



TECHNISCHE UNIVERSITÄT  
BERGAKADEMIE FREIBERG  
Die Ressourcenuniversität. Seit 1765.

# Education and Lifelong Practical Training Challenges in the Digital Mining Era

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Institute of Mining & Special Civil Engineering

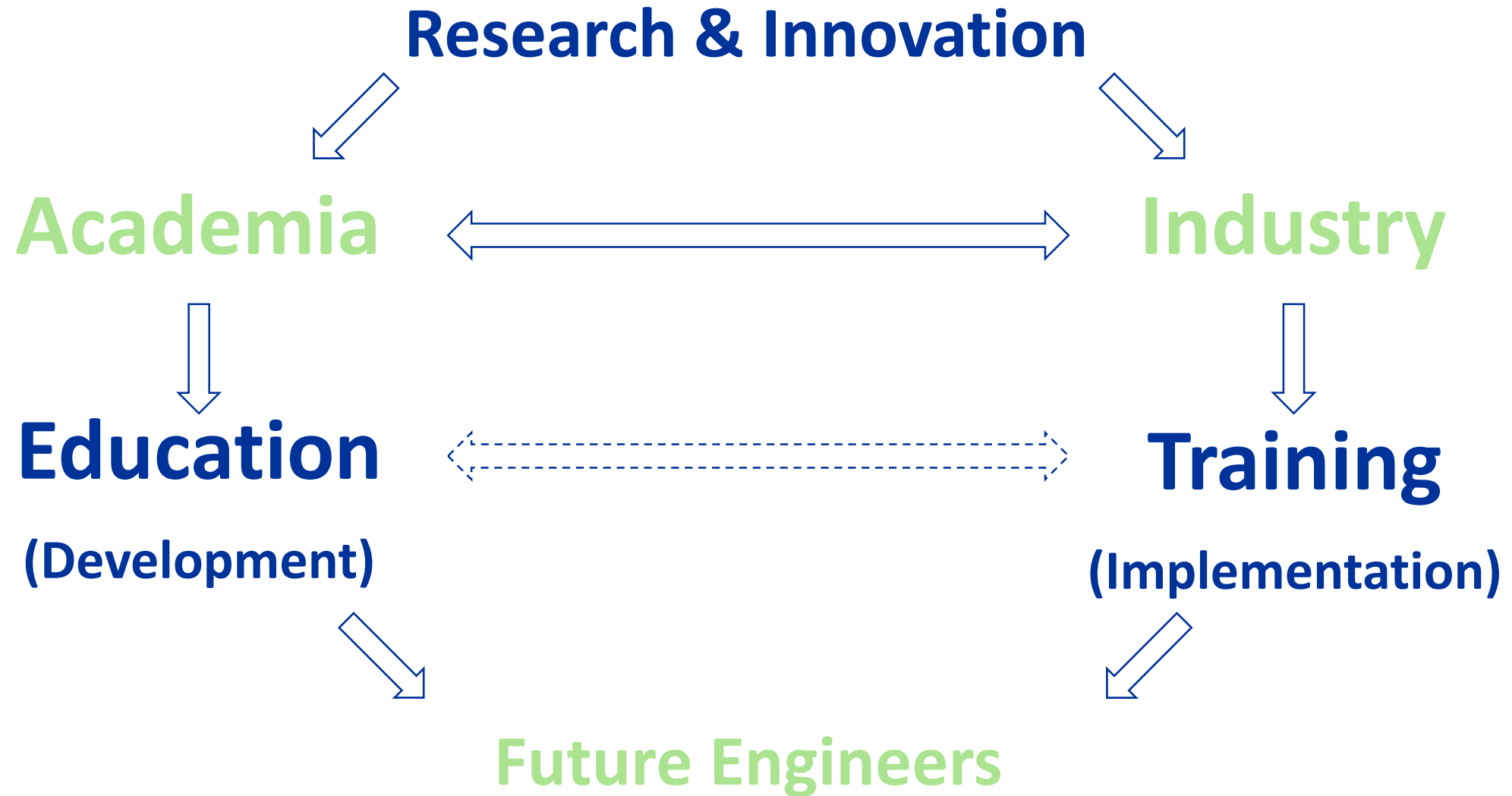
TU Bergakademie Freiberg

**4<sup>th</sup> Greek Raw Materials Community Dialogue**

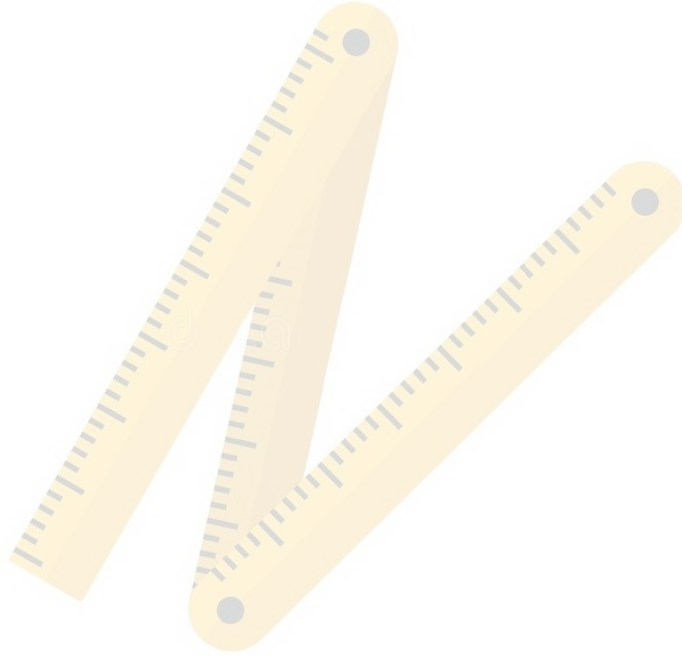
11 – 12 December 2019



