SkiComCu-Lifelong Learning Course for skills &competences in the copper sector

Project number:	23043
Project short title:	SkiComCu-LL
Project starting date:	01.09.2023
Project ending date:	31.08.2026
Project duration:	36 months

Competence framework for Responsible Sourcing, Sustainable Material and Circular Societies

Internal Identifier:	D.2.2
Description:	This deliverable articulates knowledge, skills and competences identified in 2.1 in an integrated competence framework for the copper mining, metallurgy and recycling industry. The competence framework is integrated in the sense of covering all relevant job positions for the RIS territories and providing the competencies not as static sets of information but rather as a complete package capable of covering the entire career course of young people entering the sector.
Included in BP year:	2024
Date:	30/09/2024
Version No.:	v.1

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Executive Summary

The competence framework for the copper sector presented in this document is part of a broader model of ensuring the quality of competences of its employees, which is designed to support the attractiveness and competitiveness of this strategic sector of the economy for Europe. This framework articulates learning outcomes identified in D1.1 as necessary to build the capacity and innovativeness of the Cu-sector in RIS territories.

The Integrated Sectoral Qualification Framework (SQF Cu) is a comprehensive approach to mapping the landscape of competencies and skills required to work in an innovative and competitive Cu-sector in RIS territories, establishing a common language to boost communication and cooperation among the different stakeholders. The framework also serves as a starting point for planning and structuring a wide variety of capacity building and training projects. Transparency and homogeneity about what people have learnt in order to obtain a qualification are crucial to ensuring that learners, training providers and employers give the appropriate economic, social and academic value to qualifications.

The following proposal for the structure of the qualifications framework for the copper mining, processing and recycling sector has been developed on the basis of and taking into account the following elements:

- Rules of the European Qualification Framework
- Results of the work carried out so far within the SkiComCu project (Del.2.1; Del.2.3.)
- The results of other international projects on the potential of human resources in this sector

Presented framework use learning outcomes, compared to learning level descriptors and qualifications (according to the roles of European Qualification Framework).

Initial version of SQF-Cu was validated both internally - with project partners – and externally with the participation of companies from the Cu sector beyond the partnership and their HR departments.

1. Objectives, and EIT Impact Framework and KIC Impact

Objectives

Objective	Description	Status
Objective of this deliverable is to present a map of competences required to work in an innovative and competitive Cu-sector	This deliverable articulates knowledge, skills and competences in an integrated competence framework for the copper mining, metallurgy and recycling industry. Presented framework use learning outcomes, compared to learning level descriptors and qualifications (according to EQF requirements).	Achieved

EIT Impact Framework and KIC Impact

To address the shortages of human resources in Cu sector in EU, SkiComCu, in light of the EIT RM 2021-2027 programme, aims to develop a lifelong learning course for current and future professionals in the EIT RIS countries. The competency gaps for workers in the copper sector presented in this report, constitute the basis and starting point for mentioned learning course. The key aspect is to provide the necessary skills related to industry 4.0 & 5.0, green transition and circular economy that a) boost the responsible sourcing of critical and strategic raw materials in Europe thereby securing their supply (Lighthouse Responsible Sourcing) and b) advance innovation and education related to circular economy and closing materials' loops for the Cu-sector in the EU (Lighthouse Circular Societies), in parallel with facing technological, structural and human changes management.

Impact on EIT RM strategic objectives

1. The provision of upskilled and reskilled personnel through the training curriculum will allow for achieving greater efficiency in the functioning of the Cu-industry, thereby leading to higher production levels and less EU dependency on imported raw and advanced materials, thereby contributing to EIT SO1 – securing raw materials supply.
2. The provision of skills about state of the art technologies, industry 4.0 & 5.0, green transition & circular economy as well as the reorientation of training methodologies to satisfy the needs of and attract young people (with a special focus on encouraging the incorporation of women and vulnerable social groups) in the sector is expected to indirectly increase the social acceptance of the raw and advanced materials extraction and production, thereby contributing to EIT SO1 – securing raw materials supply and SO3 – closing materials loops.

3. The emphasis of the programme to the whole life cycle of the Copper production, from mining to manufacturing and recycling, as well as the continuous updates in the training programme to be achieved by WP2 will assist the EU Cu-sector to maintain the mining of copper and the design & production of advanced materials, components and products that enable the transition to a carbon neutral Europe, thereby contributing to EIT SO 2 - designing materials solutions.

Impact on EIT RIS KPIs:
The diagnosis of competence gaps presented in this report will indirectly (by ensuring an appropriate selection of training content and innovative educational tools that are in real demand among Cu sector employees) influence the achievement of core EIT RIS KPIs:

- EITHE2.4 by launching the innovative SkiComCu course.
- EITHE8.1 by providing the lifelong learning programme to the industrial partners' staff.

2. Sectoral Competency Framework (SQF-Cu)

This report is the result of work carried out as part of the SkiComCu project, Tasks 2.2 and 2.3.

General Assumptions

Within the task 2.2, an integrated competence framework addressing skills, up-skilling and re-skilling needs of the copper industry was developed. Its aim was to present a map of competences required to work in an innovative and competitive Cu-sector.

The following assumptions were made in the work on the competence framework:

- We have three complementary areas of professional activity in the copper sector: 1) exploration for deposits, 2) mining and enrichment, 3) materials engineering and recycling of copper and its alloys.
- For each of them, a set of learning outcomes will be listed in the form of knowledge (ability to recall present information) and skills (ability to do).
- To emphasize the importance of competences related to 1|) digitization, 2) circular economy, these areas have been separated from other work processes.
- Social competences (application of knowledge and skills in context) have been treated horizontally, as a common set for all three areas of professional activity in the sector. Taking into account the opinions and expectations of employers towards current and future employees of the sector (see the results of research in Task 2.1), from the general pool of social competences defined in group "IV Labour Standards", competences related to communication and cooperation have been distinguished.
- The sectoral competence framework covers levels corresponding to EQF levels 3-8. The descriptors for each level have been prepared taking into account the EQF guidelines.

Structure of the SQF-Cu

Taking these assumptions into account, the project team adopted the following structure for the sectoral competency framework (see table below).

The content of the competency framework, that is, a template filled with sets of learning outcomes (knowledge, skills, social competencies), is the next section of this report.

	Area of professional activity	Bundle of competencies	LEVEL 3	LEVEL 4	LEVEL 5	LEVEL 6	LEVEL 7	LEVEL 8
KNOWLEDGE (he/she knows/ understands)	I Exploration	Work processes						
		Digitalisation						
		Green economy						
SKILLS: (he/she is able to do)		Work processes						
		Digitalisation						
		Green economy						
KNOWLEDGE: (he/she knows/ understands)	II Extraction and processing	Work processes						
		Digitalisation						
		Green economy						
SKILLS: (he/she is able to do)		Work processes						
		Digitalisation						
		Green economy						
KNOWLEDGE: (he/she knows/ understands)	III Material engineering and recycling	Work processes						
		Digitalisation						
		Green economy						
SKILLS: (he/she is able to do)		Work processes						
		Digitalisation						
		Green economy						
SOCIAL COMPETENCE (he/she is able to)	IV Work standards	Commitment and responsibility						
		Sustainable development						
		Safety and health						
	V Communication and cooperation	Communication						
		Cooperation						
		Problem solving						

Validation of the competence framework

Within the task 2.3 an initial validation of the integrated competence framework both internally - with project partners – and externally with the participation of companies from the Cu sector beyond the partnership and their HR departments was performed.

The main objective of the action was to identify the opinions of stakeholders related to the copper industry on the draft version of the SQF-Cu and to verify its content, if any, in accordance with the comments submitted by the participants of the validation.

Internal validation

Participants

A deliberate selection of participants in the validation process was adopted. The main criterion was employment in the copper sector (various types of entities and institutions and represented positions) and the resulting knowledge of the industry.

To participate in the validation process, people were invited who, due to the specific nature of functioning in the copper sector (place of employment, position and/or seniority), have above-average knowledge of the functioning of this sector, in particular have a good understanding of the problems, needs and expectations of both employers and people employed in this sector.

In particular, these are employers and employees of copper sector companies, including: managers at various levels, representatives of HR departments and/or training & development departments, but also: teachers/trainers with experience in skilling/reskilling/upskilling for the copper industry as well as researchers of trends in changes in the labour market, changes in expectations towards employees in the copper sector.

Procedure

Taking into account the specificity of the area of activity of individual partner institutions, the part of the opinion relating to substantive issues may concern the relevant part of the SQF Cu.

Form of expressing opinion: using a questionnaire (Annex) + additional/detailed comments (e.g. directly in the text of the SQF).

External validation

In order to ensure the widest possible spectrum of opinions from people closely related to the European copper sector, the SkiComCu project partnership also invited external experts from major bodies setting the directions for the copper sector to work on the sectoral competence framework (SQF-Cu).

Participants

The external validation of SQF - Cu was attended by representatives of employers, employees, researchers and university teachers representing organizations such as:

- International Copper Association (ICA)
- Centre for Research and Technology Hellas (CERTH)
- Hellas Gold
- University of Chemical Technology and Metallurgy
- Wroclaw University of Science and Technology
- The Employers' Organization of Polish Copper

Procedure

The task of the participants was to read the content of the sectoral qualification framework in advance and prepare answers to the questions listed below:

1. What are your impressions and feelings after reading the draft of SQF Cu?
   Comment: please respond in terms of both technical (i.e., e.g. clarity, readability of the proposed structure, linguistic correctness) and substantive (comprehensiveness, completeness of the included learning outcomes) aspects.
2. What main tasks do you see for the SQF Cu (expected areas of application)?
   Comment: please consider the various spheres of application of the framework, e.g. as a starting point for the design of learning pathways, career advancement pathways, support for the recruitment process, ensuring the comparability of qualifications, etc.
3. Does the presented draft SQF Cu meet the usability criteria (real applicability in presented form)?
   Comment: please include in your statement any weaknesses you consider that would hinder the use of the framework
4. In which areas do you see a need to improve the design of the framework?
   Comment: please consider both technical and substantive aspects.

Form of expressing opinion: verbally during the online meeting (25th of November 2024) + detailed comments (e.g. directly in the text of the SQF).

As a result of internal and external validation, comments and suggestions were collected. They allowed for the introduction of corrections to the content of SQF Cu. The next section shows the version of the SQF after considering the effects of the stage of validation.

Final content of SQF-Cu

SQF-Cu, like other qualifications frameworks, use learning outcomes, compared to learning level descriptors and qualifications (according to EQF rules). Learning level descriptors are statements that provide an indication of learning appropriate to attainment at a particular level, describing the characteristics and context of learning expected at that level.

