

Producing the Mining Professionals Required for the 21st Century

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Outline

- Background
- Numbers and Needs
- Mining Curriculum
- Recruitment and Retention
- The “new” Mining Professional
- ICREME

Background

- Number of Mining Schools worldwide ~275
- Number of "strong" schools ~60
- Closures over the past 25 years ~120
- Closures over the past 10 years ~30
- Different Approaches
 - Europe - unified program
 - Australia - unified program
 - South Africa - looking elsewhere
 - U.S. - schools closing
 - Canada - schools reopening/closing

The Problem

“...labour force growth will slow; skills requirements will keep rising; ...a growing gap between demand and supply of labour market entrants with post-secondary education...”

Innovation & Skills in the Natural Resource
Sectors: National Roundtable
Natural Resources Canada 2002

The Problem (continued)

“The Canadian mining industry will need up to 81,000 new people to meet current and future needs and to fill positions vacated by retirees...”

The Mining Industry Training and Adjustment Council – Canada (MITAC) (MITAC 2005)

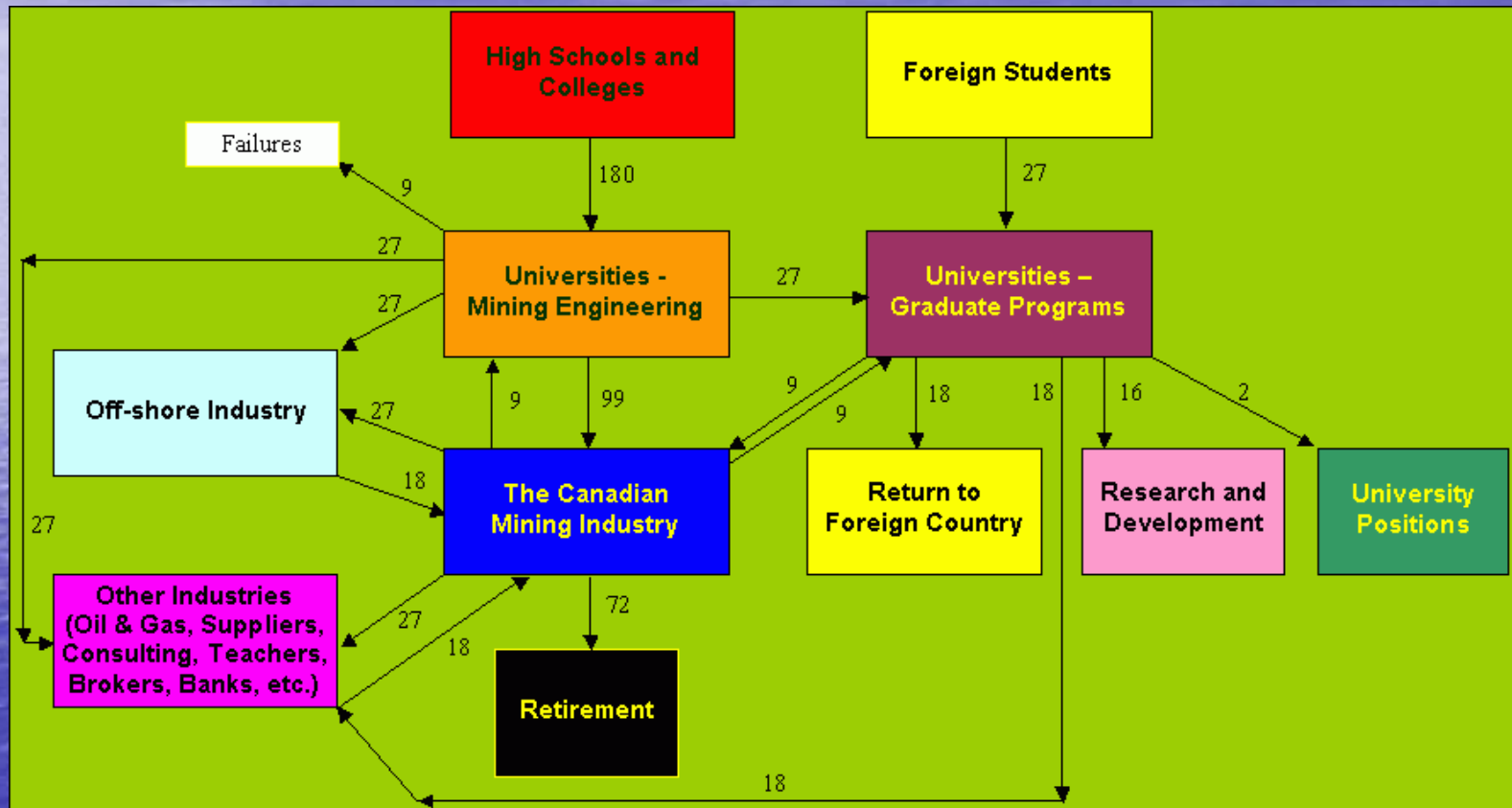
Model of Canadian Production of Mining Engineers

