GTK MINTEC SERVICES AND DEVELOPMENT
”FROM X-Y-Z TO X-Y-Z TO X-Y-Z TO X-Y-Z”

Jouko Nieminen Circular Economy Solutions

linkedin.com/in/joukonieminen/ @jouko_nieminen jouko.nieminen@gtk.fi

#mineralprocessing #circulareconomy #research #batteryminerals #batterymetals #rawmaterials #gtkmintec #mineclosure #minemanagement #circularrawmaterialshub #gtkresearchlaboratories #outokumpuminingcamp

GTK MINTEC

GTK MINTEC IS LOCATED IN NORTH KARELIA, FINLAND,

CITY OF OUTOKUMPU

GTK MINTEC TODAY AT OUTOKUMPU MINING CAMP

MINTEC PREMISES

Facilities

- *Total area 5 500 m² - Crushing plant, homogenization area, concentrator plant (pilot plant) and laboratories*
- *Workshop for maintenance work*
- *Storages for samples and equipment, 1 200 m²*
- *Tailings pond area, 1.5 hectares*

Capacity

- *Normally 5 to 10 pilot scale studies per year*
- *Unit totally: around 80-100 projects/year*

Customers

- About 60 % from confidential contract research for clients
  - *Clients abroad around 50 %*

RESEARCH CHAIN FROM ORE DEPOSIT TO MINE

GTK can assist customers in

- *Exploration - geochemistry, geophysics, consultancy*
- *Ore Potential Evaluation*
- *Chemical analysis*
- *Mineralogical analyses*

Mineral processing

  - *Bench scale tests*
  - *Mini-pilot tests*
  - *Pilot plant tests*
  - *Plant tests*
- *Basic engineering participation*
- *Mine management*
- *Water management*
- *Mine Closure*

PILOT PLANT

Process:

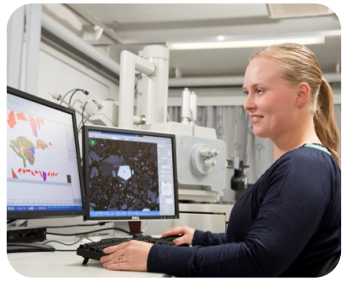
- Processes can easily be adapted to capacity ranges from 0.2 tph up to 5 tph
- Sample sizes typically from 20 to 300 tonnes
- Plant automation and process control of a high level, together with automatic sampling systems, ensure the highest quality results

Objectives:

- **Testwork** for **feasibility studies** of new ore deposits
- **Process development** for existing plants
- **Develop** comminution and benefication methods, and equipment for industry
- Generate process information for plant design
- Assist **in bankable feasibility** studies

RESEARCH ROUTE

- ***Planning*** *– preliminary information from client*
- ***Head sample characterization and bench scale testing***
- ***Pilot process designing***
- ***Pilot plant execution***
    - *Validation of bench scale results*
    - *Process optimization (grinding fineness, energy consumptions, pH, reagents, residence times, etc.)*
    - *Concentrate production*
    - *Process products for environmental and downstream studies*
- ***Data reviewing, mass balancing and reporting***



MINERAL PROCESSING AT BENCH SCALE

Grinding
- Mild steel ball and rod mills
- Stainless steel ball and rod mill
- Mergan ball and rod mill

Determination of grinding energy
- The Bond work index method (Ball and rod mill)

Flotation
- Flotation machines (Outotec/GTK type, 4 units)
- 1.5 – 15 liter, flotation cells
- Automatic froth scrappes
- Flotation machine (Twell, 1 unit)
- 1-3 liter, flotation cells
- Automatic froth scrappes

Magnetic separation
- Sala wet low intensity magnetic drum separator (LIMS 0.07 T)
- Sala wet medium intensity magnetic drum separator (MIMS 0.3 T)
- Davis Tube separation test device
- Satmagan magnetite balance instrument

Abrasion index
- The Bond Abrasion Index test

Hydrometallurgy and bioprocessing
- Cyanide leaching
- Acid leaching
- Bioleaching
- Pressure leaching