Below are the sets of knowledge, skills and social competences (in the sense of autonomy and responsibility) characterising the competences for the copper sector necessary for each of the **levels 3 to 8.**

KNOWLEDGE SKILLS SOCIAL COMPETENCES

Sectoral Competency Framework SQF-Cu: LEVEL 3

	INDUSTRY INDICATOR	COMPETENCE AREA	LEVEL 3
KNOWLEDGE: *he/she knows and understands*	I. Copper ore exploration	Work process	• Basic geological concepts and terminology, including rock types and copper ore minerals (L3-K1). • Fundamental properties of soils and rocks (L3-K2). • Types of drilling equipment (L3-K3). • Principles of operation of drilling equipment and its components, along with relevant drilling terminology (L3-K4). • Sample collection and recovery methods (L3-K5). • Organization and management of core sample repositories (L3-K6). • Basic occupational health and fire safety principles applicable to copper ore exploration (L3-K7).
		Digitalisation	• Importance and applicability of digital communication and technologies for staff localisation, equipment tracking, and transport management (L3-K8).
		Green economy	• Fundamentals of environmental science and protection (L3-K9). • Basic environmental protection principles for copper ore exploration, with a focus on energy and water consumption, as well as waste management (L3-K10).
SKILLS: *he/she is able to*		Work process	• Operate and assess the technical condition of drilling machinery and equipment (L3-S1). • Assemble and disassemble drilling equipment (L3-S2). • Perform basic maintenance operations on equipment (L3-S3). • Collect samples from soils, boreholes, and mining works for analysis (L3-S4). • Store borehole samples appropriate containers (L3-S5). • Apply occupational health and safety regulations, fire protection, and environmental regulations in hydrological and exploration processes (L3-S6).
		Digitalisation	• Utilize digital communication tools for supervision and monitoring (L3-S7).
		Green economy	• Apply basic environmental protection principles in copper ore exploration, particularly focused on energy and water conservation and waste (L3-S8).
KNOWLEDGE: *he/she knows and understands*	II. Copper extraction and processing	Work process	EXTRACTION • Basic principles of drilling and the use of explosives in mining to facilitate rock excavation (L3-K11). • Elements of open-pit and underground mining infrastructure (L3-K12). • Equipment used for rock excavation and transportation, energy consumption, and maintenance plans (L3-K13). • General construction and operation of basic mining machinery and rock excavation equipment (L3-K14). • Operation of mining machinery and equipment, energy, and consumables (L3-K15). • Basic environmental impacts of copper ore mining operations (L3-K16). • Fundamentals of rock support systems (L3-K17). • Fundamentals of underground mine ventilation systems and air quality monitoring (L3-K18). • Main environmental impacts of basic mining operations (L3-K19).

			• Principles of reading control and measuring instruments to identify emergency states in copper ore extraction (L3-K20). • Fundamentals of mine rescue (L3-K21). PROCESSING • Fundamentals of ore processing, including crushing, grinding, flotation, thickening, and tailings management (L3-K22). • General functioning and maintenance of pumps and pipelines (L3-K23). • Importance of grade control in maintaining ore quality and sample collection (L3-K24). • Principles of handling, mixing, and application of flotation reagents for copper ore concentration (L3-K25). • Principles of conducting routine maintenance tasks, including cleaning, lubrication, and inspection of equipment like crushers and flotation cells (L3-K26). • Principles of reading control and measuring instruments to identify emergency states in copper ore processing (L3-K27). • Rules of responding to emergencies like equipment failure, reagent spills, or power outages, and reporting procedures (L3-K28). EXTRACTION AND PROCESSING • Overview of copper ore extraction and processing methods, techniques, and technologies (L3-K29). • Fundamentals of geology as applied to mining, including mineral identification and rock characteristics (L3-K30). • Basic principles of occupational health, fire safety, and environmental protection applicable to copper ore extraction and processing plant (L3-K31).
		Digitalisation	• Using software and digital tools to collect and analyse operational data to improve efficiency and safety (L3-K32). • Effective communication techniques in teamwork and emergency situations (L3-K33).
		Green economy	• Operation of machinery and equipment used in the construction of dumps or other facilities for the disposal of mining and flotation waste (L3-K34).
SKILLS: *he/she is able to*		**Work process**	EXTRACTION • Read selected documents for conducting operations at the mine facility and the copper ore processing plant (L3-S9). • Read technical documentation of machines and equipment (L3-S10). • Operate mining tools and equipment in normal operations (L3-S11). • Diagnose the technical condition of mining machines and equipment and report them for inspections and repairs (L3-S12). • Take readings from control and monitoring instruments of tools, machines, and equipment necessary for operations at the mining areas (L3-S13). • Install rock support systems (L3-S14). • Operate ventilation systems for underground works (L3-S15). • Measure air velocity, pressure, temperature, and humidity of underground works air quality (L3-S16). • Take samples of mine air for laboratory analysis (L3-S17).

			• Operate water pumping systems (L3-S18). • Use basic personal and collective protective equipment in the mine (L3-S19). PROCESSING • Assist in preparing samples and materials for preliminary tests and grade control of concentrates and tailings (L3-S20). • Reload tanks with flotation reagents (L3-S21). • Keep the work area clean and organized (L3-S22). • Assist in feeding materials into crushing machines, primarily the primary crusher (L3-S23). • Perform basic cleaning and maintenance of equipment (L3-S24). • Report operational irregularities (L3-S25). • Assist in maintaining pumps and pipelines (L3-S26). • Help organize and move ore piles for dispatch (L3-S27). • Perform visual inspections to check the integrity of concentrate piles (L3-S28). • Help monitor the conditions of tailings and thickening processes (L3-S29). • Assist in packaging and labelling products for dispatch (L3-S30). • Take readings from control and monitoring instruments of tools, machines, and equipment necessary for operations at the mineral processing plant (L3-S31). EXTRACTION AND PROCESSING • Apply safety and health regulations, as well as fire protection and environmental protection laws in copper ore extraction and processing (L3-S32). • Follow safety standards and use personal protective equipment (PPE) (L3-S33). • Report unsafe conditions and inappropriate behaviours (L3-S34).
		Digitalisation	• Use digital means of communication and supervision (L3-S35)
		Green economy	• Operate machinery and equipment used in the construction of dumps or other facilities for the disposal of mining and flotation waste (L3-S36).
KNOWLEDGE: *he/she knows and understands*	III. Materials engineering and copper recycling	**Work process**	• Basic work and activities related to the processes of recovering copper from waste materials (L3-K35). • Possibilities and principles of using copper in alloys (L3-K36). • Operating parameters of machines and equipment used in copper recovery processes (L3-K37). • Occupational health and safety, fire safety and environmental protection rules and regulations relating to the production and recycling of copper and its alloys within the scope of assigned tasks (L3-K38).
		Digitalisation	• Principles for the use of information technology to increase productivity in the production facility (L3-K39). • Web sites providing the product design and use of copper metal (L3-K40).
		Green economy	• Inventory of industrial products and equipment using copper (L3-K41). • The need, importance and general principles of organizing the recovery of copper from waste (L3-K42). • Basic environmental principles applicable to the recycling processes of copper-containing products, in particular, energy and water conservation and waste management (L3-K43).

SKILLS: *he/she is able to*		**Work process**	• Perform the entrusted tasks in the field of copper recycling in a timely manner and in accordance with the applicable regulations (L3-S37). • Select and use the right materials and tools (L3-S38). • Plan required materials and tools (L3-S39). • Operate the machines and equipment assigned to work (L3-S40). • Carry out the work without exposing themselves and others to risk and harm (L3-S41).
		Digitalisation	• Operate equipment and information technology to improve the acquisition, organisation and transfer of data in the plant (L3-S42).
		Green economy	• Use inventories of industrial products and equipment that use copper (L3-S43). • Apply the basic principles of environmental protection applicable to the recycling of products containing copper, in particular energy and water savings and waste management (L3-S44).
SOCIAL COMPETENCE: *he/she is ready to*			
SOCIAL COMPETENCE: *he/she is ready to*	VIII Work standards	**Engagement and responsibility**	• Perform tasks in a responsive, accurate, and timely manner (L3-SOC1). • Work under pressure (L3-SOC2). • Take responsibility for own actions (L3-SOC3). • Take responsibility for company property and assets provided (L3-SOC4). • Self-evaluate the quality of work performed (L3-SOC5). • Effective use of working time (L3-SOC6). • Meet short-term targets (L3-SOC7). • Be open to changes and willing to implement new solutions (L3-SOC8).
		Sustainable development	• Appreciate the role of nature in human well-being, health and safety (L3-SOC9). • Comply with basic principles of professional code of conduct (L3-SOC10). • Accept change and adapt to new conditions (L3-SOC11). • Learn and develop skills (L3-SOC12). • Consciously identify stress factors (L3-SOC13). • Approve actions for sustainability (L3-SOC14).
		Health and safety	• Adhere to basic principles and regulations of occupational health and safety (L3-SOC15).
	IX Communication and cooperation	**Communication**	• Clearly communicate with the team (L3-SOC16). • Give and take feedback in a small team (L3-SOC17). • Notify supervisors and colleagues of the results of work and of any impediments (L3-SOC18). • Share knowledge and experience in a small team (L3-SOC19).
		Cooperation	• Follow the principles of teamwork (L3-SOC20). • Build relationships among team members (L3-SOC21). • Collaborate in a small team (L3-SOC22).
		Problem solving	• Solve problems in collaboration with the supervisor and team (L3-SOC23). • Adhere to agreements made to solve problems in collaboration with the supervisor and team (L3-SOC24).

Sectoral Competency Framework SQF-Cu: LEVEL 4

	INDUSTRY INDICATOR	COMPETENCE AREA	LEVEL 4
KNOWLEDGE: *he/she knows and understands*	I. Copper ore exploration	Work process	• Methods of mineral exploration, including geophysical techniques, surface and underground borehole drilling, and sampling of mining stope faces (L4-K1). • Borehole sampling methodologies (L4-K2). • Mining industry, including rules of company organization and exploration phases (L4-K3). • Rock and mineral properties, encompassing the physical and mechanical characteristics of geological samples (L4-K4). • Geological, geodetic, and geophysical data utilized in copper ore exploration, including geological cross sections and maps (L4-K5). • Principles and techniques of geological mapping (L4-K6). • Basic geological phenomena and ore-forming processes (L4-K7). • Guidelines for geological operations, along with standards and procedures to ensure compliance in exploration activities (L4-K8). • Geotechnical borehole logging and geological and geotechnical engineering operations, including their scope (L4-K9). • Drilling technology parameters, covering various drilling techniques, methods, and equipment (L4-K10). • Geophysical analysis methodologies for borehole data (L4-K11). • Principles and procedures for geological sample testing (L4-K12). • Operating principles of drilling equipment (L4-K13). • Occupational health and fire safety principles applicable to copper ore exploration (L4-K14).
		Digitalisation	• Concept of Industry 4.0, including general assumptions of digital transformation and the opportunities and risks it presents to copper exploration processes (L4-K15). • Integrated communication systems for mobile teams in the field (L4-K16).
		Green economy	• Supply chain dependencies within the copper industry (L4-K17). • Principles of sustainable development and the circular economy (L4-K18).
SKILLS: *he/she is able to*		Work process	• Select appropriate drilling tools and drill string components (L4-S1). • Assess the technical condition of drill bits, drilling crowns, and drill string components (L4-S2). • Utilize technical documentation for assembling and disassembling drilling equipment (L4-S3). • Perform measurements related to drilling activities (L4-S4). • Interpret data from control and measuring instruments to monitor drilling parameters (L4-S5). • Control borehole trajectory using an inclinometer (L4-S6). • Identify and troubleshoot common drilling problems, determining causes and finding solutions (L4-S7). • Prepare rock and soil samples for laboratory analysis (L4-S8). • Apply and supervise occupational health, fire, and environmental safety regulations in hydrological and exploration processes (L4-S9).

