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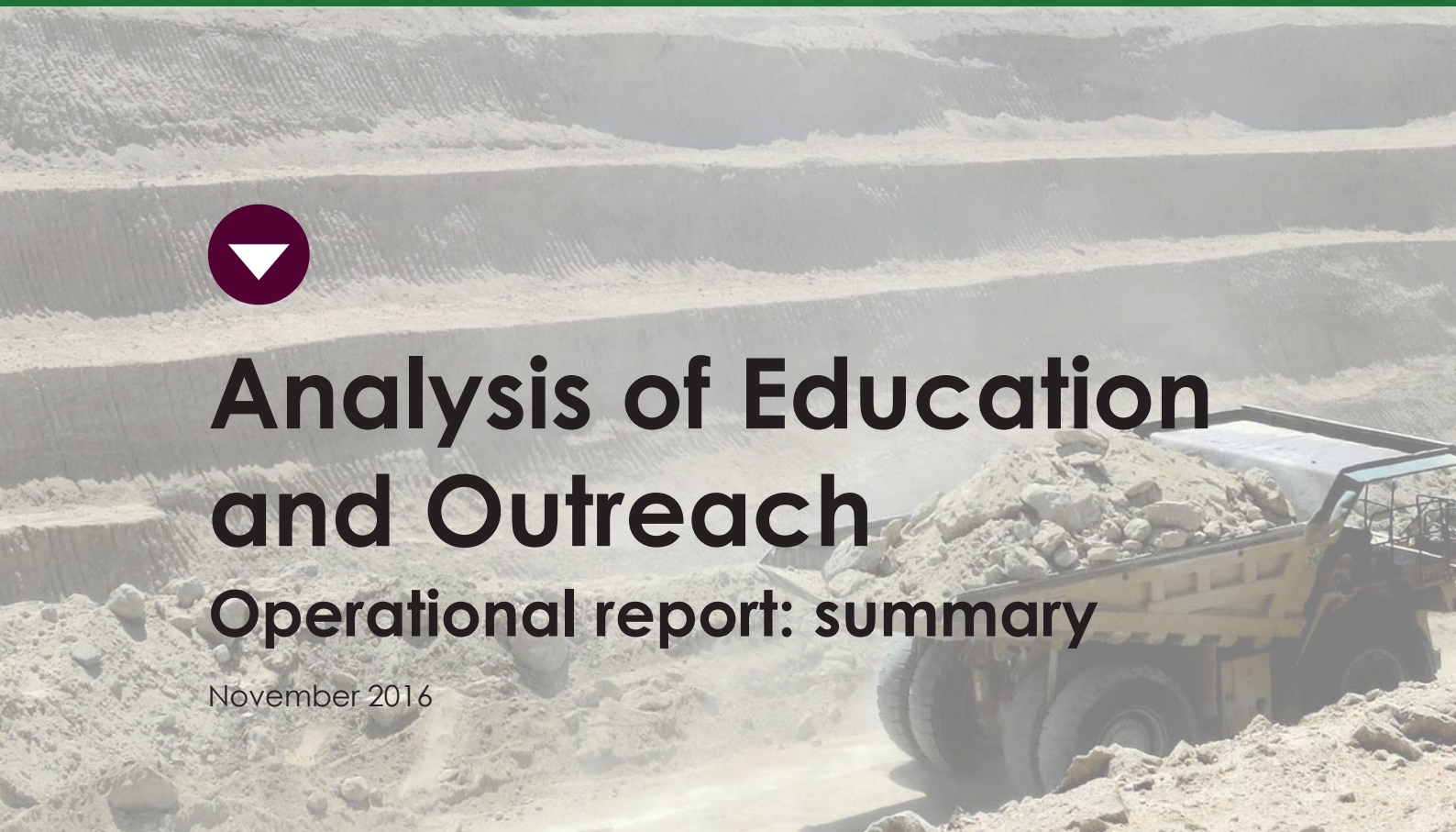

Analysis of Education and Outreach

Operational report: summary

November 2016

Abstract

This operational analysis of education and outreach (D1.4) is the outcome of INTRAW Work Package 1.3, mapping the reference countries' raw materials educational context. The aims of this report are to review the mining & raw material supply education provision and skills availability among the Reference countries, their national workforce demands, perceptions of skill levels/qualities, and funding.

