Enhancing Innovation and Technology Development Capabilities Through Collaboration

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Outline

● Cameco Technology and Innovation
  – History
  – Strategy
  – Team
  – Corporate objective for technology
● Collaboration
  – CMIC
  – IMII
  – CCNI
  – Others
● Concluding remarks
CTI History

- R&D Division of ENL (Ottawa, 1953)
- R&D labs constructed (Ottawa, 1957)
- Troubleshooting for operations (1970s/1980s)
- R&D relocated (Saskatoon, 1989)
- R&D relocated (PHCF, 1994)
- R&D named CTD (1997)
- New operations department – Innovation & Technology Development (2007)
  - Research Centre, Ideas Coordination and alphaNuclear
- Realignment of departments and formation of new team – Cameco Technology and Innovation (2011)
CTI Reformation

Renewing ourselves as we go forward - to meet Cameco’s needs

- 2007/2009: Roles and responsibilities review,
- 2009/2010: Interview of 20 stakeholders,
- 2010-1st Q: Review with COO and President,
- 2010- 4th Q: Encouragement of increased scope and budget,
- 2010/2011: Review of resource requirements, budget & action plan
- 2011-1st Q: Reorganization & review of strategy
- 2011-2012: Realignment of CTI
Stakeholder – Key Messages

CTI must:

● be aligned with the strategic plan, doubling uranium production --- support production growth, improved operating efficiencies and/or reduced environmental footprints

● enhance environmental leadership and performance

● expand research and development capabilities through collaboration internally and externally

● provide technological leadership

● educate and inform

● advance innovation culture

● build and maintain customer satisfaction
Meeting the Demand from the Business

Activities

● Internal focus
  – Assess and adjust internal workforce, expertise
  – Improve business practices – innovate
  – Coordination of distributed resources

● External focus
  – Collaboration
  – Alliances

Expand our Capabilities
CTI Strategic Plan - Focus Areas

- Strategic Focus
- Technological Leadership
- Identific’n of Future Needs
- Collaboration
- Quality Management Practices
- Qualified & Engaged Team

DRIVERS

ENABLERS
Advancing the CTI Strategy

- CTI renamed and reorganized
- Increased internal collaboration by strengthened relationships with:
  - Operations
  - Corporate Development
  - Exploration
- Increased external collaboration
  - Universities (Chairs, sabbatical, coop, contract research)
  - technology suppliers
Implementation Plan

- 2010: Technical Working Group Formed
- 2011: CTI Steering Committee Formed
- 2012: R&D Portfolio Expands to 50 Projects
- 2013: Research Partnership with USask
- 2014: Gap Bridged on Critical Process Technology Expertise
- 2015: RC Lab Complete - Move In
- 2016: Cameco Achieves 'Double U'
- 2017: CTI Continues Strategic Plan
- 2018:
- 2019:
- 2020:
Coordination of Technology and Innovation

COO

Technology and Innovation Steering Committee

VP CTI

Resources

Science Integration
Research Centre
Mining, Metallurgy & Geo-environmental Engineering
Conversion & Fuel
alphaNUCLEAR
Ground Freezing Services

Technology Networking Group

Exploration
MCA+KLO+CL+RLO
CBO+SRH+ CRI
BRR+PHCF+CFM+FSD
SHEQ
EL
Corporate Development
Major Projects
BTS

Operations/Dept. Reps.
Cameco Technology and Innovation

CTI Mandate
To enhance Cameco’s dominance in producing uranium fuel through technology leadership
CTI Roles

Science Integration

Research Centre

Mining, Metallurgy, Geo-environmental Engineering

Ground Freezing Services

Conversion and Fuel

alphaNuclear
CTI Provides Knowledge Capital

Program Areas
Customer Groups
Areas of Expertise
Products & Services
CTI – Collaboration

- CTI identifies and capitalizes on technologies, innovations and ideas to serve Cameco’s interests
- CTI expanded through collaboration with high quality R&D organizations – enhanced research output
- Greater coordination and collaboration in seeking access to higher levels of research funding
- Training of students to become future workforce in mining and nuclear industries
- Training of our people
- Flexibility

Establish a culture of collaboration, optimize research and engineering design efficiency, and enhance innovation potential
CTI – Collaboration

- Chair program
  - 4 university chairs to date

- Sabbatical program
  - Researcher embedded with Cameco (6 months – 1 year), 6 to date
  - Conducts R&D and generates ideas for future projects
  - Conduit for future interaction with involvement of graduate students

- R&D contracts
  - Focused
  - Collaborative research agreements
  - Leveraged industry funds – NSERC, OCE

- Industrial PhD or Masters degree program
  - Working on real issues
Collaboration

Divisional Teams in Technology Development

Internal Partners
- Exploration
- Mining & Milling
- Fuel Services
- Major Projects
- Safety & Environment