This activity has received funding from the European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Programme for Research and Innovation



Based on a true story...

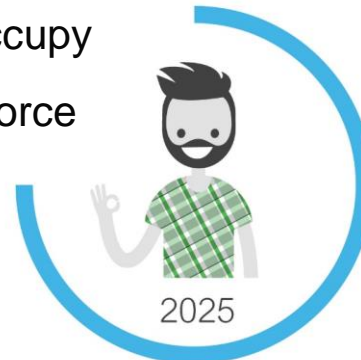


(Source: Dr.-Ing. George Barakos, 2019)



# Next Generation Workforce

Millennials will occupy  
**75%** of the workforce



Source: McKinsey & Company



Source: iStock



Source: Independent

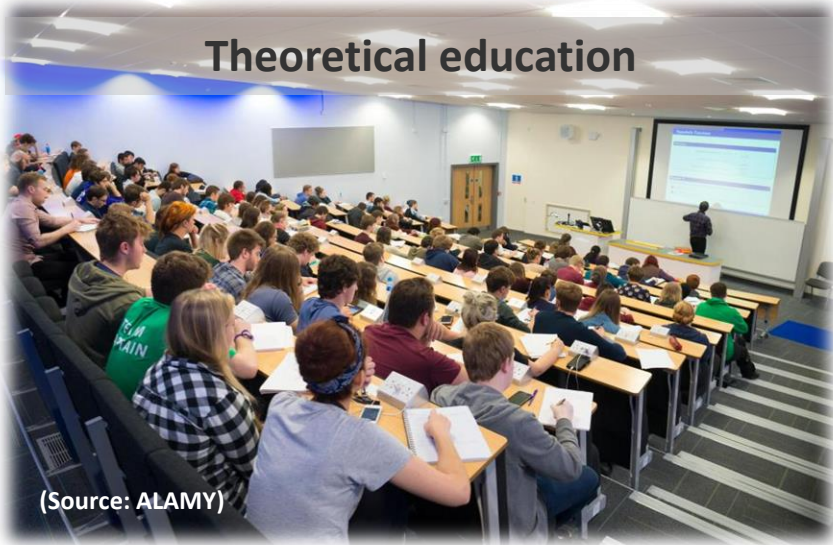


Source: Schneider Electric



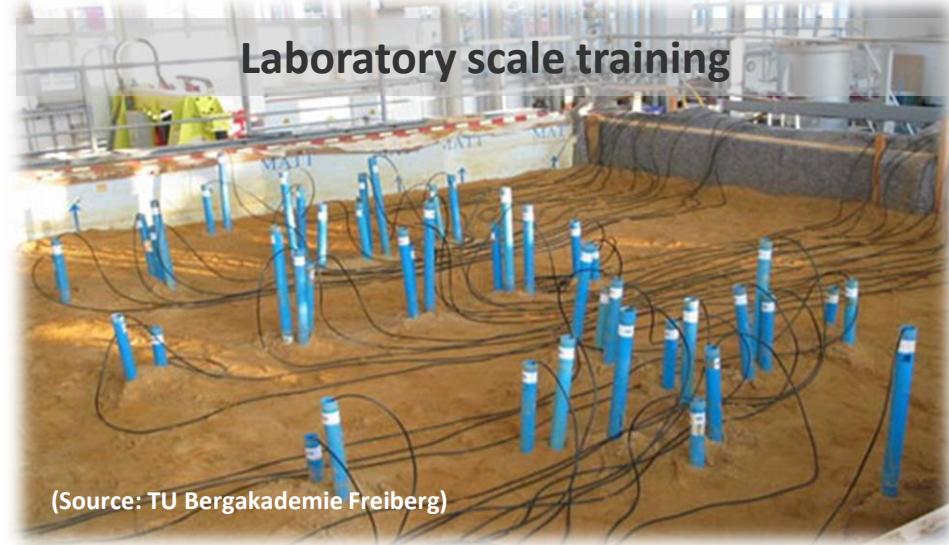
# Raw Materials Higher Education & Research Perspectives

Theoretical education



(Source: ALAMY)

Laboratory scale training



(Source: TU Bergakademie Freiberg)

(Source: TU Bergakademie Freiberg)

3D software learning



(Source: Univ. of Pretoria)

Virtual reality experience





# Raw Materials Higher Education & Research Perspectives

Visiting of mine sites and processing plants



(Source: Dr.-Ing. Jürgen Weyer, 2019)



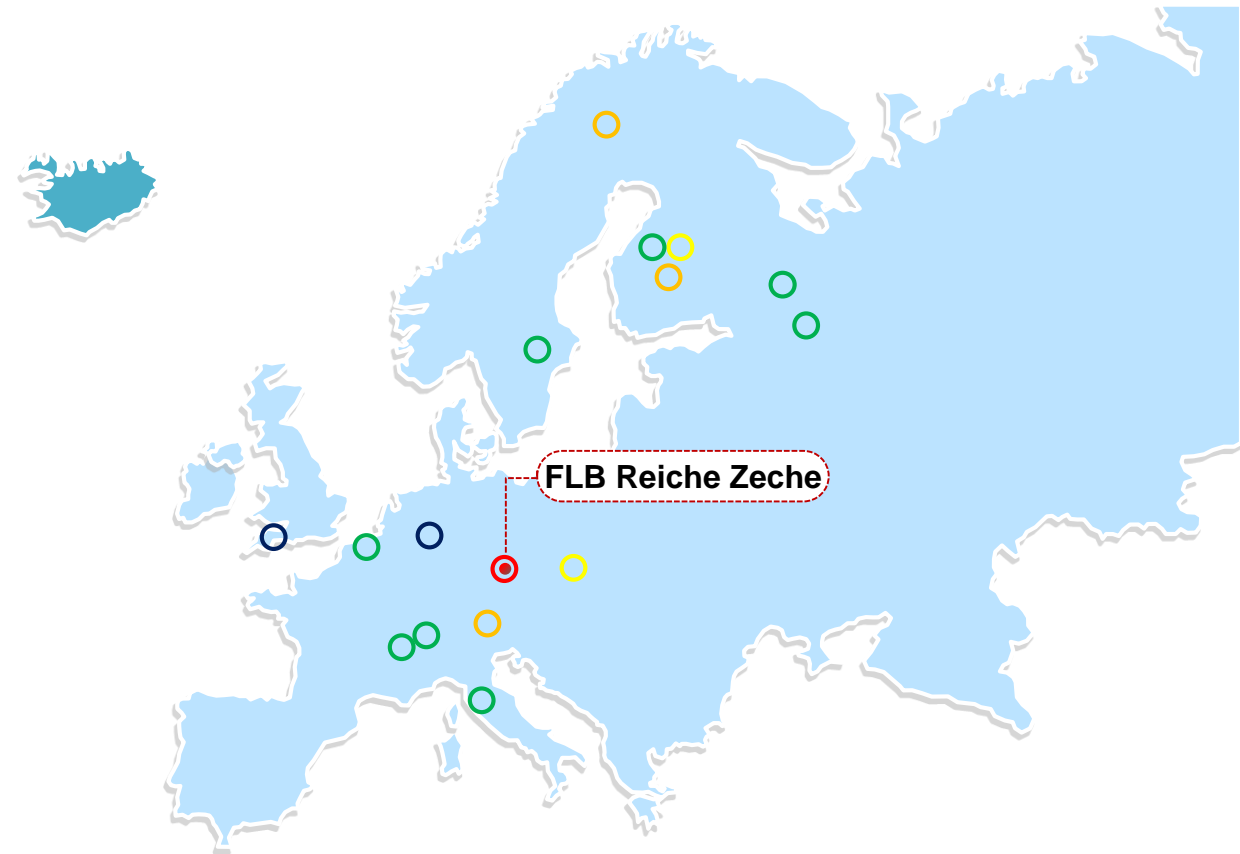
# Underground R&D Facilities in Europe

## Legend

- Underground Educational and R&D Mines
- Underground R&D Mines and Test sites
- Underground R&D Mines – planned
- Underground R&D Mines – defunct
- Underground Scientific Labs for Research