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Extended summary

1. Introduction and aims

This operational analysis of education and outreach (D1.4) is the outcome of INTRAW Work Package 1.3, mapping the reference countries' raw materials educational context. It will contribute to the development of an action plan for education and outreach in WP 2.3 and contribute to the design and functions of the EU International Observatory on Raw Materials in Work Package 3. It will to be disseminated through the activities in WP 4.

In the context of this report education encompasses formal programmes of adult education leading to diploma, certificate, degrees, further and higher education qualifications, or vocational education programmes including apprenticeships, all of which lead to a formal award. The report does not look at school level general education provision other than to comment on its importance in basic literacy and numeracy. Outreach consist of a range of initiatives, courses, organisations and schemes specifically aimed at certain sections of society, especially those from historically disadvantaged, ethnic, or native populations who wish to learn more about mining and gain access to jobs in the mining industry.

As a review, Work Package 1 (WP1) has mapped the contextual environment of Canada, USA, South Africa, Australia and Japan (the 'reference countries'), and this is one of three reports focussing specifically on: raw materials research and innovation (D1.3); education and outreach (D1.4); and industry and trade (D 1.5). WP1 also reviews policies and practices to provide a platform for comparing the reference countries to the EU.

The specific aims of this report are to summarise the mining education provision among the reference countries, their national workforce demands, perceptions of skill levels/qualities, and funding. Reviews have been performed for each Target Country to provide data on courses, student numbers, centres of excellence, delivery mechanisms and, where possible, staff numbers. The internationalization of education and barriers to access are also analysed as part of this deliverable.

The introduction of this report provides a literature based review on employment (1.2.1), global skills availability (1.2.2) and types of mining education (1.2.3). Previous research on education provision is described in Chapter 2, including a critique of the reports and data collection methodologies. Data is provided on each of the five reference countries in Chapter 3 including individual reviews of education demand and government funding provision. The chapter also describes some of the innovative joint initiatives between government-industry-academia to deliver improved mineral skills development.

This information is used to highlight major mining sector education themes and trends in Chapter 4, entitled 'Strategic Issues'. It identifies important educational and human resource issues such as gender imbalances, minority groups, local community skills development support, university recruitment and company strategy. Together these chapters provide the background for consideration of the metrics for EU comparison to be used in WP2, and an initial list of benchmarking metrics is provided in Chapter 5. Report conclusions are highlighted in Chapter 6, followed by a summative description of minerals education and the key findings for each target country in Chapter 7.

2. Country summaries

2.1. Canada

Canada is a world class mining country with high education levels, and home to world class education and training centres for the mining industry that have the capacity to train the next generation of mining staff. It is home to Edumine, an internationally recognised leader in online mining education.

Canada however has a persisting issue around skills shortages due to the workforce demographics and still modest level of graduate training and recruitment. Despite the recent downturn in the number of staff required Canada needs to maintain its recruitment to address the skills gap. There is however still underrepresentation of native peoples in the industry and programmes to address this are being funded by industry and government. There are signs that skills are being retained in downturn due to difficulty of recruitment. The training of trades and graduates demonstrates a classic lag bringing them onto the job market during mining downturns rather than when industry demand is high. Planning for these issues through the mining lifecycle has been identified as crucial to the accuracy of the national workforce planning process.

Meeting the mining skills demand currently relies on cross-Canada migration from the training rich areas of Ontario and Quebec to employment centres in BC. The mining education sector has recruited internationally to try and meet the demand for technical staff.

2.2. USA

The general education standard in the U.S. is one of the highest in the world, and at the tertiary level the U.S. has many large and high quality institutions, excelling in many geoscience and minerals engineering related fields. However, during the general decline of the mining industry and most importantly, the disbanding of the federal U.S. Bureau of Mines in 1996, there has been a major downwards shift in minerals-related education. Enrolment dropped, funding ceased, schools closed and faculty retired. Since the minerals boom there has been steady increases since 2006 and similarly decline in 2013 – 2015 related to commodity price softening.

The U.S. minerals education sector has adapted to changes by recruiting more foreign staff, but still faces shortages both in the mining workforce and within universities. The mining industry is a large supporter of schools, and there is a three-tier hierarchy of larger, more successful mining engineering departments with high student numbers or sustainable research funding versus smaller departments at risk of closure. The large ones include the Colorado School of Mines, The University of Arizona, University of Missouri S&T, Virginia Polytechnic Institute and State University, University of Kentucky and West Virginia University. The smaller ones are Montana Tech, University of Nevada, South Dakota and University of Utah. Programs at risk of closure or with very low numbers (<10 completing students/year) include the University of Alaska Fairbanks, Southern Illinois, Michigan Tech (closed since 2007, reopening in 2016), New Mexico Institute of Mining and Technology and Pennsylvania State University. Distance education has been developed at Missouri and has been a successful program for about a decade. Another proposal is to adopt the distributed education model to reduce the number of mining departments and operate similarly to MEA in Australia.

