



Making the Grade

Human Resources Challenges and Opportunities for Knowledge Workers in Canadian Mining

Executive Summary





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The opinions and interpretations in this publication are those of the author and do not necessarily reflect those of the Government of Canada.

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Who We Are

The Mining Industry Human Resources Council (MiHR) is Canada's national council for the minerals and metals industry. MiHR contributes to the strength, competitiveness and sustainability of the Canadian minerals and metals sector by bringing all industry stakeholders together to address human resources (HR) challenges and opportunities. MiHR is the recognized industry leader in the identification and analysis of HR issues facing the industry and a catalyst for development and implementation of solutions.

Acknowledgements

MiHR partnered with the Canada Mining Innovation Council (CMIC) for development of this research initiative. Consultants who worked on this project on behalf of MiHR and CMIC included Roslyn Kunin and Associates (Vancouver), Courtney Bush (Vancouver), Intergage (Ottawa), Harris Decima (Ottawa), and The Conference Board of Canada (Ottawa).

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- Thomas Hynes, Executive Director, CMIC (partner)
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- Oliver Bonham, Geoscientists Canada
- Stephanie Price, Engineers Canada
- Louise Laverdure, Natural Resources Canada

Past committee participation also included individuals from the following organizations:

- Cambrian College, Federated School of Mines
- MIRARCO Mining Innovation

About the Report

Making the Grade provides reliable, relevant and timely labour market information to support strategic workforce planning and to stimulate a proactive approach to the HR challenges related to knowledge workers in mining. Project work was divided into three phases: a situational analysis; intensive primary and secondary industry research; and stakeholder consultations to develop a strategy and action plan.

This report is an executive summary of the detailed project report: *Making the Grade: Human Resources Challenges and Opportunities for Knowledge Workers in Canadian Mining*. The executive summary report contains key findings and highlights—details and more discussion of the issues are available in the full report.

This summary begins with a brief overview of the project followed by a definition of knowledge workers and the scope of the research. This is followed by a demographic profile of Canadian knowledge workers and a discussion of the key labour market issues related to talent group. The report concludes with recommendations for addressing the issues.

Project Background

Knowledge workers (KWs) are a valuable segment of the Canadian mining industry workforce. They often occupy vital roles; provide the sector with organizational leadership; drive innovation, education, and research and development; and ensure the industry's long-term competitiveness and sustainability. Despite the importance of KWs, the industry lacks key information about this segment of the workforce. Standard sources of labour market information (LMI) do not usually report specifically on KWs, and a system for tracking the stocks and flows of KWs through the mining industry has not been firmly established. In addition, the unique HR challenges and opportunities for KWs have not been articulated.

One of the Mining Industry Human Resources (MiHR) Council's strategic objectives is to research, analyze, forecast and disseminate labour market, human resources and other human capital information relevant to the minerals and metals sector. Such information includes labour market intelligence; sector studies; occupational supply and demand forecasts; and relevant research focused on HR issues. To meet this objective MiHR has undertaken several initiatives to improve the quality and availability of LMI to industry stakeholders. *Making the Grade* will add to this work through research, analysis and dissemination of findings on labour market issues and the short- and long-term HR challenges associated with KWs in the mining industry.

For this project, MiHR partnered with the Canada Mining Innovation Council (CMIC). CMIC is a network of industry, academic and government leaders created to improve the competitiveness of a responsible mining industry by strengthening mining research excellence across Canada. One of CMIC's strategic goals is to “enhance sustainable research performance and receptor capacity through highly qualified people”. In 2008, a CMIC-led working group identified several action items targeted to KWs in mining, including mapping KWs through education and throughout their careers in the sector. MiHR partnered with CMIC to address the KW group and lay the foundation for a better understanding of the KW labour market and its HR issues.

Purpose and Objectives

The purpose of *Making the Grade* is to develop a profile of KWs in the sector and understand the stocks and flows of this segment of the workforce throughout all phases of the mining cycle. The project also seeks to increase knowledge of the related HR challenges and opportunities. Ultimately, project findings will contribute to a better understanding of KWs and enable industry partners to become more proactive and strategic in workforce planning.

Activities

Project work was divided into three phases: a situational analysis; intensive primary and secondary industry research; and stakeholder consultations to develop a strategy and action plan.

Situational Analysis

The first phase of research assessed the current state of the workforce and available labour market information on KWs. Primary activities in this phase included:

- Analysis of the current state of knowledge and a literature review on known labour market conditions for KWs;
- Determination of the scope of stakeholders' labour market information needs;
- An inventory of existing sources of information on labour supply and demand; and
- Identification of labour market information gaps, and determination of probable causes, who is affected, and what has been done to date to address the issues.

