



INTERMIN

INTERNATIONAL QUALIFICATION
FRAMEWORK FOR THE RAW MATERIALS
SECTOR

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Executive Summary

This report advances an international sectoral qualifications framework for the raw materials sector (SQF-RM), hence improving relevance, transparency and coherence between qualifications along the minerals value chain and the corresponding international recognition.

The SQF-RM is a comprehensive competency model that encompasses diverse learning achievement and education pathways across professions that intersect in the raw materials space. To embrace the existing broad spectrum of approaches to the regulation of professions within the raw materials sector, the SQF-RM uses as a reference the European Qualifications Framework (EQF). This reference covers the partial and compound qualifications attained by the formal general, vocational and higher education systems.

The level descriptors of the SQF-RM are detailed accordingly with the main areas of activity of the sector: 1) mineral exploration; 2) mineral extraction and processing; and 3) material engineering and recycling. Each qualification defined within the architecture proposed for the SQF-RM is referenced to a specific level on the EQF (including levels 3 to 7), describing sets of learning outcomes, i.e. knowledge, skills and autonomy/responsibility.

The document also outlines the governance model of the SQF-RM, prescribing the active engagement of an apex body, such as an alliance of relevant professional organisations. The governance of the SQF-RM must guarantee the coordination of policy across authorities from different countries and the adequate involvement of stakeholders at national and international level. It must also respond to emerging industry needs, including future skills needed and adjusting/redesigning sectoral qualifications and level descriptors.

The implementation of the SQF-RM will need the active involvement of a broad range of organisations, including industry standard-setting bodies, awarding providers, professional awarding bodies, government agencies and external quality agencies.

This calls for extensive consultation, involving relevant stakeholders and sponsored by the INTERMIN Consortium, that should start at the earliest opportunity.

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1. INTRODUCTION

Mineral raw materials are crucial for the sustained functioning of modern economies, and the lack of a skilled workforce is a significant problem globally affecting the mineral raw materials industry (Ernst and Young, 2016). Advancing education and training and enhancing the mobility of the workforce are the complementary tools that INTERMIN is developing to tackle this problem. INTERMIN aims to:

- Generate a comprehensive competency model for employment across the raw materials sector;
- Introduce an international qualifications framework for the raw materials sector;
- Develop standard metrics and reference points for quality assurance and recognition of training;
- Create a conceptual framework for the development of joint educational training programmes based on present and future skills' needs;
- Develop and launch an online educational platform that will optimise international interaction and collaboration between stakeholders of the minerals value-chain.

Different training and education requirements prevent the free flow of workers from one region or industry to another, hampering local and regional development. This is driving countries to develop National Qualification Frameworks (NQFs¹) and attempt to relate those NQFs to international systems. This report advances an international sectoral qualifications framework for the raw materials sector (SQF-RM), hence improving relevance, transparency and coherence between qualifications along the minerals value chain and the corresponding international recognition.

The SQF-RM is focused on the areas, subareas, professional roles and sets of key competences of the raw materials sector that were described in INTERMIN's deliverable 1.1 (Skills catalogue for the raw materials sector). Because the spectrum of approaches across the world of professional qualifications in the minerals sector is vast, the SQF-RM is based on the existing European Qualifications Framework (EQF). The EQF is a common reference framework that allows qualifications from different countries to be easily compared, using learning outcomes associated with each qualification. This establishes a basis for improving the quality, accessibility, linkages and employers' recognition of qualifications in the raw materials sector, within a country and internationally.

¹ Aiming to enhance national competitiveness, support greater mobility of learners and workers, facilitate the transferability of learning outcomes between different subsystems of education/training and non-formal and informal learning.

2. REVIEW OF QUALIFICATIONS FRAMEWORK

A qualification is ‘a formal outcome of an assessment and validation process which is obtained when a competent body determines that an individual has achieved learning outcomes to given standards’ (Council of the European Union, 2017). Learning outcomes are statements that describe the knowledge or skills students should acquire by the end of a particular assignment, class, course, or program, and help students understand why that knowledge and those skills will be useful to them². The Structure of Observed Learning Outcome (SOLO) taxonomy (Biggs and Collis, 1982) helps to formulate learning outcomes by focusing on the progression of understanding-levels, ranging from *Prestructural* (illiteracy) to *Extended abstract* (maximum understanding in a single area).

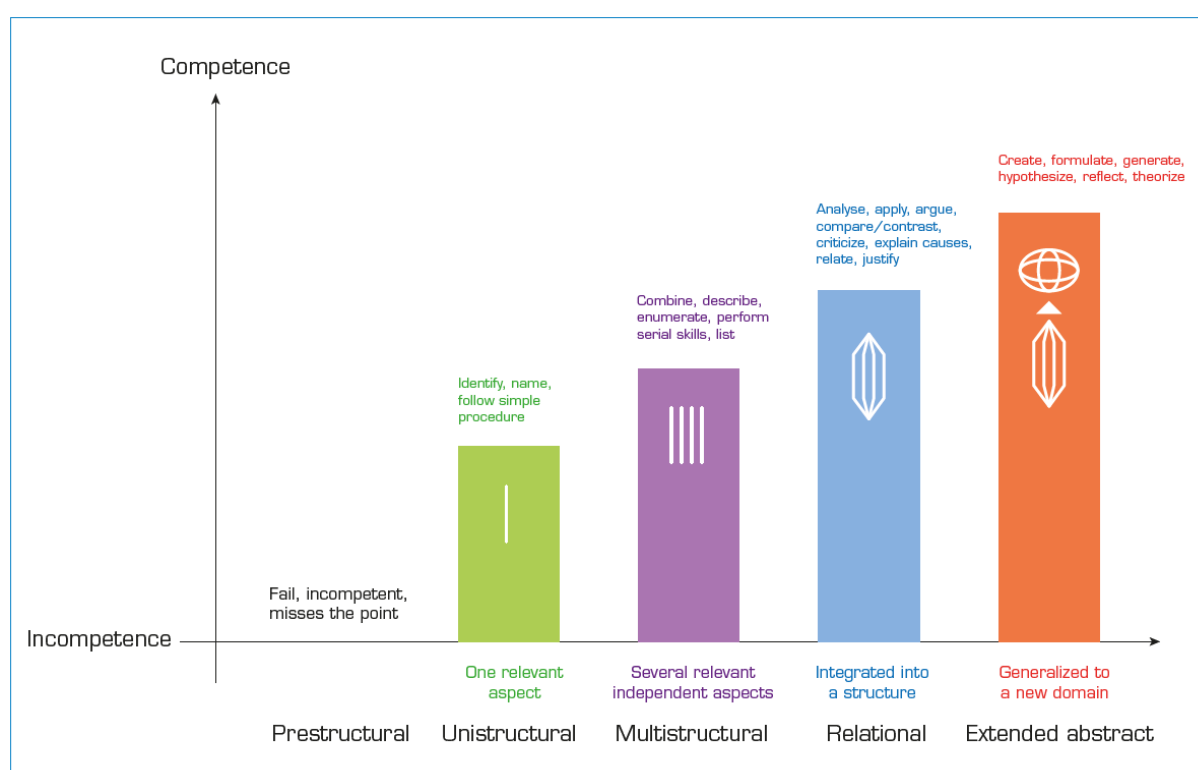


Figure 1 – Levels of learning outcomes as defined in the SOLO taxonomy (source: Keevy and Chakroun, 2015, adapted from Biggs and Collis, 1982).

There are differences in understanding of qualifications, pointed out by Keevy and Chakroun (2015). The fundamental difference is detectable between those that understand qualification as meaning the certification of achievement via a formal assessment of prescribed learning, and those that understand qualification as a status endowed by communities of practice. In the

² What Are Learning Outcomes? – Centre for Teaching Support & Innovation. Retrieved from <https://teaching.utoronto.ca/teaching-support/course-design/developing-learning-outcomes/what-are-learning-outcomes/>

first case, the concept of qualification is linked to certification, which means to possess formal certification of the level of competence that the individual has reached. In the second case, the term ‘qualification’ makes reference to the labour market: in this sense, a worker is qualified to do certain work functions.

The qualification process varies enormously from setting to setting but, in most cases, it includes the following five elements, as described by CEDEFOP (2010):

- **Learning:** the basis of qualification, an individual’s learning could be gained through a formal curriculum or through experiences in settings such as work or personal and social activities; learning might take the form of knowledge, skills or wider competences such as personal and social competences;
- **Assessment:** judgment of an individual’s knowledge, skills and wider competences against criteria such as learning outcomes or standards of competence;
- **Validation:** confirmation that the outcomes of the assessment of an individual’s learning meet predetermined criteria (standards) and that a valid assessment procedure was followed, which means that the outcomes have been quality assured and can be trusted;
- **Certification:** a record of the individual’s learning has been validated; the certificate usually issued by a body which has public trust and competence, confers official recognition of an individual’s value in the labour market and in further education and training;
- **Recognition:** follows the previous four stages; it is seen in the raised self-esteem of individuals and when third parties use the qualified status of an individual to offer progress into a new job, higher pay and/or increased social status.

A qualifications framework is a formalized structure into which accredited qualifications are placed, allowing learners, training providers and employers to gain information about the broad equivalence of qualifications (UNESCO, 1984). 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.

Modern qualifications frameworks use learning outcomes, compared to learning level descriptors and qualifications. Learning level descriptors are statements that provide a broad indication of learning appropriate to attainment at a particular level, describing the characteristics and context of learning expected at that level (Vlasceanu et al. 2007).

The qualifications frameworks establish a basis for improving the quality, accessibility, linkages and employers’ recognition of qualifications within a country and internationally. Qualifications frameworks can be used as a tool to support different policy goals, including the reform of qualifications and qualifications systems, improving relevance, transparency and the coherence between qualifications or promoting lifelong learning objectives such as access,

progress and the transfer of learning and opening up new pathways (European Training Foundation, 2011).

The first Qualification Frameworks were established at the national level. The idea of creating a National Qualification Frameworks (NQF) emerged in the United Kingdom in later 1980s, with the aim of structuring and integrating vocational training through a competency approach (Lester, 2011). The first NQFs (adopted in the 1990s by Australia, England, Scotland, New Zealand, Ireland and France) were focused in connecting qualifications from separate qualifications systems within a country (e.g. vocational qualifications and sectoral qualifications) to improve the transparency of qualifications (European Training Foundation, 2011).

Because of the increasing professional mobility of some professions and the need for recognising international qualifications, NQFs quickly evolved to regional or international levels. At the same time, International Sectoral Qualifications³ pushed the development of Sectoral Qualifications Frameworks (SQFs). This process multiplied, and Auzinger et al. (2016) mapped the existence, in 2016, of 84 international sectoral qualifications frameworks, covering a wide range of economic sectors and activities⁴. In large multinationals, the process evolved into the creation of corporate universities, that ensure all staff learning and development is globally aligned to meet global business needs⁵.

2.1 Types of qualification frameworks

There are different types of qualifications frameworks. The scope of frameworks may be comprehensive of all learning achievement and pathways or may be confined to a particular subsector of the education and training system – for example, initial education, adult education and training or an occupational area (European Training Foundation, 2011). Some frameworks may have more features or dimensions (e.g. credit or quality assurance criteria) and a tighter, more prescriptive, structure.

³ An “International Sectoral Qualification” is a certificate, diploma, degree or title awarded by an international body (or a national body accredited by an international organisation) and used in more than one country which includes learning outcomes (based on standards developed by an international sectoral organisation or an international company) relevant to a sector of economic activity (Auzinger et al., 2016). Examples of this type of qualification are frequent in the ICT sector (e.g. vendor qualifications of Microsoft, Oracle, Linux, Google) and the hospitality sector (Worldchefs, World Host, Hilton, McDonald’s).

⁴ Globally, the sectors with more initiatives addressing qualifications are the health sector (nurses, doctors), social services, hospitality, business & finance and insurance.

⁵ Typically, in these multinationals, all staff have designated courses, workshops and webinars they must complete, regardless of their hierarchy level. Well-known corporate universities are McDonald’s Hamburger University, the Disney University and the Hilton University. Corporate universities exist in all types of business sectors, including banking (Banco do Brasil Corporate University), engineering (Boeing University Relations Programme) and defence (Defense Acquisition University).

Keevy et al. (2010) classify qualification frameworks accordingly to their scope and geographical coverage (Table 1). In this approach, there are three main types of qualification frameworks:

- Sectoral qualifications frameworks, that are developed with a specific sectoral focus (e.g. the Polish Sectoral Qualifications Framework for Telecommunications), and that have a national or international focus;
- National frameworks: those that have a national focus (e.g. the Australian NQF⁶);
- Transnational frameworks: developed across a range of countries (e.g. the European Qualifications Framework).

Table 1 - Different types of qualifications framework.

Type of qualifications framework	Scope	Geographical possibilities	Examples
Sectoral	Sector-specific framework	<ul style="list-style-type: none"> – Within a country – Across countries in the same geographical proximity – Across countries that are not in the same geographical proximity 	Polish SQF Tele Humanitarian Action Qualifications Framework (HAQF) Virtual University of the Small States of the Commonwealth (VUSSC) Transnational Qualifications Framework
National	Includes all sectors	Country-wide	Australian NQF Malaysian NQF
Transnational	Includes all sectors	<ul style="list-style-type: none"> – Across countries in the same geographical proximity (referred to as Regional Qualifications Frameworks) – Across countries that are <i>not</i> in the same geographical proximity 	European Qualifications Framework (EQF) Southern African Development Community Qualifications Framework (SADCQF) Association of South East Asian Nations Qualifications Reference Framework (ASEAN QRF)

Source: adapted from Keevy et al., 2010.