Process chemistry
- Electrochemical measurements
- Hydrophobicity and surface tension
- Surface studies
- Microflotation and electroflotation
- Viscosity
- Process waters

MINI PILOT PLANT

- First study in a continuous process after bench scale results
- Sample size 400 – 2000 kg drill cores, ore sample etc.
- Sample pre-crushed to feed size of 3 - 6 mm
- Facility was originally designed and constructed in a sea container
- Feed capacity 10 - 50 kg/h

THE DEVELOPMENT VISION OF MINTEC 2.0

THE DEVELOPMENT VISION OF MINTEC 2.0

Boosters

- ***Digitalization and Automation***
- ***Ore grades*** *have been going down for some time*
- ***New processing methods*** *are needed to be taken in use*
- ***Technology suppliers*** *needs testings sites*
- ***Circular Economy*** *is only one of the solutions*
- ***Battery minerals*** *are one of the drivers*
- ***Remining*** *of old tailings –> ”new” ore deposits for battery metals alongside existing mines and new ones -*
- ***Circular ecomony requires new methods – innovations – research***
- ***SMARTT Tailings Facility;*** *research infrastructure for tailing*

FOCUS AREAS

GTK'S FOCUS AREAS FOR 2020-2023

Circular economy

Strategic target:
An internationally respected actor in research and solutions of sustainable use of mineral based materials

Battery minerals

Strategic target:
A leading expert in battery clusters and a promoter of business

Information solutions

Strategic target:
An international leader as a supplier of geodata management and application solutions