Primary and Secondary Research

In this phase, primary and secondary research led to the identification of human resources challenges and opportunities related to KWs in the minerals and metals industry. Activities included:

- Use of surveys, questionnaires, interviews and focus groups with industry stakeholders to determine their short- and long-term KW-related HR challenges;
- Review of literature on KW HR issues relevant to the sector, as well as Statistics Canada data products and reports; and
- Identification of insights into the short- and long-term HR challenges and opportunities facing the sector.

Strategy and Action Plan

In the third phase, industry stakeholders were consulted in an online forum to review project findings and begin to develop an industry strategy for addressing the issues raised. Activities included:

- Consulting with industry stakeholders about Phase 1 and Phase 2 findings through roundtable or focus group discussions and determining the overall implications for the industry;
- Providing insights and suggesting practical solutions; and
- Initiating development of an industry strategy to address identified issues.

Definition and Scope

Although the significance of this labour segment is recognized within the mining industry, there is inconsistency in how KWs are defined. Worldwide, all sectors use a variety of definitions when describing KWs. This lack of uniformity is further complicated by the various terms used in the literature to represent this segment of the workforce. When taking a broad perspective, KWs have been referred to by the following terms:

- Highly Qualified Personnel¹
- Knowledge Worker²
- Skilled Worker³
- Qualified Worker⁴
- Highly Skilled Worker⁵

The above terms have distinct meanings for some stakeholder groups but are used interchangeably by others, which can lead to confusion when examining research results. For example, one group might view “qualified” and “skilled” to mean the same thing, while others might understand them as two distinct concepts. At the outset of the project, the term “Highly Qualified Personnel (HQP)” presented challenges; different stakeholders in the mining sector have different meanings for the term “qualified”. As a result, the term “Knowledge Worker” replaces HQP, to remove as much confusion as possible for a broad audience of stakeholders.

1 McKenzie, M. (2009). Innovation Analysis Bulletin: A profile of Canada’s highly qualified personnel. *SIEID, Statistics Canada*, 1–4; Canadian Federation of Earth Scientists (2008). *Human Resources Needs in Earth Sciences in Canada A Preliminary Survey*.

2 Hall, P. (2005). Brain drains and brain gains: Causes, consequences, policy. *International Journal of Social Economics*, 32(11), 939–950; Smith, K. C. (2005). Existing Knowledge, Knowledge Creation Capability, and the rate of new product introduction in the High-Technology Firms. *Academy of Management Journal*, Vol. 48, No. 2, 346–357.

3 Wylie, J. &. (2008). Shortage of skilled workers poses hard-hitting challenge. *Canadian Mining Journal*, 129(6), 27.

4 Barta, P. (2005). Lack of qualified workers strains mining companies. *Wall Street Journal—Eastern Edition*, 246(34), A1–A7.

5 Ednie, H. (2004). Human resources—innovative solutions for mining’s human resource challenges. *CIM Bulletin*, 97(1076), 9–15.

Knowledge workers are typically defined as people who are highly educated, technologically savvy, and engaged in work that leads to the creation of knowledge and innovation. They can apply theory and factual knowledge quickly and creatively to solve complex problems with shifting parameters. Knowledge workers contribute to organizations through one of three types of knowledge work:⁶

- New or created knowledge work
- Portable knowledge work
- Specialty knowledge work

The social, technological and organizational environments facing *all* industries are changing, which is increasing the number and variety of the roles of KWs. Despite the varied language and terminology used to discuss KWs, the literature is fairly consistent in terms of the roles that KWs play across industries and nations. Common themes include:

- An important role in the application and dissemination of knowledge
- A significant role in generating innovation
- An important role within organizational leadership

Overall, stakeholders agreed that KWs comprise different and unique combinations of education, skill, experience and other special characteristics. In terms of education, they described KWs as:

- Most likely to hold a Bachelor's degree;
- Perhaps having earned a post-graduate degree (Master's or higher), noting that this level of education is particularly important for mining-industry academics and researchers; and
- Sometimes having no university degree but possessing very extensive hands-on and specialized experience in the minerals and metals sector (e.g., engineering or geosciences technicians).

Other characteristics of KWs mentioned by stakeholders include:

- Technologically savvy;
- Possessing knowledge of all phases of the mining cycle, including exploration, extraction, processing and reclamation; and
- Having the “right combination” of mining-related education, hands-on experience and people skills—including an understanding of and sensitivity towards social, political, environmental and community issues, and the ability to navigate or negotiate conflicting interests among these groups.