- Where do Canadian Mining graduates come from?
- Where do Canadian Mining graduates go?
- How many schools are needed to meet demand?
- Which schools, in any, should be closed?

Model of Canadian Production of Mining Engineers (assumptions)

- About 100 new Mining Engineering graduates are needed each year
- 15% go into post-graduate training (M.Sc., Ph.D., law, MBA, teaching)
- 50% of the intake into Mining Eng. advanced degrees is foreign
- 66% of foreign graduate students return to their home country
- About 2 new professors join each Mining Eng. faculty every 5 years
- One undergrad per school enters as a mature student from industry
- 15% of graduates take positions in off-shore countries
- 15 % of undergraduates take positions in jobs outside Mining
- 30% of graduates take positions in jobs outside Mining
- 18 mining engineers per year come to Canada from off-shore
- 18 mining engineers per year come into Mining from other industries
- 27 mining engineers are lost each year to off-shore mining operations
- 27 mining engineers are lost each year to other Canadian industries
- Annual retirement rate is 72 mining engineers per year
- Intake from high schools and colleges into Mining is 180 per year

Model of Canadian Production of Mining Engineers



Annual Canadian flow of individuals (average over the 1990s) into and out of Mining Engineering career paths.

Canadian Mining Departments

- Dalhousie Technical University (Nova Scotia)
 - Recently distributed to Civil and to Earth Sciences
- Laval University (Quebec)
 - Mainly serves the Quebec industry
- McGill/Ecole Polytechnique (Quebec)
 - Combined bilingual program shared between two universities
- Queen's University (Ontario)
 - Largest school (50% of all mining engineers in Canada)
- University of Toronto (Ontario)
 - Distributed between Civil and Earth Sciences
- Laurentian University (Ontario)
 - Smallest university but growing (heavy support from Falconbridge and Inco)
- University of Alberta (Alberta)
 - Industry saved program in 2000
- University of British Columbia (British Columbia)
 - Enrollment has tripled between 2000 and 2005

Recruitment and Retention at UBC

- Previously 50% of intake was forced
- Today 92% of 2nd Year students selected Mining as their first choice
- How did we change this?
 - Active recruitment campaign amongst 1st Year
 - Involved the local mining industry
 - Produced a CD-ROM on mining and UBC-Mining
 - Held multiple contact events
 - Changed name of the department
 - Arranged summer jobs for 1st Year students
 - Changed our curriculum
 - Increased department profile
 - Entered the DARPA Grand Challenge
 - Placed emphasis on Program Quality
 - Increased recruitment of Graduate Students

What is Team Thunderbird?

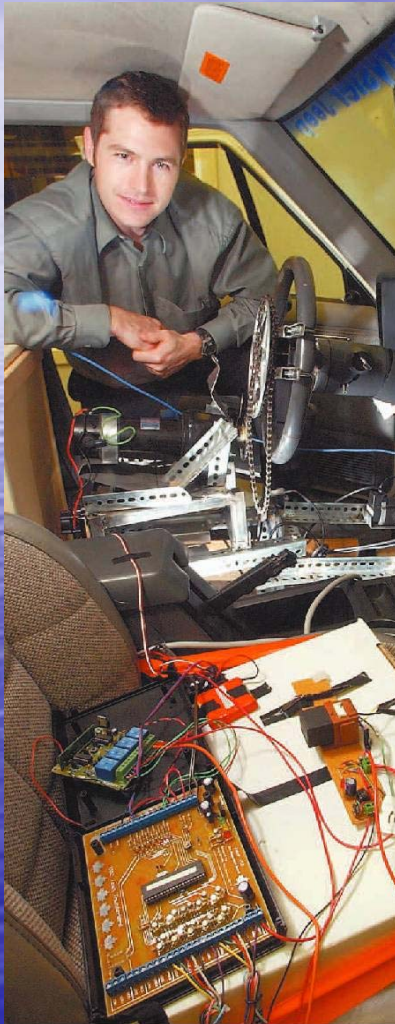
- Group of undergraduate students interested in robots (130)
- From all Engineering disciplines and Computer Science
- Formed to enter the 2005 DARPA Grand Challenge
- Activities have expanded to 5 new projects
 - NASA Centennial Challenge (moon dust excavation)
 - NASA Centennial Challenge (space elevator)
 - NASA Centennial Challenge (assembly robots)
 - University of Waterloo Robot Racing Competition
 - DARPA Grand Challenge 2007