Sectoral frameworks are developing rapidly across the world. These sectoral frameworks usually use National or Regional Qualification Frameworks as reference points but tend to offer

⁶ Generally referred as the AQF.

more practical and contextual guidance to employers, providers, professionals, workers and learners.

A relevant example, for the raw materials sector, of a sectoral qualification framework with worldwide coverage is provided by the “Competent Person” title. This title is used by geoscience professionals who report exploration results, mineral resources or ore reserves of companies whose shares are listed on a stock exchange for public trading. The standard definitions for the reporting of mineral resources and mineral reserves were established in 2012 by the Committee for Mineral Reserves International Reporting Standards (CRIRSCO)⁷, and are widely recognised by the minerals industry and enforced by securities exchange authorities⁸. A Competent Person must have: 1) relevant academic qualification⁹; 2) a minimum of five years’ experience working with the style of mineralisation or type of deposit under consideration and relevant to the activity which that person is undertaking; 3) be registered in a Recognised Professional Organisation (RPO); and 4) demonstrate his/her continuing professional development annually, i.e. the skills, knowledge and experience obtained both formally and informally in his/her work, beyond initial academic qualifications. Currently, there are 26 RPOs¹⁰, concentrated in Canada, Australia, South Africa, the US and Europe. Russia and Chile also have (each) one an RPO. An RPO must:

1. Be a self-regulatory organisation covering professionals in the mining and/or exploration industry;
2. Admit members primarily on the basis of their academic qualifications and professional experience;
3. Require compliance with the professional standards of competence and ethics¹¹ established by the organisation anywhere in the world (not just within the home jurisdiction of the organisation); and

⁷ CRIRSCO is an international organisation that groups the bodies responsible for a reporting standard, whether for a single country or a grouping of countries, including Australasia (Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves - JORC), Brazil (Comissão Brasileira de Recursos e Reservas - CBRR), Canada (Canadian Institute of Mining, Metallurgy and Petroleum - CIM), Chile (Comité de Recursos Mineros), Colombia (Comisión Colombiana de Recursos y Reservas Minerales - CCCR), Europe (Pan-European Reserves and Resources. Reporting Committee - PERC), Indonesia (Komite Bersama Komite Cadangan Mineral Indonesia - Kombers KCMI), Kazakhstan (Kazakhstan Association of Public Reporting on Resources and Reserves - KAZRC), Mongolia (Mongolian Professional Institute of Geosciences and Mining - MPIGM), Russia (“National Association for Subsoil Audit - NAEN), South Africa (South African Code for the Reporting of Exploration Results, Mineral Resources and Mineral Reserves - SAMREC), Turkey (National Resources and Reserves Reporting Committee - UMREK) and the USA (Society for Mining, Metallurgy and Exploration - SME).

⁸ As to 2017, CRIRSCO reporting standards were recognised by the following Securities Exchanges: ASIC Australasia, CSA Toronto Canada, Santiago SX Chile, ESMA Europe and the UK, AIM LSE, Hong Kong Exchanges (HKE), NYSE and NASDAQ, JSE South Africa and Moscow Russia.

⁹ The entry level is the Bachelor of Sciences degree, awarded by a recognised University, typically in geological sciences or mining engineering.

¹⁰ For the detailed list of RPOs see <http://www.jorc.org/competent.asp>.

¹¹ The application of ethical principles in the context of geosciences is being championed by the International Association for Promoting Geoethics. Geoethics consists of research and reflection on the values which underpin appropriate behaviours and practices, wherever human activities interact with the Earth system. It deals with the ethical, social and cultural implications of geoscience education, research and practice, and with the social role

4. Have disciplinary powers, including the power to suspend or expel a member for breaches of professional standards of competence or ethics anywhere in the world.

The role of Competent Persons in the classification of energy resources, including oil & gas, nuclear fuel resources, geothermal, mineral resources and CO₂ geological storage is recognised since 2009 in the United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources, hence expanding the scope of the Competent Person title.

Other examples of sectoral frameworks having worldwide scope include:

- The Association of Chartered Certified Accountants (ACCA) fellowship. ACCA is the global body for professional accountants. Its activity includes the licensing of practitioners, the regulation and monitoring of statutorily reserved areas of practice, the investigation of complaints and the enforcement of disciplinary measures. ACCA has 208 000 fully qualified members, and those who carry the ACCA and FCCA (Fellow Chartered Certified Accountant) titles have a commitment to behaving ethically and to maintaining their professional competence. ACCA members must demonstrate their continuing professional development annually;
- The Chartered Institute of Personnel and Development (CIPD) membership. CIPD is a not-for-profit professional association for human resource (HR) management professionals based in the UK. It has more than 145,000 members across the world and offers professional training and accreditation for those working in HR and learning and development. CIPD offers training resources focused on HR practice, management and development, in the introductory, undergraduate and graduate levels. CIPD has six membership grades, and successful completion of CIPD training leads to CIPD membership;
- The International Air Transport Association (IATA) certificates, broadly recognised by the aviation industry. IATA supports aviation with global standards for airline safety, security, efficiency and sustainability, and provides competency-based training and assessment. It trains more than 100 000 professionals and students each year from all areas of the world, using in-classroom, in-company, in-virtual classroom, and distance learning formats. IATA offers more than 350 courses, and 40 diplomas are developed around its areas of expertise. It owns and operates training centres and has Global Training Partners around the world, delivering training in English, French, Spanish, and Mandarin.

Relevant examples of sectoral frameworks in the European context include (Auzinger et al., 2016):

and responsibility of geoscientists in conducting their activities. For more information see <http://www.geoethics.org/>.

- The European Business Competence Licence, an initiative aimed at addressing the demand of employers to provide business management knowledge also to employees without a business management background. It was developed in close cooperation with a university (FernUniversität in Hagen) and employers, and it is managed by EBC Licencing GmbH. As the certification becomes more and more internationally recognised, it is improving mobility of certificate holders;
- The European Care Certificate, an initiative aimed at developing a knowledge-based qualification care workers could use. The certificate has relevance for both ‘receiving’ countries – where the certificate works as a basic proof of qualification – and ‘sending’ countries - where it works to improve care worker’s chances on the labour market. It is managed by the European Association of Service Providers for Persons with Disabilities (EASPD), and it is included in the UK NQF;
- The Eur Ing title, designed as a guarantee of competence for professional engineers, provided by the European Federation of Engineers (FEANI). The title facilitates the movement of practising engineers between European countries and establishes a framework of mutual recognition of qualifications, enabling engineers who wish to practice outside their own country to carry with them a guarantee of competence;
- The European Geologist (EurGeol) title, created to increase and facilitate trans-European mobility of geoscientists by ensuring the recognition of professional qualifications. This certification, held by a professional geoscientist, means that the holder has achieved suitable academic training and a level of professional experience, skill and competence to perform tasks within their professional practice. It also means that the holder undertakes continuing education and training, demonstrating a personal commitment to stay up to date and informed within the sphere of their professional work. It is managed by the European Federation of Geologists and it is recognised in 26 European Countries¹². The title is also recognised by Securities and Market authorities in Europe, Australia, Canada, the USA and South Africa stock exchanges (for the purpose of mineral reporting) whenever the EurGeol is acting as “Competent Person” (see page 7)¹³.

¹² There are equivalents of the European Geologist title in other countries, but without the transnational coverage the title has in Europe (see note below).

¹³ Each of those countries has its own professional title applicable to geoscientists: in Australia is the *Chartered Professional* title, coordinated by the AusIMM, covering geologists, mining engineers, metallurgists and environmental professionals working in the minerals sector (hence with a wider scope); to work in Canada geoscientists must be registered in a professional recognised organisation (at provincial level), that provides and manages the *Professional Geoscientist* title (including geologists and mining engineers); geoscience is a regulated profession in South Africa, and professional geoscientists must be registered in the South African Council for Natural Scientific Professions, that provides and manages the title *Professional Natural Scientist* (that covers geoscientists but excludes engineers); the US equivalent is the *Certified Professional Geologist* title, managed by the American Institute of Professional Geologists.

The group of countries who first adopted a National Qualifications Framework¹⁴ (NQF) was followed by a group of about twenty countries who developed second-generation NQFs. According to Keevy and Chakroun (2015) these NQFs, in for example Malaysia, Mauritius and Hong Kong, drew on the lessons learned from the early starters and developed relevant and contextualized models for their countries. In the early years of the twenty-first century more and more countries followed the emerging global trend. The third-generation NQFs, which currently number over 150 (CEDEFOP, 2018a), have a higher policy profile – formally contributing to the achievement of the UN’s Sustainable Development Goal (SDG) number 4 and the EU’s New Skills Agenda for Europe¹⁵.

Transnational and Regional Qualifications Frameworks (TQFs and RQFs) also have increasing international importance. They are normally rooted in NQFs, and in the need of promoting the mutual recognition of qualifications across countries. Keevy and Chakroun (2015) point out that in all instances the existence of regional recognition agreements facilitated by UNESCO constituted an important basis for the RQFs, although the impact of the agreements varies between regions¹⁶. With time, RQFs are increasingly developed, and influence NQFs (with increasing referencing between NQFs and RQFs).

As a result of the increased global development of both NQFs and RQFs there is a growing necessity to relate and compare qualifications frameworks, to facilitate recognition of qualifications and support the mobility of learners and workers. This assessment is being made between countries/regions that have preferential trade relations, and that recognise mutual benefits on the exchange of knowledge and talent¹⁷.

Although all qualifications frameworks consider a progression path across three domains (knowledge, skills and competence; Figure 2) and use the same basic building blocks¹⁸, the design varies across countries and regions.

¹⁴ Australia, England, Scotland, New Zealand, Ireland and France.

¹⁵ For more information see the 2016 Communication from the Commission ‘A New Skills Agenda For Europe - Working together to strengthen human capital, employability and competitiveness’, available in <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0381&from=EN>

¹⁶ The Lisbon Recognition Convention in Europe played a critical role as the Bologna process unfolded. The Arusha Convention in Africa played a similar, albeit less explicit, role in Africa, while similar initiatives have been under way in Asia and South America.

¹⁷ In 2016 the Australian Government and the European Commission sponsored a comparative analysis of the Australian Qualifications Framework and the European Qualifications Framework for Lifelong Learning. The same analysis is in the scope of the EU-Canada Comprehensive Economic and Trade Agreement (CETA). For more information see <https://publications.europa.eu/en/publication-detail/-/publication/ceb226e2-c35f-11e6-a6db-01aa75ed71a1/language-en>.

¹⁸ Including learning outcomes, levels, level descriptors and credits.

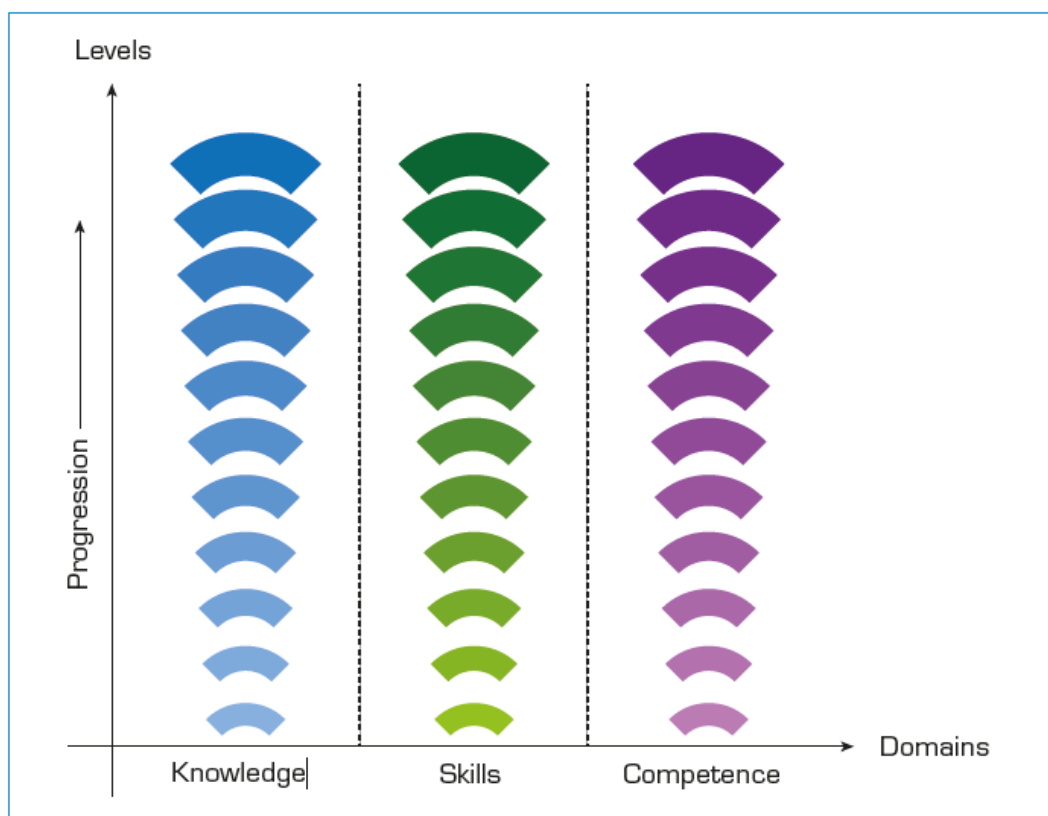


Figure 2 - Common dimensions of qualifications frameworks (source: Keevy and Chakroun, 2015).