KW occupations are most likely to include specific types of jobs, including:

- Mining engineers
- Geological engineers
- Metallurgical engineers
- Mineral processing engineers

6 Dove, Rick. (1998). The Knowledge Worker. *Automotive Manufacturing & Production* 110, no. 6: 26–27.

- Industrial engineers
- Mechanical, chemical and environmental engineers
- Geologists, geochemists, geophysicists, and other geoscientists
- Metallurgists and mineral processors
- Highly skilled technologists (who *may* have a university degree). Examples included surveyors; mineral processing technicians; chemical lab technicians; assayers; geological technicians; layout, design, and drafts people; and those working in explosive companies
- Mine managers or mill superintendents with many years of extensive hands-on experience (regardless of educational attainment)
- University and college professors in mining, geology, geosciences and engineering departments
- Mining researchers with expertise in one or more of the above-mentioned areas of specialization

List of Occupations and Industries

To obtain solid labour market information about mining KWs, and to make use of existing data sources, the definition of KWs must be compatible with commonly used categorization indices. Accordingly, the following list of occupations and industries is based on two such indices, the National Occupational Classification for Statistics (NOCS) and the North American Industry Classification System (NAICS).

Four-digit NOCS codes relevant to KWs in minerals and metals include:

C012	Chemists
C013	Geologists, geochemists and geophysicists
C015	Other professional occupations in physical sciences
C021	Biologists and related scientists
C031	Civil engineers
C032	Mechanical engineers
C033	Electrical and electronics engineers
C034	Chemical engineers
C041	Industrial and manufacturing engineers
C042	Metallurgical and materials engineers
C043	Mining engineers
C044	Geological engineers
C048	Other professional engineers, n.e.c.
C054	Land surveyors
C111	Chemical technologists and technicians
C112	Geological and mineral technologists and technicians
C121	Biological technologists and technicians
C131	Civil engineering technologists and technicians
C132	Mechanical engineering technologists and technicians
C133	Industrial engineering and manufacturing technologists and technicians
C134	Construction estimators
C141	Electrical and electronics engineering technologists and technicians

C153	Drafting technologists and technicians
C154	Land survey technologists and technicians
C155	Mapping and related technologists and technicians
A121	Engineering managers
A371	Construction managers
A381	Primary production managers (except agriculture)

When examining KWs, the minerals and metals sector must include the following industry sub-sectors as defined by the North American Industry Classification System 2007 (NAICS 2007):⁷

2121	Coal mining
2122	Metal ore mining
2123	Non-metallic mineral mining and quarrying
2131	Support activities for mining and oil and gas extraction (excluding the proportion related to support activities for oil and gas extraction)
3311	Iron and steel mills and ferro-alloy manufacturing
3313	Alumina and aluminum production and processing
3314	Non-ferrous metal (except aluminum) production and processing
5413	Architectural, engineering and related services (only as related to Mineral Exploration)
6113	Universities (only to the extent such services are directly related to mining, data permitting) ⁸
911	Federal government public administration (only to the extent such services are directly related to mining, data permitting) ⁹
912	Provincial and territorial public administration (only to the extent such services are directly related to mining, data permitting) ¹⁰

From a statistical point of view, the most ideal process for defining KWs in mining is to select specific occupational groups in mining-related industries. This approach allows for reference to data available in public sources and can be easily updated with new data series.

Stocks and Flows of Knowledge Workers

To meet the demand for KWs, the mining industry needs to both understand the roles that they play in mining and to define the stocks and flows of KWs in the sector. In Canada, the mining industry faces both universal and unique challenges in attracting and retaining KWs; a thorough review of global initiatives can provide inspiration for future strategy development.

Despite the growing body of literature on the supply and demand of KWs internationally, the industry lacks systems for monitoring the international stocks and flows of scientific, technical and engineering

7 For a description of how industries are classified in the Canadian economy and the classification codes, refer to Statistics Canada's website www.statcan.gc.ca/subjects-sujets/standard-norme/naics-scian/2007/list-liste-eng.htm

8 To net out the proportion of employment directly related to mining, one can assume that the proportion of employment in each of the KW occupational groups working in mining is the same as the proportion of mining industry employment to employment in all industries.

9 To net out the proportion of employment directly related to mining, one can make use of data available from Statistics Canada's publication *Federal Scientific Activities*, which shows expenditures on scientific research and development by different federal government departments and agencies.

10 In the absence of specific data, one can assume that the proportion of provincial government expenditures on scientific research and development allocated to mining is the same as the proportion derived from federal government expenditures.

personnel. Although as early as the 1960s, the number and distribution of KWs within science and technology (S&T) were acknowledged as important indicators of a nation's S&T effort, countries and international organizations usually saw a need for internationally comparable data only in the context of short-term policy issues. (This was exemplified in the “brain drain” debate and the “aging” of the S&T workforce.) This policy-level focus hindered development of more robust monitoring systems that would have been useful for long-term analysis and research on a wider range of issues.

Global Labour Demographics of Knowledge Workers

Globally, there is evidence of a shrinking supply of KWs in developed nations. The causes are consistent, and related to an aging workforce and increasing competition for KWs within the growing global business environment. A recent analysis of England's stocks and flows of KWs identifies the relationship between globalization and the increasing demand for qualified workers within developed nations¹¹—an important parallel to the Canadian situation.

