, in the words of JRC: '*In analytical terms, the level of granularity or discreteness of the concept of task is arbitrary*'[3].

What should separate general technical skills from granular technical skills is the fact that granular technical skills refer to tasks that agents carry out in the scope of their work. However, specifying that a granular concept is 'a discrete unit of action' is not enough for defining low-level granularity, because even 'discrete units of action' can be described with various levels of abstraction.

For example, the two concepts 'interpret medical images' and 'analyse X-ray imagery' describe discrete unites of action, however, one is more granular than the other. This means the line that separates medium-level granularity from low-level granularity is always **relational**.

3.2.1. Semantic relations between concepts

The following criteria for discerning the granularity level of a technical skill offers a guideline supporting the revamp of the ESCO skills thesaurus. However, it is not feasible to establish a single, universal set of criteria for defining granularity for technical skills for all sectors.

Because industries differ greatly — some being highly technical, like construction or IT, while others are less so, like customer service — there can't be one universal rule. Instead, the level of granularity should be defined for each sector individually.

The approach is based on how concepts are related to each other in a hierarchy, using three main types of relationships: "is_a," "instantiation," and "part-of." These relationships help identify whether a skill is a general technical skill or a granular skill (task). These relations were defined and presented in the 25th ESCO MSWG.

The "is_a" and "instantiation" relations are most useful for identifying granularity. The "is_a" relation links broader and mid-level skills (for example, "cybersecurity skills" and "protecting ICT devices"), while "instantiation" shows when a general skill becomes more specific (for instance, "diagnosing health conditions" becomes "conduct physiotherapy assessments"). Instantiation is especially effective because it indicates when a general skill is applied in a specific context or specialty, helping define detailed, low-level skills. However, this still requires careful consideration of the sector's characteristics.

[3] Rodrigues, M, Fernández-Macías, E., Sostero, M., A unified conceptual framework of tasks, skills and competences, JRC Working Papers on Labour, Education and Technology 2021/02, European Commission, Seville, 2022, JRC121897

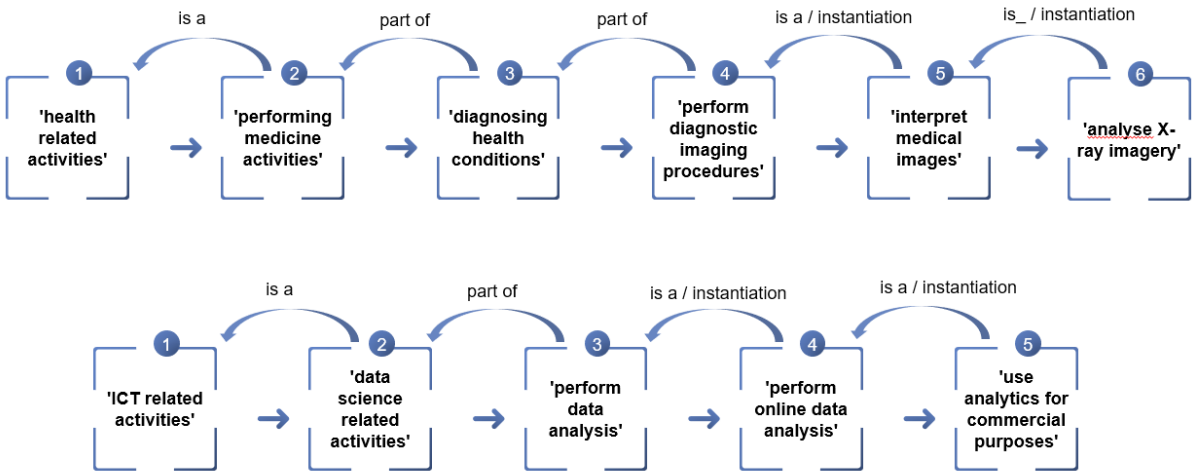


***Figure 3**: Illustration of types of hierarchical relations between concepts.*

The "part-of" (meronomy) relation, on the other hand, is less reliable. It describes how skills are parts of a process, but since these relations are transitive (one part can contain smaller parts), it's difficult to know exactly where a concept becomes truly granular.

For example, while "assist animal birth" is clearly a detailed skill, the relationship type alone doesn't explain why. Therefore, while "instantiation" can serve as a good rule for identifying specific skills, "part-of" relations depend more on human judgment and context. The document concludes that defining skill granularity requires a tailored, sector-by-sector approach supported by these relational analyses.

