DRIVING CHANGE THROUGH HIGHER MINING ENGINEER COMPETENCE

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Ensuring an ethical approach, improving safety, and protecting the environment while ensuring financial viability are key issues for mining; pressure to respond to them is growing from stakeholders globally. Mining Engineers who are competent in these areas will be instrumental in responding to these changes.

We are proposing a new, common globally-recognised competence framework for Mining Engineers that will build on the national standards that are already in place to develop higher competences relevant to these challenges and that will, therefore, help the profession change for the better.

What are these higher competences? Are they common to all Mining Engineers globally? Answering these, and similar, questions will require the various stakeholders to contribute and share their views, needs and expectations. As a prompt for these discussions, the Institute of Materials, Minerals and Mining (IOM3) and the International Competence Centre for Mining Engineering Education under the auspices of UNESCO at the St Petersburg Mining University have developed this first-draft of an international competence framework for Mining Engineers.

INTRODUCTION

1. Many nations and / or territories have structures in place through which mining engineers can or, in some cases, must be formally recognised as professionals. This is important for setting standards for the knowledge, understanding, skills and experience that underpin mining engineers' competence in their respective areas of operation.

2. Mining around the world is changing and pressure is increasing on it to change faster and more radically. For example, some major investors want to reduce the risks inherent in mining and are increasingly demanding that mining clearly demonstrates its ethics, be safer, do less damage to the environment while being financially viable. Each of these four areas, ethics, safety, the environment and finance are areas in which operating to even higher standards could reduce risks; risks to business reputation, of harm to people involved in and affected by mining, to the world that supports our way of life, and to its financial base.

3. Mining engineers are key influencers in mining businesses who work in all sectors of the industry, such as in investor relations, research and development of new technologies and processes, upstream and downstream operations, regulation, and audit and pollution prevention. They are therefore in a unique position to help respond to the pressures on mining around the world.

4. Helping mining engineers to identify the new and/or deeper knowledge in the four areas noted above, understand how that knowledge integrates and can be applied to better effect, and then demonstrate that they apply their skill in practice will improve mining practices – and so reduce risk. We refer to the combination of knowledge understanding and skill as 'competence'.

PROPOSAL

5. The Institute of Materials, Minerals and Mining (IOM3) and the International Competence Centre for Mining Engineering Education at the St Petersburg Mining University are proposing a new competence-based framework for mining engineers.

6. For ease of reference, we use the provisional working title of International Standard for Mining Engineers (**ISME**) to describe this framework.

7. The ISME framework is intended to complement existing national standards for recognising/ registering mining engineers (e.g. Chartered Engineer / Incorporated Engineer in the UK and Professional Engineer in the USA). It should sit 'above' and build on them and require mining engineers to demonstrate new and/or higher competence in specific areas of professional activity. It would not include specialist areas of practice such as Mineral Resources and Reserves Reporting, which have their own definitions of competence.

8. The framework would enable mining engineers to identify the areas of new or enhanced competence relevant to them and their businesses, to work towards being able to demonstrate them and to build on their existing recognition to the point where they can seek formal recognition through ISME.

9. The four broad areas of competence proposed are, ethics, safety, the environment, and financial planning. These would combine to create a broad set of competences summed up in the following overarching statement:

   ISME engineers combine proven technical, managerial and leadership competence with their knowledge and understanding of ethics, safety, the environment and financial planning to create mining operations that meet society's highest ethical demands, that are safer, that limit environmental damage arising from whole-life mining operations to the minimum possible, and that are financially sound.