The differences between qualifications frameworks, particularly in the number of levels descriptors used, but also in terms of qualifications and quality assurance systems, require an agreed process to make the similarities and differences explicit to policy-makers and the broader public.

In the European context, a ‘referencing’ methodology has been developed to define which levels in the NQFs and in the European Qualifications Framework (EQF¹⁹) correspond to each other. The EQF referencing methodology helps improve the recognition of initiatives in national markets and provides coherent access to linkages with the EQF.

Referencing can also be used in peer recognition between Sectoral Qualifications Frameworks, thus describing which levels in the national/regional/international frameworks correspond to each other, although the interconnection between the national and international frameworks of sectoral qualifications is still underdeveloped. Referencing is possible because all qualification frameworks use the concepts of learning outcomes and level descriptors across the knowledge, skills and competence domains (Figure 3).

¹⁹ The EQF has been adopted by 39 European countries, 33 of which are linked to each other via the EQF.

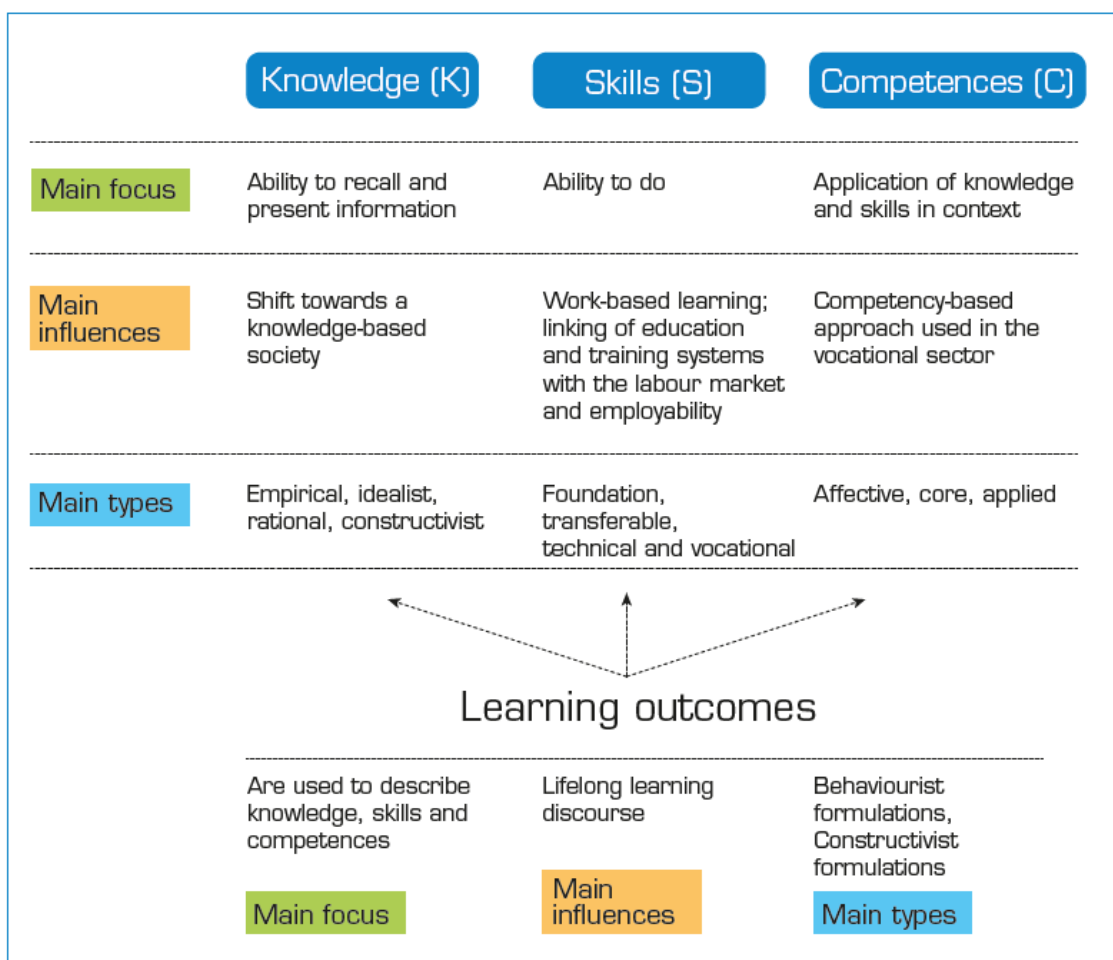


Figure 3 - How learning outcomes are used to describe knowledge, skills and competences (source: Kevy and Chakroun, 2015).

2.2 National Qualification Frameworks

A key purpose of National Qualifications Frameworks (NQFs) is to make qualifications transparent and to support learning across different areas and throughout life. For this reason, most NQFs are comprehensive, addressing all levels and types of qualifications including formal education and training (vocational education and training – VET), higher education, general education and, in some cases, qualifications awarded outside formal education and training. NQFs drive conversion to learning outcomes in qualifications and curricula. This enhances the transparency of qualifications and increases stakeholder engagement. In addition, NQFs increase the cross-border transparency of qualifications and promote international and global communication and cooperation.

Another important aspect of NQFs is the provision of reference points for quality assurance (CEDEFOP, 2016). While quality assurance arrangements already exist in NQFs, the introduction of comprehensive, learning outcomes-based frameworks allows a better

comparison of institutions and subsystems, and increase the capacity to address overall consistency and quality in education and training.

According to the latest Global Inventory of Regional and National Qualifications Frameworks (CEDEFOP, 2018a), 150 countries worldwide are now developing and implementing qualifications frameworks. Many of these countries see learning-outcomes-based NQFs as: a) instruments for supporting reforms; b) as a way to improve transparency and relevance of qualifications; and c) as a way to open opportunities to the validation of wider access to learning opportunities and pathways.

Nevertheless, there is growing international evidence that a new set of transversal skills, more suited to the needs of knowledge-rich and digital economies, are emerging (OECD, 2016). Typically, these include creativity, critical thinking, collaboration, and communication. Added to them is the fact that market-driven economies increasingly value entrepreneurship. The 2030 global education agenda also focuses on ‘learning outcomes’ and ‘skills’ that are relevant for the young and adults both in the world of work (SDGs Target 4.4) and in the context of global citizenship, in a plural and interconnected world (SDGs Target 4.7) (UNESCO, 2016). Quoting the 2016 UNESCO Global Education Monitoring report *‘Education of good quality cultivates the flexible skills and competences that prepare learners for diverse challenges. The focus of quality ensures that foundation skills – literacy and numeracy – foster additional higher order thinking, creativity, problem-solving, and social and emotional skills’* (UNESCO, 2016).

This tendency will much probably shift the NQFs emphasis on a behaviouristic approach to more socio-constructivist approach on the definition of levels descriptors and learning outcomes (Keevy and Chakroun, 2015; CEDEFOP, 2016). And this shift will have an impact on sectoral and transnational qualifications frameworks.

2.3 The European Qualification Framework

According to the Council of the European Union (Council of the European Union Recommendation, 2017), the European Qualifications Framework for Lifelong Learning (EQF) aims to improve the transparency, comparability and mobility of people’s qualifications. The EQF was set up in 2008 as a common reference framework of qualifications, expressed as learning outcomes at increasing levels of proficiency, and it was revised in 2017 in order to adapt it to new realities and challenges. Its revision has kept the core objectives of creating transparency and mutual trust in the European landscape of qualifications.

The EQF is a common reference framework that allows qualifications from different countries to be compared easily. This is achieved by supporting the use of learning outcomes for each qualification, in order to make them more transparent and easier to understand. It is intended to benefit learners, workers, job-seekers, employers, trade unions, education and training providers, qualification recognition bodies, government authorities and international organisations.

The EQF is defined by eight learning outcomes-based levels. Accompanying level descriptors show how expectations of knowledge, skills, autonomy and responsibility increase as learners progress from level 1 to level 8 (Table 2). The levels span the full scale of qualifications, from basic (Level 1, for example school leaving certificates) to advanced (Level 8, for example Doctorates) levels. As an instrument for the promotion of lifelong learning, the EQF encompasses all levels of qualifications acquired in general, vocational as well as academic education and training. Additionally, the framework addresses the qualifications acquired in initial and continuing education and training.

Table 2 - Level descriptors of the European Qualifications Framework (EQF)²⁰.

Learning outcomes relevant to Level	Knowledge	Skills	Responsibility and autonomy
	In the context of EQF, knowledge is described as theoretical and/or factual.	In the context of EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments).	In the context of the EQF responsibility and autonomy is described as the ability of the learner to apply knowledge and skills autonomously and with responsibility
Level 1	Basic general knowledge.	Basic skills required to carry out simple tasks.	Work or study under direct supervision in a structured context.
Level 2	Basic factual knowledge of a field of work or study.	Basic cognitive and practical skills required to use relevant information in order to carry out tasks and to solve routine problems using simple rules and tools.	Work or study under supervision with some autonomy.
Level 3	Knowledge of facts, principles, processes and general concepts, in a field of work or study.	A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information.	Take responsibility for completion of tasks in work or study; adapt own behaviour to circumstances in solving problems.

²⁰ Adapted from “Descriptors defining levels in the European Qualifications Framework. European Commission”, retrieved from <https://ec.europa.eu/ploteus/content/descriptors-page> on 4 April 2019.

Learning outcomes relevant to Level	Knowledge	Skills	Responsibility and autonomy
Level 4	Factual and theoretical knowledge in broad contexts within a field of work or study.	A range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study.	Exercise self-management within the guidelines of work or study contexts that are usually predictable but are subject to change; supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities.
Level 5	Comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge.	A comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems.	Exercise management and supervision in contexts of work or study activities where there is unpredictable change; review and develop performance of self and others.
Level 6	Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles.	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study.	Manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts; take responsibility for managing the professional development of individuals and groups.
Level 7	Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or	Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields.	Manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice

Learning outcomes relevant to Level	Knowledge	Skills	Responsibility and autonomy
	research; critical awareness of knowledge issues in a field and at the interface between different fields.		and/or for reviewing the strategic performance of teams.
Level 8	Knowledge at the most advanced frontier of a field of work or study and at the interface between fields.	The most advanced and specialised skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or innovation and to extend and redefine existing knowledge or professional practice.	Demonstrate substantial authority, innovation, autonomy, scholarly and professional integrity and sustained commitment to the development of new ideas or processes at the forefront of work or study contexts including research.

The level descriptors of the EQF are compatible with the Framework for Qualifications of the European Higher Education Area (EHEA) defined by the Bologna Process (Bologna Working Group, 2005). The Bologna Process was an intergovernmental higher education reform process encompassing 48 European countries, and its main purpose was to enhance the quality and recognition of European higher education systems and to improve the conditions for exchange and collaboration within Europe, as well as internationally. Launched in 1998-1999, the Process established goals for reform in the participating countries, including a three-cycle degree structure (bachelor, master's, doctorate), and adopted shared instruments, such as the European Credits Transfer and Accumulation System and the European Standards and Guidelines for Quality Assurance in the European Higher Education Area (EHEA).

The EHEA was implemented in 2010. Examples of the correspondence between the level descriptors of the EQF (for the EQF Levels 5 to 8) and the Framework for Qualifications of the EHEA are presented in Table 3.

Table 3 – Correspondence between level descriptors of the European Qualifications Framework (EQF) and the Framework for Qualifications of the European Higher Education Area (EHEA) ²¹.

EQF Level	Qualifications Framework for the European Higher Education Area	Examples of European Higher Education titles
Level 5	Higher education short cycle (within or linked to the first cycle)	(UK) HNC, HND, Foundation Degree, Certificate of Higher Education, Diploma of Higher Education, Scottish Advanced Higher; (the Netherlands) Voorbereidend wetenschappelijk onderwijs.
Level 6	Higher education first cycle	(UK) Bachelor's degree with honours, Bachelor's Degree without honours, Graduate Certificate, Graduate Diploma; (Germany) Vocational university German State-certified Engineer, Business Manager and Designer (Fachhochschule) Bachelor, German Fachwirt / Fachkaufmann, German Operative Professional, German Meister; (Spain) Diplomado or Grado; (Italy) Laurea.
Level 7	Higher education second cycle	(UK) Master's degree, Postgraduate Certificate, Postgraduate Diploma; (Germany) Vocational university (Fachhochschule) Master's, Geprüfter Betriebswirt, IHK Certified Business Administrator; (Italy) Laurea Magistrale; (Spain) Licenciado or Máster; (Portugal) Mestrado; (Greece) NTUA Diploma.
Level 8	Higher education third cycle	Doctorate, PhD, Professional Doctorate; (Italy) Dottorato di ricerca.

²¹ Adapted from https://en.wikipedia.org/wiki/European_Qualifications_Framework, retrieved on 4 April 2019.

In 2018, 35 European countries had formally linked their national qualifications frameworks to the EQF (CEDEFOP, 2018b), and 30 countries were indicating EQF/NQF levels in new qualification documents and/or Europass supplements. Having in consideration the emergence of international qualifications, the EQF also seeks to integrate international sectoral qualifications' frameworks and systems. In 2018, nine European countries had national procedures in place or under development for including international qualifications in their NQFs (CEDEFOP, 2018b).