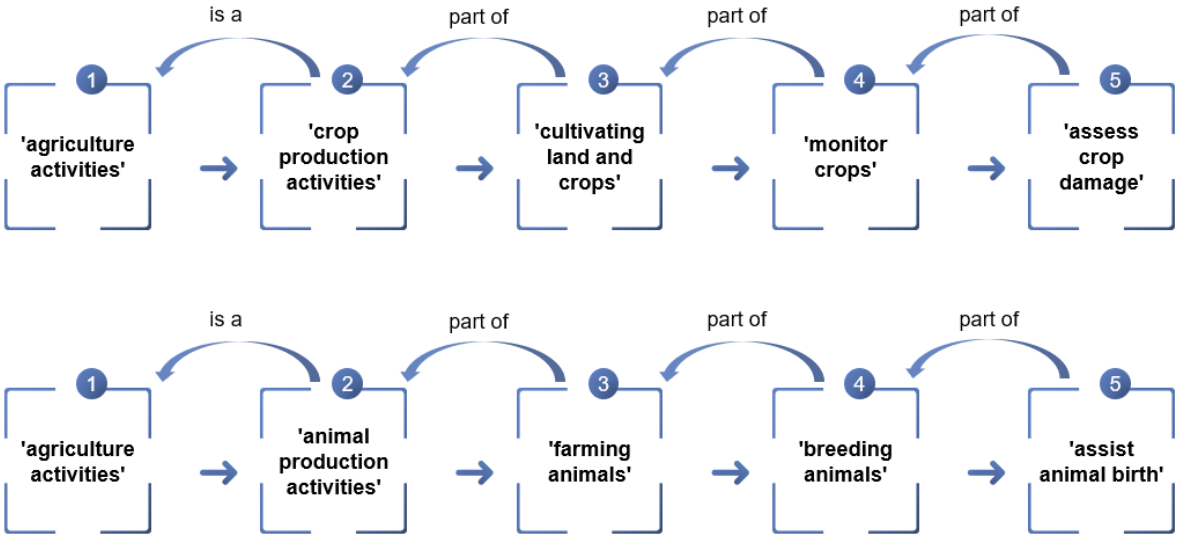


***Figure 4**: Illustration of types of hierarchical relations between concepts*

4. RENAMING OF THE ESCO SKILLS PILLAR INTO THE 'COMPETENCE PILLAR'

Currently in the ESCO taxonomy the skills pillar encompasses both skills and knowledge concepts. However, this terminology is somewhat misleading as knowledge concepts are not skills.

In the ESCO Handbook, competence is defined as "*the proven ability to use knowledge, skills, and personal, social, and/or methodological abilities in work or study situations, as well as in professional and personal development.*"

Additionally, terms like "digital skills" and "green skills" inherit this issue, as they also include knowledge concepts. To address this, a possible solution is to rename the "skills pillar" to "***competence pillar***." This change would more accurately reflect the comprehensive nature of the pillar, which includes both knowledge and skills concepts.

4.1. New overall structure of ESCO

According to this proposal, ESCO would have two pillars:

- Occupations pillar
- Competences pillar
    - Skills tree (general and granular technical skills)
    - General occupational skills
    - Transversal skills
    - Knowledge tree
    - Languages

The image below provides a draft illustration of what the new structure would look like for the competence pillar. As this is only a draft illustration, the names of the concepts still do not follow the ESCO naming conventions.

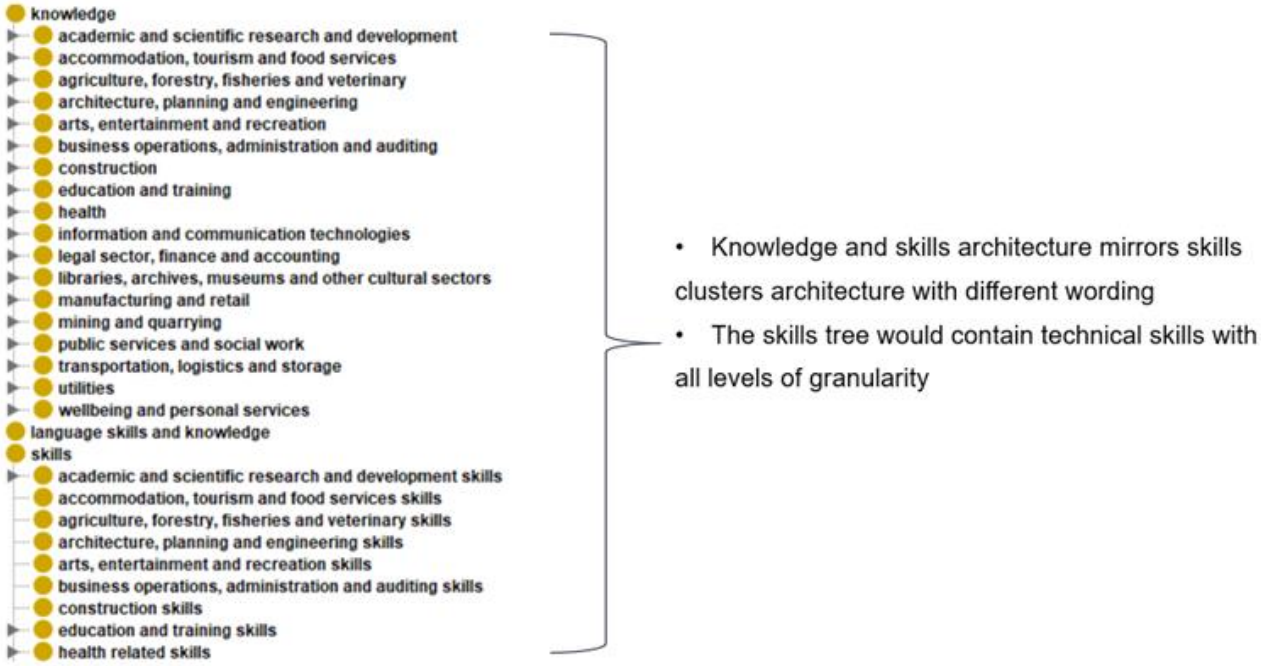


***Figure 5**: Draft of the new competence pillar*

The image above shows a competence pillar that includes knowledges, languages, general skills, transversal skills and skills trees. In other words, the structure of the competence pillar would remain very similar to what currently is.

The knowledge and skills trees have a top-level structure, based on industries, mirroring the architecture created for the skills clusters project. However, skills and knowledge concepts are separated into different trees.

This new structure of the skills / competence pillar would coexist with other alternative visualizations, such as ISCED-F for knowledge and the current skills groups for skills. The skills clusters would present a view where knowledge and skills concepts are together in the same tree. For further information on these alternative visualizations (i.e., application layers) please refer to the 27th ESCO MSWG note: Information note on updates to the skills pillar from the 27th ESCO MSWG meeting.

The image below illustrates the relation that would exist between general technical skills and the granular technical skills that denote tasks. General technical skills would function as broader categories, and granular technical skills would be located lower in the hierarchy.