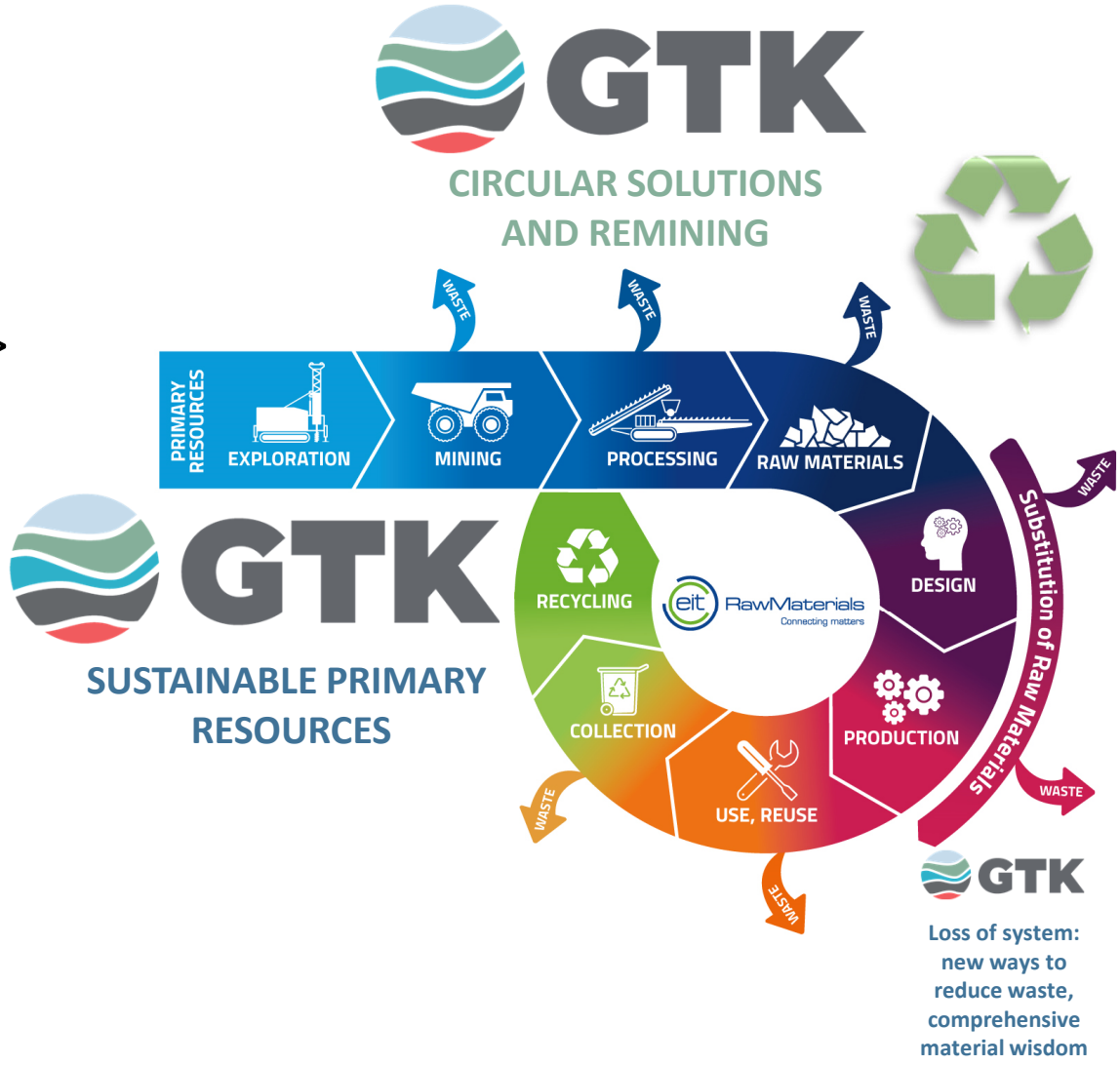
Water management

Strategic target:
Our expertise in the water sector is utilised in comprehensive water management solutions

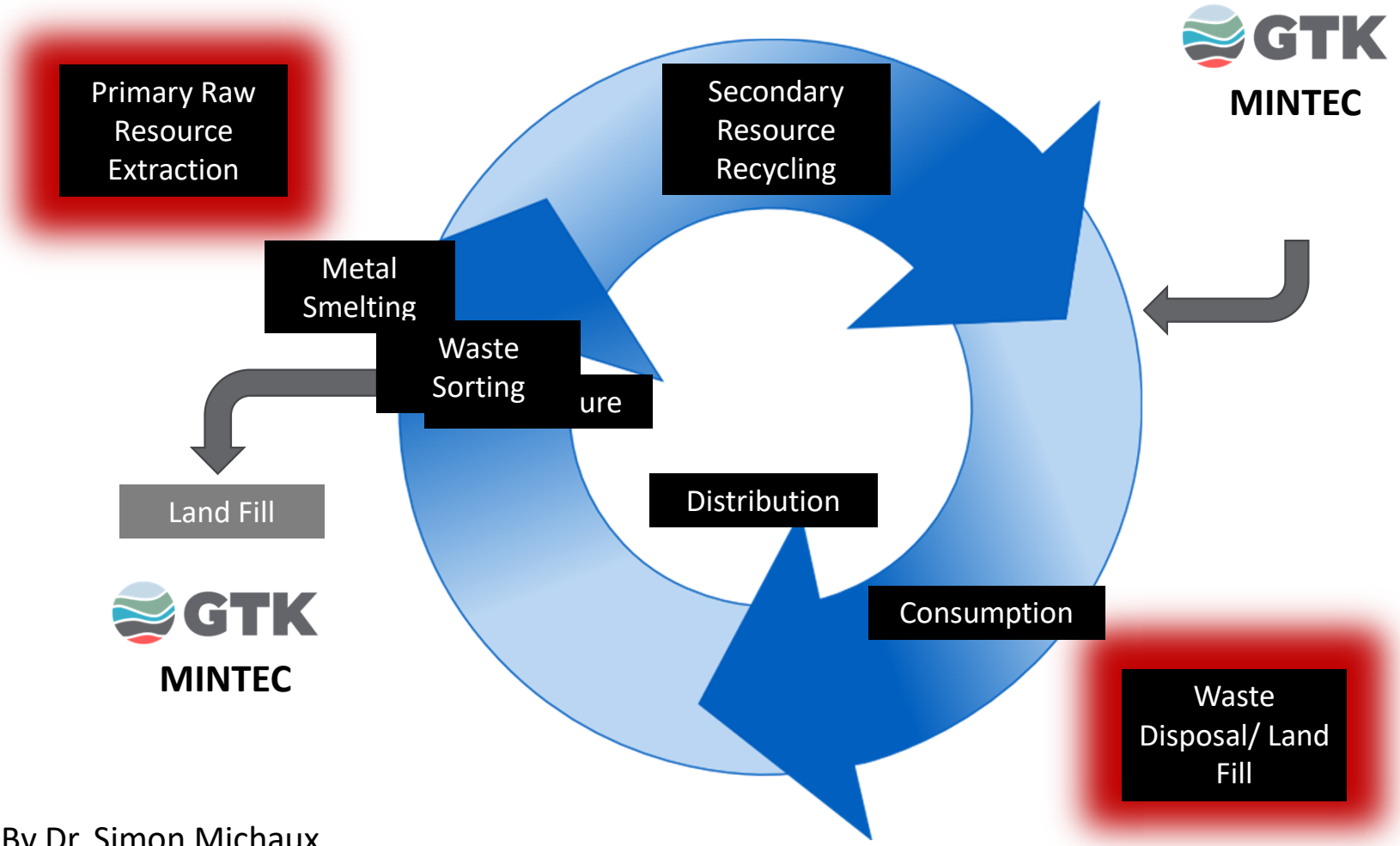
- Focus areas have the highest potential to create significant solutions for sustainable growth
- Focus areas are emphasized in research and innovation