		Digitalisation	• Operate office software packages and computing devices for organizing and reporting activities, including charting and analysis (L4-S10). • Utilize integrated communication systems for mobile groups in the field (L4-S11).
		Green economy	• Implement sustainable development and circular economy principles in copper ore exploration, adhering to industry best practices (L4-S12). • Develop and implement energy and water conservation strategies, and manage waste in accordance with company policies and regulations (L4-S13).
KNOWLEDGE: *he/she knows and understands*	II. Copper extraction and processing	**Work process**	EXTRACTION • Natural hazards in copper ore extraction and methods of prevention (L4-K19). • Principles of conducting rescue operations in a mine or copper industry plant (L4-K20). • Methods for combating and preventing hazards in underground mining plants (L4-K21). • Copper ore extraction cycle of operations (L4-K22). • Basic copper extraction methods, techniques, and technologies under simple geological and mining conditions (L4-K23). • Parameters of rock excavation and backfilling in underground works (L4-K24). • Operations related to securing underground workings (L4-K25). • Operations related to ore excavation, loading, and transportation (L4-K26). • Operations related to the transportation of ore (horizontal and vertical), equipment, and materials (L4-K27). • Construction and operation of machinery and equipment used during drilling and types of explosives used in mines (L4-K28). • Construction and principles of operation of machines and equipment used for mining, loading, and haulage of excavated rocks (L4-K29). • Basics of ventilation systems in underground mining plants (L4-K30). PROCESSING • Copper ore beneficiation plants: complete list of equipment, energy consumption, and consumables (L4-K31). • Technical and technological conditions of tasks and activities related to copper ore processing (L4-K32). • Detailed construction and operation of copper ore beneficiation equipment (L4-K33). • Processes related to water treatment, sludge thickening and dewatering, and sediment drying and processing (L4-K34). • Principles of organization of the operation of mining machinery and copper ore beneficiation equipment (L4-K35). EXTRACTION AND PROCESSING • Applicable regulations, standards, and requirements regarding copper extraction (L4-K36. • Standard notation in geological and mining documentation used in underground copper ore mining plants (L4-K37). • Construction, functions, and hazards of electrical networks in mining companies (L4-K38). • Methods for recording operating parameters of mining machinery and copper ore beneficiation equipment (L4-K39). • Methods for identifying typical emergencies in copper ore extraction and processing (L4-K40).

			• Mechanisms of copper extraction and processing impact on the surrounding environment (L4-K41). • Impacts of copper ore mining operations on systems and technical facilities of copper ore mines (L4-K42).
		Digitalisation	• Concept of Industry 4.0, general assumptions of digital transformation, and the resulting opportunities and risks for copper exploration processes (L4-K43).
		Green economy	• Supply chain dependencies in the copper industry (L4-K44). • Techniques and technologies for forming waste dumps or facilities for the disposal of mining and flotation waste (L4-K45). • Assumptions of sustainable development and circular economy (L4-K46). • Processes of circulating water treatment, sludge thickening and dewatering, as well as sludge drying and processing (L4-K47).
SKILLS: *he/she is able to*		**Work process**	EXTRACTION • Assemble, start up, and dismantle machines and equipment for underground operations (L4-S14). • Select and operate tools, machines, and equipment necessary for conducting operations in the mining facility (L4-S15). • Operate mining tools and equipment in normal and unusual operations (L4-S16). • Interpret indications from control and measurement instruments of tools, machines, and equipment in mining operations (L4-S17). • Apply the drilling and blasting hole design plans (L4-S18). • Monitor the condition of mining supports (L4-S19). • Assemble and operate ventilation systems for underground works (L4-S20). • Assemble and operate pumping water systems for mining works (L4-S21). • Monitor the condition of the grid and electrical machines and equipment (L4-S22). • Supervise the use of basic personal and collective protective equipment in the mine (L4-S23). • Conduct regular surveys of the mine's topography (L4-S24).

			• Follow procedures for conducting particularly hazardous works in mining operations (L4-S25). PROCESSING • Draft necessary documents for conducting operations in the copper ore processing plant (L4-S26). • Perform regular inspections and maintenance of equipment used in the mineral processing plant (L4-S27). • Monitor machines and equipment used for comminution of ore minerals (crushing, screening and grinding) (L4-S28). • Monitor machines and equipment used for concentration of ore minerals (froth flotation banks) (L4-S29). • Keep accurate records of processing activities and production outputs (L4-S30). • Manage the processes of storing and loading solid mineral processing products (L4-S31). • Maintain dewatering, water treatment, thickening and drying equipment's (L4-S32). • Monitor and control technical and technological parameters of ore mineral processing (L4-S33). • Interpret indications from control and measurement instruments for tools, machines, and equipment used in copper ore processing (L4-S34). • Apply procedures related to conducting particularly hazardous work in copper ore beneficiation processes (L4-S35). • Supervise the use of basic personal and collective protective equipment in the copper ore processing plant (L4-S36). EXTRACTION AND PROCESSING • Prevent improper use of machines and equipment and its consequences (L4-S37). • Report identified cases of non-compliance in mining operations to the mine manager (L4-S38). • Apply and supervise safety and health regulations, as well as fire protection and environmental protection laws, in copper ore extraction and processing operations (L4-S39).
		Digitalisation	• Use intelligent technologies (including AI, cloud communications) in copper ore mining and beneficiation processes (L4-S40). • Operate office software packages and IT devices and use them for organizing and reporting activities (L4-S41).
		Green economy	• Recognize natural hazards and apply principles of prevention (L4-S42). • Form mining and flotation dumps using various technologies (L4-S43). • Apply principles of sustainable development (in accordance with ESG requirements) in copper ore mining and beneficiation processes (L4-S44). • Operate/implement processes for treatment of circulating water, thickening and dewatering of sludge, and drying and processing of sludge (L4-S45).
KNOWLEDGE: *he/she knows and understands*	III. Materials engineering and copper recycling	**Work process**	• Physical and chemical processes involved in copper production and recycling (L4-K48). • Methods and techniques used in copper production and recycling (L4-K49). • Dependencies of supply chains based on copper mineral raw materials (L4-K50). • Value chain in a copper and its alloys recycling company (L4-K51). • Market operations and principles of recycling non-ferrous metals, especially copper (L4-K52).

			• Organization and workflow in copper recycling plants, detailing stages such as collection, sorting, impurity removal, grinding, melting, cleaning, moulding, and post-processing (L4-K53). • Quality assurance and quality control policies and procedures (L4-K54).
		Digitalisation	• The concept of Industry 4.0 and the general assumptions of the digital transformation and the resulting opportunities and threats for the processes of processing and recycling products containing copper (L4-K55).
		Green economy	• Climate change and its effects on the environment (L4-K56). • Circular economy concepts and their role in promoting sustainable consumption and production patterns (L4-K57). • Environmental impact of copper recycling, focusing on resource conservation, landfill waste reduction, and decreased greenhouse gas emissions and pollution compared to copper ore production (L4-K58).
SKILLS: *he/she is able to*		Work process	• Select and implement appropriate methods and techniques in copper recycling (L4-S46). • Analyse properties and select copper materials for technical applications (L4-S47). • Comply with and enforce from others compliance with the applicable rules and regulations of health and safety, fire protection. and environmental protection (L4-S48). • Implement quality assurance and control systems procedures (L4-S49).
		Digitalisation	• Use smart technologies in copper production and recycling processes (L4-S50). • Operate office software packages and IT devices and use them for the purpose of organizing and reporting activities (L4-S51).
		Green economy	• Promote sustainable consumption and production patterns both in and out of the workplace (L4-S52).
SOCIAL COMPETENCE: *he/she is ready to*			
SOCIAL COMPETENCE: *he/she is ready to*	VIII Work standards	Engagement and responsibility	• Manage personal work and the team (L4-SOC1). • Undertake initiatives to improve and increase the effectiveness of tasks carried out (L4-SOC2). • Take responsibility for personal actions and make decisions concerning the small team managed (L4-SOC3). • Assume responsibility for company property and assets provided to the members of small teams (L4-SOC4). • Evaluate the quality of work of members of small teams (L4-SOC5). • Effectively manage the work of direct reports (L4-SOC6). • Meet medium-term targets (L4-SOC7). • Initiate changes that improve the effectiveness of work (L4-SOC8).
		Sustainable development	• Act in accordance with the professional code of conduct and social standards (L4-SOC9). • Systematically improve professional qualifications by participating in various forms of formal and informal education and training (L4-SOC10). • Motivate others to learn and develop skills (L4-SOC11). • Maintain stress at an optimal and safe level (L4-SOC12). • Implement actions for sustainability as part of small team management processes (L4-SOC13). • Apply the principles of using fewer resources, achieving better results with fewer resources, and reusing the same resources (L4-SOC14).

			• Respect the needs and rights of nature in order to restore and regenerate ecosystems (L4-SOC15). • Recognise the causes of unsustainable development for which humans are responsible (including depleting natural resources) and stop unsustainable practices (L4-SOC16).
		Health and safety	• Ensure the health and safety of subordinate employees in small teams (L4-SOC17).
	IX Communication and cooperation	**Communication**	• Effectively convey messages and give instructions (L4-SOC18). • Give and receive feedback when managing a small team (L4-SOC19). • Notify supervisors and direct reports of the results of the work of the small team and any impediments (L4-SOC20). • Share knowledge and experience in a small team during difficult situations (L4-SOC21).
		Cooperation	• Adhere to the principles of small team management (L4-SOC22). • Make decisions relating to the tasks assigned (L4-SOC23). • Enforce proper and timely completion of tasks (L4-SOC24). • Collaborate while leading a small team (L4-SOC25).
		Problem solving	• Apply principles of effective negotiation (L4-SOC26). • Jointly resolve problems with the managed small team and ensure that all instructions are followed (L4-SOC27). • Ensure that rules laid down in the problem-solving process are adhered to by the managed small team (L4-SOC28).