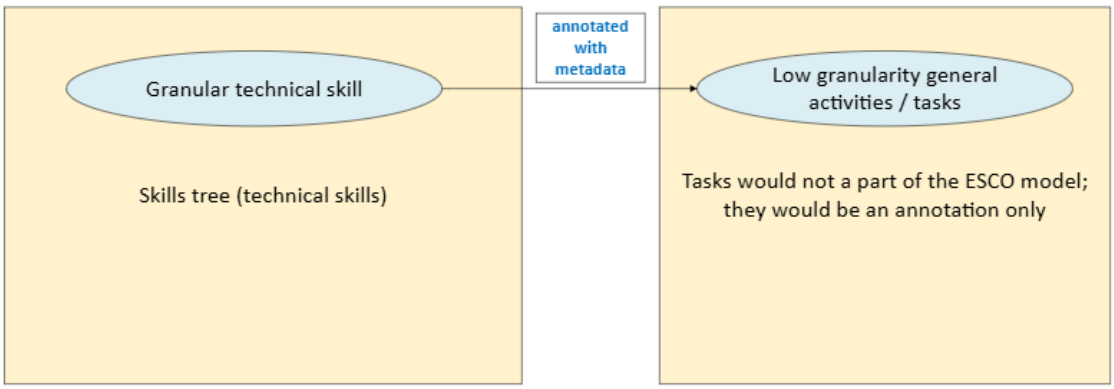
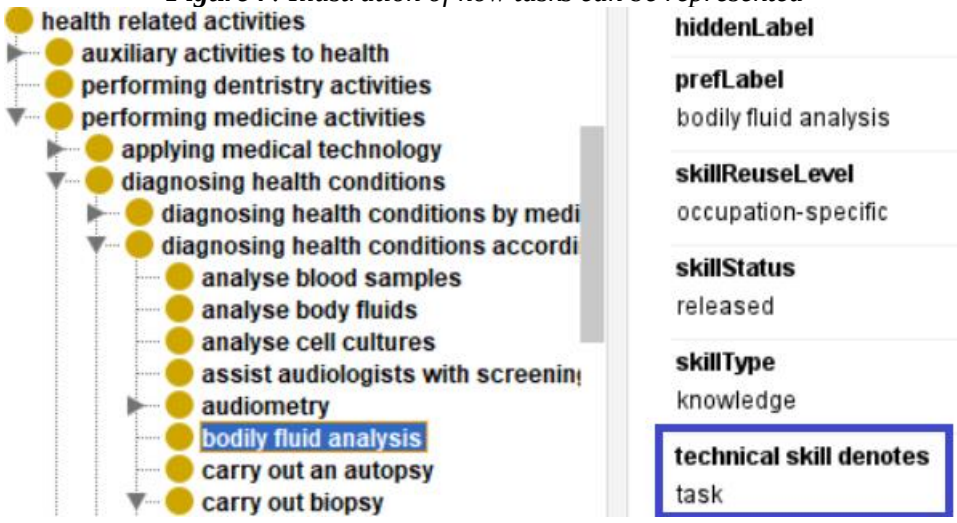


***Figure 6**: Illustration of relation between technical skills and tasks.*

In the longer term, granular technical skills could be identified through a new property that marks them as denoting tasks, as illustrated in the image below.

***Figure 7**: Illustration of how tasks can be represented*



In this way it would be possible to represent which skills concepts refer to tasks without creating repetition across ESCO by adding a new pillar.

5. ANNEX: PILOT PROJECT FOR DISTINGUISHING GENERAL TECHNICAL SKILLS FROM GRANULAR TECHNICAL SKILLS

As previously discussed in this document, distinguishing between general and granular technical skills is highly context-dependent, supported by analysis of relations of instantiation and meronomy.

Several pilot projects were created to test this methodology for measuring granularity, and to analyse the impact its implementation would have on ESCO.

Pilot project: technical skills for the health sector

For the health sector, the Commission has decided to keep general technical skills that apply horizontally to all areas of the health sector (common to dentistry, all medical specialties, and mental health). Concepts such as 'monitor patient's health condition' or 'provide therapy and rehabilitation' are skills that are relevant to all areas of the health sector. This approach effectively limits the number of general technical skills while ensuring they remain applicable to a wide range of occupational activities within the sector.

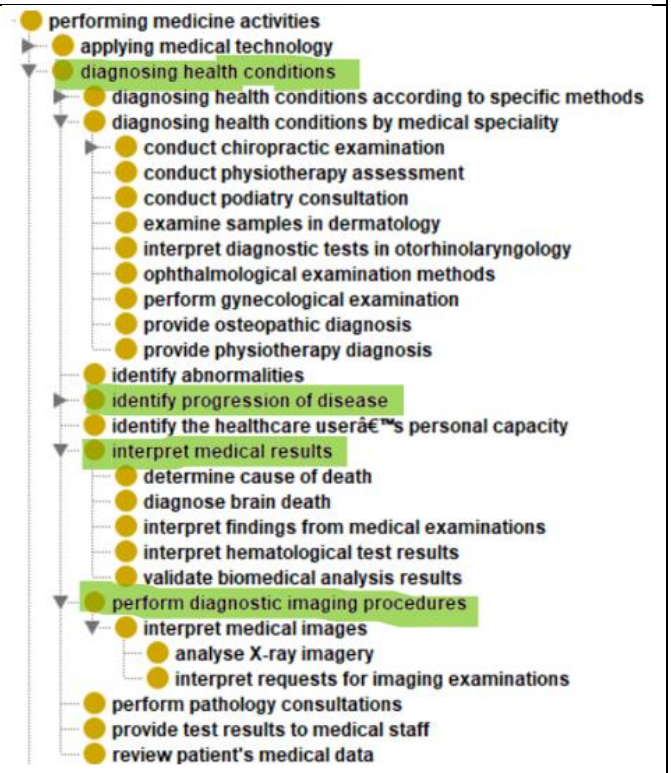
Health tree with only general technical skills	Health tree with only general technical skills & granular technical skills
	