Technology Development Portfolio Management

Cameco Technology and Innovation (CTI) Services
- Expertise Support Testing
- Technology Leadership
- Strategic Projects
- Identification Future Needs

External Partners
- Government Agencies
- Universities
- Engineering Firms
- Test Laboratories
- Technology Suppliers

Cameco Technology and Innovation
Collaboration

CTI Services
- Expertise
- Technology Leadership
- Strategic Projects
- Identification Future Needs

External Partners
- Government + Agencies
- Universities
- Engineering Firms
- Test Laboratories
- Technology Suppliers

- Cameco Technology and Innovation
Collaboration

CTI Services
- Expertise Support Testing
- Technology Leadership
- Strategic Projects
- Identification Future Needs

External Partners
- Government + Agencies
- Test Laboratories
- Technology Suppliers

Cameco Technology and Innovation
CTI Resources

Over the last 10 years $4 to 8 million, <40 people

Last 2 years $12 to 14 million, ~80 people
Measuring Success

We count applications to operations
We count the financial impact
We recognize the innovation
Measuring Success

Safe, Healthy & Rewarding Workplace
Environmental Leadership
Supportive Communities
Outstanding Financial Performance
Cameco Technology and Innovation Future!

Continual improvement of existing operations
Provide oversight to growth projects
Provide technical expertise during due diligence

Look for Game Changing Technologies
Game Changing Technologies

- Long List of 17 Options
- Short List of 10 High Priority Projects
- 2 Game-changer Project Areas
Uranium Recovery Transformation

- A spectrum of opportunities

High Grade

MCA/CL 220,000
MLM 45,500
EP 4,400
SRH 930
Inkai 680

Low Grade

Seawater
0.003 ppm

Low Grade/High Volume
- Kintyre
- Others

Uranium as Byproduct
- U from phosphate
- U from shales
- U from base metal production
Key Messages

- Skilled motivated team focused on Cameco’s future
- Concept to commercialization
- Expand our capabilities through internal and external collaboration

CTI Mandate
To enhance Cameco’s dominance in producing uranium fuel through technology leadership
“fostering innovation” is in Cameco’s leadership competencies, and innovation is not one person or one group’s job, it is everybody’s job!
Every project we implement is an opportunity to bring in new technology or to improve what we are doing!
Cameco’s Technology and Innovation department is a world mining industry leader.

If solving complex technical issues appeals to you – from recovery of uranium to producing nuclear fuel – then Cameco has a career for you.

Making a difference!
Canadian Mining Industry: Innovation for Survival and Growth

Canada Mining Innovation Council
Canada’s Mining Industry

• Globally significant producer of aluminum, diamonds, nickel, potash, sulfur, titanium, uranium, and substantial producer of coal, copper, gold, molybdenum, platinum, silver, zinc and other specialty products and metals

• Over 320,000 well-paid jobs

• Major employer of northern Canadians (& largest private employer of aboriginal people)

• Supported by 3,200 suppliers and contract companies

• 3.5% of Canada’s GDP – taxes & royalties of $8.4B (2010)

• Major face of Canada abroad through the Canadian exploration industry, Canadian-owned operations in other countries, and financing capacity

• Historical leader in mining education, research and technology development

• With increasing emphasis on high tech mining, competitor nations now leading in specific areas such as automation
Canadian Mining Challenges
Innovation Drivers --- Opportunities

- Canadian reserves for major commodities are in decline
- Exploration is more challenging and more expensive
- Many Canadian mining operations are going deeper,
- The industry competes in a global market – many costs are escalating (materials, labour, power)
- The shortage of critical personnel will be exacerbated by demographics – retiring baby boomers
- The industry pursues high and consistently increasing standards of safety and environmental performance
- The industry is “high tech” with many new applications of automation, processing and planning – innovation and creative talent are fundamental requirements
A group from Government, Industry and Academia formed the Canada Mining Innovation Council (CMIC) in 2006-7

**Landscape**

- Global resource boom and intense competition for resource investment
- Canada’s resource base declining
- Canada’s leadership position in exploration, mining and mining technology slipping – competition from Australia
- Developing shortage of Canadian talent in mining
- Many traditional academic centres seeing reduced funding, faculty and students related to mining

A Pan-Canadian collaborative organization was required to address these issues – CMIC
In 2008, EMMC

• Endorsed the creation of CMIC as a not-for-profit organization
• Endorsed CMIC’s Pan-Canadian Mining Research and Innovation Strategy

Progress since endorsement:

• 2009: CMIC was incorporated and industry led technical committees were organized to prioritize and implement needed research initiatives
• 2010: Exploration initiative developed – set the standard for industry alignment and involvement
• 2011: Similar process started for the mining, processing, energy, highly qualified people (HQP) initiatives; CMIC assisted formation of the oil sands tailings consortium
• 2012: New initiatives developed in environmental stewardship and mineral tailings
Vision: Canada is the global leader in a socially and environmentally responsible, safe and productive mining industry through leading-edge research and innovation.
To pursue this vision and address the innovation challenges, CMIC seeks to achieve the following:

• Improve the rate of mineral discoveries to reverse Canada’s declining mineral reserves

• Improve energy and cost efficiency in the development and operation of Canada’s mines leading to enhanced economic viability for the industry

• Improve safety and environmental performance

• Increase educational and research capacity leading to the development of critical Canadian talent
CMIC Members in 2012

3M
Abitibi Géophysique
Adriana Resources
Advanced Applied Physics Solutions
Agnico-Eagle
Altius
Anglo-American
Arcelor-Mittal
Barrick Gold Corporation
Boart Longyear
Cambrian College
Cameco
Canadian Association of Mining
Equipment & Services for Export
Canadian Institute of Mining, Metallurgy & Petroleum
Canadian Light Source
Canadian Mining Industry
Research Organization Centre for Excellence in Mining Innovation

Cliffs Natural Resources
Consortium de recherche en ressources minérales
De Beers Canada
Denison Mines Corp.
DGI Geoscience Inc.
DIVEX
École Polytechnique
Franklin Geosciences Ltd.
Fugro Airborne Surveys Corp
Gedex
Golden Star Resources
Gold Fields
Goldcorp
Hatch
HudBay Minerals Inc.
IAMGold Corporation
Inmet Mining
Kingston Process Metallurgy
Kinross Gold Corporation
Laboratoire international de géophysique minière
Laurentian University
Laval University

LookNorth
McGill University
Memorial University of Newfoundland
Mining Association of Canada
Mira Geoscience Ltd.
Mirarco
Natural Resources Canada
New Millennium Capital Corp.
Oil Sands Tailings Consortium
Osisko Mining Corporation
Prospectors & Developers Association of Canada
Queen's University
RD Corporation - NL
Saskatchewan Research Council
Shore Gold
SNC-Lavalin
SRK Consulting (Canada)
Symboticware
Teck
Université du Québec à Montréal
Université du Québec en Abitibi-Témiscamingue
University of Alberta
University of British Columbia
University of Manitoba
University of New Brunswick
University of Saskatchewan
University of Toronto
University of Waterloo
University of Western Ontario
University of Windsor
University of Winnipeg
UR Energy
Vale
Western Potash Corp.
Xstrata Nickel
Yukon Cold Climate Innovation Centre

Members include all the provinces and territory shown in green
Canada Mining Innovation Council
Support for CMIC

- Active engagement with research and innovation funding agencies: NSERC, SDTC and IRAP

- Endorsed by EMMC and supported by MAC, PDAC and CIM, and

- Strong support from NRCan that helped establish CMIC by building from existing programs such as the Green Mining Initiative and Targeted Geoscience Initiative
Canada Mining Innovation Council
Approach to Innovation Challenges

• industry-led groups to define priority areas within and between traditional sub-disciplines
• Develop initiatives through partnerships among companies, academia, and governments to build effective programs that address specific innovation needs
• Develop collaborative networks and links across Canada to better understand innovation drivers and barriers to innovation – capacity, talent, funding or regulatory
• Engage with funding agencies, associations and other research groups related to mining to seek new and innovative ways to fund research and development
• Support new/increased education-research capacity – focus on highly qualified people (HQP); collaboration with the Mineral Industry Human Resource Council
• Organize an annual innovation meeting, seek ideas and disseminate results through the web and engagement
Canada Mining Innovation Council
Innovation Initiatives

- **Exploration**: “Footprints” program – $8M over 5 years to define the integrated signatures of Canada's major base metal, gold and uranium deposits and hence improve recognition, targeting, discovery and evaluation

- **Mining**: focused on improved mine development rates, safer and more efficient deep mining, and improved mine logistics

- **Processing**: seeking increased efficiency in comminution, new engineering technologies for the North, and more efficient use/recycling of water

- **Energy**: seeking dramatic savings in energy use/intensity (e.g., the concept of a “40% Mine”) through efficiencies (mining-milling-processing), alternatives to liquid fuels, and application of co-generation and renewables

- **Environmental stewardship and tailings**: will evaluate new water treatment and tailings technologies that will reduce footprints and improve performance
• Successful initiatives and programs will advance the Canadian mining industry and improve efficiency, revenue generation, global competitiveness, technology exports, and Canada’s reputation

• CMIC facilitated programs and innovation will benefit other sectors by providing research opportunities and employment possibilities for students – building new R&D capacity from the traditional strength in mining

• The improved high tech profile will transform the image of the Canadian mining industry and will help to attract the talent that we need
International Minerals Innovation Institute
Saskatchewan
Background