Nevertheless, the number of completing U.S. mining engineering graduates is meeting the needed supply. The mining workforce is "graying" and on average is several years older than other occupations, although there is unclear picture of the mining trade skills market (welders, maintenance technicians, etc.). It's likely that there will be a constant imbalance due to market cycles. Many organizations including the Society for Mining, Metallurgy and Exploration (SME) are actively involved in primary and secondary minerals education outreach, but socio-political changes in the U.S. in general are slowly moving away from domestic raw materials production and becoming more reliant on trade relationships.

2.3. South Africa

South Africa minerals education is an enigma because there is a severe shortage of mining professionals. Although the country is probably the most highly endowed with large ore deposits and some years produces more mining engineering graduates per year than any other English-speaking nation, the retention rate is the poorest globally. Political, social and economic issues has driven an increasing number of qualified mining staff towards Australia, Canada and elsewhere. There are four major mining schools, and several more geoscience departments of high regard. The University of Witwatersrand and University of Pretoria are two mining departments of high global repute.

A major reason that mineral occupations rank so highly on the National Scare Skills List each year is because South Africa has poor education standards at basic level, and performs the worst among the reference countries globally in the ranking of science, engineering, technology and mathematics primary-secondary educational quality. The nature of most mining in South Africa (very deep, low tonnage, manual-labour intensive, highly sensitive to market prices) has resulted in a bipolar skills distribution. Much of the industry is still at risk of collapse due to declining competitiveness, international market forces, disputes between industry and labour, and the complex black economic empowerment transformation process. Education is similarly undergoing significant changes. The Mining Qualifications Authority is the government institution responsible for skills and training distributes over R700 million per year for bursaries, internships, trade sills development, and scholarships, financed by a 1% levy on mining companies' payroll budgets. There is reduced research occurring in South Africa, most of which has shifted in-house. Despite this, the industry is closely linked to the two leading universities which will likely continue to lead minerals education.

2.4. Australia

Australia is one of the world leading mining countries and minerals dominate it exports. Despite its 8.5% contribution to GDP mining only employs around 2% of the workforce, but this is twice the levels seen in previous decades. It has become a high salary, high skills mining location, but employs relatively few young people, women and those from aboriginal or other minority groups.

The industry spends around AUD 1.1 billion per year on training and there are numerous programmes to facilitate underrepresented groups entering the industry and address related literacy and numeracy challenges. Companies also facilitate widespread support for students, schools, teachers, and others to gain a better understanding of the industry.

Skills shortages in the trades during the recent commodity cycle were exacerbated by simultaneous housing and infrastructure booms. The country however has a set of high quality Universities that are in a unique collaboration around mining education through the MEA Programme which delivers 85% of country's mining engineering graduates. Universities host may Centres of Excellence particularly in geosciences and mineral processing undertaking world-class research. Graduate and apprentice availability has increased through the recent mining booms but demonstrated a lag on commodity cycles creating graduate oversupply during downturns and shortages during the peaks. The mining workforce are generally older than comparative industries and faculty in the universities show an even greater demographic challenge. The country has introduced a strategic programme to address its recent lack of international competitiveness.

2.5. Japan

Japan is not a major mining country but is a major consumer of raw materials and exporter of manufactured products. It has few mines. Japanese culture places a value on education and one of the highest levels of participation in higher education. The country has a skilled but ageing workforce due to the low birth rates. Educational and training capacity is based around a life-cycle concept that highlights recycling, mineral and material processing, metallurgy and materials science. The country however is currently

not a high growth economy and this lack of indigenous raw materials has made it vulnerable to the international commodities markets. Government initiatives are therefore around 'mineral diplomacy', with the negotiation of bi-lateral agreements with major mineral producing countries especially in South America as a means to ensure raw material supply. Mining technology collaborations especially around potential sea floor metal extraction, and the support for increased recruitment of international students has been part of this process. The use of strategic stockpiles to de-risk critical raw material supply has also been introduced. Strategic financial investments in project financing of major new mines has also been part of the strategy. JOGMEC is a new single state body to ensure a stable supply of the raw materials for the country.