Table 10: Granularity of technical skills in health

<u>Pilot project: technical skills for agricultural and animal care sectors (excluding veterinary)</u>

For the agricultural sector, general technical skills were identified using a different approach than in the health sector. Instead of looking at the technical skills which are shared across all areas of agriculture, the identification was based on the different parts of the '*process'* (meronomy relations). For example, 'propagate plants skills', 'monitor crops skills', 'harvest crop skills', 'carrying out soil maintenance skills', are all parts of the process of crop production. Even though the same happens with health - diagnosing, providing advice, treating, rehabilitating, are all part of the process of treating a patient - the major difference is that while in the health sector, the same processes are repeated for all areas of health - medicine, psychology, veterinary - in agriculture crop production and animal production do not share the same process components.

In the agricultural sector, the method for measuring granularity - i.e., distinguishing between a general skill and granular occupational activities - was based on separating the general process from its specific application to a circumstance (instantiation). For example: 'harvest crop' is a general process (the general technical skill) while the granular technical concept (task) would be the application of that general process to a specific circumstance ('manage grape harvest'). Granularity can also emerge from identifying a specific step within the broader process (a part-of relation) where the granular concept combines a specific skill with a general one - for instance, *"organise harvests"* or *"oversee harvest process"* combine the general skill *"harvest crops"* with broader skills like organising and supervising.

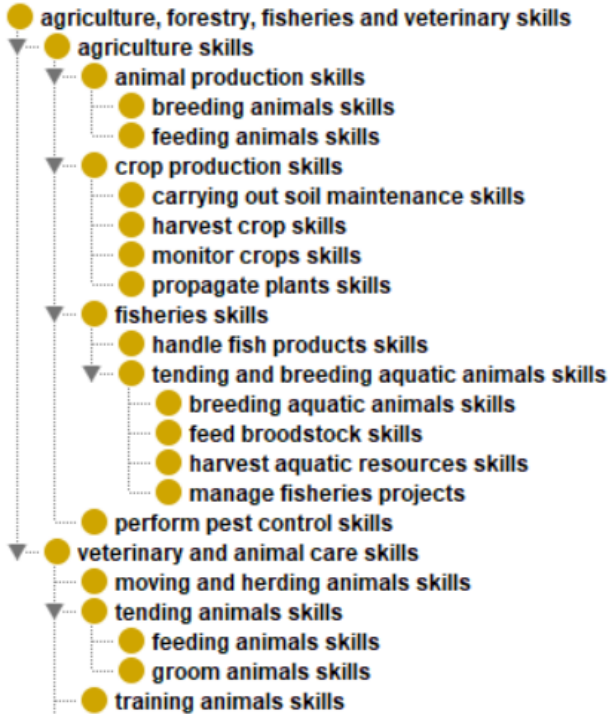
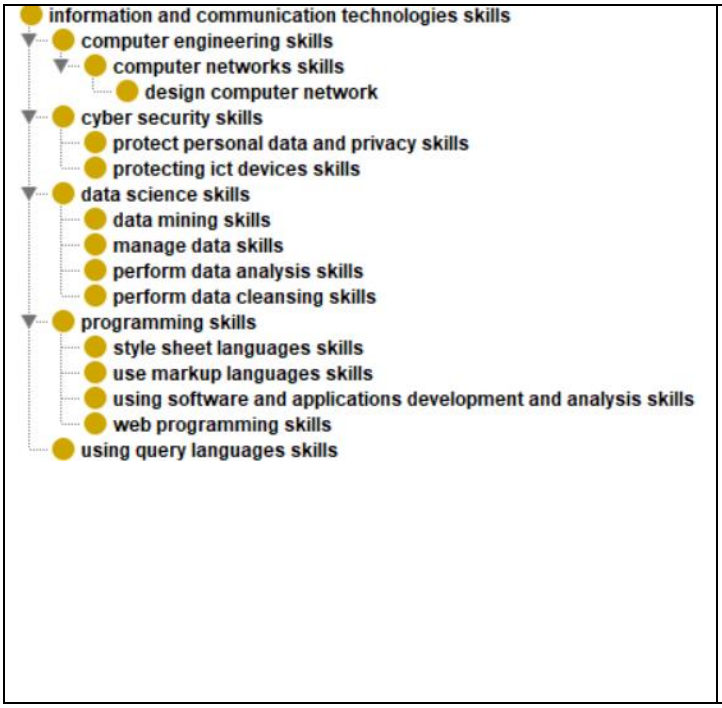
Agriculture with only general technical skills	Agriculture with only general technical skills & granular technical skills
	