Sectoral Competency Framework SQF-Cu: LEVEL 5

	INDUSTRY INDICATOR	COMPETENCE AREA	LEVEL 5
KNOWLEDGE: *he/she knows and understands*	I. Copper ore exploration	Work process	• Methods for obtaining and using geological, geodetic, geophysical, and drilling information in copper exploration (L5-K1). • Approaches to copper ore exploration (L5-K2). • Complex geological ore-forming processes (L5-K3). • Field geological mapping techniques and the principles of using geological field books (L5-K4). • Standards and technical requirements for copper exploration activities (L5-K5). • Types of surface and groundwater, along with the hydrogeological properties of rocks (L5-K6). • Geological and mining laws, environmental laws, and relevant standards (L5-K7). • Hydrogeology, geological, and geotechnical engineering operations, including their scope (L5-K8). • Principles of using Global Positioning Systems and related equipment (L5-K9). • Technologies for real-time measurements of ore and copper grades, such as portable XRF, portable LIBS, and spectroscopy (L5-K10). • Drilling performance metrics and optimization techniques (L5-K11).
		Digitalisation	• Basic principles of cybersecurity applicable to Industry 4.0 and their application to copper exploration processes (L5-K12).
		Green economy	• Environmental regulations and legal requirements for exploration processes (L5-K13).
SKILLS: *he/she is able to*		Work process	• Read and interpret job-specific documents, maps, and geological measurement documentation related to copper ore deposit exploration (L5-S1). • Analyse geological, geodetic, geophysical, and drilling data (L5-S2). • Conduct field geological surveys (L5-S3). • Perform hydrogeological in-situ measurements, including infiltration and permeability tests (L5-S4). • Classify rocks and soils based on criteria such as strength, weathering, and fractures spacing (L5-S5). • Conduct laboratory tests to assess the chemical, physical, and mechanical properties of water, soils, and rock samples (L5-S6). • Supervise the collection of samples using side samplers (L5-S7). • Organize and supervise drilling processes (L5-S8). • Supervise the assembly and disassembly of equipment and machines (L5-S9). • Prepare drilling reports (L5-S10). • Organize and manage sample storage (L5-S11). • Supervise compliance with safety, health, fire protection, and environmental regulations in geological, hydrological, and exploration processes (both planned and implemented) (L5-S12). • Execute all tasks in accordance with standard copper exploration procedures (L5-S13).
		Digitalisation	• Querry and utilize digital documentation (L5-S14). • Act as a dispatcher for integrated field communication systems for mobile groups (L5-S15).

		Green economy	• Conduct copper deposit exploration in compliance with environmental protection legal requirements (L5-S16).
KNOWLEDGE: *he/she knows and understands*	II. Copper extraction and processing	Work process	EXTRACTION • Surveying results and geological documents (L5-K14). • Principles of estimating the cost of mining operations and team efforts (L5-K15). • Mining operations (all and in detail, from drill and blast to transportation of ores to the mineral processing plant and mine development works) (L5-K16). • Detailed construction and operation of normal and specialised mining machinery (L5-K17). • Ventilation systems and their importance in maintaining air quality and safety in underground mines (L5-K18). • Methods for interpreting operating parameters of mining machinery and copper ore beneficiation equipment (L5-K19). PROCESSING • Principles of rock mechanics, hydraulics, and chemistry to develop copper ore processing projects (L5-K20). • Detailed construction and rules of operating all mining equipment in the mineral processing plants (L5-K21). • Techniques for calculating the inputs, outputs, and losses of materials during processing (L5-K22). • Principles and methods of extracting metals from ores through froth flotation (L5-K23). • Control systems used in copper ore processing to maintain optimal operating conditions and ensure product quality (L5-K24). • Principles of rescue operations in mining plants (L5-K25). • Environmental and social conditions of tasks and activities related to copper ore processing (L5-K26). EXTRACTION AND PROCESSING • Actions required to obtain a licence for copper ore extraction (L5-K27). • Basic documentation necessary to commence mining operations (L5-K28). • Principles of work ergonomics in the mining industry (L5-K29). • Factors affecting the outcome of copper extraction and processing (L5-K30). • Copper ore extraction and processing methods, techniques, and technologies under complex geological and mining conditions (L5-K31). • Methods for identifying serious emergencies in copper ore extraction and processing (L5-K32). • Methods for assessing the impact of copper extraction and processing on the surrounding environment (L5-K33).
		Digitalisation	• Basic principles of cybersecurity in force in Industry 4.0 and their application in the processes of mining and enrichment of copper ore (L5-K34).
		Green economy	• Principles of managing mining and flotation waste (L5-K35). • Environmental regulations and legal requirements relating to ore extraction and enrichment processes (L5-K36).
SKILLS: *he/she is*		Work process	EXTRACTION • Interpret surveying, geological, drilling, and geophysical documents, as well as mine development maps and reports (L5-S17). • Analyse key documents for mining operations (L5-S18).

			• Prepare data for extraction permits and required reports and estimate the costs of various mining operations and team efforts (L5-S19). • Select and organize the necessary systems, tools, and equipment for mine operations, and prepare data summaries from control and measurement instruments (L5-S20). • Plan and allocate machines, materials, and tools for copper ore extraction processes (L5-S21). • Analyse the indications from control and measurement instruments of tools, machines, and equipment necessary for conducting operations in the mine (L5-S22). • Supervise drilling, blasting and the quality of anchor support installation and scaling in headings and workings (L5-S23). • Supervise the transport of extracted materials to dumps via conveyor belts (L5-S24). • Supervise rock transport to primary crushers and the crushing of large rock blocks with hydraulic hammers (L5-S25). • Supervise ore extraction to the surface using skip devices, dumpers and/or conveyor systems (L5-S26). • Define methods for assessing the impacts of mining on technical systems and facilities (L5-S27). • Plan maintenance of machines, equipment, and general infrastructures related with the rock excavation areas (L5-S28). • Optimize procedures for hazardous tasks in mining operations and supervise the use of specialized personal and collective protective equipment (L5-S29). • Optimize working conditions to ensure compliance with safety, health, fire protection, and environmental regulations during copper ore extraction (L5-S30). • Apply procedures related to carrying out particularly hazardous work in mining operations (L5-S31). PROCESSING • Analyse documents necessary for conducting operations in the copper ore processing plant (L5-S32). • Select basic systems and equipment necessary for conducting operations in the copper ore processing plant (L5-S33). • Organise the use of tools, machines, and equipment necessary for conducting operations in the copper ore processing plant (L5-S34). • Prepare tabular summaries, diagrams, and charts based on indications from control and measurement instruments of tools, machines, and equipment used in the copper ore processing plant (L5-S35). • Assess the quality of ore mineral beneficiation, such as metal recovery and copper grades (L5-S36). • Supervise the process of loading copper concentrates for storage and expedition (L5-S37). • Supervise the processes of dewatering, water treatment, as well as solid mineral processing product thickening and drying (L5-S38). • Coordination and communication with other departments to ensure alignment on production goals (L5-S39). • Managing budgets and resources for operational efficiency (L5-S40). • Supervise the use of specialised personal and collective protective equipment in the copper ore processing plant (L5-S41). • Assist in troubleshooting and resolving operational issues during processing (L5-S42). • Optimise working conditions in accordance with safety and health regulations, as well as fire protection and environmental protection laws in copper ore processing operations (L5-S43).

			• Supervise occupational health and safety, as well as fire and environmental protection regulations applicable to laboratory work related to copper beneficiation (L5-S44).
		Digitalisation	• Use IT equipment and mineral extraction and/or processing documentation software, along with innovative solutions such as cloud computing and real-time analytics (L5-S45). • Apply cybersecurity principles to the processes of copper ore mining and beneficiation (L5-S46).
		Green economy	• Predict natural hazards and oversee the implementation of hazard prevention principles (L5-S47). • Define methods for assessing the environmental impacts of copper ore mining operations and their extent (L5-S48). • Monitor the quality of water deposits and the variability of quality parameters during copper extraction processes (L5-S49).
KNOWLEDGE: *he/she knows and understands*	III. Materials engineering and copper recycling	Work process	• Provisions and standards applicable to copper and copper alloy production and recycling (L5-K37). • Technologies for the production and recycling of copper and its alloys (L5-K38). • Factors affecting the efficiency of copper production and recycling processes (L5-K39). • Basic physics, mathematics, and statistics necessary for interpreting and processing measurement data (L5-K40).
		Digitalisation	• The potential for using innovative technologies to acquire and process measurement data (L5-K41).
		Green economy	• The importance of renewable energy sources for the global management of raw materials (L5-K42).
SKILLS: *he/she is able to*		Work process	• Select and implement technologies for recycling copper and its alloys (L5-S50). • Use simple measuring and testing equipment during laboratory tests of copper and other non-ferrous metals (L5-S51). • Analyse factors affecting the efficiency of copper production and recycling processes (L5-S52). • Apply principles of mathematics and statistics necessary to interpret and process measurement data (L5-S53). • Optimize working conditions according to health and safety, fire protection, and environmental protection regulations applicable in the company (L5-S54).
		Digitalisation	• Analyse measurement data using information technology (L5-S55).
		Green economy	• Carry out copper recycling processes in compliance with legal requirements for environmental protection (L5-S56).
SOCIAL COMPETENCE: *he/she is ready to*			
SOCIAL COMPETENCE: *he/she is ready to*	IV Work standards	Engagement and responsibility	• Ensure timely implementation of tasks (L5-SOC1). • Take responsibility for one's own actions and make decisions concerning the small and medium-sized team managed (L5-SOC2). • Assume responsibility for coordinating the distribution of resources to employees in small and medium-sized teams (L5-SOC3). • Evaluate the quality of work of members of small teams and their supervisors (L5-SOC4).

			• Effectively manage the work of direct reports during crisis and rescue operations (L5-SOC5). • Meet long-term targets (L5-SOC6). • Manage changes to improve the effectiveness of work in small and medium-sized teams (L5-SOC7).
		Sustainable development	• Act responsibly and in accordance with the professional code of conduct and social standards (L5-SOC8). • Follow the principles of corporate social responsibility (L5-SOC9). • Seek and acquire new knowledge that is useful for professional work. • Use relaxation techniques and promote assertiveness (L5-SOC10). • Implement actions for sustainability as part of medium and large team management processes (L5-SOC11). • Take into account local circumstances when considering sustainability issues and opportunities (L5-SOC12). • Analysing the risks and benefits of human activities, using life-cycle thinking (L5-SOC13).
		Health and safety	• Ensure the health and safety of subordinate employees in medium-sized teams (L5-SOC14).
	V Communication and cooperation	**Communication**	• Notify supervisors and direct reports of the results of the work of the teams managed and any impediments (L5-SOC15). • Provide feedback to change negative attitudes and behaviours with respect and dignity (L5-SOC16). • Effectively convey messages and give instructions using modern means of communication (L5-SOC17). • Act as a mentor to employees (L5-SOC18).
		Cooperation	• Follow the principles of team management during crisis and rescue operations (L5-SOC19). • Share expertise with colleagues, direct reports, and subcontractors (L5-SOC20). • Manage collaboration between and among small teams (L5-SOC21). • Appreciate good relationships with external clients (L5-SOC22).
		Problem solving	• Jointly resolve problems occurring in the small team managed with supervisors (L5-SOC23). • Ensure that the rules laid down in the problem-solving process are followed by the supervisors (L5-SOC24).

