REQUISITE ORGANIZATION INTERNATIONAL INSTITUTE

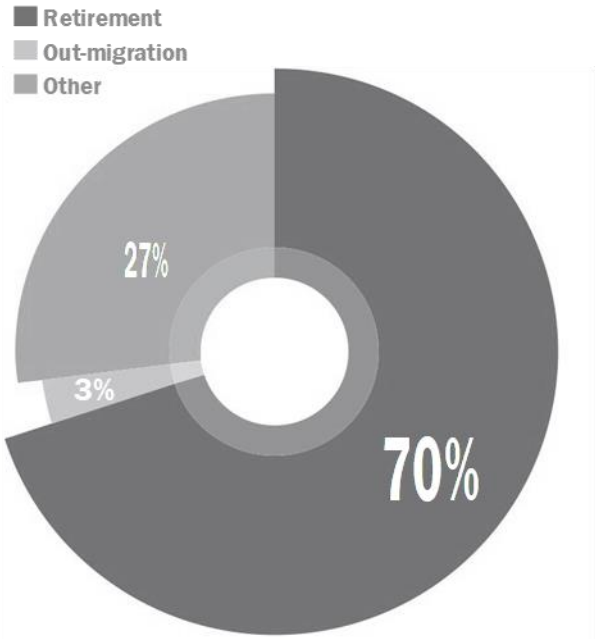
Challenges to Knowledge Operationalization:

Example of Metallurgy Knowledge Operationalization at Metallurgical Operations

Metallurgical Operations face constantly increasing complexity of external and internal issues that need to be dealt with to maintain profitable metallurgical operations

- Decreasing margins and cashflow
- Unique and complex flowsheet aim to extract multiple products
- Significant increase in the cost of electricity
- Through the years the company is accustomed to stable homogeneous concentrate supply from the single source mine that belongs to the parent company.
- Decreasing availability of "good" concentrate with lower impurities and higher margins
- Unreliable supply of "good" concentrate
- Low level of concentrate flexibility
- Complex logistics for concentrate shipment and logistics
- High cost of labour
- High level of variability

Breakdown of forecasted exits by category in Mining & Metals in (2018–2027)



Source: Mining Industry Human Resources Council, 2017

Need to develop and manage more complex metallurgical flowsheets with an increased number of interdependencies

Increased Complexity

Risk of insufficient capability when the wave of retirements hits paired with insufficient supply of metallurgical engineers in Canada

Loss of Experience

Key Objective of Experience Retention is to maintain stable metallurgical performance of unit operations after the experienced employees have retired

Loss of Experience → Loss of Knowledge

Working Definition

Knowledge is facts, information, and skills acquired by a person through **experience** or **education**

Knowledge about What?

About problems with a Unit Operation and successful troubleshooting

Retiring Metallurgical Engineer

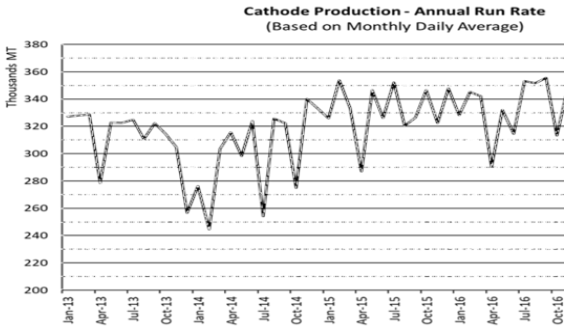
Knowledge mapping

Unit Operation for which retiring metallurgist is accountable

Typical Knowledge mapping areas

- What are **typical problems** with the unit?
- What are **successful solutions** to deal with problems?
- What **data** was collected and from what sources?
- How was the **data analysed**?
- How was **solution implemented**?
- **Who was involved** in solution development and implementation?

New Chemical Engineer



High Variability

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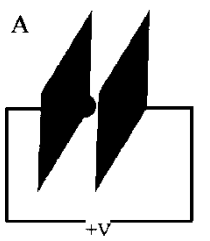
What should be done to improve knowledge retention?

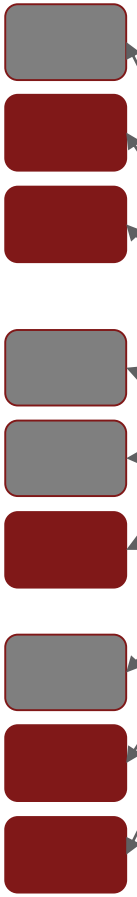
Analysis of experience retention / knowledge retention programmes and their ineffectiveness leads to several key conclusions:

Focus on problems that happened

Unit Operations



There are problems that have not been experienced yet



Leads to

Problems at unit operations

BIG 6 processes — **New Focus**

- ✓ Less scope to focus
- ✓ Impacts all the Units Operation
- ✓ Prevents all the problems at Units Operation

- Metallurgy Design
- Metallurgy Control
- Metallurgy Analysis
- Utility / Reagent Modelling
- Troubleshooting
- Optimization

Inefficient and non-compliance

To be applied consistently at every unit operation

Metallurgy Standardization is a system of technical policies, procedures, standards, instructions to which all metallurgical engineers must adhere to ensure that all Metallurgy Processes are performed within set guidelines.

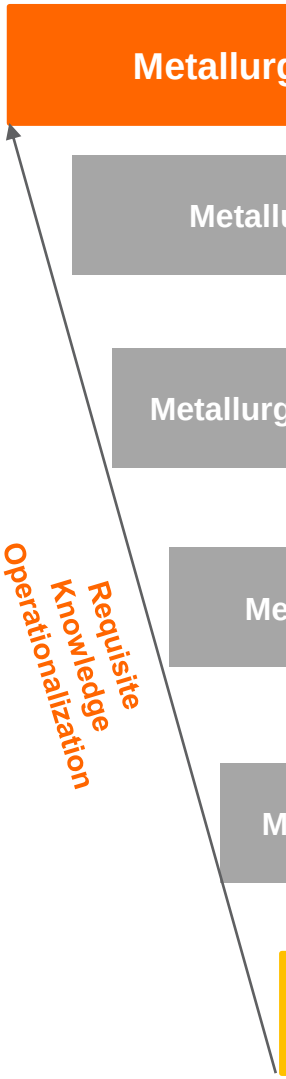
Metallurgy Standardization is necessary to maximize:

- Consistency
- Stability
- Compatibility
- Safety
- Repeatability
- Quality

Analysis was conducted to assess the quality of metallurgy standardization for BIG 6 metallurgical processes at one metallurgical operation:

Effective Standardization	Findings	
Metallurgy Standardization (Procedures, Standards and Instructions)	➢ No standardized list of metallurgical processes to be used for Metallurgy Control and Development management ➢ Absence of metallurgy standardization (procedures and standards for the metallurgical processes) to ensure the consistency of operation and control of different unit operations	
Metallurgy Standardization Compliance Audit	➢ Absence of the tool and process that audit the compliance by various stakeholders to the metallurgy standardization requirements (procedures, standards, instructions) at the unit operation ➢ Lack of analytics on compliance to the metallurgy standardization and the causes of non-compliances	
Metallurgy Standardization Effectiveness Audit	➢ Absence of the tool and process that audit the effectiveness of our metallurgical standardization (procedures and standards, and their adaptation to various unit operations) ➢ Lack of analytics on effectiveness of the metallurgy standardization for all metallurgical processes	

Requisite Knowledge Operationalization is an ability to apply metallurgical knowledge of the metallurgical processes at Unit Operations by accountable metallurgical engineers consistently to the metallurgy standards with the purpose to achieve Metallurgy Excellence



Metallurgy Excellence

Every unit operations consistently achieve the designed metallurgical performance without impacts of risks of metallurgy personnel and experience loss

Metallurgy Application

Metallurgy knowledge is applied to the required standards without discrepancies or deviations at every Unit Operation

- **Metallurgy Critical Control**
- **Behaviour Compliance Audits**
- **Effectiveness Audits**

Metallurgy Skilled Knowledge

Metallurgy personnel is capable of applying the knowledge required by the roles and metallurgy standardization

- **Metallurgy Training & Learning**
- **Production-driven Metallurgy Reliability**

Metallurgy Personnel

Metallurgy personnel selected and assigned to the metallurgical roles are capable of making metallurgical decisions required by the roles

- **Human Resource Planning**
- **Metallurgy Talent Management**
- **Metallurgy Graduate Management**
- **Metallurgy Career Management**

Metallurgy Knowledge

Knowledge requirements are defined to apply metallurgy standards at Units operation effectively

- **Metallurgy Knowledge Management** (metallurgical decision mapping, metallurgy knowledge mapping, critical knowledge identification)

Metallurgy Standardization

- Policies, procedures standards for every BIG 6 metallurgical process
- Clear list of Units Operation

The **Requisite Organization International Institute** was established in 1999 to provide support and services to those engaged in implementation and further development of the work on human organizational development begun by Elliott Jaques as Stratified Systems Theory over sixty years ago

- **Provide access to and authoritative knowledge** about the full body of work in human organization and human capability developed by Dr. Jaques (and colleagues)
- **Provide authoritative guidance for the development of tools and resources** which contribute to and support the implementation of Requisite Organization (RO) in organizations and institutions around the world
- **Provide guidance and support to those seeking to conduct research** and development in the Institute's specialized areas
- Ensure that Jaques' body of work, known as Requisite Organization, becomes **the standard by which all other organizational development programs** are measured

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Delivers a unique range of **integrated project support services** across a **full array of industries** by bringing together **specialists** with different expertise to ensure **successful project delivery** for our clients

Unique Methodologies

based on Industry Best Practices & Requisite Organization

- Requisite **Mining**
- Requisite **Metallurgy**
- Requisite **Maintenance**
- Requisite **Integrated Planning**
- Requisite **Production**
- Requisite **Project Management**
- Requisite **Safety**

Subject Matter Experts

Our Team includes:

- Requisite Organization Experts
- Mining Engineers
- Chemical Engineers
- Mechanical & Electrical Engineers
- Production & Industrial Engineers
- Safety Engineers
- Project Managers

Digital Technologies

Partnering with industry best providers of digital technologies:

- Open Pit Mining
- Underground Mining
- Metallurgy Intelligence
- Asset Management
- AI & Virtual Reality

Worldwide Applications

- Australia
- Africa (Namibia, DRC Congo, Zambia, Ghana, South Africa, Mozambique, etc.)
- South America (Chile, Argentina)
- North America (USA, Canada)
- Europe (UK, France, Ireland, Sweden, Russia & CIS, etc.)