Growing the Future Mining Workforce Through an Innovation Mindset

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Introduction

The Problem

- Sufficient and appropriate labor is a challenge (across the economy too)
- Mining needs to compete for hearts and minds of future workers (and society)
- What we have been doing clearly isn't working

A Potential Solution Construct

- Utilizing scenarios for raw materials 2050, what drives success for the sector
- Picking up on the need for outwardly modern posture
- End the legacy of "telling them" and live the future

State of Raw Materials Sector

- Perception of archaic mining industry
- Uneven modernization
- Limits from public's traditional view of mining
- A new name, a new space in society: Raw Materials
 - Recognizes societal systemic challenges over materials, including "traditional" mining
 - Critical recycling and processing problems can use more geoscience expertise (extractive vs synthesis chemistry)
 - Enters conversation about limits of recycling; material use efficiencies
 - Innovation opportunities in secondary recovery/recycling
 - Opens discussion for frontier mineral extraction approaches



Perception is Powerful

- 75% of opponents to mining had no prior engagement with mining activities (Lee and Ji, 2015)
- Unmitigated historical issues are the stuff of public legend
- Brutal employment cyclicity deepens negative views





Successful Mining Gets No Satisfaction

- Modern Successful Mining:
 - Nearly invisible to society
 - Delivers the commodity reliably
 - Provides stable employment
 - Underwrites local infrastructure
 - Locally inclusive & cross-sectoral beneficial



The Excellent Official Phenomena





Geoscience is Professionalizing

- Oil and Gas, Mining, and Environmental industries are not the big source of direct employment
- >43% of all US geoscientists now work in professional services
- Geoscientists are expected to work across the discipline on diverse problems
- This trend is universal globally

This is a good development, but can we embrace it?



What can change the trajectory?



Scenarios of Raw Materials 2050

- Strategic insights into dynamics of the raw materials sector
- Examine the relationship of factors that influence workforce







The Great Transition

A new generation of leaders abandon self-interest to confront shared environmental, social, technological, and industrial challenges

policies and frameworks that prioritize the well-being of all peoples

shared prosperity

mining industry becomes widely accepted

integrated across major industrial ecosy enhancing industry performance

A global crisis sparks unprecedented unity

Advancement Wave

Fechno-nationalism incited rivalry between ideological blocs, occasionally sparking competing societal visions competing societal visions fechnology race part AI, robotics, quantum

Countries on the outside of the blocs suffer economic and political instability as well as limited access to novel technologies, some choosing to become client states

Raw materials production is tolerated to crystalize transformations in energy and other advanced technology sectors

Spillover technologies like robotics and battery advances transform mining practices and business models despite persistent skills gaps

A technology boom drives progress but widens inequality



Downward Spiral

Rampant resource nationalism hampers

- Nativist policies breed economic vo while constantly shifting opportuni
- repeated crises of legitimacy Industrial goals override other consi
- normalizing environmental degradation and t repression of local communities' rights, fuellin unrest and conflict in resource-rich regions
- Increased burden on countries' water and energy supply prompts mining companies prioritize conservation over innevation
- Resource wars between powers and socioeconomic divides erode prospec global peace, cooperation, and shared

Countries fall into a regressive trap in pursuit of total self-sufficiency



Divided Dominions

- Geopolitical rivalries and competition between historically and ideologically aligned blocs fragm markets and supply chains, and hampers global connersition on shared challenges
- Heavy state interference skews market sig and leads to a substantial misallocation o capital that results in stranded assets and
- redundant capacities Environmental and social impact of reso
- extraction depends on governance capac with irresponsible practices fuelling publi
- scepticism of and resistance to mining
- Volatility in commodity markets shrinks corporate budgets, prompting blocs to priori improvements in manufacturing, recycling, a
- improvements in manufacturing, recycli substitution over disruptive innovation
- Weakened by trade animosities, underinvestment, and fragmented m the global mining industry stagnates
- Self-contained blocs imperil economic growth and development



https://intraw.eu

Raw Materials Factors in the updated Scenarios



Political Factors

- Stability of Domestic Policies
- International Cooperation and Trade
- Full Supply Chain Tracking and Traceability of Mined Minerals