The most dramatic illustration of the shrinking labour supply is observed in the U.K., which has one of the world's most intense skilled-worker labour shortages as a result of an aging workforce. In an effort to mitigate this shortage, the U.K. has looked towards adopting the Australian point system to help attract highly skilled workers, particularly focusing on entrepreneurs and professionals such as scientists and engineers.

Enrolment Patterns in Mining-Related Post-Secondary Education in Canada

In Canada, public post-secondary educational institutions are regionally based. Universities in several provinces have specific engineering programs in mining and metallurgy. An inventory of those universities offering programs specific to the metals and minerals sector is shown in Table 2 on page 15.

There are also programs in colleges, university colleges, and technical institutes that prepare students for careers in metals and minerals. In addition, most Canadian universities have geosciences departments that produce professionals in exploration and other geosciences occupations (although their graduates may not necessarily pursue a career in the metals and minerals sector). Similarly, almost all universities offer physical and life-science programs, although again, graduates from these programs do not uniquely work in the mining sector.

Throughout Canada, the current number of graduates from mining-specific post-secondary programs is not sufficient to meet the sector's needs. In Canadian universities, in 2009, a total of 860 students were enrolled in Bachelor-level programs within the nine Canadian mining-engineering schools.¹²

11 Bosworth, D., Jones, P., & Wilson, R. (2008). The transition to a highly qualified workforce. *Education Economics*, 16(2), 127–147.

12 Engineers Canada, www.engineerscanada.ca/files/w_report_enrolment_eng.pdf

Table 1
Enrolment in Canadian Mining Engineering Programs, Bachelor-Level

YEAR	NUMBER OF STUDENTS
2000	463
2001	332
2002	313
2003	281
2004	327
2005	323
2006	473
2007	636
2008	755
2009	860

Source: Engineers Canada, MiHR.

A similar shortage is reflected internationally, in an analysis by the U.S. Bureau of Labour Statistics. This analysis recommends that organizations attempt to fill this gap, by looking at other sources of KWs, such as civil engineering graduates.¹³

Globalization and International Mobility of Knowledge Workers

Knowledge workers are a globally mobile labour segment. This is a factor of educational attainment, access to opportunities and the transferable nature of higher-level skill sets. Knowledge workers often participate in high-tech industries, manage multinational enterprises and occupy scientific and technological professions. They are frequently involved with industries that are largely knowledge-based and global in scope.

The movement of KWs has significant impact on the labour market of both the source and destination countries. The market for KWs has become increasingly competitive as industrialized countries compete strategically for this human capital. For permanent inflows of highly-skilled workers, Canada, Australia and the U.S. have comprehensive immigration schemes specifically aimed at attracting skilled workers. Although these systems are not industry-specific, Canada and Australia are the major beneficiaries of skilled immigrants; more than half of their permanent inflows are highly skilled.

From the mining industry's perspective, it will be important to attract a fair portion of workers from national migrant inflows, while also developing specific strategies geared to attracting international KWs who will respond to specific opportunities in the Canadian mining industry.

¹³ Madison, A. (2004). Finding tomorrow's miners. *Rock Products*, 107(10), 24–27.

Increasing Flows with Investment in Research and Development

Knowledge workers play an essential role in the research, development and implementation of new mining and exploration technologies and systems for next-generation mines. Yet, a significant proportion of this group is nearing retirement age.¹⁴ This could lead to a devastating loss of both specialist knowledge and leadership in the sector. To address this issue, in 2008, the Canada Mining Innovation Council assembled industry working groups to discuss KWs. They identified the following action items for the sector:

- Focus on the attraction, development and retention of KWs;
- Improve the research capacity of Canadian mining schools and strengthen links to industry;
- Increase involvement in training and offer more opportunities for students in co-operative programs; and
- Increase the profile of mining research within educational institutions and strengthen the industry's research base.¹⁵

However, a challenge facing the global supply of KWs is the relative sensitivity of R&D investment to the economic climate. Even during times of economic instability, industry leaders recognize the importance of investment in R&D to drive innovation, to help decrease costs and improve efficiencies. Despite the industry leaders' agreement about the importance of investment in R&D, they acknowledged that during an economic downturn, other realities come into play.

Dropping commodity prices and economic downturn negatively affect industry's R&D resource allocation. Historically, R&D expenditure slowed markedly during the economic downturns of the 1990s and the early 2000s. R&D is predominately financed from cash flow, which contracts during downturns. This coincides with banks and markets becoming increasingly risk-averse, creating barriers for firms seeking external funding for research. For example, in Australia the global downturn caused Australian mining companies to put fewer resources into R&D. Mineral broker AMIRA estimated that in some quarters, corporate research investment was down 20 to 30 per cent—due to the drop in commodity pricing in 2009.