Table 11: Granularity of technical skills in agriculture

<u>Pilot project: technical skills for ICT sector (programming, data science and cyber security)</u>

In the ICT sector, the tree is highly technical, which means that almost all the concepts can be considered to be general technical skills. To determine where granular concepts begin, the rule of instantiation was applied. For example, specific programming languages such as *JavaScript* were considered instantiations of the broader technical skill *"web programming languages."*.

ICT with only general technical skills	ICT with only general technical skills & granular technical skills



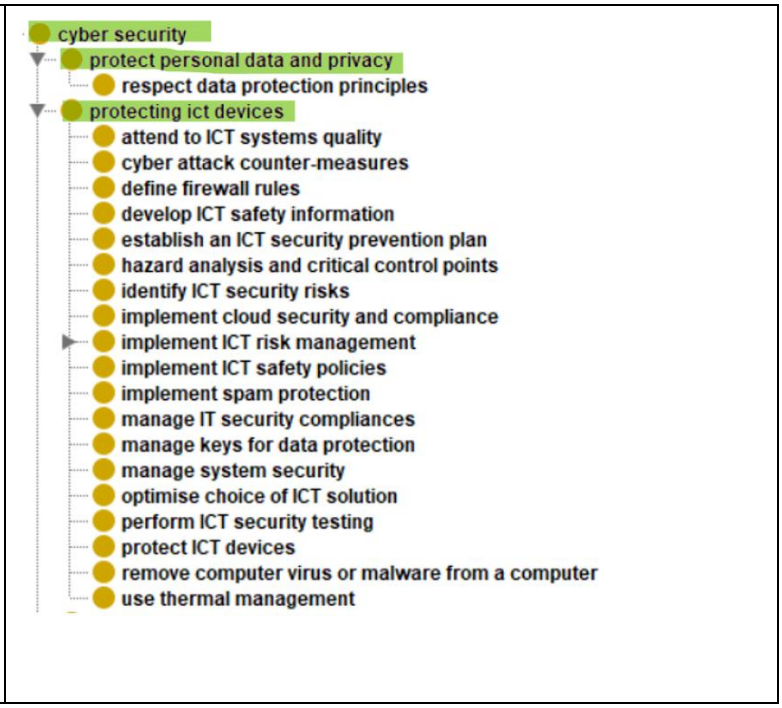


Table 12: Granularity of technical skills in ICT

Technical skills for business support skills

In the auditing tree, three general technical skills were identified - 'implement quality management systems skills', 'conduct quality control analysis skills', 'conduct evaluation of quality standards skill'. The remaining concepts were classified as granular technical skills, because either they represent the application of auditing skills to a specific context – such as internal audit – or correspond to subprocesses within a broader activity, as 'liaise with quality assurance'.

The same methodology was applied for the skills in the management activities. In this tree the following general technical skills were identified: 'perform escalation procedure skills', 'performance diagnosis skills', 'manage processes skills' and 'develop business plans skills'. The remaining concepts of the management activities tree were considered either an application of a general skill to a specific circumstance – e.g. 'provide improvement strategies' is an instantiation of 'develop business plans skills' - or a process that is a part of another process – eg. 'manage workflow processes' is a part of the process 'manage processes', that is denoted by the skill 'manage processes skills'.