CIRCULAR ECONOMY – BATTERY MINERALS

- Electrification requires large amounts of **mineral raw materials** -> research in Lab and Pilot Plant
- The **raw material supply chain** also has to deliver on the promise of environmental excellence
- Increase in digitalization degree
- New Circular Raw Materials HUB
  - *Primary minerals: GTK Mintec*
  - *Circular economy: GTK Mintec*
  - *Remining: GTK Mintec*
  - *Tailings research; GTK Mintec*



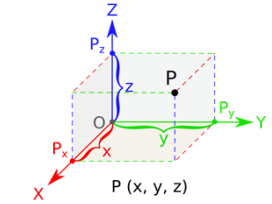
THE CIRCULAR ECONOMY THE HOLISTIC WAY



 By Dr. Simon Michaux

GTK

X,Y,Z TO X,Y,Z TO X,Y,Z TO X,Y,Z (CIRCULAR)



X, Y, Z coordinate of mineral rock in ground

Exploration

Feasibility

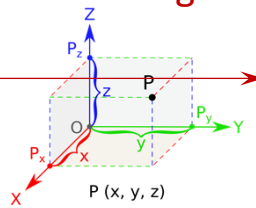
Mining

Mineral Processing

Mining of Waste

Tailings Management

X, Y, Z coordinate of mineral tails in ground



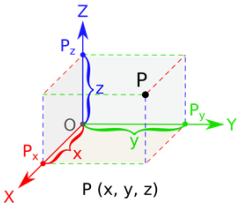
Mineral Refining

Smelting

Track and manage each metal/material between these four kinds of X,Y,Z spatial location Creation of digital knowledge on each location – ready for future use!

Industrial Waste Plume

Refining

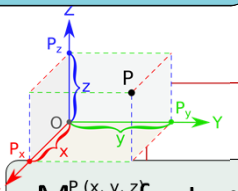


X, Y, Z coordinate of waste product in ground

Waste Management

Recycling

Design



Design

Use & Application

Manufacture

Distribution

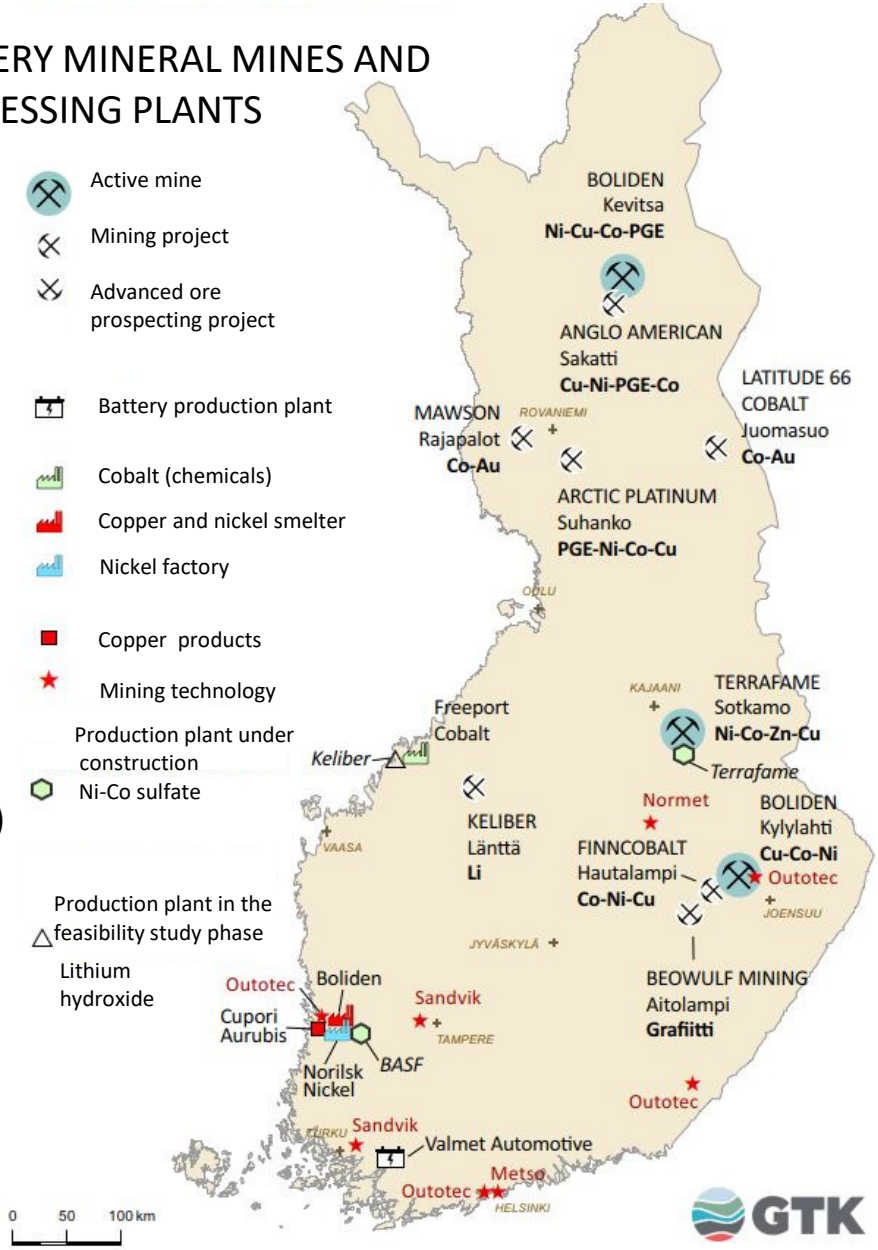
X, Y, Z coordinate of ~~waste output~~ in ground

By Dr. Simon Michaux

BATTERY MINERALS

- Finland is the only country in Europe whose bedrock contains all of the most significant battery minerals.
- Finland has excellent expertise in the entire value chain of battery minerals.
  - *GTK Mintec, Outokumpu*
  - *GTK Research laboratory, Espoo*
- **GTK aims for global leadership in the know-how of battery minerals.**
  - *Primary raw materials*
  - *Circular economy*
  - *Utilization of old mining areas*

Cobalt (Co)
Lithium (Li)
Nickel (Ni)
Graphite (C)
Manganese (Mn)
Copper (Cu)
Aluminum (Al)



DEVELOPMENT PLAN TO MEET THE CIRCULAR ECONOMY AND BATTERY MINERAL REQUIREMENTS

MINTEC 2.0

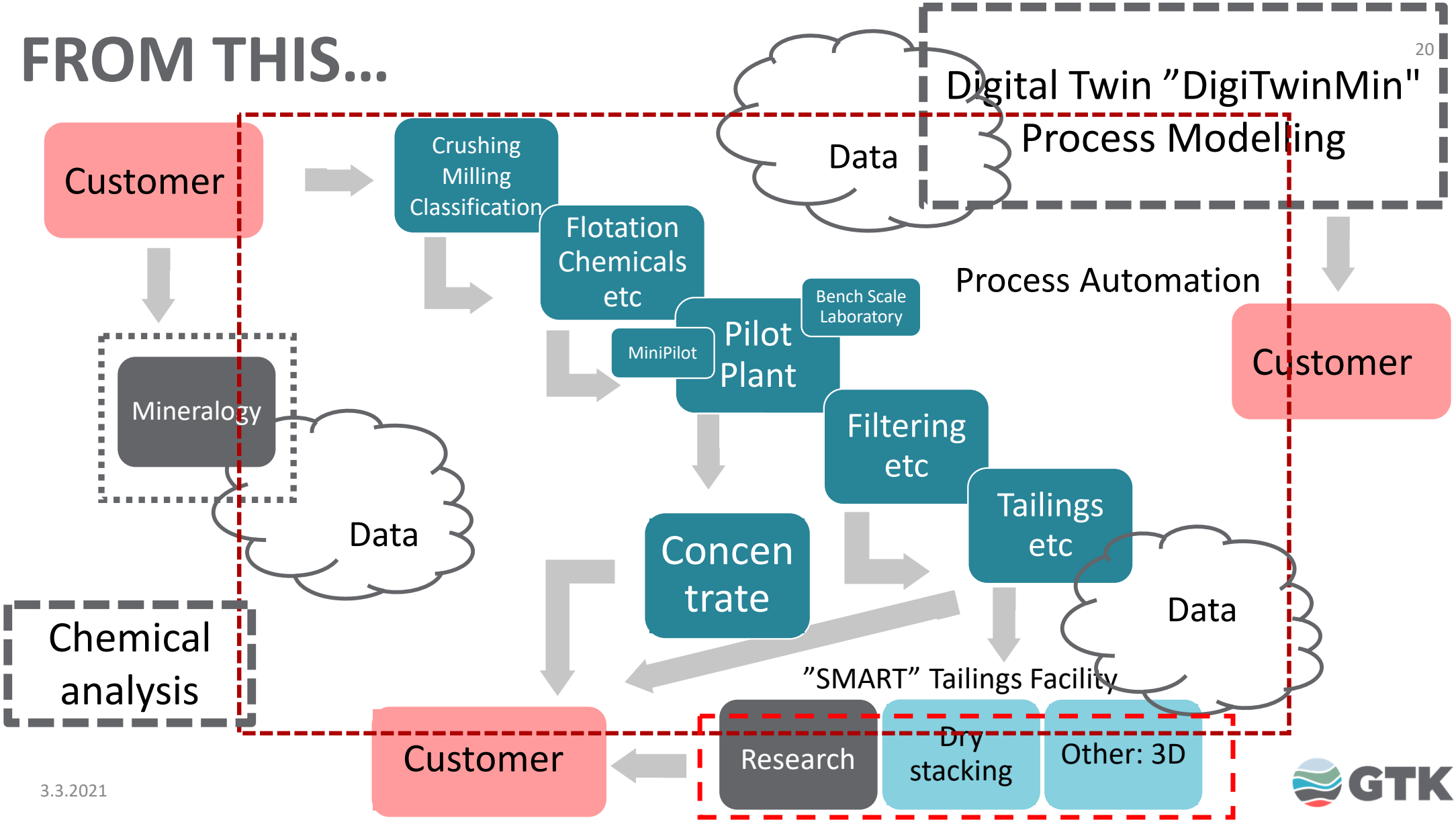
***New pilot plant**: Transformation from conventional ”pilot facility to a ”Development Platform / Research Platform / Collaboration suite”*

- *Full Digitalization - Digital Twin: ”third processing line”*
- *Digital fingerprint from the **deposit** that follows **through geometallurgy – processing – tailings – new raw material -path***
- *Two Simultaneous processes: Research and verification of flow sheet*
- *Capacity x 2 or more*
- *Smart Tailings Facility*
- *Co-working space for researchers*