¹⁴ Canada Mining Innovation Council. (2008). "Profiles of Canadian Mining Institutions."

¹⁵ *Ibid.*

Demographic and Labour Market Trends

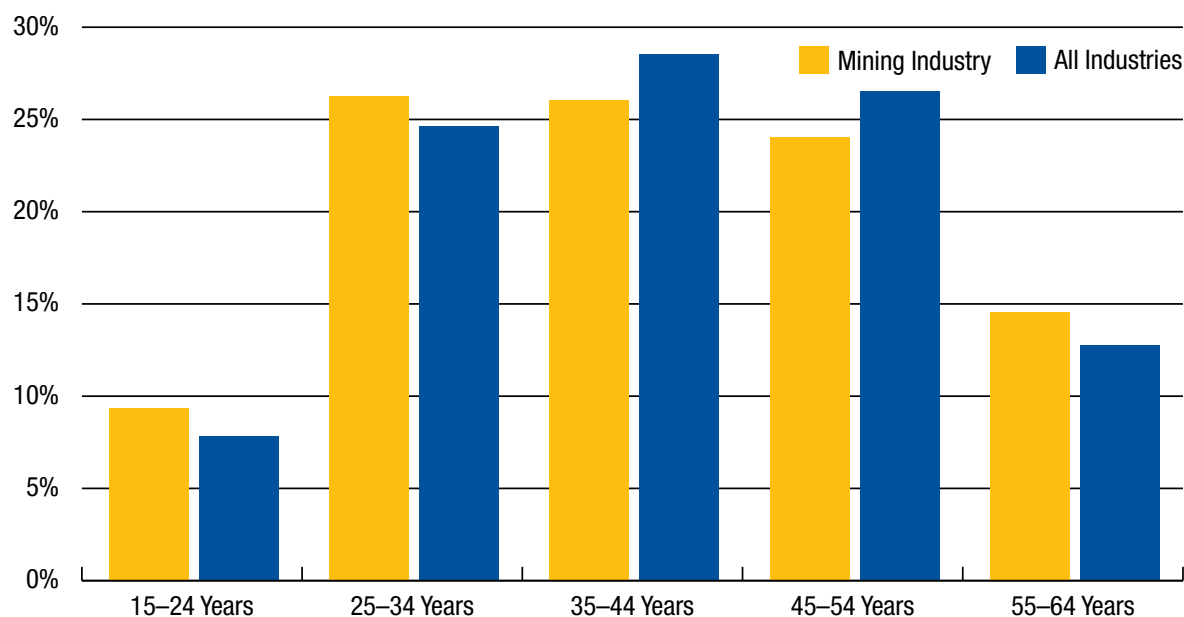
At the time of Statistics Canada's 2006 Census, the total number of individuals estimated to be employed in KW occupational groups in core mining-related industries was about 21,880 people. This accounted for five per cent of individuals in the selected occupational groups employed in all industries. This represents just over 11 per cent of the mining workforce.

Age

Due to their higher educational requirements, the average age of KWs is slightly higher than that of the overall labour force in Canada.¹⁶ However, the age distribution of KWs in mining and exploration is very similar, if not slightly younger, than the age distribution of employees holding the same occupations in the rest of the Canadian labour force.¹⁷ (See Figure 1)

Figure 1
Age Distribution of Knowledge Workers in Mining-Related Industries and in All Industries in Canada, 2006

(Per cent)



Source: Roslyn Kunin & Associates, MiHR, 2010.