KEY FEATURES

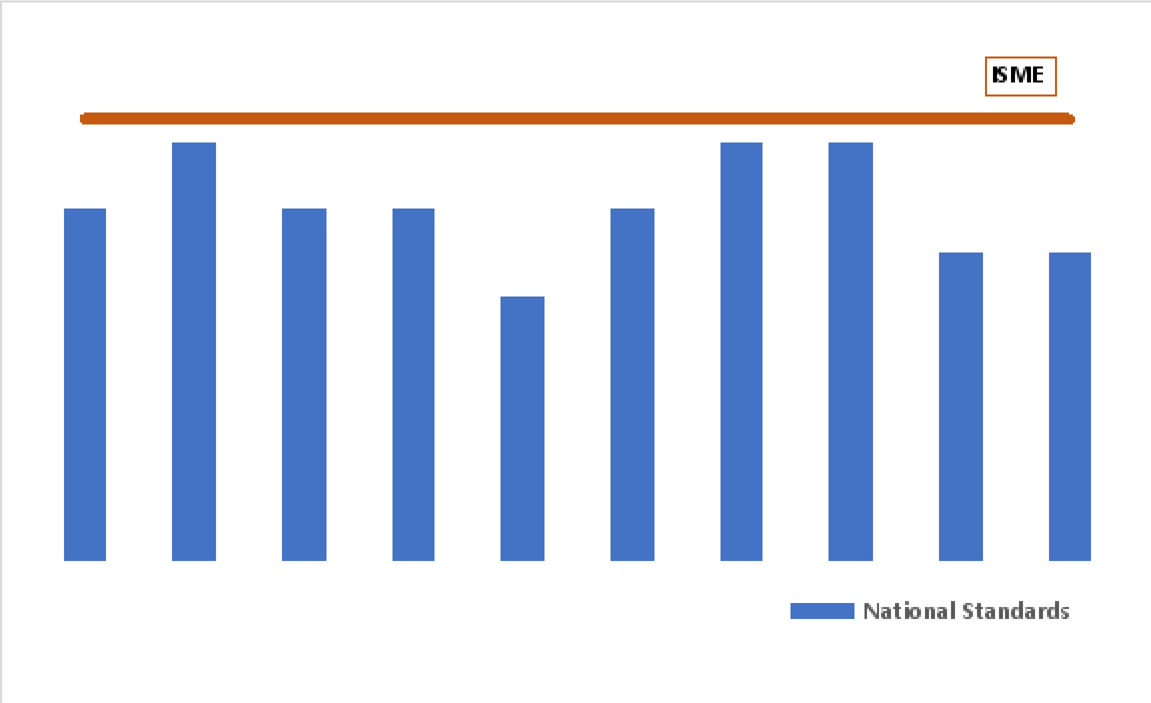
Substantive equivalence

10. Each existing national standard for Mining Engineers operates in its own way, taking an approach developed over time and in accordance with its own national needs and history. ISME makes no judgement of these different standards other than to regard them as being substantially equivalent[1]. That is to say that, although they may be different, they are taken to achieve similar outcomes. ISME is intended to be a new, shared framework that allows Mining Engineers to achieve a higher and, importantly, international form of registration; it would sit 'above' the national standards; see Figure 1.

[1] The proposal does not require mutual recognition of Mining Engineers by ISME Partners, as provided by APEC for example. ISME would form a 'bridge' over and above the national standards.

Figure 1:

How ISME would relate to national standards for Mining Engineers



12. It is, therefore, proposed that the national bodies operating the different national standards could each be recognised as a Partner to ISME. Mining Engineers who wish to apply for ISME recognition would need to be registered with, or be a member of, the ISME Partner for their home nation before being able to apply for ISME. If there is no ISME Partner for their home nation, they would need to be registered with, or be a member of, another ISME Partner.

Who could register?

13. ISME would be open to all mining engineers who:

    a. Were registered with or were members of their home nation ISME Partner (or, if there is no ISME Partner for their home nation, were registered with or a member of an ISME Partner elsewhere); and
    b. Could satisfy the requirements for underpinning knowledge and understanding (see paragraph 19, below); and
    c. Could demonstrate the ISME competences (see paragraphs 15 to 17, below).

The award

14. Successful applicants would be awarded a title and post-nominal designation. This has yet to be identified, but could take a form along the lines of:

    Resource Specialist Engineer (REng/ResEng); or

    Specialist Mining Engineer (SenEng); or

    International Mining Engineer (IntMinE); or

    International Professional Mining Engineer (IntPMinE)

Competence

15. The following definition of competence is proposed[2]:

    Competence refers to a professional's ability to carry out tasks successfully and safely within their field of practice. This includes having the individual skills, knowledge and understanding, personal behaviour and approach, to be able to work collaboratively with others to achieve the intended outcomes. Competence includes the ability to make professional judgments and an awareness of the limits of one's own ability and knowledge.