- SK has diverse mineral base & highly sought after commodities

- Minerals - dominant source of economic opportunity for SK:
  - Fastest growing and largest sector (4.2% of GDP)
  - Planned expansions of $20 billion in next 5-10 years
  - Headquarters for major and many junior companies
  - Is a major employer:
    - 5th highest total income, 5th highest average salaries
    - Major employer/trainer of northerners and Aboriginal people

The Saskatchewan Mining Association estimates that over next 20 years, industry will invest over $43 billion in new projects
Background

- Saskatchewan needs to do more to:
  - Recognize the importance of mining to the SK economy
  - Ensure long term sustainability of the mining sector
  - Enhance benefits (revenues and employment) for SK citizens
  - Improve mining industry’s brand/image to attract employees

- Canada versus Australia
  - Australia produces 40% more, growing at twice the rate with 7% less employment
  - One factor is Australia spends 5X Canada on Mining R&D ($1 B vs. $200M)
  - Canada’s spending on R&D is low, and SK is lower – ranked 9th of 10 provinces on Gross Expenditures on R&D
Taking Action…

Steering Committee:

- Established in 2009
- To explore ways to enhance sector sustainability
- Representation from
  - SK minerals industry
  - Post-secondary Institutions
  - Federal & Provincial Governments
What Became Clear…

- After Discussion the Committee Realized:
  - A coordinated, collaborative effort was needed to address SK’s unique mining and HQP challenges
  - Areas of expertise exist across organizations, but no mechanism to coordinate, collaborate & focus
  - An Environmental Scan (Phase 1) and a Business Plan (Phase 2) were needed
Designed a stand alone organization with industry-led board in partnership with government & institutions

Governance

Board of Directors
12 members (7 industry)

Executive Director

Executive Committee
Finance & Audit Committee
Governance, Nomination & HR Committee

Education & Training Advisory Panel (representative group)
Research & Development Advisory Panel (representative group)
Goal

1. Provide leadership in capacity building through development of education and training programs
2. Enhance competitiveness through research, development and knowledge transfer, and provision of those with latest knowledge and skills
3. Attract and retain skilled people who can build SK research and industrial capacity
4. Establish Institute for research and development to serve as problem-solver and catalyst for addressing fundamental, industry-wide issues
5. Be focal point for positioning SK among world’s largest minerals jurisdictions
Focus of the Institute

Focus skill development and research efforts on:

- Mining Technology
- Processing Technology
- Environment and Safety Management and Technology
- Exploration
- Social License and Policy Research
- Business and Economics of Global Commodities

Innovation in two central streams

- Developing and training highly qualified people
- Conducting research, development and implementation support
Partnerships and Collaborations

Institute focuses on needs of Saskatchewan companies, but solutions world class in nature.

Public
- Innovation Saskatchewan
- Ministry of Advanced Education
- Ministry of Energy & Resources
- Western Economic Diversification
- Natural Resources Canada
- Saskatchewan Research Council
- Canada Mining Innovation Council
- PAMI
- Canadian Light Source
- Saskatchewan Opportunities Corporation
- etc.

Private
- Saskatchewan Mining Association
- Cameco
- AREVA
- PotashCorp
- Mosaic
- BHP Billiton
- Claude Resources
- Shore Gold Inc.
- Hatch
- Vale Canada Limited
- K+S Potash Canada
- Sherritt Coal International
- Agrium Inc.
- etc.

Post-Secondary
- University of Saskatchewan
- University of Regina
- First Nations University of Canada
- Saskatchewan Institute of Applied Science and Technology
- Saskatchewan Indian Institute of Technologies
- Gabriel Dumont
- Lakeland
- Northlands
- The Carson Centre
- etc.
Getting Started

- Created non-profit corporation January 25, 2012 with three founding members (Cameco, UofS, IS)
- Appointed Gordon Barnhart as Interim Chair and David Grier as Acting Executive Director
- Publically announced May 14, 2012
- Expanded to 12 members June 21, 2012
  - Cameco, PCS, Mosaic, BHP Billiton, K+S, Shore Gold, SMA (seven industry)
  - UofS, UofR, SIAST, Adv Ed, IS (five non-industry)
- Full Board Meetings held June 21 and Sept 28, 2012
Getting Started

- Initial funding from large companies ($200k/yr X 5)
- IS ($500k)
- Approaching Ministers of Adv ED and the Economy for long term government funding

Next Steps:
- Identify volunteers to staff E&T and R&D panels
- Develop membership model
- Promote to wider audience
The Point....

Thanks to The Steering Committee and the many individuals from industry, post-secondary institutions and government...

...who gave so generously of their time and wise counsel throughout this process in a most collaborative and visionary way.
Enhancing Innovation and Technology Development Capabilities Through Collaboration
INNOVATION --- COLLABORATION

INDUSTRY

GOVERNMENTS

UNIVERSITIES
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Making a difference!