2.3.1 Quality assurance of the EQF

Quality assurance instruments at European level mainly relate to the European Standards and Guidelines for Quality Assurance in Higher education and the European Quality Assurance Reference Framework for Vocational Education and Training (Devaux et al., 2013).

European Standards and Guidelines (ESG) for Quality Assurance in Higher Education were adopted in 2003 by European representative bodies of quality assurance agencies, students, universities and other higher education institutions. The ESG support a common approach to quality assurance in higher education based on actions at three levels (Devaux et al., 2013):

- Internal (institutional): Higher education institutions are expected to have a quality assurance approach that covers the key issues described in the ESG (for example programme design, student assessment, learning resources);
- External (accreditation process): Bodies that accredit higher education institutions and programmes are expected to follow certain common quality assurance procedures in doing so (for example periodic review);
- Quality assurance of accreditation bodies: Accreditation bodies should apply quality assurance processes to their own work and should be subject to peer-review.

The European Quality Assurance Reference Framework for Vocational Education and Training (EQAVET) is applicable to quality assurance of Vocational Education and Training (VET) systems. Besides quality assurance, it also covers VET policy planning, monitoring and relations with stakeholders. The EQAVET approach to quality assurance is based on the quality/PDAC cycle²²: planning; implementation; evaluation; and review. These four phases are applied to all aspects of VET systems.

EQAVET and ESG are both expected to support the quality assurance of NQFs. As the EQF covers all education sub-systems, it provides a consistent approach to quality assurance, but the credibility of EQF referencing depends on effective quality assurance being established at the national level (Devaux et al., 2013). There is therefore a mutual dependency between the

²² Developed by W. Edwards Deming: For more information on the PDAC cycle see Tague, Nancy R., 1995. "Plan-Do-Study-Act cycle". The quality toolbox. Milwaukee: ASQ Quality Press.

EQF in the long-term and NQFs initiatives aiming to reinforce the quality assurance of qualifications, institutions and systems.

2.3.2 Governance of the EQF

The EU governance of the EQF relies on the EQF Advisory Group and the EQF National Coordination Points, supported by the Commission and its agencies (Devaux et al., 2013). The Commission coordinates both networks and provides the resources for the operation of the governance structures (including technical and logistical support). Commission agencies – namely CEDEFOP and the European Training Foundation – provide expertise, analysis and follow up on progress made. CEDEFOP and the European Training Foundation participate in the meetings of the EQF Advisory Group and National Coordination Points. CEDEFOP provides an important contribution to the referencing process through its insights on referencing reports presented to the EQF Advisory Group, as well as technical expertise to the EQF implementation process – through specific studies and its annual NQF outlook. The European Training Foundation supports and transfers EQF knowledge to partner countries.

The EQF Advisory Group is chaired by the European Commission and it is composed of representatives of all countries taking part in the European cooperation in education and training process²³, key EU level social partners and stakeholders²⁴. It also contains representatives from the Council of Europe (in order to ensure coordination with the qualifications framework for the European Higher Education Area), CEDEFOP and the European Training Foundation.

The EQF National Coordination Points (NCP) were advanced by the EQF Council Recommendation²⁵. All designated NCPs meet twice a year at EU level with a view to exchanging experience and discussing issues of common interest. In the context of one of these meetings, NCPs also have an annual joint meeting with national correspondents for the QF-EHEA. This aims to ensure consistency between activities linked to the over-arching implementation of the qualifications' frameworks at the national level.

²³ Known as 'ET 2020'.

²⁴ The full list of members of the EQF advisory group is available in the Register of Commission Expert Groups – European Qualifications Framework Advisory Group (E02107) on <http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=2107>

²⁵ The 2008 Council recommendation on the European Qualifications Framework for lifelong learning foresaw NCPs being designated by participating countries to support and guide the relationship between national qualifications systems and the EQF and to ensure promotion of the quality and transparency of that relationship.

3. THE SECTORAL QUALIFICATIONS FRAMEWORK OF THE RAW MATERIALS SECTOR

Raw materials industries are facing skills shortages in many countries. This problem has been recognised as one of the significant challenges facing the sector^{26 27}. At the same time, the global demand for raw materials is increasing, the value chains based on mineral raw materials are becoming increasingly complex, and concerns on the security and sustainability of supply of some raw materials are boosting research on recycling and substitution of critical raw materials. On top of this changing environment, the extractive and recycling industry's technological advances, cyclicity and demographics are snowballing skills' shortages.

Technological advances

Modern mining operations are highly automated, and equipment operators have largely replaced hands-on miners. Today's mining companies are looking for graduates and technical specialists with not only mining knowledge but also the ability to use sophisticated technology and computing techniques, operating in challenging environments. The same is happening in the recycling sector. As industrial societies began to demand increasing varieties of raw materials to build up sophisticated equipment and devices, recycling of metals and minerals became much more complex. In the last 30 years, recycling took a leap forward, from basic scrap collection into a mix of operations supported by materials engineering and inverse manufacturing, fostered by the principles of the circular economy and eco-design.

This is in line with a recent analysis made by Ernst and Young (2019), that revealed the following impacts of technological developments on the workforce across the minerals value chain²⁸:

- Robotics and automation through drones, autonomous vehicles and remote-controlled operational systems will redesign traditional occupations such as drill operators, surveyors and field geologists, and increase demand for remote vehicle operators and geologists with greater skills in contemporary data and digital technologies;
- There will be increasing demand for data and digital literacy skills across all phases of the minerals value chain that will redesign most occupations as the human-to-machine interface evolves and becomes more prevalent. These skills can be expected to increase in demand into the future and play an important role in enhancing decision-making and

²⁶ Mining is perceived as a “dirty” industry, responsible for significant environmental pollution. This is the root of several difficulties affecting the sector. See Ernst and Young, 2016.

²⁷ Strategic Implementation Plan for the European Innovation Partnership on Raw Materials <https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/content/strategic-implementation-plan-sip-0>, retrieved on 30 January 2019.

²⁸ The minerals value chain encompasses mineral exploration, mining, transformation, product design, engineering, fabrication and recycling.

optimising everyday work;

- Cloud computing, information sharing and big data continue to change the nature of work and enable integrated operating centres so more work can be performed remotely and more flexibly. This trend will accelerate within the sector and increasingly take employees away from hazardous on-site events.

With increasing technological innovation, one can expect more blind disruptors- those things that will hit society (and the minerals value chain) unexpectedly, with an immediate impact.

Cyclicality

Cyclicality in commodity prices provokes an inconsistent supply and demand for skills. Mining is a high capital investment industry, extremely sensitive to economic cycles and primarily governed by the international commodities market. Regardless of location, all mines are competing on the cost of production and efficiency of the project capital. Demand and supply can change rapidly and, as a result, job security and long-term viability of individual mines is always an issue. Cyclicality in commodity prices also affects recycling operations and metals processing, and the industry has therefore recently seen rapid increases and decreases in the number of people it employs.

Cyclicality results in skills shortages and demographic gaps followed by retrenchments and over-capacity on a recurring basis²⁹. This is mainly caused by the time required for training and education, creating a lag in trained staff becoming available to the raw materials sector. In the start of an upturn, staff are not available, but the sector becomes attractive for new entrants who start relevant education and training programmes. Unfortunately, 2-5 years later as they emerge, the peak has passed, and these new graduates find it difficult to find jobs in a declining market. The cyclicality in the sector has caused endemic skills shortages and then oversupply that lags the commodity cycles and results in elevated costs and loss of experience from the sector.

Demographics

Company retrenchment in many countries in the 2012-2017 commodities downturn caused a ‘demographic gap’ in the raw materials sector, worsened by lack of recruitment during the 1980s and 1990s in similar downturns. In addition, increasing global competition for talent and migration are challenging the sector ability to retain local talent and attracting talent from elsewhere. This is a real issue in mining and recycling, that is becoming critical in Europe³⁰, as senior staff retires and there are few mid-career staff available to replace them.

²⁹. Jeffrey, K. et al, 2016. Analysis of Education and Outreach. Intra Project, https://intra.eu/wp-content/uploads/2017/03/INTRAW_WP1_Transactionalreport_E-O.pdf retrieved on 30 January 2019.

³⁰ Ibidem.

Miners, metal producers and recyclers need global talent to cope with the above-mentioned tendencies affecting the supply of resources^{31 32}, that is well-trained professionals in the raw materials sector (geologists, mining engineers, metallurgical specialists, materials engineers, managers for mining facilities, managers for recycling plants, foremen, drillers, etc.). This calls for a better alignment between the sector specificities, its needs, and the functioning forms of education, validation and certification of knowledge, skills and competencies.

This context underlines the importance of the development of a Sectoral Qualifications Framework for the Raw Materials sector (SQF-RM) that can serve as a basis to facilitate:

- 1) International comparability and mutual recognition of qualifications;
- 2) Training programmes and validation processes;
- 3) International recognition of skills and certification processes;
- 4) Identification of the competencies of job candidates;
- 5) Professional development choices made by employees or other people interested in working in the raw materials industry;
- 6) The mobility of learners and workers.

Developing and governing the SQF-RM is a complex task because the SQF-RM must encompass diverse learning achievement and education pathways across professions that intersect in the raw materials space. In addition, even if only one job is considered (e.g. geologists) there is usually a spectrum of different approaches to the regulation of the professional exercise, that can range from full governmental control (e.g. mandatory exam and register in Serbia) to voluntary registers (e.g. Ireland) and no regulation (the majority of European, African, Asian and South American countries)^{33 34}.

In this context, the proposed structure for the SQF-RM mirrors the EQF, advancing a

³¹ Summa, Lori L. 2008. The 21st Century Geoscience Workforce: Global Opportunities and Challenges in the Energy Industry. Joint Meeting of The Geological Society of America, Soil Science Society of America, American Society of Agronomy, Crop Science Society of America, Gulf Coast Association of Geological Societies with the Gulf Coast Section of SEPM.

³² American Geological Institute (AGI) 2012. Critical Needs for the Twenty-first Century. The Role of the Geosciences. retrieved from <https://www.americangeosciences.org/sites/default/files/CriticalNeeds2012.pdf> on 30 January 2019.

³³ Some countries use a multilayer approach, where testing and evaluation is made or controlled by the State (e.g. USA) and the register and follow up is managed by professional orders or associations (if required by state-level regulatory frameworks.)

³⁴ Still using geologists as an example, there also many different approaches across the understanding of qualifications and professional registers, expressed in the South African divide between geologists and hydrologists, the Canadian merge of geologists and mining engineers, and the European (EFG) and Australian (AGI) split on skills.

comprehensive competency model for employment across the raw materials sector using a common reference framework of qualifications, expressed as learning outcomes at increasing levels of proficiency. By mirroring the EQF, the SQF-RM facilitates the adaptation of professional development models³⁵, and education and employee training programmes to the requirements of the labour market. As an instrument for the development and classification of qualifications, it also enables the quality of non-formal education to be assessed, thus also of continuing education in all its forms, such as, for example, on-the-job training.

The SQF-RM is focused on the areas, subareas, professional roles and sets of key competences of the raw materials sector that were described in INTERMIN's deliverable 1.1 (Skills catalogue for the raw materials sector), and it includes descriptors for each level of qualifications.

3.1 Areas of activity and key competences

3.1.1 Areas of activity in the raw materials sector

Having in consideration the push to increase resource efficiency of current processes and products and the ongoing re-thinking of the linear economic model towards a circular approach³⁶, the value chains based on the mineral raw materials sector can be separated in three main areas of activity:

1. Mineral exploration, including:
 - a. The collection, analysis and integration of various thematic geoscience data obtained by surface and subsurface exploration methods and techniques;
 - b. Geologic modelling, target generation and estimation of resources;
2. Mineral extraction and processing, including:
 - a. Activities and processes aiming to exploit mineral deposits by means of mining techniques;
 - b. Mineral processing, including comminution, concentration and methods of separating commercially valuable minerals from their ores;

³⁵ It worth mentioning a professional development model recently validated in New Zealand, based on the concept of a 'micro-credential', which could be a collection of short courses at any particular level in the qualification framework. These courses can be completed as a standalone exercise or used as a pathway to a full qualification. For more information see <https://www.nzqa.govt.nz/about-us/consultations-and-reviews/recognising-micro-credentials/>.

³⁶ Communication from the Commission to the European Parliament and the Council. The raw materials initiative — meeting our critical needs for growth and jobs in Europe. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0699:FIN:en:PDF>

3. Material engineering and recycling of waste, including:
 - a. Methods and processes to extract metals from mineral concentrates and solutions;
 - b. Mechanical and chemical recycling processes to recover metals and minerals from waste materials³⁷.

The above division in three areas is determined by the type of technologies and processes used in the raw materials sector (encompassing primary and secondary sources of raw materials). Despite this distinction, these areas of activity are intertwined and have several common operations and procedures. This explains why professionals with similar knowledge and skills can be found in any of the three fields of activity, and the relatively high number of specialities and specialisations that can be associated to a role or function in the raw materials sector. The interlinkages between mineral exploration, minerals extraction and materials engineering/minerals processing and recycling also emphasise the importance of developing training and education courses for professional roles across the sector, boosting human resources' adaptability and mobility³⁸.

3.1.2 Competence categories

The variety of meanings given to the concept of competence is seen not only in its many uses (including: economic, technological and technical competencies; social competences; creativity and innovation skills; and mobility and flexibility combined with persistence, reliability, and precision), but also in the construction of terminology to express competence, such as cognitive, social, motivational, and personal competences. In this context, the raw materials' sector competences, or even the whole category of professional competences, is just one element of the broad area of competences.

Naturally, the key competences required in the mineral raw materials sector depend on the professional roles considered and result from a dynamic process that includes the continuous development of technologies and equipment, as well as changes in materials sought and exploration, mining and recycling methods. At the same time, personal and functional competences, such as teamwork, communication skills, involvement, effectively taking action, innovation and problem-solving are also important and can be paramount for a given role or position. In this context, the SQF-RM considers the following professional competence categories:

³⁷ The potential for re-mining large urban landfills as prospective ore bodies – rolling in the recycling into the mineral extraction side – exists and might be leveraged by the scarcity of some raw materials.

³⁸ The SQF-RM level descriptors presented in this document were developed by identifying the typical professional competences for the defined areas and processes in the raw materials sector.

1. Raw materials' competences, which include the breadth and depth of knowledge, skills and social competences required for each position specified in the industry;
2. Management competences, which include decision-making activities and activities that create linkages between raw materials' knowledge/technologies and products/services;
3. Conceptual competences, i.e. activities requiring the development of new solutions for novel situations;
4. Implementation competences, i.e. activities ensuring the execution of formerly agreed action plans.

3.1.3 Sets of key competences

To facilitate the definition of key competences for the SQF-RM, this report considers a pragmatic approach, advanced by Weinert (2001), that defines competencies as *the necessary prerequisites for meeting complex demands*.

The key competences for the SQF-RM combine competences specific to the raw materials industry with functional and personal competences required in professional contexts. In this framework, there are seven key competences considered in the SQF-RM:

1. The ability to communicate clearly verbally and in writing;
2. Mathematical competence and competences in science and technology;
3. General understanding of sustainability and materials efficiency;
4. General understanding of the raw materials value chain;
5. Knowledge and understanding of geological processes in space and time;
6. Digital competence;
7. Knowledge of and commitment to safe working practices.

The pertinence of the key competences listed above is evident when one considers the processes associated to each of the three main areas of activity of the mineral raw materials sector mentioned in section 3.1.1 (mineral exploration, mineral extraction & processing and materials engineering & recycling of waste; Table 4).

Table 4 – Relation between key competences, and the SQF-RM areas of activity and corresponding subareas and processes.

Key competences	Areas	Subareas and processes
<ul style="list-style-type: none"> • The ability to communicate clearly verbally and in writing; • Mathematical competence and competences in science and technology; • General understanding of sustainability and materials & energy efficiency; • General understanding of the raw materials value chain; • Knowledge and understanding of geological processes in space and time; • Digital competence; • Knowledge of and commitment to safe working practices 	Mineral exploration	<ul style="list-style-type: none"> • Exploration logistics and planning • Surveying and mapping • Legal and regulatory requirements • Acquisition, manipulation and analysis of digital terrain data for geological applications • Drilling and sampling techniques • Distribution of elements in rocks, soils, sediments and other natural media in relation to mineralization • Geophysical methods applied to mineral's exploration • Property and prospect evaluation • Community relations
	Mineral extraction and processing	<ul style="list-style-type: none"> • Permitting • Mine design and planning • Procurement • Mine development (including construction of infrastructure and facilities) • Ore extraction and ore processing • Environmental assessment and management • Waste disposal and site restoration • Cost monitoring • HR management • Corporate social responsibility • Data management / digital technologies • Geotechnics • Mining technologies • Community relations
	Materials engineering and recycling of waste	<ul style="list-style-type: none"> • Materials science (including ores and composite materials) • Metallography and crystallography • Extractive metallurgy • Metalworking

Key competences	Areas	Subareas and processes
		<ul style="list-style-type: none"> • Collection, crushing and shredding • Separation, melting and purification • Cost monitoring • HR management • Corporate social responsibility

3.2 Architecture of the Sectoral Qualifications Framework for the Raw Materials sector

The architecture proposed for the SQF-RM considers the following premises:

1. Professional qualifications required by the three main areas of the raw materials sector are determined by diplomas, certificates and other documents which confirm that a professional or academic qualification has been awarded or that qualifications, rights and privileges have been attained;
2. The SQF-RM level descriptors are based on qualifications levels typical for vocational education and training and higher education;
3. The SQF-RM level descriptors will further elaborate on the European Qualifications Framework level descriptors typical for general education, vocational education & training, and higher education;
4. The quality assurance system of the SQF-RM will encompass validation, accreditation and assessment mechanisms.

3.2.1 Levels of the Qualifications Framework for the Raw Materials sector

The starting point for structuring the SQF-RM are the areas, subareas, professional roles and sets of key competences in the raw materials sector, described in INTERMIN's deliverable 1.1 (Skills catalogue for the raw materials sector). They formed the determinants for developing the SQF-RM level descriptors appropriate for a given level and to identify the most important sectoral qualifications (see Annex 1).

Considering the level descriptors of the EQF and the Framework for Qualifications of the European Higher Education Area (see Section 2.3), the proposed SQF-RM is centred in the EQF levels 3 to 7, covering the partial and compound qualifications in the raw materials sector attained by the formal general, vocational and higher education systems (Figure 4).

It is important to emphasise the diversity of vocational training in comparison to higher education in the architecture proposed for the SQF-RM. This calls for increasing cooperation in relation to accreditation and audit of courses and certification of training institutions.

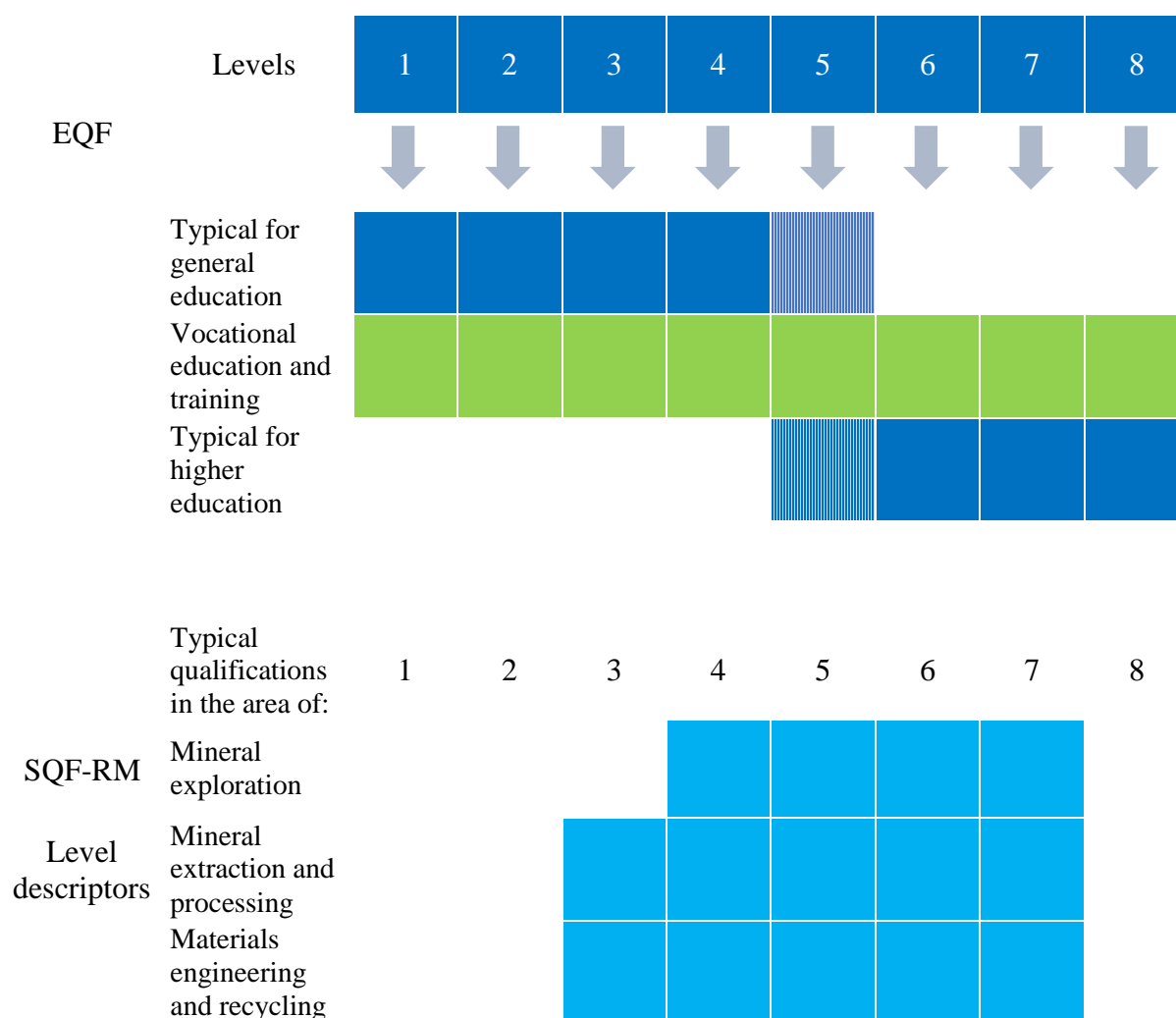


Figure 4 - Architecture proposed for the SQF-RM.

Each qualification defined within the architecture proposed for the SQF-RM is referenced to a specific level on the EQF (describing sets of learning outcomes – knowledge, skills and competencies – including key competencies; see Annex 1). The SQF-RM qualifications should:

- Be recognised and validated no matter in what context it was acquired (formal, non-formal and informal).
- Be organised in “credit points” recognised by the industry stakeholders and, if possible (mainly for the key competencies) across the three main areas of activity of the raw materials sector;
- Be recorded in one or several components of the Europass portfolio;

- Specify the occupations (as defined in the European Skills, Competences, Qualifications and Occupations – ESCO – system or equivalent³⁹) the possessor is able to perform.

3.2.2 Level descriptors of the Sectoral Qualifications Framework for the Raw Materials sector

Level descriptors indicate the outcome of learning (and do not deal with the process of learning) and play a key role in the assessment of achievements required to awarding a qualification⁴⁰. The primary purpose of level descriptors is to allow learners, awarding organisations, employers and the public to understand the range of knowledge and skills required to complete a particular level. Assigning qualifications to levels involves judgements about the relative ‘worth’ or ‘value’ of different qualifications, and it is normal that experts from various fields hold different views. This is particularly relevant where qualification levels are associated with national regulations or agreements on pay and promotion. Besides, the global context of the SQF-RM can assume political significance because of the relationships and equivalences between the qualifications in one country and those in the rest of the world.

The level descriptors of the SQF-RM are based in the eight levels used in the European Qualifications Framework (EQF, see section 2.3), defined in terms of learning outcomes, i.e. knowledge, skills and autonomy-responsibility. Learning outcomes express what individuals know, understand and are able to do at the end of a learning process.

The description of the SQF-RM level descriptors differentiates general knowledge, skills and autonomy from occupational knowledge, skills and autonomy. The general characteristics are derived from the EQF, and the occupational features are specific to the occupations of the raw materials sector.

The tables included in Annex 1 detail, for the mineral exploration, mineral extraction and processing and materials engineering and recycling areas, the level descriptors of general and occupational learning outcomes that are considered appropriate to emphasise the most relevant qualifications of a given level. Unlike other areas of the raw materials sector, the mineral exploration area only considers EQF levels 4 to 7 (the other two areas included in the SQF-RM consider EQF levels 3 to 7; see section 3.2.1).

³⁹ For more information on ESCO see <https://ec.europa.eu/social/main.jsp?catId=1326&langId=en#navItem-1>

⁴⁰ Level descriptors indicate the learner’s achievement at a particular level, but do not indicate the learner’s performance within the level.

3.3 Governance of the Sectoral Qualifications Framework for the Raw Materials sector

The governance of the SQF-RM must guarantee the coordination of policy across authorities from different countries and the adequate involvement of stakeholders at national and international level. It must also respond to emerging industry needs, including future skills required and adjusting/redesigning sectoral qualifications and level descriptors.

Typically, the governance of an SQF is assigned to an apex body, such as a national qualifications authority for National Qualifications Frameworks or international organisations for Regional Qualifications Frameworks. In the case of the SQF-RM, and having in consideration the existing international professional organisations of the raw materials sector, a coalition of professional organisations would be the best option to govern the SQF-RM. Desk research on possible bodies that could assume this responsibility highlighted two possible options:

1. The Task Group on Global Geoscience Professionalism of the International Union of Geological Sciences. The International Union of Geological Sciences (IUGS⁴¹) is a non-governmental scientific organisation that comprises representatives of 121 countries, that promotes the development of the Earth sciences through the support of broad-based scientific studies relevant to the entire Earth system. The IUGS contributes to preserve Earth's natural environment and to improve the prosperity of nations and the quality of human life, and it strengthens public awareness on geoscience. The IUGS supports a Task Group on Global Geoscience Professionalism (TGGGP⁴²), and the objectives of this Task Group are:
 - a. To provide information that will result in a greater understanding of geoscience professionalism by all geoscience stakeholders;
 - b. To facilitate collaboration between geoscientists operating in all areas of geoscience;
 - c. To encourage rapid conversion of research findings to applied geoscience;
 - d. To promote higher relevancy in applied geoscience at the university level;
 - e. To increase education in professional skills, including ethics, at the university level;
 - f. To provide a recommendation on priority research project design and fund allocation through more significant appreciation of societal needs; and
 - g. To provide greater clarity concerning pathways and assessment criteria for geoscience graduates seeking to attain professional qualifications.

⁴¹ For more information see <http://iugs.org/>.