Economic Factors

- Industry Structure and Value
 Chain Structure
- Profit / ROI
- Economic Development
- Infrastructure
- Price Volatility
- Water and Energy Strategies
- Market Demand for Raw Materials



Social Factors

- Social Attitude towards Mining, Public Acceptance
- Mining Workforce
- Responsible Consumption and Production



Technology Factors

- Extraction Technologies
- Exploration techniquesRaw materials R&D



Combined Factors

Integrated Climate Action



Legal Factors

Government Regulation



Environmental Factors

- Environmental Impact of Mining
- Mining in Extreme Conditions

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Scenario Development Process

Identify Factors of Influences

Gathering input from experts (Delphi-inspired approach)

Synthesis of expert inputs

Modelling generate proposed scenarios

Selection of most representative scenarios

Analyze causal relationship between every factor across every scenario – factbook development

Authoring of scenario "stories" and framework for use

Majors Drivers Moving to Raw Materials in2050

Certainties

- Speed of innovation
- Application of new technologies
- Focus on profit

Probably Pathways

- Partnerships with OEMs
- More contractors and professional services

Consequences

- Successful miners will focus on:
 - Managing the orebody
 - Financial aspects
 - Environmental impacts
 - Community relations

Workforce and Sector Success Drivers



- Weak points in system opportune for technologic disruption
- Innovation and new frontiers drive growth and acceptance
- Growth begets further innovative investment
- Lends to stable employment
- Political instability is biggest risk



The Forces of Change

- Fewer qualified workers are the quickest way to force increased automation
- When technology meets the need, permanent replacement of labor occurs
- Ancillary, how the remaining workers work changes too





Technology Transforms Raw Materials Sector

- AI Impacts
 - More data, but less data munging, doing more geology
 - Facilitating new frontiers of exploration (Kobold Metals, etc)
- IoT/Drones/Remote Data
 - Faster data acquisition
 - Improved interdisciplinary integration
 - Improved safety, efficiency, and comfort
 - Less field time; increased basing in metro areas

• Efficiencies improve financial stability



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Improves value of geologist to the company!

Closing the recruitment gap

- If we can recruit workers to be based in more "comfortable" environments
- We can show improved employment stability
- We can provide intellectual stimulation
- We only got to the baselevel of recruitment

• We need to attract the best and brightest







Europe's Horizon 2020 Examples ~\$290 million/year in raw materials sector research

¡Vamos!

- Submerged remotely controlled mining vehicle
- Full extraction within the confines of a mine
- Secondary recovery of flooded open mines
- No waste leaves mine pit





UNEXMIN

- Autonomous Exploration of Flooded Mines
- Multi-sensor, hyper-precise geomapping of abandoned flooded mines for resources
- Many old mines have high grade ore by today's standards
- Reopening of old mines can have lower environmental impacts

Projects for Extreme Environments



ROBOMINERS & PERSEPHONE

Autonomous Exploration & Extraction of Deep Mineral Deposits

- Self-assembling mining robots for ultra deep holes
- Frontier resources
- Minimal waste production

LUVMI-Extended

- Developing extra-terrestrial mineral and water resources to support humanity's expansion into the solar system
- Advancing exploration technologies



Reframing Workforce Development

- Attracting the students is the first step, preparation is the next
- For more insights on workforce dynamics and global efforts in nextgeneration workforce preparation in the geosciences:

https://www.americangeosciences.org/webinars/heads-and-chairs-sep2024





Conclusion

- Making mining (Raw Materials) an attractive career trajectory is about living and co-inventing the future
- Attract the best and brightest by doing the more transformative work
- Always remember, you can only change an industry from the inside
- Getting the interest is only the first step for the community



Questions?

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More information:



