



# FRAMING THE CONTEXT

INNOVATION AND  
MANAGEMENT OF TAILINGS  
FACILITIES

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Innovation

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# Outline

- Where we have been and progress so far
- Current risks, challenges and innovation



## □ **Several unacceptable catastrophic failures of tailings facilities**

Affected the mining industry social license

Affected investors' attitudes

## □ **A recognition of cases of poor practices worldwide**

Management, engineering, construction and/or operation

## □ **Compounding the issue**

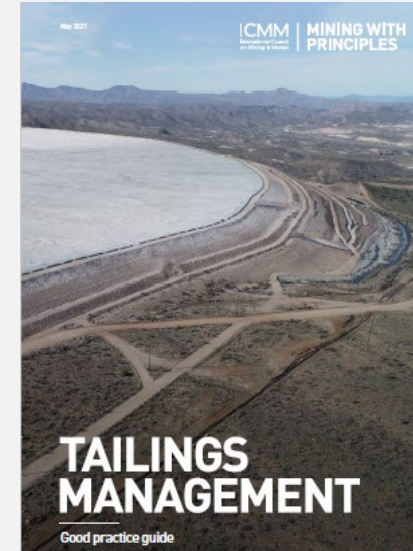
Unprecedented increase in tailings production projected in the near future

Increased societal expectations of the mining industry for high standards of social and environmental stewardship

# Where we have been



# Response to catastrophic failures of tailings facilities



ICMM, UNEP and PRI initiative



**Global Industry Standard on Tailings Management (GISTM)**

Development of a supporting document:

**ICMM Good Practice Guide**

## Where we are today

- ✓ **Broad global acceptance and implementation of the GISTM**
- ✓ **Significant progress in tailings-related governance**

GISTM required the Board of Directors adopt and publish a policy on or commitment to the safe management of tailings facilities. This creates the overarching guidance that sets the **safety culture** for the company.

Requirement to appoint an Accountable Executive answerable to the CEO and with scheduled communication with both the EoR and the Board.

GISTM led to a change of tailings management from asset-centric to portfolio-centric.

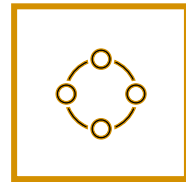




## Where we are today



**More awareness of tailings technical issues and risk management**



**Synergetic relationship between industry and academia**



**Some progress in tailings training and education**



**Creative initiatives by mining companies to train their personnel and service suppliers.**





but there is still a lot  
to be done ...

- Wider implementation of the GISTM
- Challenges upgrading and managing existing and legacy facilities
- Improve approaches to new tailings facilities including closure
- Address the exponential increase in tailings production

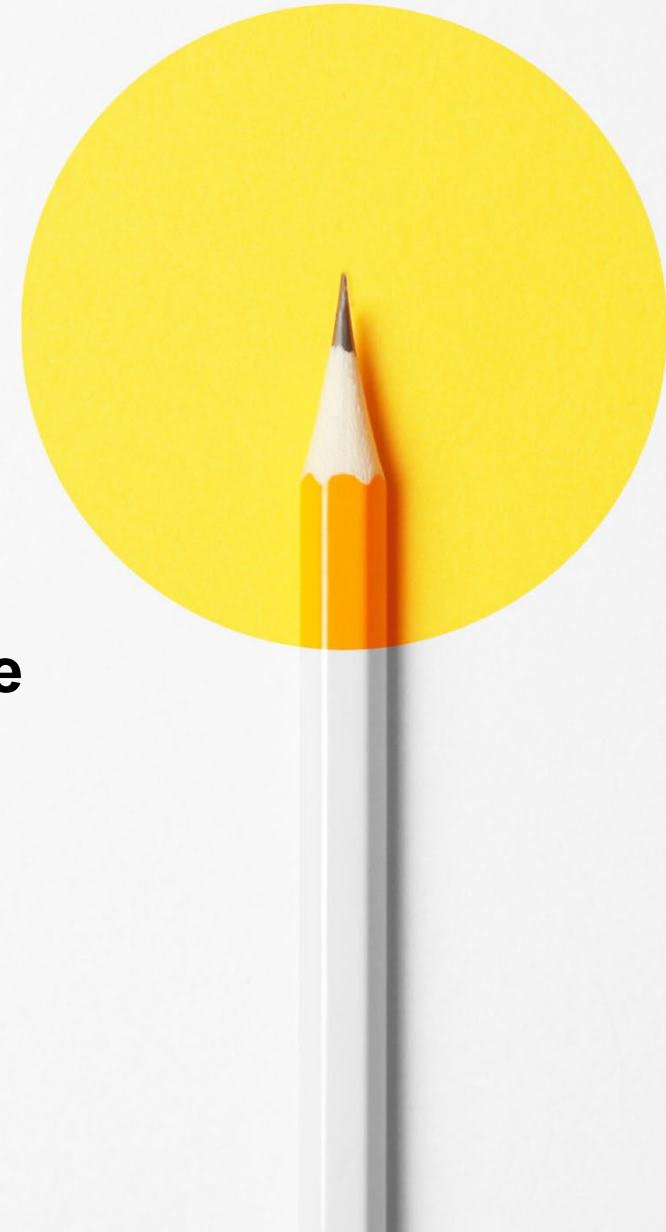
Thus, we need to focus on accelerating development and innovation.

# A fundamental point

Innovation carries inherent risks and potential unintended consequences due to limited real-time, full-scale performance data and experience in complex physical and human environments.

**Managing risk and maintaining the integrity of tailings facilities at all stages of their lifecycle is paramount.**

**Risk management must guide all considerations for development and implementation of innovative approaches and tools.**







**Risk and  
challenges  
provide direction  
for the most  
effective  
innovation.**

The can opener wasn't invented until  
more than *50 years after* the can.



# Risks and Challenges

- Water
- Closure
- People
- Regulatory System
- Technology





## Risks and Challenges: Water

# Water - likely the biggest risk relative to dam integrity

## Hydrology

Requirements for surface water management on and around a tailings facility to reduce the risks of excessive erosion and overtopping.

Climate change is expected to bring higher frequency of events of higher intensity and more uncertainty in predictions, challenging risk management.



## Management of water in the ground

- ❑ Negative impact on the strength of foundation soils and tailings deposits
- ❑ Degree of saturation also affects the strength of materials and their liquefaction potential – cannot be readily and accurately determined for in situ tailings deposits

## Infiltration assessment and management

**Potential for significant rise in groundwater level**



## Risks and Challenges: Water





## Risks and Challenges: Water



### Some areas that could benefit from further development and innovation:

- Refinements in meteorological and hydrological assessment in a dynamic climate situation
- Erosion/scour prediction and management
- Emergency spillway design and performance
- Infiltration assessment and management – especially for filtered, dewatered deposits
- Characterization of unsaturated materials



- Closure issues will become increasingly important given the current social and cultural changes and where they can be expected to go.
- There is significant development to be had in most disciplines and aspects of closure, especially considering the long timeframes involved.
- Must be considered in the early stages of any project and included in conceptual design of tailings facilities

## Risks and Challenges: Closure







## Risks and Challenges: Closure

- Must be considered on the overall cost of the enterprise from mining, processing, tailings disposal and closure
- Can have a positive impact on permitting, public acceptance and cost through the life of the facility.
- In most jurisdictions there is little to no guidance on the long-term stewardship of closed tailings sites, including: transfer of ownership, maintenance, and governance.

# Risks and Challenges: Regulatory System



## Regulations and personnel

- Regulatory system can support tailings management
- In many jurisdictions, the regulatory system has not kept up to the current needs of the industry.
  - Regulations need updating to adequate modern standards.
  - Poor definition of closure requirements.
  - Shortage of qualified personnel in regulatory agencies.
- Industry support and political support are necessary

# Risks and Challenges: People

## Tailings Professionals



**Worldwide shortage of qualified tailings professionals at all levels**

**Challenges → attract/retain people and provide professional training**

**Formation of tailings professionals → support from academia**

**Formation:** The process of guiding a person to a deeper understanding of a particular knowledge area and its theoretical fundamentals. It includes the development of perspectives, ways of thinking, knowing, and doing.



## Technical formation needs to lead to the development of:

- A solid understanding of the natural phenomena
- A strong grasp of the assumptions and simplifications in the models
- A clear and critical thinking process for effective problem solving and innovation
- An ability to report on the above in a logical, clear and concise manner



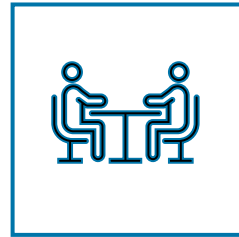
**Risks and  
Challenges: People**

**Tailings Professionals**



## Risks and Challenges: People

## Community Relations



More needs to be done to engage communities - early in the process



Development of productive relationships



Communication of risk



# Risks and Challenges: Technology



## Recent developments are focused on:

- Tailings processing
  - Filtration, co-deposition, chemical treatment, etc.
- Tailings characterization
  - CPT, VST, geophysics, laboratory tests
- Tailings deposit behaviour (saturated and unsaturated conditions)
- Surface deformation monitoring of tailings facilities by remote sensing



## Recent developments are focused on:

Dam breach analyses

Approaches to risk assessment and ALARP

Field instrumentation



**Risks and Challenges:  
Technology**



# CONCLUDING REMARKS

An aerial photograph of a mining operation. In the foreground, there is a large, terraced tailings dam with a light-colored, sandy surface. To the left, a cyanide leach pad is visible, characterized by its grid-like structure and reddish-brown color. The background shows a dense forest of evergreen trees. The sky is clear and blue.

**All risks and challenges are opportunities for innovation!**

**Integration** from resource drilling through mining, processing, tailings disposal and closure **will be critical**; multidisciplinary work is a must.

We are now working within a **new cultural, social, legal and financial context**.

**These are exciting times** that support high quality, sustainable mining that is both beneficial to society and environmentally responsible.



# Thank You



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