16. This recognises two important points:

    a. Competence is fundamentally about what the individual can do in professional practice.
    b. Competence is built on the foundation of knowledge and understanding.

17. The principle of competence is such that individuals develop competence over time. How long it takes them to do so will depend on the nature of their individual learning and experience and, as this varies for everyone, the time it takes to become competent will also vary. That said the proposal is that Mining Engineers would not normally be able to meet the ISME competences in fewer than three (3) years from becoming registered with their own national body. The procedures should, however, allow for exceptions in individual cases; each such case would need to be argued on its own merits and should be subject to review.

[2] Based on the definition of competence in *UK-SPEC 4th Edition* (Engineering Council); www.engc.org.uk/media/3417/uk-spec-fourth-edition.pdf (accessed on 15 October 2020).

Assessment

18. Assessment should be managed and controlled by the ISME host organisation[3]. In practice, however, applicants would come through each of the home nation ISME Partners, using agreed procedures and standards to achieve consistency. When a Partner approves an application for ISME, it would support the application which would be considered by the ISME host organisation.

19. The general approach proposed is that applicants would be required to:

    a. Demonstrate that they have relevant knowledge as the basis for their new/higher competence, by having either:
        i. A recognised Masters' level qualification that can underpin a career in mining engineering; or
        ii. The equivalent knowledge gained through other means. This could include a combination of work experience and in-company or other industry training (in this way ISME would recognise that formal education is only one way of demonstrating the necessary knowledge).
    b. Demonstrate their competence by:
        i. Submitting documented evidence of relevant qualifications, training and experience and explaining how this relates to and demonstrates the competences.
        ii. Being interviewed by two interviewers; one in-country interviewer and one out-of-country interviewer who would, together, assess the applicant against the ISME competences[4].

20. When demonstrating competence, applicants should focus on their professional work as a Mining Engineer rather than their studies or academic achievements. Despite this emphasis on professional competence, it is reasonable for interviewers to expect the applicant's competence to be based on suitable knowledge and understanding and for that knowledge and understanding to be evident.

Continuing Professional Development

21. As a condition of ISME registration mining engineers would be obliged to:

    a. Maintain their registration with or membership of the relevant ISME Partner.
    b. Meet their obligations to their ISME Partner for continuing professional development

[3] The identity of the host organisation has yet to be agreed.

[4] Arrangements would need to be made to create an initial pool of ISME-approved expert interviewers, comprising six to twelve from each ISME Partner, to conduct the early interviews. The procedure and criteria for appointing these interviewers will need to be agreed.

THE FOUR BROAD AREAS OF COMPETENCE

22. Work will be needed to identify and agree the detail in each of these four areas of competence, ethics, safety, the environment, and financial planning. It is proposed that all applicants should be required to demonstrate competences in each of the four broad areas but in proportions that reflect their career trajectory.

23. As an indication of the proposed approach and as the basis for further discussion, Annex A shows examples of possible competences for inclusion in the framework.

24. Annex B shows, for illustration purposes only, how a mining cycle could be used to map the relevance of competences to phases of mining projects; note the mapping shown is for illustration purposes only.

End.

The International Standard for Mining Engineers

Indicative competences for discussion

Mining Engineers seeking ISME accreditation are expected to demonstrate the following competences in relation to their career path and trajectory:

A. Ethics

Apply a broad range of relevant **technical, managerial and leadership skills** to lead change in relevant aspects of the mining cycle[5] such that society's highest ethical standards are met and, in particular:

1. Identify and mitigate mining-related risks and elect when to make decisions with uncertain and incomplete information.
2. Conduct stakeholder engagement based upon an analysis of the local context.
3. Implement inclusive approaches with local communities to identify their development priorities and support activities that contribute to their lasting social and economic wellbeing.
4. Demonstrate how advanced knowledge and understanding have been applied to develop mining operations that take full account of Human Rights.
5. Build effective reciprocal working relationships with host and local communities.
6. Manage change of ownership of the mine, its effects, and impacts.
7. Manage closure planning, redeployment of local staff, transferable skills, and retraining.
8. Ensure an ethical approach to aftercare management, including lasting legacies, and to any economic effects on local communities following closure or sudden liquidation.
9. Manage closure funds and other financial mechanisms to sound ethical principles.
10. Promote sound ethical approaches within the 'supply chain'.