Business support with only general technical skills	Business support with only general technical skills & granular technical skills

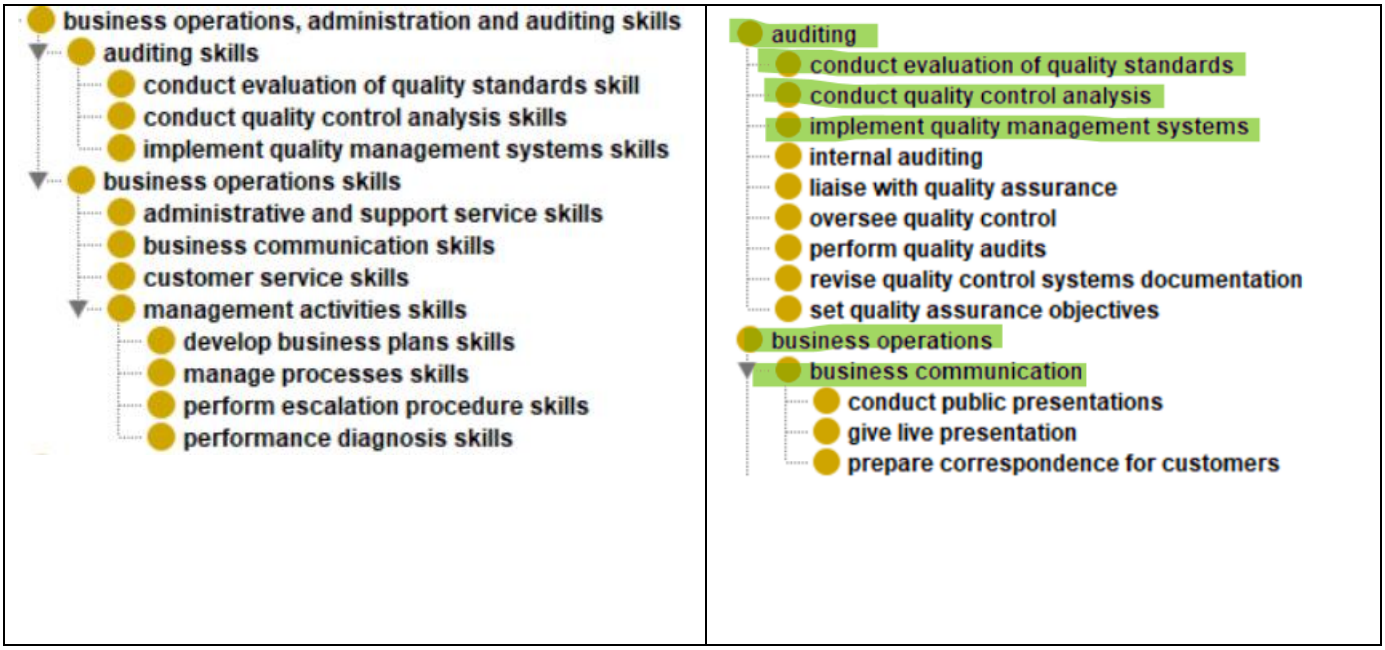


Table 13: Granularity of technical skills in business support

Conclusions taken from the pilot projects

If the objective of this proposal is to maintain a small, well-curated set of general technical skills in ESCO and link them to tasks, then the proposed methodology proves effective. Despite the challenges of measuring granularity of concepts, the approach successfully produces a coherent and user-friendly list of general technical skills.

As previously mentioned in this document, ESCO was originally designed to contain with very granular concepts mapped to very broad categories, such as ISCED-F and skills groups. A close examination of the agriculture pilot project -where the small number of general technical skills is the most obvious – clearly shows that the concepts classified as granular technical skills are indeed very granular, and it would be inaccurate to classify them as general. In this respect, the methodology works.

With the restructuring of the skills pillar, work will be carried out in the creation of mode mid-level groups, and the granularity levels of some existing concepts will be adjusted. The completion of this work will likely result in a larger percentage of general technical skills.

If the objective is to address the challenges ESCO stakeholders face due to the large volume of skills concepts - and their desire to adopt only the more general concepts - the proposed solution may fall short. This is because the tree of technical skills tree is too small in size. Stakeholders adopting only the general technical skills trees would find it insufficient for most ESCO use cases (job matching, skills intelligence, upskilling, green and digital transition, etc). Moreover, users would still need to rely on the knowledge tree which also contains granular concepts. In the end, stakeholders would end up with a very small set of skills concepts, and a very large number of knowledge concepts.

However, for this specific use case, there is the possibility to complement the proposed methodology with a data-driven approach. In this case, the implementers could adopt the general technical skills but also selectively adopt the granular technical skills that are relevant to them according to data.