⁴² For more information see <https://tg-ggp.org/>.

2. The Global Mineral Professionals Alliance (GMPA⁴³). The GMPA is an organisation comprised of the Australasian Institute of Mining and Metallurgy, the Canadian Institute of Mining, Metallurgy and Petroleum, the Peruvian Institute of Mining Engineers, the Institute of Materials, Minerals and Mining, the Southern African Institute of Mining and Metallurgy, and the Society for Mining, Metallurgy and Exploitation. Despite not having a broad geographic coverage, this organisation connects industry and professionals active in the minerals value-chain, encompassing geology, mining and metallurgy as core disciplines in their membership.

Currently, the TGGGP represents 14 professional associations of geoscientists from North and South America, Europe and Oceania. This ensures a broad geographic coverage, but the mining and metallurgy disciplines are misrepresented in the professional organisations of the TGGGP. On the other hand, the GMPA does not have broad geographic coverage, but connects industry and professionals active in the minerals value-chain, encompassing geology, mining and metallurgy as core disciplines in their membership.

Although the SQF-RM is a process and not a fixed instrument, the governance of the SQF-RM shall encompass:

- Developing and upkeeping standards and qualifications;
- Defining audit points for compliance;
- Developing, implementing and reviewing the SQF-RM procedures;
- Establishing a clearinghouse for stakeholders on SQF-RM development and implementation;
- Disseminating public information and advice on the SQF-RM.

The mention of the TGGGP and the GMPA does not exclude other possible options that might be identified by the INTERMIN Consortium. The governance structure of the SQF-RM should foster co-ownership and shared responsibility by industry and professional stakeholders, and it must guarantee policy coordination across authorities from different countries. It must also respond to emerging industry needs, including future skills needed and adjusting/redesigning sectoral qualifications and level descriptors.

⁴³ For more information see <http://www.mining.com/global-mineral-professionals-alliance-launches-tailings-initiative/>

3.4 Quality assurance of the Sectoral Qualifications Framework for the Raw Materials sector

Quality assurance of qualifications is a set of activities established by relevant authorities or bodies to ensure that educational services satisfy customer requirements in a systematic and reliable fashion, and it is critical to building up confidence in educational services provided by training providers under the remit of relevant authorities or bodies. However, quality assurance does not guarantee the quality of educational services; it can only make them more likely (Bateman et al., 2009). The three important measures of quality assurance are:

- a) Validation of qualifications and/or standards;
- b) Accreditation and audit of education and training institutions;
- c) Quality assurance of assessment leading to the award of qualifications.

These measures are normally associated with six parameters (Bateman et al., 2012), common to the majority of quality assurance systems⁴⁴ of qualifications:

1. The accreditation of the product; such as achievement standards (this could include educational and/or competency standards as well as complete rules for a qualification);
2. The registration of education and training providers through evaluation of their infrastructure, financial probity and health, staff qualifications and experience, management systems, delivery systems, and student support systems;
3. The monitoring and auditing of provider's processes and outcomes, including student learning and employment outcomes, and student and employer satisfaction levels;
4. The control, supervision or monitoring of assessment, certification and graduation processes and outcomes;
5. Provider or system-wide evaluations, including evaluations by external agencies; and
6. The provision of public information on the performance of providers such as program completions, employment outcomes, and student and employer satisfaction.

Among these parameters, accreditation is normally considered the key feature of quality assurance systems, because it is during the process of accreditation, whether organised by a higher education institution, a vocational training provider, a professional body, an industry company or an external agency, that the learning outcomes for a specific programme are linked to those laid down in the level descriptors of the SQF-RM.

⁴⁴ Necessary to enhance trust among the various stakeholders so that they can have confidence in the integrity of the resultant qualifications' framework.

External quality assurance bodies or agencies play a crucial role in the implementation of the SQF-RM, particularly if considered its international scope and coverage. The following is a non-exclusive list of the types of bodies or agencies that should be involved in the implementation of the SQF-RM:

- Industry standard-setting bodies, such as CRIRSCO (Committee for Mineral Reserves International Reporting Standards), ICMM (International Council on Mining and Metals) and MAC (Mining Association of Canada);
- Self-accrediting and/or awarding providers, with self-accrediting and/or awarding status conferred through legislation or through delegation, such as universities;
- Professional awarding bodies, with the authority to accredit and award and/or quality assure qualifications, such as the European Federation of Geologists, the Australian Institute of Geoscientists, the Institute of Materials, Minerals and Mining, the Ilustre Colegio de Geólogos or the American Institute of Professional Geologists;
- Provider registration and monitoring agencies, with the responsibility for the approval and monitoring (e.g. audit or evaluation) of providers delivering qualifications within the remit of the agency, such as Government agencies;
- External quality agencies such as those responsible for the ISO standards levels.

Mutual trust in the quality of qualifications is essential to promoting the global mobility of learners and workers, underpinned by continuing professional development strategies that include both vocational training and higher education courses. In this context, effective quality assurance requires the involvement of a diverse group of stakeholders, that will access the training system, the training courses and the training provider levels.

A key issue in examining the relationship between qualifications and quality assurance is that of language. In the case of the SQF-RM, the level descriptors defined in this document (see Annex 1) provide shared concepts which are readable across a diversity of education and training systems, hence supporting the quality assurance of qualifications in the raw materials sector.

4. CONCLUSIONS

The SQF-RM proposed in this document is a comprehensive competency model that encompass diverse learning achievement and education pathways across professions that intersect in the raw materials space. But there are two crucial aspects to be considered during the implementation of the SQF-RM:

1. The development of quality assurance approaches that reinforce the trust in the quality of qualifications;
2. The governance model and policy coordination across authorities.

Mutual trust in the quality of qualifications is essential to promoting the global mobility of learners and workers, underpinned by continuing professional development strategies that include both vocational training and higher education courses. In this context, effective quality assurance requires the involvement of a diverse group of stakeholders, that will access the training system, the training courses and the training provider levels. Accreditation is a crucial feature of the quality assurance of the SQF-RM, and it is critical that, during the process of accreditation (whether organised by a higher education institution, a vocational training provider, a professional body, an industry company or an external agency), the learning outcomes for a specific programme are linked to those laid down in the level descriptors of the SQF-RM. The selection, monitoring and control of the external quality assurance bodies or agencies that will be involved in the implementation of the SQF-RM is also critical, and the common understanding of concepts that are applicable across a diversity of education and training systems must be periodically assessed. Quality assurance goes beyond procedures and technical approaches to looking at whether qualifications or certification and/or accreditation processes are fit for purpose. And this relates to the governance model.

The governance of the SQF-RM shall be assigned to an apex body capable of providing the basis for negotiation and decision making among industry and professionals active in the minerals value-chain. This body must have the capacity to adjust/redesign sectoral qualifications and level descriptors in response to emerging industry needs, and it must upkeep standards, provide audit points for compliance and establish a clearinghouse for those who meet the standards. Therefore, the governance model of the SQF-RM should incorporate a broad range of organisations, including industry standard-setting bodies, awarding providers, professional awarding bodies, government agencies and external quality agencies.

This calls for extensive consultation, involving relevant stakeholders and promoted by the INTERMIN Consortium, , that should start at the earliest opportunity.

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ANNEX 1 – LEVEL DESCRIPTORS OF THE SECTORAL QUALIFICATIONS FRAMEWORK OF THE RAW MATERIALS SECTOR

Mineral exploration

Mineral extraction and processing

Materials engineering and recycling

Mineral exploration

Level 4 – Mineral Exploration

GENERAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- the basic conditions and dependencies in the structure and activities of the organisation, and the connections to the works being carried out;
- the basic principles of safety relating to the occupation and field work;
- the principles of teamwork.

GENERAL SKILLS – IS ABLE TO:

- effectively motivate colleagues and subordinate employees;
- use technical documentation;
- improve his/her work performance by analysing observed errors, irregularities;
- work under pressure, alone and in a team;
- organise his/her own working time;
- plan and forecast activities;
- solve problems influencing the scope, quality or timeliness of the tasks being carried out;
- comply with organisational rules and confidentiality requirements;
- apply occupational health & safety and employment regulations.

GENERAL SOCIAL COMPETENCE – IS READY TO:

- direct colleagues and subordinate employees so that they act according to laws, regulations, best practices and professional ethics;
- systematically raise professional qualifications through self-improvement, participation in on-the-job demonstrations, training courses and industry fairs;
- exercise self-management within the guidelines of work context;
- supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities.

OCCUPATIONAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- the guiding principles for geoscientific investigations, and the Principles of Geology;
- elementary geometry, algebra and trigonometry;
- principles of mapping and navigation and use of global positioning systems and equipment;
- the raw materials value chain and the core principles of sustainability;
- health and safety requirements within the scope of assigned tasks;
- the rules and procedures of quality assurance/quality control systems;
- the provisions and standards in force in mineral exploration.

OCCUPATIONAL SKILLS – IS ABLE TO:

- use office software (spreadsheet, word processing, email) and IT equipment to organise and report activities;

- perform assigned tasks in mineral exploration programmes effectively, promptly and in compliance with relevant regulations;
- implement and advance initiatives aiming to safeguard environmental values and ecological services, save energy and water, and manage waste according to best practice;
- assign tasks to subordinate employees diligently and proactively and enforce their timely and suitable performance;
- cooperate with subcontractors;
- plan for and notify of needed materials and tools.

OCCUPATIONAL SOCIAL COMPETENCE – IS READY TO:

- assume responsibility for assigned tasks in mineral exploration programmes, in compliance with applicable standards and best practice;
- observe and enforce occupational health and safety regulations;
- keep materials and equipment in a good state of repair and cleanliness;
- establish and maintain good interpersonal relations with local communities, customers, subordinate employees and subcontractors.

The holder of an SQF-RM Level 4 qualification works, for the most part, in the following areas:

- Geophysical or geochemical exploration programmes;
- Exploration drilling;
- Rock sampling;
- Laboratory testing.

Example positions requiring qualifications at this level: Field Assistant; Driller; Driller Assistant; Laboratory Technician; Core Technician; Land Surveyor.

Level 5 – Mineral Exploration

GENERAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- the legal provisions relating to mineral exploration;
- the methods and dependencies relating to the development and execution of mineral exploration programmes;
- the application of methods and techniques used in mineral exploration programmes.

GENERAL SKILLS – IS ABLE TO:

- implement good practice in handling technical documentation;
- learn autonomously from textbooks and multimedia tools, and engages in learning discussions in training courses, workshops, fairs, etc.;
- think analytically, work under time pressure, work in a group, organise his/her own working time.

GENERAL SOCIAL COMPETENCE – IS READY TO:

- perform tasks in a responsive, accurate and timely manner;
- establish and maintain good interpersonal relations and undertake initiatives to improve and increase the effectiveness of the tasks being carried out;
- train and develop subordinate employees and subcontractors;
- perform work with accuracy, thoroughness and under the pressure of time.

OCCUPATIONAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- geological cross sections and maps;
- the grounds of mineral exploration methods;
- the factors that affect the outcome of mineral exploration programmes;
- the legal provisions relating to mineral exploration programmes and the minerals industry;
- environmental and social best practice in the implementation of mineral exploration activities;
- occupational health and safety regulations applicable to mineral exploration.

OCCUPATIONAL SKILLS – IS ABLE TO:

- autonomously perform tasks following the standard procedures of mineral exploration methods and techniques;
- use IT equipment and mineral exploration design and documentation software;
- develop and update the technical (e.g. activity planning) and economic outline (e.g. budget) of mineral exploration activities.

OCCUPATIONAL SOCIAL COMPETENCE – IS READY TO:

- file and maintain technical records and documentation of mineral exploration activities in a timely and consistent manner and ensure its good quality;
- comply with regulations, standards and instructions relating to mineral exploration activities;
- systematically raise his/her qualifications by participating in different forms of formal and informal training (autonomous learning included).
- engage with communities, reinforcing mutual trust, respect and effective communication between his/her team and the communities affected by mineral exploration works.

The holder of an SQF-RM Level 5 qualification works, for the most part, in the following areas:

- Geophysical or geochemical exploration programmes;
- Exploration drilling;
- Laboratory testing;
- Classification and evaluation of mineral deposits.

Example of a position requiring qualifications at this level: Drilling Supervisor; Foreman; Senior Laboratory Technician; Operations Planner; Permitting Manager.

Level 6 – Mineral Exploration

GENERAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- geological processes in space and time and mechanisms involved;
- the complex dependencies between data obtention, data processing, modelling and simulation;
- his/her professional and ethical responsibilities;
- communicative English relating to the mineral exploration sector.

GENERAL SKILLS – IS ABLE TO:

- use geoscience information to generate predictive models;
- prepare non-standard project solutions in accordance with best practice and the requirements of laws and norms;
- respond to changes in the external environment of the mineral exploration sector;
- transfer his/her knowledge on mineral exploration methods and techniques to colleagues, subordinate employees and subcontractors;
- manage teams, plan, forecast and work under pressure;
- autonomously perform functions and actions relating to project management, including:
 - using IT tools in the design and plan process,
 - launch and execute exploration activities.

GENERAL SOCIAL COMPETENCE – IS READY TO:

- assume responsibility, demonstrate innovativeness in the assigned tasks;
- motivate employees to comply with regulations, best practices and professional ethics;
- establish and maintain good interpersonal relations with customers and subcontractors;
- undertake initiatives to improve the effectiveness of projects and the financial results of his/her organisation;
- systematically raise professional qualifications through self-improvement and participation in formal and informal training courses;
- autonomously make decisions.

OCCUPATIONAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- the principles of the investment process, including the rights and obligations of its participants;
- the principles of site and property management, and the corresponding environmental and social obligations;
- the specialised requirements in mineral exploration relating to the applied methods, technologies and standards.

OCCUPATIONAL SKILLS – IS ABLE TO:

- autonomously perform technical functions in mineral exploration, including:
 - designing and supervising exploration works;
 - validating the design of exploration programmes;
- coordinate, monitor and validate the work of subcontractors engaged in project implementation;
- identify and select new subcontractors;
- obtain and manage new work orders.

OCCUPATIONAL SOCIAL COMPETENCE – IS READY TO:

- assume responsibility and demonstrate innovativeness in the design and implementation of mineral exploration programmes;
- apply the legal provisions related to mineral exploration and industry recommendations and best practices;
- seeking, listening to and considering community feedback that may be useful in his/her decision-making process;
- assume responsibility for the proper implementation of projects.

The holder of an SQF-RM Level 6 qualification works, for the most part, in the following areas:

- Geophysical or geochemical exploration programmes;
- Exploration drilling;
- Laboratory testing;
- Classification and evaluation of mineral deposits.

Example of a position requiring qualifications at this level: Geophysicist; Exploration Geologist; Project Manager; Geotechnical Engineer; Geospatial Analyst; Mine Engineer.

Level 7 – Mineral Exploration

GENERAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- professional and ethical responsibilities of professional geoscientists;
- the interdependencies of value chains based on mineral raw materials;
- the complex dependencies between economic effectiveness and data obtention, processing, modelling and simulation;
- the complex dependencies between safety and functionality of the work, economic effectiveness and data obtention, data processing, modelling and simulation;
- communicative English.

GENERAL SKILLS – IS ABLE TO:

- solve complex, non-routine problems of mineral exploration programmes;
- design unique mineral exploration projects in accordance with best practice and the requirements of laws and norms;
- organise working plans and forecasts, and his/her own working time and that of subordinate people;
- train team members, subordinate employees and subcontractors;
- independently perform functions and activities relating to contract management, including:
 - using IT tools,
 - writing and talking in English;
 - measure performance and control deviations;
- motivate team members and subordinate employees.

GENERAL SOCIAL COMPETENCE – IS READY TO:

- take responsibility and demonstrate innovativeness;
- motivate employees to adopt best practices;
- work with and motivate a team under pressure;
- implement best practices and establish good interpersonal relations with all relevant stakeholders;
- undertake initiatives aimed at improving effectiveness and financial results.

OCCUPATIONAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- the provisions of exploration contracts, including the rights and obligations of its participants;
- in depth, the regulations applicable to mineral exploration programmes;
- the specific norms and requirements of site and property management applicable in the scope of a contract, and the corresponding environmental and social obligations;
- the application of methods and techniques of mineral exploration to improve the processes of mineral extraction and processing.

OCCUPATIONAL SKILLS – IS ABLE TO:

- design mineral exploration programmes, using different methods and technologies in a manner consistent with budget and client's goals and requirements;
- manages, controls and assesses the implementation of exploration programmes;
- prepare reports of mineral exploration programmes in a manner consistent with existing reporting codes and norms;
- prepare mineral exploration contracts and the corresponding technical documentation.

OCCUPATIONAL SOCIAL COMPETENCE – IS READY TO:

- design and manage mineral exploration programmes;
- organise the participation of persons with relevant knowledge, qualifications and competence in preparing contracts;
- fully use his/her specialised knowledge and skills in the design, implementation and follow up of exploration programmes;
- assume responsibility for mineral exploration programmes;
- properly assess opportunities and counteract threats in the implementation of exploration programmes.

The holder of an SQF-RM Level 7 qualification works, for the most part, in the following areas:

- Geophysical or geochemical exploration programmes;
- Exploration drilling;
- Laboratory testing;
- Classification and evaluation of mineral deposits.

Example of a position requiring qualifications at this level: Senior Exploration Geologist; Senior Project Manager; Mineral Potential Supervisor; Geologists Supervisor.

Mineral extraction and processing

Level 3 – Mineral Extraction and Processing

GENERAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- the basic conditions and dependencies applicable at the department level of his/her organisation;
- the principles of teamwork under the supervision of a superior;
- the basic principles of occupational health and safety requirements applicable to assigned tasks.

GENERAL SKILLS – IS ABLE TO:

- work in a team;
- work under pressure;
- organise his/her own working time;
- plan and forecast activities.

GENERAL SOCIAL COMPETENCE – IS READY TO:

- act according to laws, regulations, best practices and professional ethics;
- participate in on-the-job demonstrations, training courses and industry fairs.

OCCUPATIONAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- basic principles of mineral extraction and processing;
- elementary geology and arithmetic;
- the basic principles of sustainability;
- the concept of raw materials value chain;
- safety principles within the scope of assigned tasks.

OCCUPATIONAL SKILLS – IS ABLE TO:

- work without risk or harm to self and others;
- perform assigned tasks in mineral extraction and processing operations, in due time and compliance with relevant regulations;
- use correct materials and tools;
- care for the materials and equipment used;
- plan for and notify of needed materials and tools.

OCCUPATIONAL SOCIAL COMPETENCE – IS READY TO:

- assume responsibility for assigned tasks in mineral extraction and processing operations;
- maintain good interpersonal relations with colleagues, customers and subcontractors;
- comply with work and occupational health and safety regulations applicable in mineral extraction and processing operations.

The holder of an SQF-RM Level 3 qualification works, for the most part, in the following areas:

- Mining and quarrying;
- Mineral processing;
- Mine surveying;
- Tunnelling.

Example positions requiring qualifications at this level: Process Operator; Equipment Operator Assistant; Underground Driller Helper; Mine Surveyor Assistant; General Labourer.

Level 4 – Mineral Extraction and Processing

GENERAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- the basic conditions and dependencies in the structure and activities of the organisation, and the connections to the works being carried out;
- the basic principles of safety relating to the occupation and field work;
- the principles of teamwork.

GENERAL SKILLS – IS ABLE TO:

- effectively motivate colleagues and subordinate employees;
- use technical documentation;
- improve his/her work performance by analysing observed errors, irregularities;
- work under pressure, alone and in a team;
- solve problems influencing the scope, quality or timeliness of the tasks being carried out;
- comply with organisational rules and confidentiality requirements;
- apply occupational health & safety and employment regulations.

GENERAL SOCIAL COMPETENCE – IS READY TO:

- direct colleagues and subordinate employees so that they act according to laws, regulations, best practices and professional ethics;
- systematically raise professional qualifications through self-improvement, participation in on-the-job demonstrations, training courses and industry fairs;
- exercise self-management within the guidelines of work context;
- supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities.

OCCUPATIONAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- elementary geometry, algebra and trigonometry;
- elementary physics and chemistry;
- elementary geology and the basics of the mining cycle;
- the raw materials value chain and the core principles of sustainability;
- health and safety requirements within the scope of assigned tasks, including mine/plant rescue operations;
- the rules and procedures of quality assurance/quality control systems;
- the provisions and standards in force in mineral extraction and processing.

OCCUPATIONAL SKILLS – IS ABLE TO:

- use office software (spreadsheet, word processing, email) and IT equipment to organise and report activities;
- perform assigned tasks in mineral extraction and processing effectively, promptly and in compliance with relevant regulations;

- implement and advance initiatives aiming to safeguard environmental values and ecological services, save energy and water, and manage waste according to best practice;
- assign tasks to subordinate employees diligently and proactively and enforce their timely and suitable performance;
- cooperate with subcontractors;
- plan for and notify of needed materials and tools.

OCCUPATIONAL SOCIAL COMPETENCE – IS READY TO:

- assume responsibility for assigned tasks in mineral extraction and processing works, in compliance with applicable standards and best practice;
- observe and enforce occupational health and safety regulations;
- keep materials and equipment in a good state of repair and cleanliness;
- establish and maintain good interpersonal relations with subordinate employees, customers and subcontractors.

The holder of an SQF-RM Level 4 qualification works, for the most part, in the following areas:

- Mining and quarrying;
- Mineral processing;
- Mine surveying.

Example positions requiring qualifications at this level: Mine Surveyor; Blaster; Excavator/Dumper/Crusher Operator; Underground Driller; Assay Lab Technician.

Level 5 – Mineral Extraction and Processing

GENERAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- the legal provisions relating to mineral extraction and/or processing;
- the methods and dependencies relating to mineral extraction and/or processing;
- the methods and techniques used in mineral extraction and/or processing.

GENERAL SKILLS – IS ABLE TO:

- implement good practice in handling technical documentation;
- learn autonomously from textbooks and multimedia tools, and engages in learning discussions in training courses, workshops, fairs, etc.;
- think analytically, work under time pressure, work in a group, organise his/her own working time.

GENERAL SOCIAL COMPETENCE – IS READY TO:

- perform tasks in a responsive, accurate and timely manner;
- establish and maintain good interpersonal relations and undertake initiatives to improve and increase the effectiveness of the tasks being carried out;
- train and develop subordinate employees and subcontractors;
- perform work with accuracy, thoroughness and under the pressure of time.

OCCUPATIONAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- the grounds of mineral extraction and/or processing methods;
- the factors that affect the outcome of mineral extraction and/or processing;
- the legal provisions relating to mineral extraction and/or processing;
- environmental and social best practice in the implementation of mineral extraction and/or processing activities;
- occupational health and safety regulations applicable to mineral extraction and/or processing.

OCCUPATIONAL SKILLS – IS ABLE TO:

- autonomously perform tasks following the standard procedures of mineral extraction and/or processing methods and techniques;
- use IT equipment and mineral extraction and/or processing documentation software;
- develop and update the technical (e.g. activity planning) and economic outline (e.g. budget) of mineral extraction and/or processing activities.

OCCUPATIONAL SOCIAL COMPETENCE – IS READY TO:

- file and maintain technical records and documentation of mineral extraction and/or processing activities in a timely and consistent manner and ensure its good quality;

- comply with regulations, standards and instructions relating to mineral extraction and/or processing activities;
- systematically raise his/her qualifications by participating in different forms of formal and informal training (autonomous learning included).
- engage with communities, reinforcing mutual trust, respect and effective communication between his/her team and the communities affected by mineral extraction and/or processing works.

The holder of an SQF-RM Level 5 qualification works, for the most part, in the following areas:

- Mining and quarrying;
- Mineral processing;
- Mine surveying.

Example of a position requiring qualifications at this level: Foreman; Operations Planner; Welder; Mechanic; Development Miner; Electrician; Senior Laboratory Technician.

Level 6 – Mineral Extraction and Processing

GENERAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- geological processes in space and time and mechanisms involved;
- the complex dependencies between data obtention, data processing, modelling and simulation;
- his/her professional and ethical responsibilities;
- communicative English relating to the mineral raw materials sector.

GENERAL SKILLS – IS ABLE TO:

- use geoscience information to generate predictive models;
- prepare non-standard project solutions in accordance with best practice and the requirements of laws and norms;
- respond to changes in the external environment of the mineral extraction and/or processing area;
- transfer his/her knowledge on mineral extraction and/or processing methods and techniques to colleagues, subordinate employees and subcontractors;
- manage teams, plan, forecast and work under pressure;
- autonomously perform functions and actions relating to project management, including:
 - using IT tools in the design and plan process,
 - launch and execute activities.

GENERAL SOCIAL COMPETENCE – IS READY TO:

- assume responsibility, demonstrate innovativeness in the assigned tasks;
- motivate employees to comply with regulations, best practices and professional ethics;
- establish and maintain good interpersonal relations with customers and subcontractors;
- undertake initiatives to improve the effectiveness of activities and the financial results of his/her organisation;
- systematically raise professional qualifications through self-improvement and participation in formal and informal training courses;
- autonomously make decisions.

OCCUPATIONAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- the principles of site and property management, and the corresponding environmental and social obligations;
- the specialised requirements in mineral extraction and/or processing relating to the applied methods, technologies and standards.

OCCUPATIONAL SKILLS – IS ABLE TO:

- autonomously perform technical functions in mineral extraction and/or processing, including:
 - designing and supervising mining works;
 - validating the design of mining plans / mineral processing operations;
- coordinate, monitor and validate the work of subcontractors engaged in project implementation;
- identify and select new subcontractors;
- obtain and manage new work orders.

OCCUPATIONAL SOCIAL COMPETENCE – IS READY TO:

- assume responsibility and demonstrate innovativeness in the design and implementation of extraction/mineral processing activities;
- apply the legal provisions related to mineral extraction and/or processing recommendations and best practices;
- seeking, listening to and considering community feedback that may be useful in his/her decision-making process;
- assume responsibility for the proper implementation of projects.

The holder of an SQF-RM Level 6 qualification works, for the most part, in the following areas:

- Mining and quarrying;
- Mineral processing;
- Mine surveying.

Example of a position requiring qualifications at this level: Mine Geologist; Mine Engineer; Geotechnical Engineer; Metallurgical Engineer; Health & Safety Manager.

Level 7 – Mineral Extraction and Processing

GENERAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- professional and ethical responsibilities of professional geoscientists;
- the interdependencies of value chains based on mineral raw materials;
- the complex dependencies between economic effectiveness and data obtention, processing, modelling and simulation;
- the complex dependencies between safety and functionality of the work, economic effectiveness and data obtention, data processing, modelling and simulation;
- communicative English.