Sponsor Support



History of Press Coverage

Vancouver Sun



...and just have it give you
"You could throw this into a non-
powered car or vehicle — giving it a
operations systems that could be
developed and mechanical
start-up, said the group hopes to
develop software and mechanical
members.
controls developed by the students
range of controllers ranging in
range of controllers ranging in
the Association of B.C. with a wide
Project sponsors include the Min-
ent cars."
that could be transferred into differ-
able of terrain and weather systems
we know is capable of driving in that
we've elected to start with a vehicle
building a vehicle from scratch,
one part in my opinion,
the driver's seat. It could be built
into a single box that sits on
much of the system as possible inte-
grated into a single box is to have as
"On the long term goal is to have as
our next goal is to survive the air-
said. "Now that we've achieved that,
UBC's winning program from Mech
AWARD to come up with the
"On top of this year was to get
Roberts.
at a brief demonstration in Point
needed for a VAMP that was man-
the first dubbed Quantum will be
round for this year's competition and
already made it through the first
student recruit as team leader has
The UBC group, with a U.S. team
gender for humans.
ing operations that may be too dan-
erous for humans — using
autonomous robot vehicles in mini-
ature environments — a task
that would have applications in
robotics that can develop technol-
ogy that can develop technol-
UBC students leading the project.
last year's contest.
vehicle only contest that has been of
warded after the most successful
and no prize was
It was a tougher challenge than
ministry gave military applications
robotics and vehicle design that could
competitors would come to the
DAVIAI, launched the event in 2004
Research Projects Agency for
The U.S. Defense Advanced
wire forces.
to other undergrads and parked
offering everything from saved loads
to a 12-mile obstacle course
maintain distance systems to cars, it
through the course with only air way
the vehicle must make its way
— No remote controls allowed —
of 80 mph.
its on track as it travels at speeds up
with no human pilot to keep the ve-
hicle across the Mojave Desert —
for that, look to enter in a 10-hour
on the development of a self-drive
ments have spent thousands of hours
mental group of about 60 UBC stu-
Since September a multi-depart-
ment's logical notes are
winner of what appears to be the
offered by the U.S. military to be
R.C. has claimed a 23-million U.S. prize
students at University of



DARPA Video



Name Change from MMPE

- Mineral Resources Engineering NO!
- Mining Engineering YES!
- Can't sell Mining? YES, we can!
- Did Processing lose? NO, we gained!

How is Curriculum is Developed

In response to

- industry needs
- teaching loads
- available instructors
- student interests
- competition amongst Engineering disciplines

Modern Mining Curriculum

Canadian Engineering Accreditation Board (basic requirements)

<u>ELEMENTS</u>	<u>STANDARD</u>	<u>TYPICAL</u>
Fundamental Sciences	1-2 terms	2 terms
Mathematics	1-2 terms	1 term
Complementary Studies	1-2 terms	1 term
Engineering Sciences	2-4 terms	2 terms
Engineering Design	2-4 terms	2 terms

Modern Mining Curriculum

- First Year (general program)
 - Chemistry
 - Physics (and into 2nd year)
 - Mathematics (and into 2nd year)
 - Computing
 - Complementary Studies