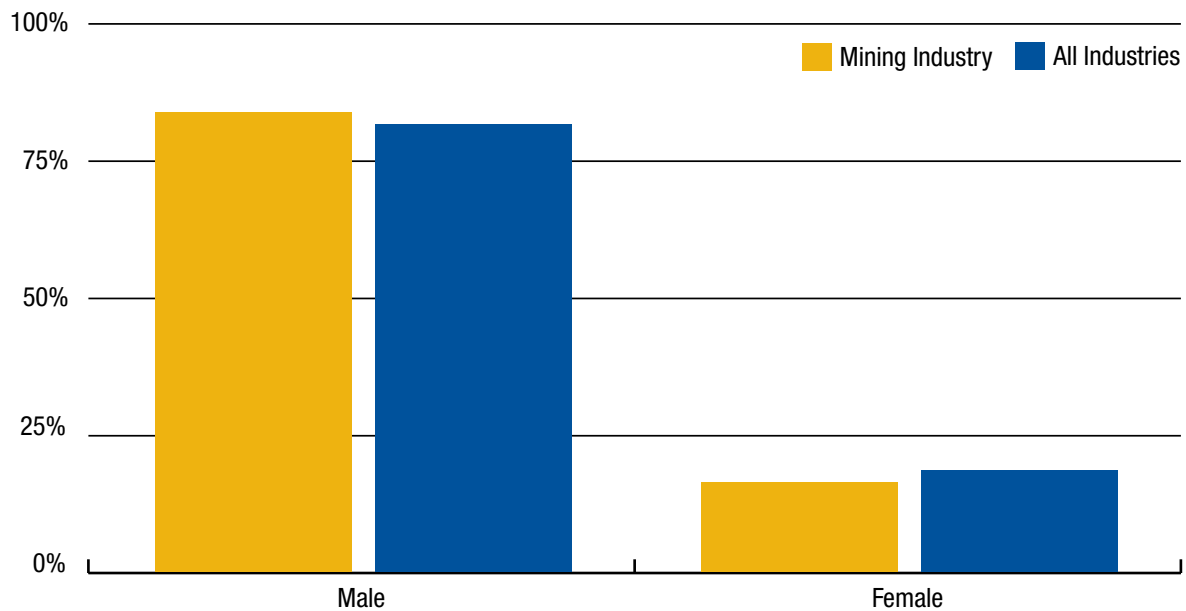
¹⁶ Roslyn Kunin & Associates, Inc. (2009). *Making the Grade: Current and Projected Supply and Demand for Highly Qualified People in the Canadian Minerals and Metals Industry*. Situational Analysis, unpublished report for MiHR.

¹⁷ *Ibid.*

Gender

Mining and exploration has traditionally been a male-dominated industry; today, women are still significantly under-represented in the sector's labour force.¹⁸ Furthermore, women are also under-represented in KW occupations in mining and exploration.¹⁹ This pattern is not restricted to the mining and exploration sector, as women are not as prevalent as men in these occupations across all industries in Canada. (See Figure 2)

Figure 2
Female Knowledge Workers in Mining and Exploration and in All Industries in Canada, 2006
(Per cent)



Source: Roslyn Kunin & Associates, MiHR, 2010.

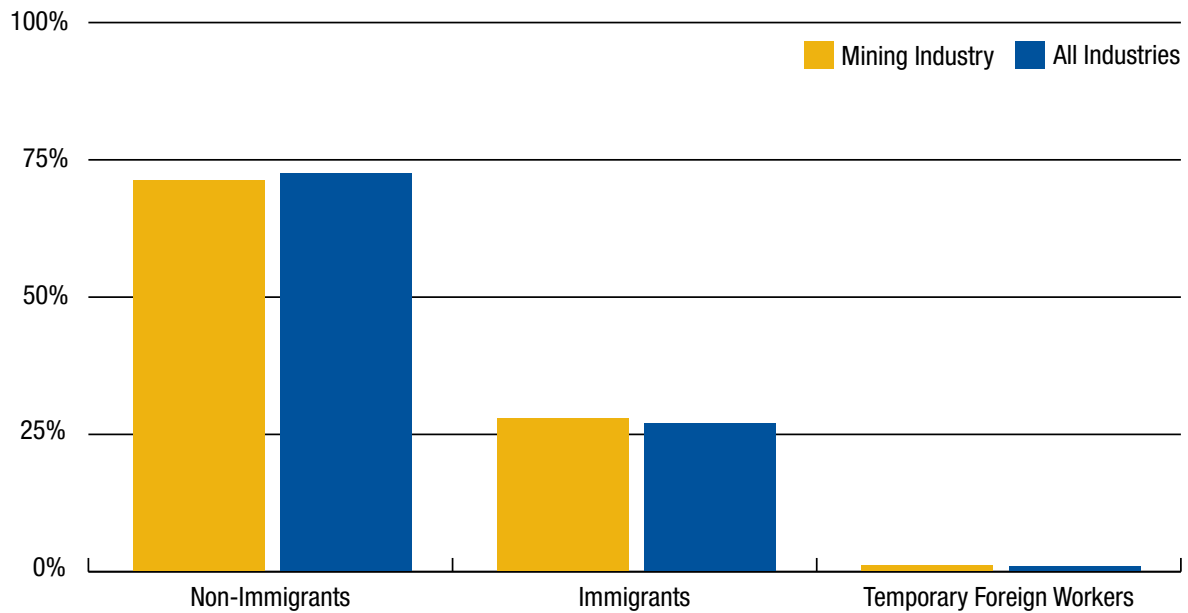
18 Women in Mining Canada. (2010). *Ramp-UP: A Study on the Status of Women in Canada's Mining and Exploration Sector*. Ottawa: Women in Mining Canada.

19 Roslyn Kunin & Associates, Inc. (2009). *Making the Grade: Current and Projected Supply and Demand for Highly Qualified People in the Canadian Minerals and Metals Industry*. Situational Analysis, unpublished report for MiHR.