GENERAL SKILLS – IS ABLE TO:

- solve complex, non-routine problems of mineral extraction and/or processing;
- design and implement mineral extraction and/or processing operations in accordance with best practice and the requirements of laws and norms;
- organise working plans and forecasts, and his/her own working time and that of subordinate people;
- train team members, subordinate employees and subcontractors;
- independently perform functions and activities relating to contract management, including:
 - using IT tools,
 - writing and talking in English;
 - measure performance and control deviations;
- motivate team members and subordinate employees.

GENERAL SOCIAL COMPETENCE – IS READY TO:

- take responsibility and demonstrate innovativeness;
- motivate employees to adopt best practices;
- work with and motivate a team under pressure;
- implement best practices and establish good interpersonal relations with all relevant stakeholders;
- undertake initiatives aimed at improving effectiveness and financial results.

OCCUPATIONAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- the provisions of mining contracts, including the rights and obligations of its participants;
- the regulations applicable to mineral extraction and/or processing activities;
- the specific norms and requirements of site and property management applicable in the scope of a mining contract, and the corresponding environmental and social obligations.

OCCUPATIONAL SKILLS – IS ABLE TO:

- combining different methods and technologies of plan mineral extraction and/or processing activities, in a manner consistent with budget and client's goals and requirements;

<ul style="list-style-type: none"> • manages, controls and assesses mineral extraction and/or processing activities; • prepare reports on mineral extraction and/or processing in a manner consistent with existing reporting codes and norms.
<p>OCCUPATIONAL SOCIAL COMPETENCE – IS READY TO:</p> <ul style="list-style-type: none"> • manage mineral extraction and/or processing activities; • organise the participation of persons with relevant knowledge, qualifications and competence in preparing contracts; • fully use his/her specialised knowledge and skills in the design, implementation and follow up of mineral extraction and/or processing activities; • assume responsibility for mineral extraction and/or processing activities; • properly assess opportunities and counteract threats in the implementation of mineral extraction and/or processing activities.
<p>The holder of an SQF-RM Level 7 qualification works, for the most part, in the following areas:</p> <ul style="list-style-type: none"> • Geophysical or geochemical exploration programmes; • Classification and evaluation of mineral deposits. • Mining and quarrying; • Mineral processing; • Management. <p>Example of a position requiring qualifications at this level: Senior Mine Geologist; Senior Mine Engineer, Environmental Coordinator; Metallurgical Engineer; Mine/Quarry Manager.</p>

Materials engineering and recycling

Level 3 –Materials engineering and Recycling

GENERAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- the basic conditions and dependencies applicable at the department level of his/her organisation;
- the principles of teamwork under the supervision of a superior;
- the basic principles of occupational health and safety requirements applicable to assigned tasks.

GENERAL SKILLS – IS ABLE TO:

- work in a team;
- work under pressure;
- organise his/her own working time;
- plan and forecast activities.

GENERAL SOCIAL COMPETENCE – IS READY TO:

- act according to laws, regulations, best practices and professional ethics;
- participate in on-the-job demonstrations, training courses and industry fairs.

OCCUPATIONAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- basic principles of metal production and recycling;
- elementary arithmetic;
- the basic principles of sustainability;
- the concept of raw materials value chain;
- safety principles within the scope of assigned tasks.

OCCUPATIONAL SKILLS – IS ABLE TO:

- work without risk or harm to self and others;
- perform assigned tasks in metal production and recycling operations, in due time and compliance with relevant regulations;
- use correct materials and tools;
- care for the materials and equipment used;
- plan for and notify of needed materials and tools.

OCCUPATIONAL SOCIAL COMPETENCE – IS READY TO:

- assume responsibility for assigned tasks in metal production and recycling operations;
- maintain good interpersonal relations with colleagues, customers and subcontractors;
- comply with work and occupational health and safety regulations applicable in metal production and recycling operations.

The holder of an SQF-RM Level 3 qualification works, for the most part, in the following areas:

- Metals' sorting and scrapping;
- Recycling;
- Smelting.

Example positions requiring qualifications at this level: Operations Assistant; Equipment Operator Assistant; Recycling Labourer; Sorter.

Level 4 – Materials engineering and Recycling

GENERAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- the basic conditions and dependencies in the structure and activities of the organisation, and the connections to the works being carried out;
- the basic principles of safety relating to the occupation and field work;
- the principles of teamwork.

GENERAL SKILLS – IS ABLE TO:

- effectively motivate colleagues and subordinate employees;
- use technical documentation;
- improve his/her work performance by analysing observed errors, irregularities;
- work under pressure, alone and in a team;
- solve problems influencing the scope, quality or timeliness of the tasks being carried out;
- comply with organisational rules and confidentiality requirements;
- apply occupational health & safety and employment regulations.

GENERAL SOCIAL COMPETENCE – IS READY TO:

- direct colleagues and subordinate employees so that they act according to laws, regulations, best practices and professional ethics;
- systematically raise professional qualifications through self-improvement, participation in on-the-job demonstrations, training courses and industry fairs;
- exercise self-management within the guidelines of work context;
- supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities.

OCCUPATIONAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- elementary geometry, algebra and trigonometry;
- elementary physics and chemistry;
- the basics of metal production and recycling cycles;
- the raw materials value chain and the core principles of sustainability;
- health and safety requirements within the scope of assigned tasks, including plant rescue operations;
- the rules and procedures of quality assurance/quality control systems;
- the provisions and standards in force in metal production and recycling.

OCCUPATIONAL SKILLS – IS ABLE TO:

- use office software (spreadsheet, word processing, email) and IT equipment to organise and report activities;
- perform assigned tasks in metal production and recycling effectively, promptly and in compliance with relevant regulations;

- implement and advance initiatives aiming to safeguard environmental values and ecological services, save energy and water, and manage waste according to best practice;
- assign tasks to subordinate employees diligently and proactively and enforce their timely and suitable performance;
- cooperate with subcontractors;
- plan for and notify of needed materials and tools.

OCCUPATIONAL SOCIAL COMPETENCE – IS READY TO:

- assume responsibility for assigned tasks in metal production and recycling works, in compliance with applicable standards and best practice;
- observe and enforce occupational health and safety regulations;
- keep materials and equipment in a good state of repair and cleanliness;
- establish and maintain good interpersonal relations with subordinate employees, customers and subcontractors.

The holder of an SQF-RM Level 4 qualification works, for the most part, in the following areas:

- Metals' sorting and scrapping;
- Recycling;
- Smelting.

Example positions requiring qualifications at this level: Equipment Operator; Steel Mill Operator; Baler Operator; Loader Operator.

Level 5 – Materials engineering and Recycling

GENERAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- the legal provisions relating to metal production and recycling;
- the methods and dependencies relating to metal production and recycling;
- the methods and techniques used in metal production and recycling.

GENERAL SKILLS – IS ABLE TO:

- implement good practice in handling technical documentation;
- learn autonomously from textbooks and multimedia tools, and engages in learning discussions in training courses, workshops, fairs, etc.;
- think analytically, work under time pressure, work in a group, organise his/her own working time.

GENERAL SOCIAL COMPETENCE – IS READY TO:

- perform tasks in a responsive, accurate and timely manner;
- establish and maintain good interpersonal relations and undertake initiatives to improve and increase the effectiveness of the tasks being carried out;
- train and develop subordinate employees and subcontractors;
- perform work with accuracy, thoroughness and under the pressure of time.

OCCUPATIONAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- the grounds of metal production and recycling methods;
- the factors that affect the outcome of metal production and/or recycling;
- the legal provisions relating to metal production and/or recycling;
- environmental and social best practice in the implementation of metal production and/or recycling activities;
- occupational health and safety regulations applicable to metal production and/or recycling.

OCCUPATIONAL SKILLS – IS ABLE TO:

- autonomously perform tasks following the standard procedures of metal production and/or recycling methods and techniques;
- use IT equipment and metal production and/or recycling documentation software;
- develop and update the technical (e.g. activity planning) and economic outline (e.g. budget) of metal production and/or recycling activities.

OCCUPATIONAL SOCIAL COMPETENCE – IS READY TO:

- file and maintain technical records and documentation of metal production and/or recycling activities in a timely and consistent manner and ensure its good quality;

- comply with regulations, standards and instructions relating to metal production and/or recycling activities;
- systematically raise his/her qualifications by participating in different forms of formal and informal training (autonomous learning included).
- engage with communities, reinforcing mutual trust, respect and effective communication between his/her team and the communities affected by metal production and/or recycling works.

The holder of an SQF-RM Level 5 qualification works, for the most part, in the following areas:

- Metals' sorting and scrapping;
- Recycling;
- Smelting.

Example of a position requiring qualifications at this level: Foreman; Operations Planner; Tracking Coordinator; Welder; Mechanic; Electrician; Senior Laboratory Technician.

Level 6 – Materials engineering and Recycling

GENERAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- Physical and chemical processes and mechanisms involved in metal production and/or recycling;
- the complex dependencies between data obtention, data processing, modelling and simulation;
- his/her professional and ethical responsibilities;
- communicative English relating to the mineral raw materials sector.

GENERAL SKILLS – IS ABLE TO:

- prepare non-standard project solutions in accordance with best practice and the requirements of laws and norms;
- respond to changes in the external environment of the metal production and/or recycling area;
- transfer his/her knowledge on metal production and/or recycling methods and techniques to colleagues, subordinate employees and subcontractors;
- manage teams, plan, forecast and work under pressure;
- autonomously perform functions and actions relating to project management, including:
 - using IT tools in the design and plan process,
 - launch and execute activities.

GENERAL SOCIAL COMPETENCE – IS READY TO:

- assume responsibility, demonstrate innovativeness in the assigned tasks;
- motivate employees to comply with regulations, best practices and professional ethics;
- establish and maintain good interpersonal relations with customers and subcontractors;
- undertake initiatives to improve the effectiveness of activities and the financial results of his/her organisation;
- systematically raise professional qualifications through self-improvement and participation in formal and informal training courses;
- autonomously make decisions.

OCCUPATIONAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- the principles of site and property management, and the corresponding environmental and social obligations;
- the specialised requirements in metal production and/or recycling relating to the applied methods, technologies and standards.

OCCUPATIONAL SKILLS – IS ABLE TO:

- autonomously perform technical functions in metal production and/or recycling, including:

- supervising smelter operations and/or recycling works;
- validating smelter/recycling operations;
- coordinate, monitor and validate the work of subcontractors engaged in project implementation;
- identify and select new subcontractors;
- obtain and manage new work orders.

OCCUPATIONAL SOCIAL COMPETENCE – IS READY TO:

- assume responsibility and demonstrate innovativeness in the design and implementation of smelter operations and/or recycling activities;
- apply the legal provisions related to smelter operations and/or recycling recommendations and best practices;
- seeking, listening to and considering community feedback that may be useful in his/her decision-making process;
- assume responsibility for the proper implementation of projects.

The holder of an SQF-RM Level 6 qualification works, for the most part, in the following areas:

- Recycling;
- Smelting.

Example of a position requiring qualifications at this level: Metallurgical Engineer; Materials Engineer; Health & Safety Manager; Recycling Centre Manager.

Level 7 – Materials engineering and Recycling

GENERAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- professional and ethical responsibilities of registered professionals;
- the interdependencies of value chains based on mineral raw materials;
- the complex dependencies between safety and functionality of the work, economic effectiveness and data obtention, data processing, modelling and simulation;
- communicative English.

GENERAL SKILLS – IS ABLE TO:

- solve complex, non-routine problems of metal production and/or recycling;
- design and implement metal production and/or recycling operations in accordance with best practice and the requirements of laws and norms;
- organise working plans and forecasts, and his/her own working time and that of subordinate people;
- train team members, subordinate employees and subcontractors;
- independently perform functions and activities relating to contract management, including:
 - using IT tools,
 - writing and talking in English;
 - measure performance and control deviations;
- motivate team members and subordinate employees.

GENERAL SOCIAL COMPETENCE – IS READY TO:

- take responsibility and demonstrate innovativeness;
- motivate employees to adopt best practices;
- work with and motivate a team under pressure;
- implement best practices and establish good interpersonal relations with all relevant stakeholders;
- undertake initiatives aimed at improving effectiveness and financial results.

OCCUPATIONAL KNOWLEDGE – KNOWS AND UNDERSTANDS:

- the regulations applicable to metal production and/or recycling activities;
- the specific norms and requirements of site and property management applicable in the scope of metal production and/or recycling, and the corresponding environmental and social obligations.

OCCUPATIONAL SKILLS – IS ABLE TO:

- combining different methods and technologies of metal production and/or recycling activities, in a manner consistent with budget and client's goals and requirements;
- manages, controls and assesses metal production and/or recycling activities;

- prepare reports on metal production and/or recycling in a manner consistent with existing reporting codes and norms.

OCCUPATIONAL SOCIAL COMPETENCE – IS READY TO:

- manage metal production and/or recycling activities;
- organise the participation of persons with relevant knowledge, qualifications and competence in preparing contracts;
- fully use his/her specialised knowledge and skills in the design, implementation and follow up of metal production and/or recycling activities;
- assume responsibility for metal production and/or recycling activities;
- properly assess opportunities and counteract threats in the implementation of metal production and/or recycling activities.

The holder of an SQF-RM Level 7 qualification works, for the most part, in the following areas:

- Recycling;
- Smelting.

Example of a position requiring qualifications at this level: Senior Metallurgical Engineer; Senior Materials Engineer, Environmental Coordinator; Recycling Centre Coordinator, Smelting Inspector.