Modern Mining Curriculum

- Earth Sciences
 - Geology, mineralogy, rock structures
 - Orebody modeling (geostats)
- Mining Technologies
 - Open pit / underground methods
 - Shaft-sinking, hoisting, stoping
 - Ground support & stability
 - Ventilation systems
 - Drilling, blasting and explosives
 - Mine design and scheduling
- Mineral Processing/Metallurgy
 - Comminution
 - Flotation
 - Hydrometallurgy
 - Pyrometallurgy
 - Dewatering
 - Plant Design
- Mine/Mineral Economics
 - Time-value, risk assessment
 - Mineral commodity markets
- Electro-mechanical Equipment
 - 3-D AutoCAD
 - Mechanical equipment (design/use)
 - Materials handling (waste and ore)
 - Industrial automation and robotics
 - Electrical machines and power
 - Process Control
- Sustainability & People Skills
 - Water, Power, Sanitation
 - Environmental Protection
 - Communities/First Nations
 - Occupational Health and Safety
 - Mine Management and Leadership
 - Complementary studies

Students Respond to:

- Jobs and Coop Programs
- Environment
- Sustainability
- Robotics and High-Tech
- Management and Leadership Training
- Research Opportunities
- How the industry is doing

The “new” Mining Professional

- More breadth of knowledge
- More emphasis on environment and sustainability
- More instruction in process control & computing
- More flexibility and independence
- More understanding of global issues
- More Research and Development
- More interaction with industry
- Higher academic standard

Statement made this week by a South African Mining Executive

“We can always find people”

“If *black students* aren't choosing Mining,
then we are just looking in the wrong place!”

Statement made this week by an Australian Mining Executive

"Why are there 12 Earth Science programs in
the Ontario university system?"

"You need to consolidate!"

What's wrong with these statements?

1. They are looking to the past.
2. They ignore the quality aspect of training Miners.
3. They don't identify the real competition.
4. They consider universities the same as companies.
5. "Economies of scale" don't work in the long-run in a university (people-producing) system.
6. They demonstrate a bias against academia.

Bias against Academics

- Is it real and widespread? YES (*my opinion!*)
- Is it an earned attitude? YES (*my opinion!*)
- How do we overcome it?
 - By working together to solve the problem
 - By developing a sustainable approach
 - By linking academics to industry
 - By linking strong academic programs to weak ones
 - By developing “quality-based” programs that
 - Attract new people
 - Compete directly with other disciplines for funding

Industrial Viewpoints MUST Change

- Universities are not companies
 - Mergers/closures work counter to improving numbers or quality
- Miners need Processing Knowledge and vice-versa
 - Mineral Processors == Miners
- Chemical Engineering is only a Partial Answer!
 - Lack of mining or geology
 - Lack of comminution or flotation
- Quality Programs and Quality Research is the Answer!
 - Compete with other Disciplines (not amongst Earth Science departments)
- High-tech and the Environment attract Young People
- Sustainability is the Answer!
 - Communities
 - Mining companies
 - University programs

ICREME – an opportunity to plan

The First International Conference on Research
and Education of Mining, Metallurgy, and
Materials Engineers

Location: Vancouver, British Columbia

Dates: March 11th – 14th, 2007

Venue: The Wosk Centre for Dialogue

ICREME – an opportunity to plan

The First International Conference on Research and Education of Mining, Metallurgy, and Materials Engineers

Objective

To develop a long-term strategy to strengthen Earth Science –related Programs around the World

The conference will focus on a plan of action to be implemented collaboratively by industry and academia

ICREME – an opportunity to plan

The First International Conference on Research and Education of Mining,
Metallurgy, and Materials Engineers

Program

Technical Papers on

- Recruitment and Retention
- Developing the Mining Professors of the future
- Linking First World and Third World Educators
- Putting industry into the classroom
- Continuing education programs
- Research activities that support education
- Research (short-term) that can be done by academia for industry
- Research (long-term) that can transform industry

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Program

Round Table Discussions on

- A Plan of Action
- Industry-University Collaborative Projects
- Funding Support Opportunities
- Elevating the Quality of Mining Programs Worldwide
- Industrial Research Needs
- Academic Approaches to Research Idea Generation
- Engaging with Non-traditional Disciplines
- Future Trends (after sustainability, what's next?)

ICREME – an opportunity to plan

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Program

Social Program

- Opening Reception
- Lunches
- Speaker Breakfasts
- Conference Banquet
- Student Demonstrations, Posters, and Competitions
- Tours (UBC, Britannia Beach, HVC, Quinsam Coal)

So plan on coming to Vancouver, B.C. next March 11th – 14th, 2007