## Europe

- One operating Educational and R&D Mine in Freiberg
- One R&D Mine at MU Leoben University under construction
- Two company owned mines under construction
- Two former R&D mines defunct now
- 8 underground labs open to raw materials research



(Source: Prof. Dr.-Ing. Helmut Mischo, 2018)



# Research & Educational Mine at Reiche Zeche in Freiberg

(Source: Dr.-Ing. Jürgen Weyer, 2017)

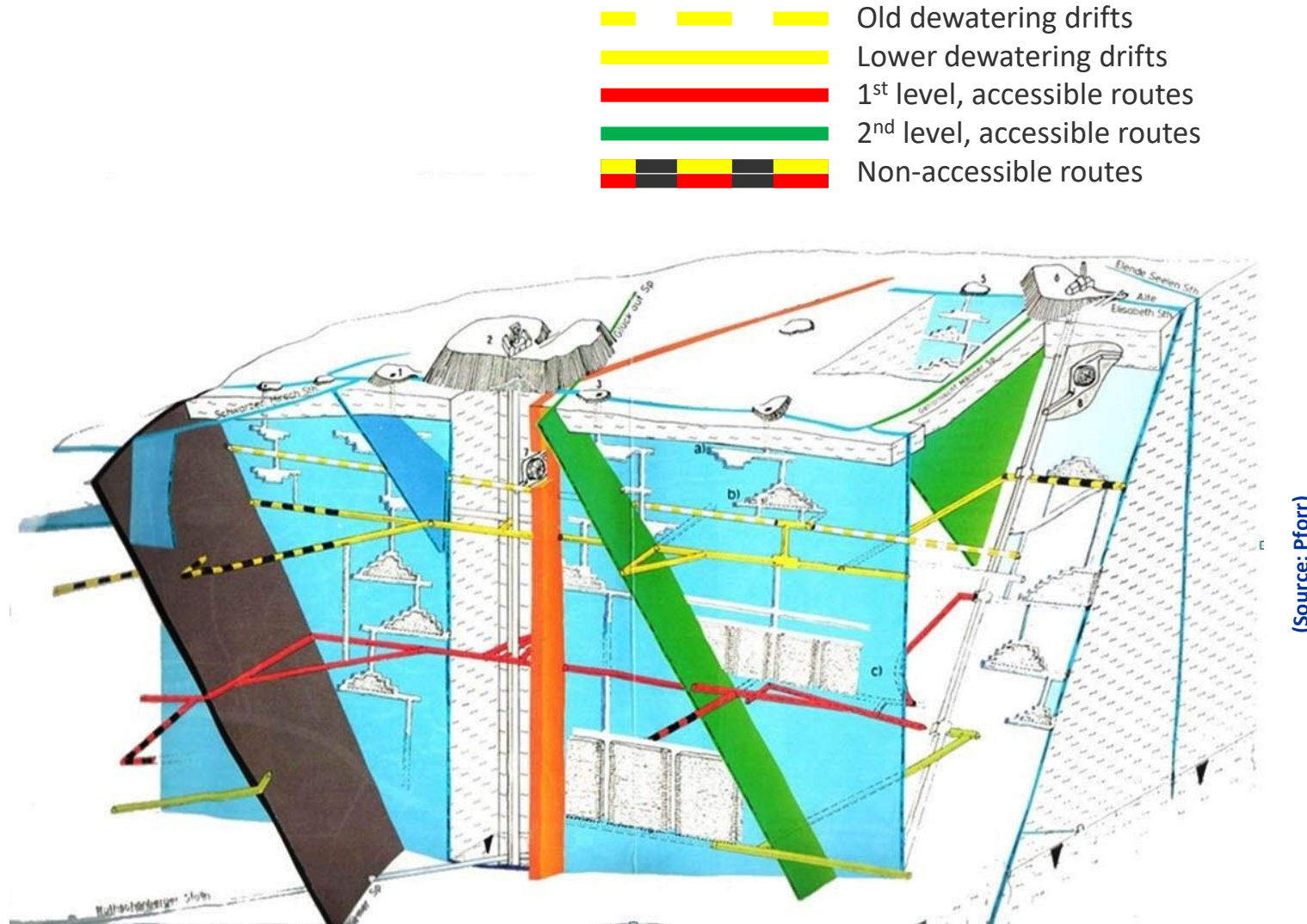




## Research & Educational Mine at Reiche Zeche in Freiberg

## Mine Structure

- 1,270 km of horizontal openings
- 129 km of accessible openings
- 14 km in Reiche Zeche area
- 15 levels (down to 750 m)
- 5 levels accessible



# Research & Educational Mine at Reiche Zeche in Freiberg

(Source: TU Bergakademie Freiberg)