Knowledge and understanding requirements:

- How mining operations are financed.
- How investment and finance plans are created.
- How safety, ethical, and environmental concerns are accounted for in investment and finance plans.
- The importance of whole-life assessment when developing investment and finance plans.
- How mining engineering helps mining businesses fulfil their corporate and social responsibilities.

[5] A mining cycle has been defined for the purpose of the ISME competence framework (see Annex 1 for an example).

Mining Engineers seeking ISME accreditation are expected to demonstrate the following competences in relation to their career path and trajectory:

B. Safety

Apply a broad range of relevant **technical, managerial and leadership skills** to build the best available safety measures for all stakeholders, into the planning and design of mining operations and, in particular:

1. Incorporate safety as a fundamental consideration during the design of processes and systems and of the application of technologies.
2. Implement effective risk-management strategies that consult and take account of the safety of all stakeholder groups.
3. Implement risk-based controls to avoid/prevent, minimise, mitigate and / or remedy health, safety and environmental impacts to workers, local communities, cultural heritage, and the natural environment, based upon a recognised international standard or management system.
4. Optimise the application of new technologies and / or new applications of technologies for improving the safety of mining operations.
5. Assess and manage safety risks of new projects and of significant changes to existing operations in consultation and collaboration with interested and affected stakeholders, using the established best available techniques.
6. Develop, maintain, and test effective disaster prevention and emergency response plans.
7. Take a lead in encouraging partners, suppliers, and contractors to adopt responsible health and safety, environmental, human rights and labour policies and practices.

Knowledge and understanding requirements:

- Relevant safety legislation and industry best-practice guidelines.
- Latest safety measures.
- Stakeholder analysis methods.
- The relationship between safety and Corporate and Social Responsibility.
- Design for safety methodologies.
- Risk assessment techniques.
- Local emergency service protocols.

Mining Engineers seeking ISME accreditation are expected to demonstrate the following competences in relation to their career path and trajectory:

C. The Environment

Apply a broad range of relevant **technical, managerial and leadership** skills to limit environmental impacts arising from whole-life mining operations to the minimum possible, commensurate with the latest available techniques and, in particular:

1. Comply with international best available practices e.g. Equator Principles, those from the International Finance Corporation, and the International Council on Mining and Metals.
2. Integrate sustainable development principles into decision-making relating to the design, operation, maintenance, protection, of physical assets and facilities, and the closure of facilities.
3. Assess environmental risks and opportunities of new projects and of significant changes to existing operations in consultation with interested and affected stakeholders.
4. Assess and address risks and impacts to biodiversity and ecosystem services by implementing the mitigation hierarchy, with the ambition of achieving no- net-loss of biodiversity.
5. Apply the mitigation hierarchy to prevent pollution, manage releases and waste, and address potential impacts on human health and the environment.
6. Implement best available techniques to limit emissions from mine plant.
7. Create and implement energy consumption and reduction plans/targets using the best available techniques.
8. In project design, operation, and de-commissioning, implement cost-effective measures for the recovery, reuse or recycling of energy, natural resources, and materials.
9. Implement measures to improve energy and water efficiency.
10. Plan and design for closure in consultation with relevant authorities and stakeholders, implement measures to address closure-related environmental and social aspects, and make financial provision to enable agreed closure and post-closure commitments to be realised.
11. Design, construct, operate, monitor, and decommission tailings disposal/storage facilities using comprehensive, risk-based management and governance practices in line with internationally recognised best practice and industry standards, to minimise the risk of catastrophic failure.
12. Undertake external and internal audit planning.
13. Manage mine wastes from waste oils to overburden and storage.
14. Effectively manage hazardous and non-hazardous reagents and storage.