3. Report conclusions

Review of the reference countries has revealed a number of themes around mining skills availability and especially how this was exposed during the recent mining boom. During the last decade skills shortages have been arguably the mining industry's most significant problem.

- Shortages may be local, regional, national or international and government policies can cause, reduce or exacerbate these.
- Skills shortages are different to labour shortages and there is increasing recognition in many countries, especially in a down turn, that we have sufficient access to people but their skills levels are too low.
- There is under-utilisation of women, disadvantaged communities, native peoples and young people in the industry – and industry have programmes in most countries to address these but at a modest scale
- The cyclicity of the industry is a major challenge to predicting staffing needs and skills demand.
- Workforce plans are generally good but suffer from the same lack of data.
- Employers need to consider funding, retaining and upskilling staff through the downturns and this may need new models of employment
- That said the reference countries all have established infrastructure of training, education and skills development.
- Real-time skills and employment data are not easily accessible and new methods are needed if prediction through the cycle are to be realistic.
- There appear to be few absolute skills shortages, perhaps in mining engineering and mineral processing but not critically so.
- Criticality is caused by timing of availability as the training duration lag time re-enforces the skills shortage as the upturn develops and compounds the oversupply at the next downturn.
- Training needs to be more aligned with industry cycles – evidence of good practice is there but there is a need for more creative solutions to in-work education and industry-education partnership arrangements.
- Education and training is too slow and not able to respond when needed. If possible it should be speeded up but also cyclicity in education and training institutional income needs to be evened out to avoid capacity loses in downturns.
- Industry and educational sector staff performance metrics need closer alignment - current academia preoccupation on research outputs creates disincentives for industry-education engagement.
- Trades availability is more difficult to assess due to their 'sectorial permeability', and superimposition of mining, infrastructure and housing booms in some countries.
- Mining investment in efficiency, mechanisation and automisation will push up the required skills levels and reduce the opportunities for low skill jobs.
- Mining needs to attract skills not on pay but other career features and, dispel by its actions, the 'hire and fire' reputation of the industry, which drives the high wages sought by people entering what they believe to be a temporary job while a mining upturn lasts
- South Africa needs to retain its newly trained mining staff, address its brain drain, confront labour unrest and cost escalation. It is becoming inefficient and expensive and many mines are only working now due to the currency weakening.
- South Africa needs to improve the basic education required to facilitate mining training and improve university retention and completion rates. It has recently been the beneficiary of much investment so needs to consolidate on this.
- Canada has a major and persisting demographic and skills issue that even the downturn has not solved and needs strategic actions. Canada needs to continue recruitment into the mining industry to avoid another demographically driven skills crisis.
- Australia needs to regain efficiency

and address its high labour costs to avoid under investment in the next decade. Australia has to return to competitiveness, avoid the problems of boom economics and societal expectations, and gear up for a recovery.

- The US will continue to face Mining School closures and major hierarchical divisions of quality minerals education, and must recognize the success of the MEA joined-up model in Australia
- Japan is operating an interesting alternative model of a trade driven raw material strategy, mineral diplomacy and some targeted high technology support for new partners.
- Japan focuses on lifecycle history through products and novel techniques for processing, recovery and re-use.
- Japan's strategy is centred on bi-lateral and multi-lateral, high level international engagement.
- Outreach is relatively minor, and needs hearts and minds education to attract the best staff into the industry in competition with other industries.
- In the past commodity booms and busts were frequently local, national or regional – now they are more interconnected and global as a result of trade, multinational companies, investor expectations, higher capital intensity, and investor prerequisites. Risk management in mining companies is done by the Treasury function to mitigate price and exchange rate volatility – it would be interesting to explore whether mining countries could develop a similar attitude to risk management for skills and staffing through a mining cycle.

Overall it is about strategically managing through constant change: long term trends, commodity cycles, changing politics, and changing human aspirations – indeed a company analysis, insight, and management of these may be considered a strategic advantage as well as being of value in EU policy development.

The next stage of INTRAW is to see how these lessons need to be developed into strategies that would mark the EU out as a place where mining could thrive and the industry would therefore invest. These should aim to create conditions where raw material supply would be a holistically coherent exercise covering physical raw material handling i.e. mining and recycling, but also the diplomatic, legal, and the human resources to undertake these.

References and bibliography

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