## Training & Lecture Facilities

- 4 lecture rooms underground
- Up to 50 persons/course





# Research & Educational Mine at Reiche Zeche in Freiberg

(Source: Dr.-Ing. Jürgen Weyer)

## Practical modules for students

- Drill & blast practice
- Ventilation measurements
- Mine surveying
- Haulage
- Hoisting
- ...
- Microbiology
- Water protection
- Materials research

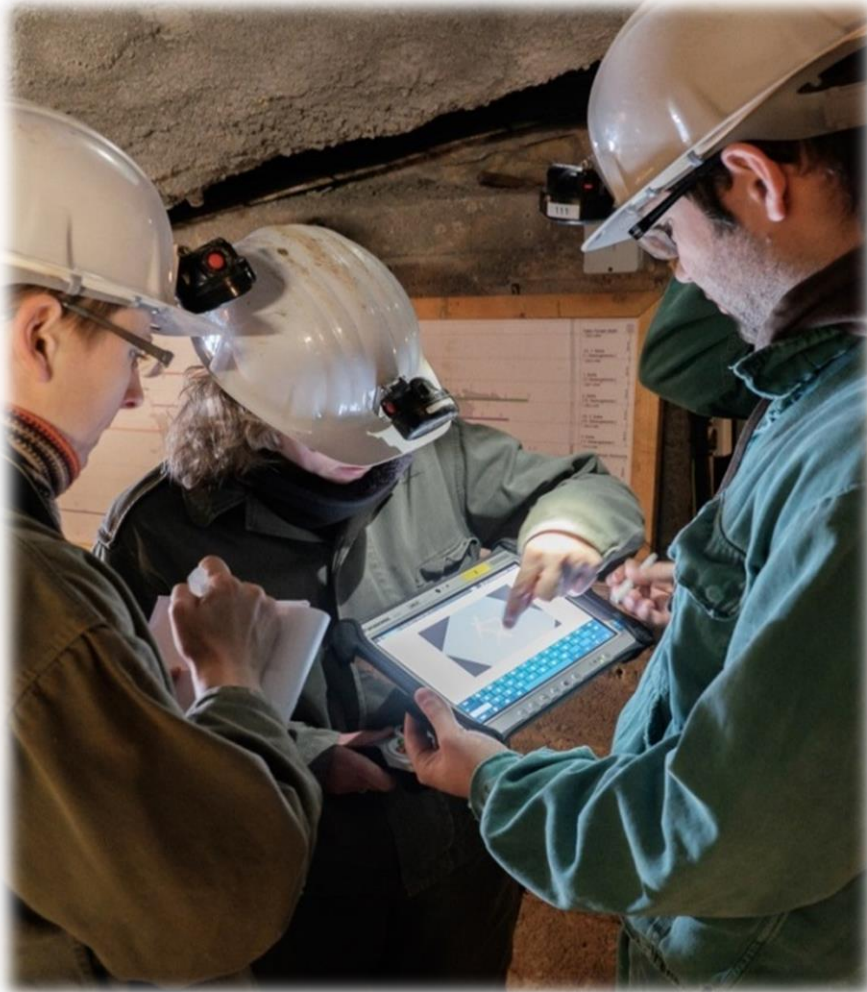




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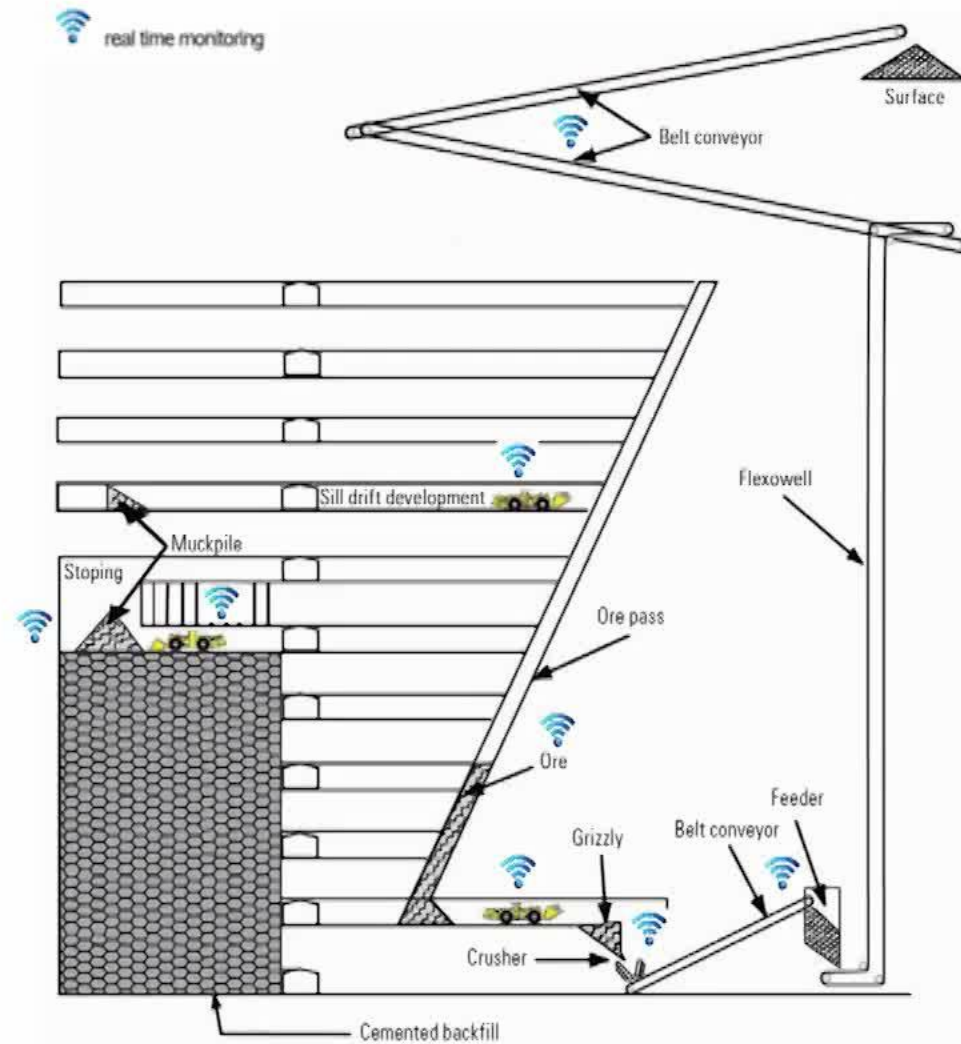
(Source: TU Bergakademie Freiberg)

## Autonomous Robots & the IoT





# Positioning of sensor technologies



# Research & Educational Mine at Reiche Zeche in Freiberg

(Source: TU Bergakademie Freiberg)





# The MINETRAIN Project

01.01.2018 – 31.03.2021



(Source: Calliolab, 2018)