Knowledge and understanding requirements:

- The Mining Cycle.
- Relevant environmental legislation and industry best practice guidelines.
- Specific local environmental considerations.
- Risk assessment techniques.
- Stakeholder analysis methods
- Latest environmental impact costing techniques.

Mining Engineers seeking ISME accreditation are expected to demonstrate the following competences in relation to their career path and trajectory:

D. Financial Planning

Apply a broad range of relevant **technical, managerial and leadership** skills to relevant elements of the finance planning process to ensure that full account is taken of safety, ethical and environmental matters relevant to mining operations and, in particular:

1. Develop, implement, and manage capital expenditure plans.
2. Develop, implement, and manage operating expenditure plans.
3. Develop, implement, and manage project and programme financial plans.
4. Integrate ethical, safety, and environmental principles into financial planning decisions.
5. Take a lead in encouraging partners, suppliers, and contractors to adopt responsible health and safety, environmental, human rights and labour policies and practices.
6. Manage the balance between short-term profitability and the creation of financial and non-financial value in the long-term.

Knowledge and understanding requirements:

- How mining operations are financed.
- Principles of capital and operating expenditure.
- Relevant financial statements and ratios.
- How financial plans are developed, implemented, and controlled.
- The importance of whole-life assessment when developing financial plans.
- The relationship between financial planning and Corporate Social Responsibility.
- What-if analysis to better understand risks and costs.

Annex 1. Competences mapped to the phases of a Mining Project

This is a sample mining cycle with sample mapping for illustration only.

	Areas of competence			
Phases of a mining project (simplified)	Ethics	Safety	Environment	Financial planning
1. Exploration				
a. Stake claim(s)				
b. Acquire permits				
c. Understand & engage communities	Input	Input	Input	Input
d. Assess reserves				
e. Create environmental baseline	Input	Input	Input	Input
2. Feasibility, assessment, and approval				
a. Undertake economic feasibility study	Input	Input	Input	Input
b. Identify infrastructure needs	Input	Input	Lead	Input
c. Scope socio-economic challenges	Input	Input	Input	Input
d. Create investment & financing plan	Input	Input	Input	Lead
e. Design mine and operations	Lead	Lead	Lead	Lead
f. Ensure community readiness	Input	Input	Input	Input
g. Undertake environmental assessments and gain approvals	Input	Input	Input	Input
h. Design environment impact mitigation measures, including, water, air, wildlife, soil and communities	Input	Input	Input	Input
i. Design climate-change impact mitigation measures	Input	Input	Input	Input
3. Development				
a. Prepare land	Input	Input	Input	Lead
b. Prepare community	Input	Lead	Lead	Input

c. Construct and commission mine and related infrastructure	Lead	Lead	Lead	Lead
d. Address social impacts	Lead	Input	Input	Input
e. Ensure compliance with approvals	Lead	Input	Input	Input
f. Develop and gain approval for mine closure plan	Input	Input	Input	Lead
4. Active mining				
a. Extract ore	Input	Lead	Lead	Lead
b. Process ore (beneficiation)	Lead	Lead	Lead	Lead
c. Dispose of overburden and waste rock	Lead	Lead	Lead	Lead
d. Dispose of tailings	Lead	Lead	Lead	Lead
e. Rework inactive or abandoned mines and tailings	Lead	Lead	Lead	Lead
f. Monitor operational impacts	Input	Input	Input	Lead
g. Ensure compliance with approvals	Input	Input	Input	Lead
h. Ensure application of impact reduction measures (social, environmental etc); review & amend	Input	Input	Input	Input
5. Closure and reclamation				
a. Obtain approval for final (amended?) mine closure plan	Input	Input	Input	Input
b. Decommission mine and related operations.	Lead	Lead	Lead	Lead
c. Restore land/environment and communities.	Input	Input	Input	Input