Sectoral Competency Framework SQF-Cu: LEVEL 6

	INDUSTRY INDICATOR	COMPETENCE AREA	LEVEL 6
KNOWLEDGE: *he/she knows and understands*	I. Copper ore exploration	Work process	• Fundamentals of geology and structural measurements (L6-K1). • Provisions of geological and mining law, industry regulations, and standards (L6-K2). • Genetic differentiation of mineral deposits and their occurrence patterns (L6-K3). • Factors influencing the success of mineral exploration programs (L6-K4). • Principles of reconnaissance exploration in the search for copper ore deposits and the preparation of copper exploration projects (L6-K5). • Principles of drafting copper exploration reports and updating geological maps and photogrammetric materials (L6-K6). • Identification of minerals and rocks through microscopy and hand samples (L6-K7). • Rock mechanics laboratory tests accompanying copper ore exploration (L6-K8).
		Digitalisation	• IT tools used in geological, geodetic, geophysical, and drilling processes (L6-K9).
		Green economy	• Best environmental and social practices related to mineral exploration activities (L6-K10).
SKILLS: *he/she is able to*		Work process	• Search for and analyse geological, geodetic, geophysical, and drilling information, and update geological maps and photogrammetric materials (L6-S1). • Represent geological observations and terrain relief on maps, including hand-drawn sketches of geological-mining cross-sections (L6-S2). • Select and use appropriate drilling equipment, applying geological-engineering and geotechnical documentation (L6-S3). • Conduct copper ore exploration, reconnaissance operations, and specialized field tests, estimating the size of ore resources and deposits (L6-S4). • Determine the presence and size of underground water resources in mining areas, and analyse the location of deposits and groundwater sources (L6-S5). • Prepare geological and mining documentation, including borehole logs and exploration reports, in accordance with applicable standards and regulations (L6-S6). • Conduct geological, geotechnical, mineralogical, and petrographic studies, and evaluate laboratory test results (L6-S7). • Use of drones and remote sensing technology for collecting multispectral images of exploration areas (L6-S8). • Apply geological and mining laws, along with environmental regulations, in mineral exploration (L6-S9). • Coordinate and monitor the work of subcontractors, validating their performance and selecting new subcontractors as needed (L6-S10). • Optimize working conditions in compliance with safety and health regulations, as well as fire protection and environmental protection laws, in geological, hydrological, and exploration processes (both planned and implemented) (L6-S11).

		Digitalisation	• Create sketches of terrain relief and geological-mining cross-sections during copper ore deposit exploration using digital technologies (L6-S12). • Utilize IT equipment and software to organize and report geological activities safely, adhering to cybersecurity protocols (L6-S13). • Prepare measurement and geological documents related to copper ore deposit exploration processes using digital technologies (L6-S14). • Draft essential technical documentation related to resource extraction, including deposit extraction plans, deposit management concepts, work schedules, and simplified economic analyses, employing digital technology (L6-S15). • Analyse laboratory results with specialized software and smart technologies (including AI, cloud connectivity, and real-time data analysis) (L6-S16).
		Green economy	• Develop waste management initiatives in alignment with best practices and principles of a circular economy applicable to copper exploration (L6-S17).
KNOWLEDGE: *he/she knows and understands*	II. Copper extraction and processing	Work process	EXTRACTION • Methods and techniques used in copper extraction under restricted geological and mining conditions (L6-K11). *Common and specialized mining methods, along with various backfill types. • Details of mining operations related to drilling and blasting excavation, as well as the loading and transportation of ores (L6-K12). • Types and principles of selecting mining machines, equipment, and consumables (L6-K13). • Principles of constructing and utilizing technical and technological systems for complex mining machinery (L6-K14). • Methods for evaluating the stability of rock formations and underground workings to prevent collapses and ensure safe mining operations (L6-K15). • Specialized methods for identifying and addressing typical emergencies in copper ore extraction (L6-K16). PROCESSING • Processes of comminution, concentration, and beneficiation specific to copper ores, including standard procedures and optimization techniques (L6-K17). • Criteria for selecting appropriate systems and equipment for copper ore processing (L6-K18). • Interactions between different reagents and minerals during processing, including their effects on separation efficiency and environmental impact (L6-K19). • Water management strategies and sludge disposal methods relevant to copper ore processing operations (L6-K20). • Impact of operating parameters of mining machinery and copper ore beneficiation equipment on the efficiency of technological processes and economic results (L6-K21). • Safety protocols related to hazardous tasks in copper beneficiation, ensuring compliance with legal and safety standards (L6-K22). EXTRACTION AND PROCESSING • Relationship between natural disasters and occupational health and safety in mining operations (L6-K23). • Principles of rescue operations in mining areas (L6-K24). • Structure and principles of operation of copper extraction companies (L6-K25). • Principles of mine operation planning (L6-K26).

			• Administrative procedures and documentation necessary for commencing mining operations (L6-K27). • Importance, need and principles of conducting evaluation and monitoring of the impact of copper extraction and processing on the surrounding environment (L6-K28). • Importance of safety audits, assessments, and regulations governing occupational health, fire protection, and environmental safety in mining operations (L6-K29).
		Digitalisation	• Opportunities arising from the application of new real-time technologies in mining operations (L6-K30). • Digital tools and opportunities for forecasting natural hazards (L6-K31).
		Green economy	• Principles of responsible business, sustainability, and ESG requirements in copper ore mining and processing (L6-K32). • Good environmental and social practices in copper ore mining and processing (L6-K33). • Environmental impact of the entire production chain and development of strategies to enhance environmental efficiency (L6-K34). • Methods and techniques for measuring the environmental impacts of copper ore mining operations (L6-K35).
SKILLS: *he/she is able to*		**Work process**	• EXTRACTION • Design water pumping facilities (L6-S18). • Design ventilation systems (L6-S19). • Design pipelines for mining backfill (L6-S20). • Draft the necessary documentation for conducting operations within the mining facility (L6-S21). • Utilize the full range of geological, geodetic, geophysical, and drilling information (L6-S22). • Assist in preparing documents required to obtain and renew extraction permits (L6-S23). • Collaborate with subcontracted companies for specialized tasks (L6-S24). • Develop multi-scenario copper ore mining and processing projects for simple geological and mining conditions (L6-S25). • Select and plan the most appropriate mining method for each mine area, level, or panel (L6-S26). • Choose mining machines, equipment, and tools based on operational needs (L6-S27). • Optimize the use of tools, machines, and equipment necessary for mining operations (L6-S28). • Mitigate water hazards, particularly those arising during shaft and tunnel sinking (L6-S29).

			• Perform ongoing analysis and assessment of the hydrogeological situation during mining operations (L6-S30). • Conduct periodic and planned inspections of underground mining activities (L6-S31). • Organize and oversee operations related to securing underground workings (L6-S32). • Mitigate rock burst hazards in relation to extraction technologies, technical safety measures, and work organization (L6-S33). • Mitigate thermal hazards by implementing technical solutions to ensure a suitable microclimate (L6-S34). • Perform tasks in accordance with standard copper extraction procedures (L6-S35). • Estimate costs associated with copper ore mining operations (L6-S36). • Establish rules for the use of basic personal and collective protective equipment in the mine (L6-S37). • Critically assess and enhance safety, health, fire protection, and environmental regulations related to copper ore extraction (L6-S38). PROCESSING • Draft documents necessary for conducting operations in the copper ore processing plant (L6-S39). • Perform tasks following the standard procedures of copper beneficiation (L6-S40). • Select systems and equipment necessary for conducting operations in the copper ore processing plant (L6-S41). • Monitor technical parameters of copper beneficiation processes (L6-S42). • Lay down the principles and terms of use of machines and equipment for comminution and concentration (L6-S43). • Analyse the indications from control and measurement instruments of tools, machines, and equipment necessary for conducting operations in the copper ore processing plant (L6-S44). • Estimate the costs of the copper ore processing plant operations (L6-S45). • Create preventive maintenance schedules for equipment and machines to minimize downtime and extend the lifespan of assets (L6-S46). • Establish rules for the use of basic personal and collective protective equipment in the copper ore processing plant (L6-S47). • Lead safety audits and assessments to ensure compliance with regulations (L6-S48). • Critically assess and improve safety and health regulations as well as fire protection and environmental protection laws in copper ore processing operations (L6-S49). • Critically assess and improve procedures related to carrying out particularly hazardous work in copper ore beneficiation processes (L6-S50). • Establish and enforce procedures related to executing particularly hazardous work in copper ore beneficiation processes, prioritizing worker safety and regulatory compliance (L6-S51).
		Digitalisation	• Explore the new real-time technologies in mining operations (L6-S52). • Plan mining operations using digital technologies (L6-S53).

		Green economy	• Supervise the application of hazard prevention principles (L6-S54). • Monitor and forecast the environmental impact of copper ore mining (L6-S55). • Implement responsible business practices in alignment with sustainability and ESG (Environmental, Social, and Governance) requirements in copper ore mining and beneficiation companies (L6-S56). • Select methods and techniques for measuring the environmental impacts of copper ore mining operations (L6-S57). • Assess the environmental impact of the entire production chain and develop area-specific strategies to enhance environmental performance (L6-S58).
KNOWLEDGE: *he/she knows and understands*	III. Materials engineering and copper recycling	Work process	• Mathematics, physics, and chemistry necessary to shape materials and metallurgical engineering processes, particularly in copper metallurgy, recycling, and processing (L6-K36). • Properties of non-ferrous metals, including physical and chemical characteristics, crystal structure, metallurgy, and metallography (L6-K37). • Industrial production processes and processing methods/techniques for non-ferrous metals, such as alloy production, shaping, heat treatment, and surface treatment (L6-K38). • Specialized requirements for copper production and recycling, focusing on the methods, technologies, and standards used (L6-K39).
		Digitalisation	• Possibilities and principles for utilizing computer programs and intelligent technologies (including AI, cloud connectivity, and real-time data analysis) to analyse and process data (L6-K40).
		Green economy	• Environmental and social obligations related to copper production and/or recycling (L6-K41).
SKILLS: *he/she is able to*		Work process	• Perform technical functions in the field of copper production and recycling, including supervising the plastic processing of copper and its alloys (L6-S59). • Design installations for the recycling and processing of copper and its alloys (L6-S60). • Apply material testing techniques (for both raw materials and products) and metallurgical technological processes related to the processing of copper and other non-ferrous metals, in compliance with applicable standards (L6-S61). • Evaluate the suitability of various test methods for determining the properties of non-ferrous metallic materials and their recyclability (L6-S62). • Create design specifications for producing modern materials suitable for the copper and other non-ferrous metals industries (L6-S63). • Report on metal production and/or recycling in a manner consistent with applicable laws and reporting standards (L6-S64). • Select recycled raw materials and other materials to produce copper and its alloys with defined properties and operating parameters (L6-S65). • Plan and utilize the appropriate machines, tools, and materials in copper production and/or recycling processes (L6-S66).
		Digitalisation	• Apply fundamental IT techniques (including AI, cloud connectivity, and real-time data analysis) to process data in the field of materials engineering (L6-S67).
		Green economy	• Control and analyse the operation of equipment used for environmental protection (L6-S68). • Monitor the size and condition of metallurgical waste sites using measurement and imaging techniques (L6-S69).