Immigrant Status

The Canadian mining and exploration sector must compete for its KWs on a global scale. The Canadian mining and exploration industry appears to be successful in attracting foreign workers—particularly engineers—since the proportion of immigrant KWs in the sector is higher than in all industries in Canada across several key occupations. (See Figure 3)

Figure 3
Immigrant Status of Knowledge Workers in Mining and Exploration and in All Industries in Canada, 2006
(Per cent)



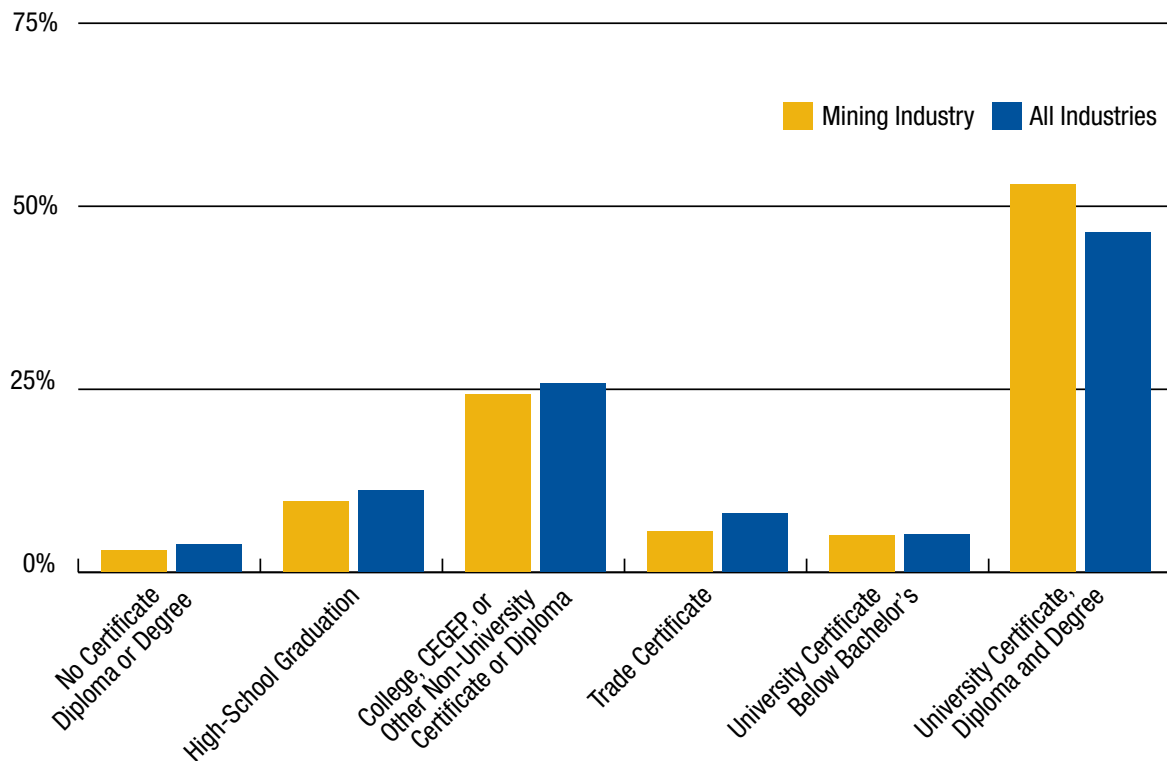
Source: Roslyn Kunin & Associates, MiHR, 2010.

Educational Attainment

Not surprisingly, individuals employed in the KW occupational groups have attained higher levels of education and training than the general workforce, especially given that these workers need a minimum of a Bachelor's degree to be considered for employment.

Almost 70 per cent of individuals in the KW occupational groups have completed at least a college-level education. This level is remarkably higher than the 41 per cent in the general workforce. Figure 4 shows the educational attainment of that portion of the KW workforce between the ages 15 and 64. The figure includes all industries, including mining. It shows that the KW workforce in general is comprised of highly educated individuals, and thereby enforces the importance of ensuring Canadian universities and other educational institutions continue to produce a reliable supply of these individuals.

Figure 4
Educational Attainment of Knowledge Worker Workforce in Mining-Related Industries and All Industries, Canada Age 15–64, 2006