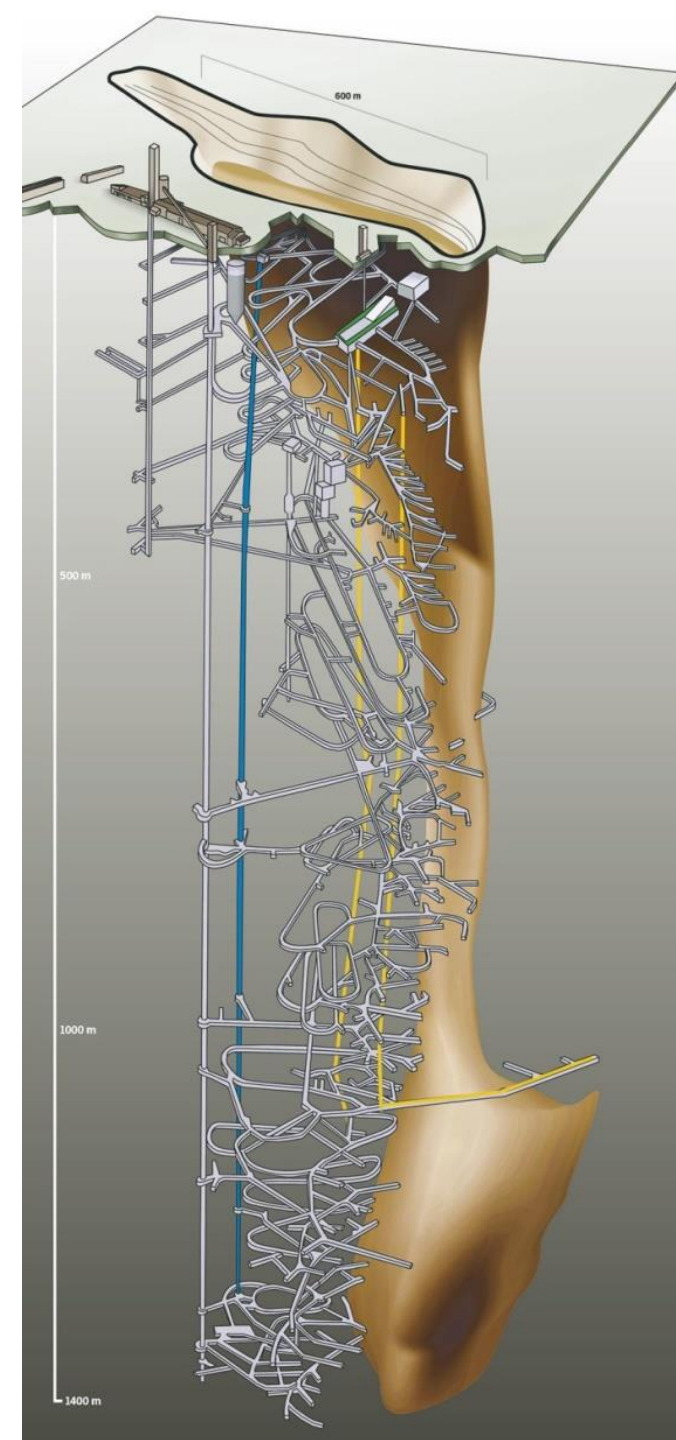


# The MINETRAIN Project

(Source: CallioLab, 2018)

## The Pyhäsalmi Mine

- Open pit at 210m
- Underground mine at 1450m
- Blind shaft at 660m
- Shaft from surface at 1410m
- State-of-the-art equipment
- Big concentration plant
- Remote control of mining equipment
- Ore crusher established underground





# The MINETRAIN Project

## Lifelong training for professionals

- Online courses & on site training
- Understanding of value chain



(Source: George Barakos, 2019)



# The MINETRAIN Project

## On site training for professionals

- 1<sup>st</sup> Pilot module – August 2019



(Source: George Barakos, 2019)



# The MINETRAIN Project

## On site training for professionals

- 2<sup>nd</sup> Pilot module – August 2020



(Source: Sandvik, 2019)

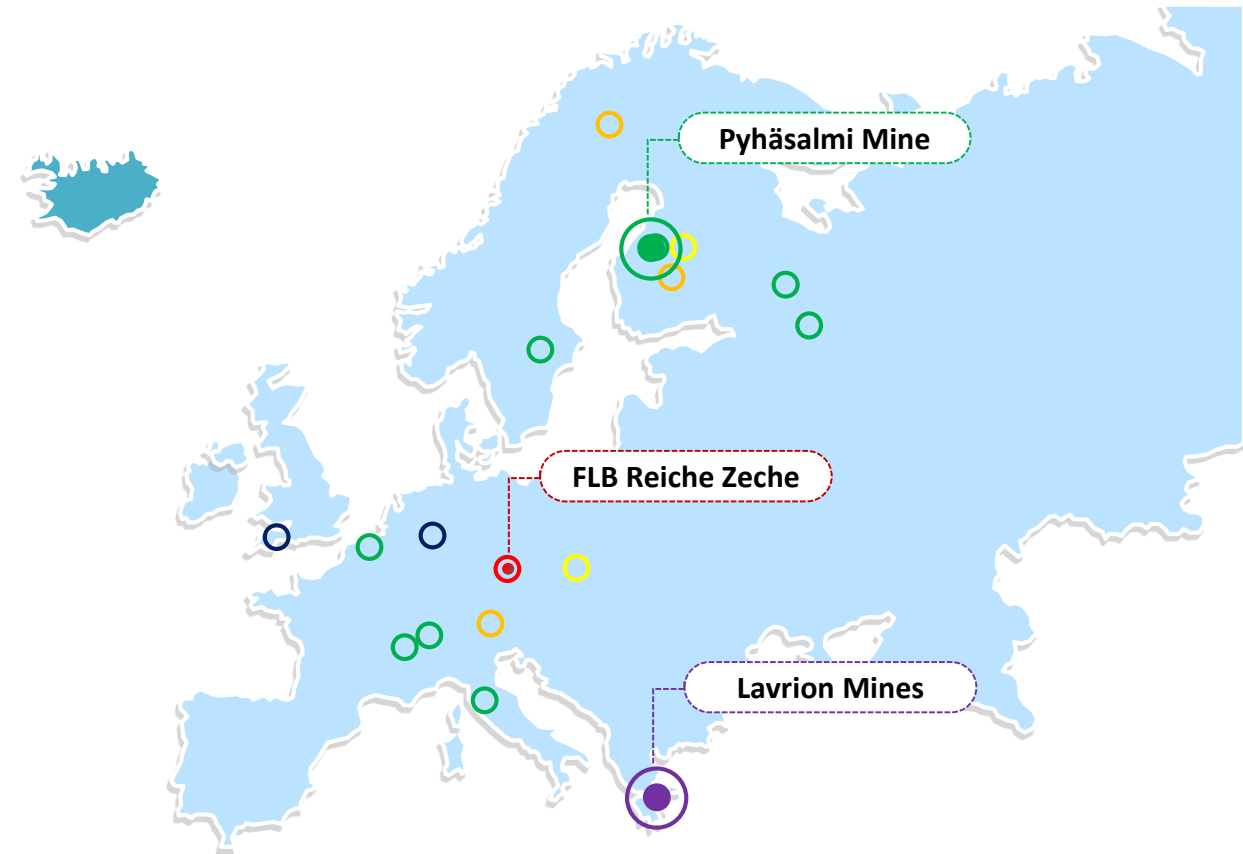
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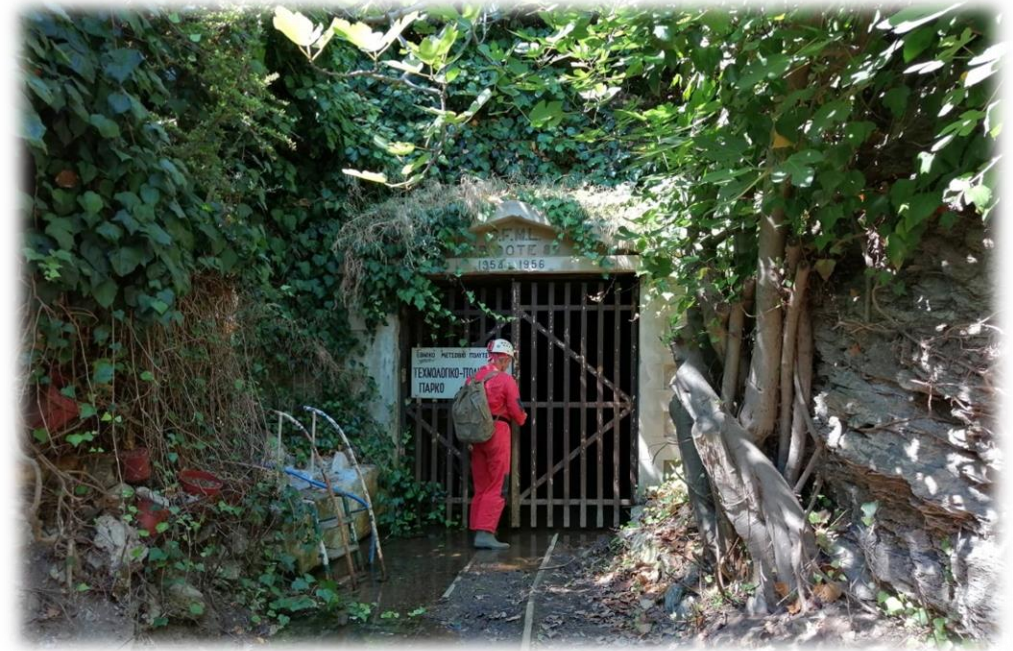
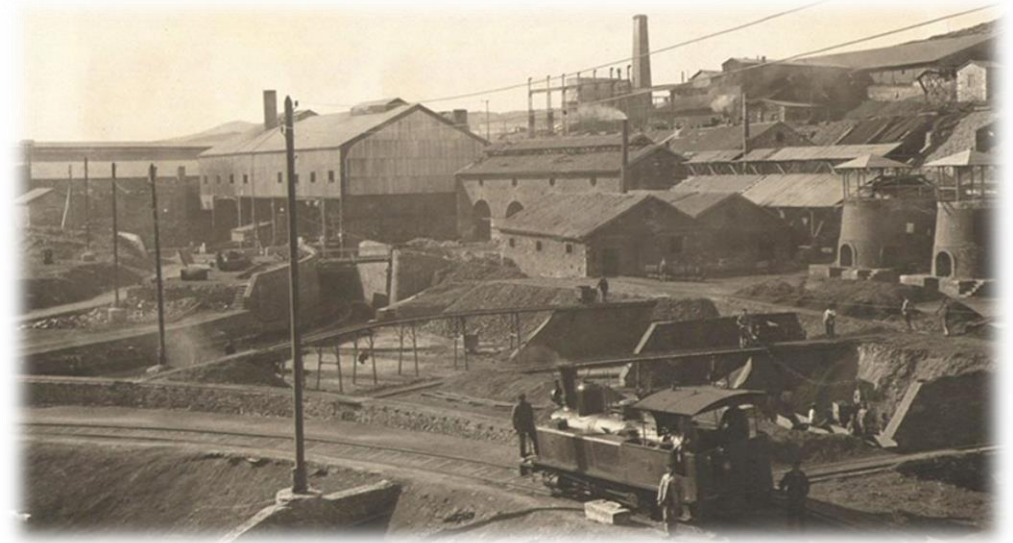
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(Source: Prof. Dr.-Ing. Helmut Mischo, 2018)



# Lavrion Mines



(Source: oryktosploutos.net, 2019)



# Lavrion Mines



(Source: Vasilis Stergiou, 2019)

(Source: George Barakos, 2019)





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