			• Use methods and equipment for measuring and imaging the size and condition of metallurgical waste sites (L6-S70).
SOCIAL COMPETENCE: *he/she is ready to*			
SOCIAL COMPETENCE: *he/she is ready to*	IV Work standards	Engagement and responsibility	• Manage, control, and assess copper extraction and/or processing activities (L6-SOC1). • Take responsibility for the outcomes of the decisions made with reference to selected company operations (L6-SOC2). • Evaluate the quality of work of members of medium-sized teams and their supervisors (L6-SOC3). • Take responsibility for company property and assets (L6-SOC4). • Critically evaluate the effectiveness of time management in the company (L6-SOC5). • Meet targets despite sporadic difficulties (L6-SOC6). • Manage changes that improve the effectiveness of the company's operations (L6-SOC7).
		Sustainable development	• Implement principles of professional conduct that help create a positive work environment and maintain a work-life balance (L6-SOC8). • Process and create new knowledge useful for professional work (L6-SOC9). • Manage stress in small teams (L6-SOC10). • Plan short-term actions for sustainability (L6-SOC11). • Comprehensively perceive the issue of sustainability (covering environmental, economic, social, and cultural elements) and the links between natural events and human actions (L6-SOC12). • Critically analyse arguments about sustainability issues (L6-SOC13). • Make unusual choices and deal with trade-offs in making sustainable development decisions (L6-SOC14). • Creatively apply the concepts of a circular economy, including quality over quantity, reuse, and repair (L6-SOC15).
		Health and safety	• Ensure the health and safety of company employees (L6-SOC16).
	V Communication and cooperation	Communication	• Human resources management methods and techniques (L6-SOC17). • Engage in a dialogue and cooperate with others based on the feedback from the teams managed (L6-SOC18). • Effectively change negative attitudes and behaviours in medium-sized and large teams with constructive feedback (L6-SOC19). • Effectively convey messages and give instructions to large teams using digital technologies (L6-SOC20). • Act as a mentor to supervisors and managers (L6-SOC21).
		Cooperation	• Critically evaluate the quality and results of small team work (L6-SOC22). • Make decisions concerning task delegation and assignment (L6-SOC23). • Plan and delegate tasks (L6-SOC24). • Manage collaboration between interdisciplinary teams built to complete complex tasks (L6-SOC25). • Establish and maintain good relationships with external clients (L6-SOC26).
		Problem solving	• Solve problems influencing the scope, quality, or timeliness of the tasks carried out (L6-SOC27). • Solve problems occurring in the medium-sized and large teams managed (L6-SOC28).

			• Ensure that rules laid down in the problem-solving process are followed by the medium-sized team managed (L6-SOC29).

Sectoral Competency Framework SQF-Cu: LEVEL 7

	INDUSTRY INDICATOR	COMPETENCE AREA	LEVEL 7
KNOWLEDGE: *he/she knows and understands*	I. Copper ore exploration	Work process	• Legal principles and legislative processes concerning labour, environmental protection, and industry-specific laws and regulations, including geological and hydrogeological requirements for mine operations (L7-K1). • Principles of preparing investment projects and understanding administrative procedures related to copper ore exploration (L7-K2). • Principles of mine and property management, encompassing environmental and social obligations, corporate social responsibility, and the code of conduct (L7-K3). • Influence of geometrical, hydrogeological, geological, atmospheric, and thermal conditions on copper ore extraction technologies and processes (L7-K4). • Principles for building predictive 3D models used in copper ore exploration (L7-K5).
		Digitalisation	• Opportunities and threats associated with the use of smart technologies in copper exploration (L7-K6). • GIS and geostatistics software application (L7-K7).
		Green economy	• Laws governing water resources, land protection, environmental protection, forestry, and agricultural land (L7-K8). • Opportunities and challenges posed by the principles of Industry 5.0 (i.e., sustainable, environmentally friendly, human-centric, and crisis-resistant industry) in copper extraction and processing (L7-K9).
SKILLS: *he/she is able to*		Work process	• Implement corporate social responsibility principles and adhere to the code of conduct (L7-S1). • Manage, control, and assess copper exploration activities, ensuring alignment with the client's budget, objectives, and sustainable development regulations (L7-S2). • Prepare copper exploration projects utilizing various methods, technologies, and geophysical data (L7-S3). • Organize, coordinate, and supervise geological and hydrogeological operations, including mapping, profiling, and sampling in mining and drilling activities (L7-S4). • Develop maps of groundwater resources and evaluate their quality (L7-S5). • Construct predictive 3D geological models (L7-S6). • Report reserves using international classification criteria (L7-S7). • Oversee the administrative process of copper ore deposit exploration in compliance with Geological and Mining Law and the Code of Administrative Procedure (L7-S8). • Specify geometrical, hydrogeological, geological, atmospheric, and thermal conditions for copper ore extraction (L7-S9). • Assess opportunities and mitigate threats during the implementation of copper exploration programs (L7-S10). • Continuously enhance work performance by analysing potential errors and irregularities (L7-S11). • Develop new safety and health regulations, along with fire protection and environmental protection laws, in geological, hydrological, and exploration processes (both planned and implemented) (L7-S12).

		Digitalisation	• Process geological, geodetic, geophysical, and drilling data using specialized software and intelligent technologies (including AI, cloud connectivity, and real-time data analysis) (L7-S13). • Develop and update technical and financial plans for copper exploration activities using IT equipment and software, ensuring compliance with cybersecurity principles (L7-S14). • Utilize digital technologies in creating surveying and geological documentation during copper ore deposit exploration (L7-S15). • Apply modern statistical and geostatistical methods for deposit evaluation, and employ advanced digital technologies and artificial intelligence for documentation purposes (L7-S16).
		Green economy	• Develop land reclamation projects for areas following mine closure (L7-S17). • Create innovative and cost-effective solutions to address and mitigate climate crises and health threats (L7-S18). • Construct alternative business models to promote awareness of environmentally friendly production and consumption practices (L7-S19).
KNOWLEDGE: *he/she knows and understands*	II. Copper extraction and processing	**Work process**	EXTRACTION • Methods for monitoring and preventing technical emergencies during copper ore processing (L7-K10). • Long-term mine planning techniques for copper extraction, including budgeting, client goal assessment, and compliance with regulations and standards (L7-K11). • The importance of ventilation design and ventilation information (L7-K12). • Regulations and permits related to drill and blast excavation (L7-K13). • Complex methods and techniques used in copper extraction under restricted geological and mining conditions (L7-K14). • Methods for optimising the operation of mining machinery and personnel allocation (L7-K15). PROCESSING • Technical parameters of copper ore processing (L7-K16). • Methods for ensuring high technical efficiency of copper ore beneficiation equipment (L7-K17). • Chemical reagents and their use in copper ore processing operations (L7-K18). • Methods for monitoring and preventing technical emergencies during copper ore processing (L7-K19). EXTRACTION AND PROCESSING • Documents and administrative procedures necessary to initiate mining and processing operations (L7-K20). • Interdependency of the work carried out in the various business units of copper ore mining enterprises (L7-K21). • Methods for limiting the impact of copper extraction and processing on the surrounding environment (L7-K22). • Safety and health regulations, fire protection, and environmental protection laws applicable to copper ore processing operations, ensuring all processes adhere to these requirements (L7-K23).

		Digitalisation	• Principles of using digital tools to analyse the technical and technological systems of mining machinery and equipment (L7-K24). • Principles of using digital tools to organize work and activities related to the enrichment of copper ores (L7-K25). • Opportunities and threats arising from the use of intelligent technologies in the processes of mining and processing copper ores (L7-K26).
		Green economy	• Opportunities and threats stemming from the application of Industry 5.0 principles (sustainable, ecologically based, people-oriented, and crisis-proof) in copper ore mining processes (L7-K27). • Impact of geotechnical, physical, and chemical parameters on the design of waste dumps or facilities for disposing of mining and flotation waste (L7-K28). • Quality assessment and certification systems, including EU and international standards and labels (L7-K29). • The principles of corporate social responsibility and code of conduct (L7-K30).
SKILLS: *he/she is able to*		**Work process**	EXTRACTION • Identify and prevent natural disasters and technical emergencies (L7-S20). • Plan copper extraction activities, while sticking to the budget, keeping in mind client's goals and requirements, and complying with good practices, standards, and legal requirements (L7-S21). • Plan and monitor mining operations to ensure compliance with the mine's long- and medium-term development plans (L7-S22). • Develop multi-variant copper ore mining projects for complex geological and mining conditions (L7-S23). • Organise and supervise operations related to the closure plan (L7-S24). • Plan the mining sequence of excavation at medium and short term (L7-S25). • Monitor technical parameters of copper ores extraction (L7-S26). • Supervise mining and drilling operations with consideration of the rational use of minerals, compliance with permits and the deposit management project, the operation plan, selective exploitation, and dumping of multi-resource deposits (L7-S27). • Select methods and techniques for measuring the impacts of mining operations on the technical systems and facilities of copper ore mines (L7-S28). • Evaluate possible deviations between the mined copper ores and those planned, and refresh mining productivity (L7-S29).