Source: 2006 Census, Statistics Canada

Table 2
Universities Offering Mining Education in Canada²⁰

MINING AND MINERAL ENGINEERING	METALLURGICAL ENGINEERING	GEOMATICS ENGINEERING	PETROLEUM ENGINEERING	GEOLOGY, ENVIRONMENTAL, AND EARTH SCIENCES	MINING OPERATIONS
Dalhousie University École Polytechnique Laurentian University McGill University Queen's University Université Laval University of Alberta University of British Columbia University of New Brunswick Université du Québec en Abitibi-Témiscamingue University of Toronto	Dalhousie University École Polytechnique McGill University Université du Québec à Chicoutimi Université Laval	University of New Brunswick	Dalhousie University Memorial University of Newfoundland University of Alberta University of Calgary University of Regina	Acadia University Brandon University Brock University Carleton University Dalhousie University École Polytechnique Lakehead University Laurentian University Malaspina University/College McGill University McMaster University Queen's University Saint Mary's University Simon Fraser University St. Francis Xavier University Université du Québec à Chicoutimi Université du Québec à Montréal Université Laval University of Alberta University of British Columbia University of Calgary University of Guelph University of Manitoba University of New Brunswick University of Ottawa University of Regina University of Saskatchewan University of Toronto University of Waterloo University of Western Ontario University of Windsor York University	University of Regina

Source: Roslyn Kunin & Associates, 2009. Adapted from Association of Universities and Colleges of Canada—Directory of Canadian Universities.

20 Canada Mining Innovation Council. "Profiles of Canadian Mining Institutions." 2008.

Flow of Knowledge Workers into the Industry

Mining is in competition with several other industries, most notably oil and gas, when it comes to attracting KWs. Post-secondary institutions must address students' concerns about careers in mining and mineral exploration, if they are to be competitive in attracting them to the industry. The following are some of the concerns and misperceptions that arose in this study's *Student Survey* and which academic institutions can help mitigate:

- Lack of awareness about the industry
- Need for increased student work opportunities
- Remote work locations
- Perceptions about poor environmental impacts

Although a variety of programs are offered to address some of these issues, these offerings do not appear to be consistent across institutions. It also appears there is little awareness about many of these initiatives outside the industry.

HR Challenges and Opportunities

Due to global competition and the increasingly technological nature of the work, KWs are crucial to the future prosperity of Canada's mining and exploration industry. To ensure a knowledge-rich workforce, sector employers will need to adapt their recruitment, retention and succession-planning strategies to better suit the needs and career aspirations of these highly skilled professionals. Understanding the importance of these individuals to mining and exploration, the Mining Industry Human Resources Council (MiHR) undertook a research study to collect and analyze key stakeholder opinions on the needs and expectations of KWs in the sector.

Interviews with employers and industry experts revealed that the most pressing HR concerns within the industry are attraction and retention. Issues relating to impending retirements and succession planning did not emerge as a primary concern during the interviews; however, demographic data for the industry as a whole indicate that the loss of senior professionals will become an issue in the near future.

Quantitative data were obtained through two surveys conducted by MiHR: a *Student Survey* (using a student sample) and a *Knowledge Worker Survey* (using an employee sample). The surveys addressed areas of concern for current and future KWs, including:

- Attractive elements of mining careers
- Unattractive elements of/deterrents to mining careers
- Relative importance of various job factors in choosing a mining career
- Industry and career awareness

Qualitative data were obtained through key informant interviews with the following stakeholder groups:

- Industry employers
- Industry experts
- Academics
- Students

The research revealed several key insights that outline some of the primary motivators of KWs. These findings provide industry employers and post-secondary institutions with strategies and practices to attract and retain KWs. Among these findings:

- While KWs represent only 11 per cent of the industry's workforce (compared to 22 per cent for all other industries), they play a crucial role in ensuring innovation and performance within the industry.
- Students place less emphasis on compensation as an attractor to the industry than do KWs currently employed in mining and exploration.
- Students are more concerned about the sector's environmental impacts than are current KWs in the industry.
- Students currently in mining programs believe that the industry is competitive in attracting new recruits. Those who are not currently enrolled in mining programs, however, do not see the industry as competitive.
- Fewer women than men currently employed in the industry indicate that they will still be employed in the industry in three years' time. This pattern for women is not due to retirements, but rather to mid-career attrition.
- Female KWs currently employed in the industry list compensation as one of the least rewarding aspects of their career, whereas men currently in the industry list it as the most attractive aspect of their careers.
- A majority of students in non-mining-related programs (77 per cent) indicate potential interest in a career in mining and exploration in the future. A very similar percentage of KWs not currently employed in the sector indicate an interest in the industry (78 per cent).
- Both students and current KWs acknowledge the importance of work opportunities in the sector as a means of building career awareness among students. While students think that post-secondary opportunities (e.g., work placements and co-operative education) are of primary importance, current KWs see opportunities for high school students as the top priority.

The recommendations arising from this research include the following:

- Align recruitment strategies with the expectations of KWs.
- Reach broader audiences through informational and recruitment initiatives.
- Ensure that the concerns of female KWs are addressed.
- Explore alternate forms of career development for mid-career technical professionals.
- Ensure stable and continued investment in research and development activities.
- Continue to build collaboration among academic institutions, employers, government and industry associations.
- Expand work opportunities for both secondary and post-secondary students.



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