			• Monitor and supervise operational documentation for compliance with geological and mining regulations (L7-S30). • Optimise systems, equipment, and machines necessary for conducting operations in the mine (L7-S31). • Model mine technological processes based on the indications from control and measurement instruments (L7-S32). • Create new safety and health regulations as well as fire protection and environmental protection laws in copper ore excavation (L7-S33). • Establish new procedures related to carrying out particularly hazardous work in mining operations (L7-S34). • Establish rules for the use of specialised personal and collective protective equipment in the mine (L7-S35). PROCESSING • Develop the assumptions of copper ore processing projects for simple geological and mining conditions (L7-S36). • Develop documents necessary for copper ore processing plant operations (L7-S37). • Select and procure advanced systems and equipment necessary for conducting operations in the copper ore processing plant, ensuring they meet operational and safety standards (L7-S38). • Plan water and sludge management (L7-S39). • Establish and supervise quality control protocols to ensure that final products consistently meet desired specifications and regulatory standards (L7-S40). • Monitor and analyse technical parameters of copper beneficiation processes to ensure optimal performance and compliance (L7-S41). • Plan and manage copper processing activities while adhering to budget constraints, aligning with client goals and requirements, and ensuring compliance with industry standards and legal regulations (L7-S42). • Optimize comminution size to ensure minimum energy consumption while maximizing material recovery and efficiency in processing (L7-S43). • Utilize production data analytics to identify trends and operational issues, facilitating informed decision-making aimed at improving overall operational efficiency (L7-S44). • Collaborate effectively with interdisciplinary teams, including geology, maintenance, and safety, to ensure seamless integration of processes and enhance operational efficiency across all facets of the copper processing operation (L7-S45). • Develop and implement new safety and health regulations, as well as fire protection and environmental protection laws, tailored to the specific needs of copper ore processing operations (L7-S46). • Formulate rules for the effective use of specialized personal and collective protective equipment within the copper ore processing plant to enhance worker safety (L7-S47). • Establish rules for safety and health regulations, as well as fire protection and environmental protection laws in copper ore processing operations (L7-S48).
		Digitalisation	• Process data using specialized computer programs and intelligent technologies (including AI, cloud connectivity, and real-time data analysis), while adhering to cybersecurity principles (L7-S49).

			• Apply digital tools to measure the environmental impacts of copper ore mining operations (L7-S50). • Use digital technologies to create multi-variant documents necessary for operations in the mining facility and copper ore processing plant (L7-S51).
		Green economy	• Predict natural hazards and oversee the application of hazard prevention principles (L7-S52). • Implement and develop solutions aimed at minimizing the negative environmental impact of companies by counteracting the depletion and degradation of natural resources (L7-S53). • Develop and provide public administration authorities with warnings regarding dangerous phenomena occurring in groundwater recharge and abstraction zones (L7-S54). • Implement and develop initiatives to conserve energy and water, and reduce greenhouse gas emissions in copper production and processing (L7-S55). • Apply the 3R principles (reduce, reuse, recycle) in accordance with the realities of copper ore mining and processing companies (L7-S56).
KNOWLEDGE: *he/she knows and understands*	III. Materials engineering and copper recycling	**Work process**	• Principles of plant and property management and related environmental and social responsibilities (including the ESG concept) (L7-K31). • Principles for organizing human teams in a copper recycling plant (L7-K32). • Good environmental and social practices for the implementation of copper production and/or recycling processes (L7-K33). • Principles and processes of material management and recycling in the metallurgy and copper industry (L7-K34). • Methods and tools for quality control of copper production and its products (L7-K35). • Opportunities offered or threats posed by copper engineering and copper waste recycling processes (L7-K36). • Materials engineering necessary to shape the properties and structure of materials made from copper and other non-ferrous metals (L7-K37). • Principles and procedures for controlling and analysing the quality of metallurgical products (L7-K38). • Principles of site and property management applicable to copper production and/or recycling (L7-K39).
		Digitalisation	• Computational programs and techniques used to simulate causal relationships between controlled inputs for copper production and recycling and the corresponding outputs (L7-K40). • Advanced sensors for real-time measurement of parameters of various metallurgical processes (L7-K41). • Principles and ways to integrate metallurgical process sensors with appropriate digitization platforms for data visualization and analysis (L7-K42).
		Green economy	• Methods and devices for measuring and imaging the size and condition of metallurgical waste sites (L7-K43). • Principles and methods for installing and integrating sensors to measure and image the size and condition of metallurgical waste sites (L7-K44).

SKILLS: *he/she is able to*		Work process	• Design copper production and/or recycling operations in accordance with best practices, standards, legal requirements, and utilizing intelligent technologies (L7-S57). • Design and develop production technologies for modern materials in the copper industry and other non-ferrous metals (L7-S58). • Manage manufacturing processes for semi-finished and finished products made from copper and multi-material composites based on non-ferrous metals, utilizing various synthesis techniques (L7-S59). • Manage, control, and evaluate copper production and/or recycling activities in line with ESG principles (L7-S60). • Control and analyse the operation of metallurgical machinery and equipment (L7-S61). • Monitor and analyse the quality of metallurgical products using specialized control and measurement devices and defined procedures (L7-S62). • Control and analyse the quality of products resulting from the plastic processing of copper and its alloys (L7-S63). • Combine different methods and techniques for copper production and/or recycling while adhering to budget constraints and considering the client's goals and requirements (L7-S64). • Assess opportunities and counteract threats in the implementation of copper production and/or recycling activities (L7-S65). • Evaluate the suitability of individual research methods for determining the structure and properties of copper and other non-ferrous metals (L7-S66). • Acquire new orders in the field of copper production and its products (L7-S67).
		Digitalisation	• Design innovative technologies for copper production and recycling using digital technologies and artificial intelligence (L7-S68). • Utilize advanced digital technologies to address material challenges in metallurgy and copper production and recycling (L7-S69).
		Green economy	• Apply principles of environmentally friendly design for products and multi-material composites based on copper, considering various raw material sourcing methods (L7-S70). • Design and improve technological metallurgical processes for recycling anthropogenic materials containing copper, aiming to maximize yield and company profits (L7-S71). • Develop processing technologies for copper and recycled copper alloys (L7-S72). • Implement and develop initiatives to save energy and water, reduce greenhouse gas emissions, and manage waste in copper production and/or recycling processes (L7-S73).
SOCIAL COMPETENCE: *he/she is ready to*			
SOCIAL COMPETENCE: *he/she is ready to*	IV Work standards	Engagement and responsibility	• Take responsibility for the outcomes of the decisions made with reference to all company operations (L7-SOC1). • Select methods and techniques for evaluating the quality of work of employees, teams, and their supervisors (L7-SOC2). *Enforce responsibility for company property and assets (L7-SOC3). • Lay down the principles of effective time management in the company (L7-SOC4). • Meet targets, even in difficult, complex, and dangerous situations (L7-SOC5). • Treat change as a permanent element of the company's organizational culture (L7-SOC6).

		Sustainable development	• Amend and revise the code of professional conduct (L7-SOC7). • Inspire others to seek knowledge useful for professional work (L7-SOC8). • Manage stress in medium-sized and large teams (L7-SOC9). • Plan medium- and long-term actions for sustainability (L7-SOC10). • Identify the challenges and opportunities with the greatest potential to create change for sustainable development (L7-SOC11). • Be concerned about the unpredictable consequences of human actions (L7-SOC12).
		Health and safety	• Select methods and techniques to ensure individual and collective health and safety in the workplace (L7-SOC13).
	V Communication and cooperation	Communication	• Develop common agreements and conclusions based on the feedback from the teams managed (L7-SOC14). • Teach and set an example in giving constructive feedback (L7-SOC15). • Select channels, technical means, and methods for effective communication in the workplace (L7-SOC16). • Act as a teacher to the company's mentors (L7-SOC17).
		Cooperation	• Critically evaluate the quality and results of medium-sized and large team work (L7-SOC18). • Motivate colleagues and direct reports to comply with regulations, best practices, and codes of conduct, and to meet targets (L7-SOC19). • Establish and maintain good interpersonal relations with different stakeholders by building mutual trust, showing respect, and improving communication (L7-SOC20). • Cooperate with subcontractors, coordinate, monitor, and validate their work and, where necessary, identify and choose new subcontractors (L7-SOC21). • Teach and set a good example between differently sized teams (L7-SOC22). • Search for and find solutions that satisfy external clients (L7-SOC23).
		Problem solving	• Conduct negotiations with internal and external stakeholders (L7-SOC24). • Engage in a dialogue with the medium-sized and large teams managed to prevent conflicts and problems (L7-SOC25). • Establish principles for solving problems in medium-sized and large teams (L7-SOC26).

Sectoral Competency Framework SQF-Cu: LEVEL 8

	INDUSTRY INDICATOR	COMPETENCE AREA	LEVEL 8
KNOWLEDGE: *he/she knows and understands*	I. Copper ore exploration	Work process	• Innovative technologies for copper ore exploration, including predictive models used in copper ore exploration (L8-K1). • National and international regulations affecting the copper mining industry (L8-K2). • Principles of negotiation in administrative proceedings related to the exploration of copper ore deposits (L8-K3). • Copper ore quality control methods and techniques (L8-K4). • Principles of copper ore management (L8-K5). • Advanced technologies for characterization of ores (e.g., SEM) (L8-K6).
		Digitalisation	• Innovative digital and AI technologies of geological, geodetic, and drilling data processing used for the purpose of copper exploration (L8-K7). • Mobile digital means of communication and localization of employees, technical and transportation means (L8-K8).
		Green economy	• Innovative tools to assess the environmental impact of copper exploration processes (L8-K9).
SKILLS: *he/she is able to*		Work process	• Acquire and interpret aerial and satellite images for geological research (L8-S1). • Use geoscience information to generate predictive models and report on mining reserves (L8-S2). • Propose new copper exploration projects and conduct negotiations with institutions involved in administrative proceedings, leveraging the latest technical advancements (L8-S3). • Analyse and control the quality of copper ore deposits and monitor the variability of quality parameters during extraction processes (L8-S4). • Conduct periodic analyses of resource management and document causes of copper ore deposit depletion (L8-S5).
		Digitalisation	• Apply computer programs and artificial intelligence for geological, geodetic, geophysical, and drilling data modelling (L8-S6). • Use computer programs and artificial intelligence for the development of multi-variant surveying and geological documentation during copper ore deposit exploration (L8-S7). • Conduct exploration for copper ore deposits using smart technologies (L8-S8).
		Green economy	• Assess the environmental impact of planned copper ore extraction operations using available innovative tools (L8-S9).
KNOWLEDGE: *he/she knows and*	II. Copper extraction and processing	Work process	EXTRACTION • Current research trends and advancements in mining technology and sources of energy in mines (L8-K10). • Geological models to inform the sequence of excavation (L8-K11). • Mine planning principles, including resource estimation and scheduling (L8-K12).

			• Innovative methods for predicting and preventing natural disasters (L8-K13). PROCESSING • Innovative systems and technologies of copper ore processing (L8-K14). • Innovative methods for ensuring safety of rescue operations in mining plants (L8-K15). • Innovative long term storage dams for tailings and prevention of acid waters (L8-K16). EXTRACTION AND PROCESSING • Process optimization, equipment performance analysis, and maintenance practices (L8-K17). • Market trends, demand for copper, and economic factors that affect mining investments (L8-K18). • Development of sustainable supply chains for the copper mining industry (L8-K19).
		Digitalisation	• Statistical methods for data analysis and interpretation (L8-K20). • 3D Visualization and AI in copper ore mining (L8-K21). • Software tools and methodologies for simulating copper ore processing operations (L8-K22). • Digital environmental monitoring tools for predicting the environmental impact of copper extraction and processing (L8-K23). • Remote control and automation in mining technologies for copper ore extraction and processing operations (L8-K24). • Methods for using Internet of Things (IoT) technology to monitor and control mining machinery and copper ore processing (L8-K25). • Techniques for predicting equipment failures in copper extraction and processing, utilizing digital technologies and AI (L8-K26).
		Green economy	• Procedures for optimising the technology of building waste dumps or facilities for the disposal of mining and flotation waste with regard to environmental protection and economic outcomes of investment projects (L8-K27).
SKILLS: *he/she is able to*		**Work process**	EXTRACTION • Propose, justify, and design innovative solutions for copper ore extraction (L8-S10). • Design new indicators and methods for assessing labour costs in mines (L8-S11). • Analyse the feasibility of mining investment projects with the consideration of market needs and a multi-variant cost assessment (L8-S12). PROCESSING • Propose, justify, and design innovative solutions for copper ore processing plants in a perspective of the circular economy (L8-S13). • Design new indicators and methods for assessing labour costs in copper ore processing plants (L8-S14). • Analyse the feasibility of mining investment projects, considering market needs and conducting multi-variant cost assessments (L8-S15). • Conduct studies on new technologies or processing methods that can be applied in the processing plant (L8-S16). • Optimize systems and equipment essential for efficient operations in the copper ore processing plant, focusing on sustainability and cost-effectiveness (L8-S17).

		Digitalisation	• Apply modern digital technologies and artificial intelligence in documentation work (L8-S18). • Use computer programs and artificial intelligence for data modelling (L8-S19).
		Green economy	• Create innovative solutions to reduce the energy intensity of copper ore mining and enrichment processes (L8-S20). • Optimize the technological processes of copper ore mining and enrichment from the point of view of reducing water consumption and minimizing the impact on the environment (in accordance with the assumptions of a closed-cycle economy) (L8-S21).
KNOWLEDGE: *he/she knows and understands*	III. Materials engineering and copper recycling	**Work process**	• Methods of communicating and disseminating knowledge on the status and achievements of materials engineering in the copper industry (L8-K28). • Forms and ways of team-based solution of technical and organisational problems in the metallurgical plant (L8-K29).
		Digitalisation	• Ways to utilize virtual and augmented reality for interpreting models of metallurgical processes (L8-K30). • Forecasting systems that incorporate predictive maintenance of metallurgical machinery and equipment, based on data collection regarding machinery utilization and processing parameters (L8-K31). • Forecasting systems to ensure safety in metallurgical processes by capturing and integrating data from monitored areas and equipment, providing an accurate representation of the working environment (L8-K32).
		Green economy	• Principles and methods for combining and interpreting multi-source data to monitor metallurgical waste sites (L8-K33). • Operation of an analytical platform to support risk mitigation strategies, with opportunities for recovery and recycling of materials used in copper production and processing (L8-K34). • Operation of an analytical platform based on blockchain technology to track social and environmental parameters within the framework of sustainable metallurgical waste management (L8-K35).
SKILLS: *he/she is able to*		**Work process**	• Plan and organize individual and team work in addressing material and recycling challenges in metallurgy and the copper industry, including interdisciplinary issues (L8-S22). • Solve complex problems related to copper production control and quality assurance (L8-S23). • Ensure cost-effectiveness in solving complex problems of copper production control and quality assurance (L8-S24). • Prepare and deliver presentations, participate in discussions and seminars covering non-ferrous metal engineering, copper recycling, fundamentals of economics, patent and copyright law, and work organization in non-ferrous metal industries and related sectors (L8-S25). • Establish cooperation with specialists and expert groups regarding complex technical and organizational issues in the workplace (L8-S26).
		Digitalisation	• Utilize prognostic systems based on the systematic collection of condition parameters of machinery and equipment to ensure continuity of copper production and recycling (L8-S27). • Implement prognostic systems that rely on systematic data collection to guarantee safety in the working environment (L8-S28).

			• Develop and employ sensor-based digital twins for the copper smelting system (L8-S29).
		Green economy	• Analyse and optimize metallurgical and recycling processes to effectively select raw materials and secondary materials for synthesizing products with specified parameters (L8-S30). • Address complex copper production issues while ensuring an appropriate level of environmental protection (L8-S31). • Analyse and optimize control and management systems for energy transformers and converters to promote sustainable consumption and recuperation of energy (including energy from waste) (L8-S32). • Design and implement an analytics platform to monitor the recovery and recycling of materials used in copper production and processing (L8-S33). • Create and utilize a blockchain-based analytics platform to track social and environmental parameters in the sustainable management of metallurgical waste (L8-S34).
SOCIAL COMPETENCE: *he/she is ready to*			
SOCIAL COMPETENCE: *he/she is ready to*	IV Work standards	Engagement and responsibility	• Take responsibility for the outcomes of the decisions made with reference to the copper industry (L8-SOC1) (L8-SOC1). • Promote innovative and scalable methods and techniques for evaluating the quality of work of employees, teams, and their supervisors (L8-SOC2). • Promote the culture of responsible management of the company's property and assets (L8-SOC3). • Promote innovative and scalable methods and techniques of effective time management in the company (L8-SOC4). • Create an atmosphere of agency in achieving long-term industrial objectives (L8-SOC5). • Refine change processes aimed at fostering innovation and flexibility (L8-SOC6).
		Sustainable development	• Promote principles of professional conduct within the company and at national and international industry forums (L8-SOC7). • Create a knowledge-based organisational culture in the company (L8-SOC8). • Coordinate actions for sustainability on a national and international scale (L8-SOC9). • Formulate current and potential sustainability problems in order to create appropriate approaches to solving them (L8-SOC10). • Combine knowledge and resources to address sustainability challenges, including broadening the range of possible solutions (L8-SOC11).
		Health and safety	• Promote innovative and scalable methods and techniques for occupational risk assessment and for ensuring individual and collective health and safety in the workplace (L8-SOC12).
	V Communication and cooperation	Communication	• Inspire and lead proactive actions based on the feedback from large teams (L8-SOC13). • Create an organisational culture facilitating constructive feedback (L8-SOC14). • Evaluate and optimise the effectiveness of the company's outbound communication (L8-SOC15). • Promote mentoring in the workplace (L8-SOC16).

		Cooperation	• Define and model principles and attitudes that ensure good outcomes of teamwork (L8-SOC17). • Create an organisational culture based on cooperation between teams (L8-SOC18). • Build a lasting, crisis-resistant network of cooperation with external clients (L8-SOC19).
		Problem solving	• Critically evaluate problem and conflict prevention mechanisms (L8-SOC20). • Apply innovative problem-solving methods and techniques (L8-SOC21). • Build an atmosphere of creative and ethical problem-solving in the workplace (L8-SOC22).

3. Conclusions

SkiComCu project aims to offer the copper sector innovative lifelong learning courses to help companies from EU RIS territories address challenges identified in Del.2.1, but also taking into account the foresight view of the copper sector (Del.2.3).

The purpose of this report is to present a map of competences required to work in an innovative and competitive Cu-sector. This deliverable articulates knowledge, skills and competences in an integrated competence framework for the copper mining, metallurgy and recycling industry. Presented competence framework incorporates the results of Del.2.1, which showed, among other things, that copper processing is a highly specialized field that requires basic technical knowledge, e.g.: the physical and chemical properties of copper, or metallurgical processes. On the other hand, in order to make the European sector innovative and attractive, employees and managers have to take into account the realities and requirements of the Industry 4.0, namely, the intelligent technologies, cloud connectivity, real-time data analysis, etc., which are used in remote control of activities, reducing the risk associated with the human-machine interface by implementing modern robotics and autonomous device solutions, virtual and augmented reality (VR, AR) applications, real-time monitoring and analysis of production through scanning, monitoring, and real-time decision-making based on incoming data etc.

All of the above aspects make up the picture of the modern copper industry and its needs in terms of competence potential. They could not be missing from the integrated competency framework for the Cu sector that is being developed and presented in this report.

Thanks to the involvement of industry representatives in the work on the SQF-Cu from the very beginning (the development of the content of the framework and its internal and external validation), it can be assumed that it corresponds to reality and will be useful, especially in the design of education and vocational training paths for current and future employees in the sector (WP3).

Transparency and homogeneity about what people have learnt in order to obtain a qualification are crucial to ensuring that learners, training providers and employers give the appropriate economic, social and academic value to qualifications. The qualifications frameworks establish a basis for improving the quality, accessibility, linkages and employers' recognition of qualifications within a country and internationally.

4. Sources

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5. Annex: Internal validation tool

Validation of the Integrated Sectoral Qualification Framework (SQF Cu) -Task 2.3

Instruction

After reviewing the attached excel file containing the draft Sectoral Qualifications Framework for the copper sector (SQF Cu), please indicate which of the criteria listed below have been met in your opinion by the validated document. If a given criterion is not met, or is partially met, please provide a brief justification.

Validation criteria for Cu Sectoral Qualification Framework (SQF Cu)

Structure of the SQF	YES *criterion met*	PARTLY *criterion needs to be corrected*	NO *criterion not met*
1. The adequacy of the number of levels in relation to the needs and specificities of the Cu sector			
2. Division into the so-called bundles of competences			
3. Overall clarity and legibility of the Frame			
If you choose "NO" or "PARTLY", please justify:			
Other comments and observations on this group of criteria (including suggestions for improving the SQF Cu):			
Substantive aspects	YES *criterion met*	PARTLY *criterion needs to be corrected*	NO *criterion not met*
4. Completeness of sets of learning outcomes for successive levels			
5. Proposed approach to social competences			
6. Compliance of the proposed provisions with the employers' requirements for potential and current employees of the copper industry			

If you choose "NO" or " PARTLY ", please justify:			
Other comments and observations on this group of criteria (including suggestions for improving the SQF Cu):			
The utility of the frame for the:	YES *criterion met*	PARTLY *criterion needs to be corrected*	NO *criterion not met*
7. improving educational curricula for people who want to work in the Cu sector (e.g. organizing the subject of teaching, ensuring the comparability of qualifications)			
8. improving training programs for employees of the Cu sector			
9. improving the comprehensiveness and completeness of qualifications in the Cu sector			
10. increasing the level of effectiveness of recruitment of employees for the Cu sector			
11. support for the process of defining criteria for career advancement and determining possible career paths in the Cu sector			
If you choose "NO" or " PARTLY ", please justify:			
Other comments and observations on this group of criteria (including suggestions for improving the SQF Cu):			
Other aspects	YES *criterion met*	PARTLY *criterion needs to be corrected*	NO *criterion not met*
12. Language (understandable form of writing, linguistic correctness)			
13. The "cumulative" nature of individual learning outcomes for successive levels (in accordance with the EQF principles)			
14. Correctness of the level of detail of the characteristics for subsequent levels of SQF			
If you choose "NO" or " PARTLY", please justify:			

Other comments and observations on this group of criteria (including suggestions for improving the SQF Cu):
COMPREHENSIVE (FINAL) ASSESSMENT OF THE DRAFT SECTORAL QUALIFICATIONS FRAMEWORK FOR THE COPPER SECTOR