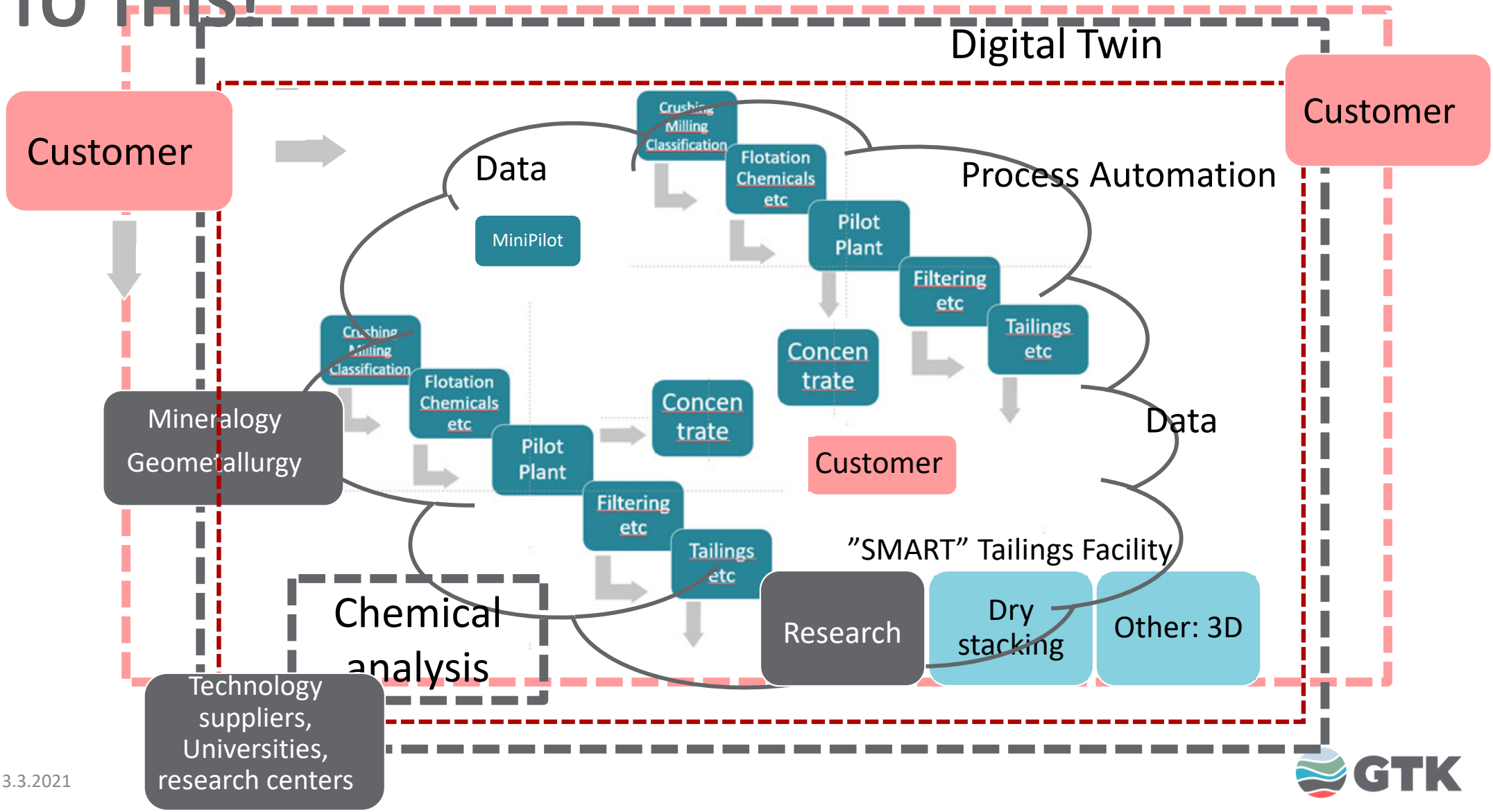
Deep cooperation /collaboration with Technology Suppliers, Start-Ups, Universities and Research centers–> Enables Technological innovations

New Circular Raw Materials Hub in Espoo opens huge opportunities in cooperation with Aalto and VTT

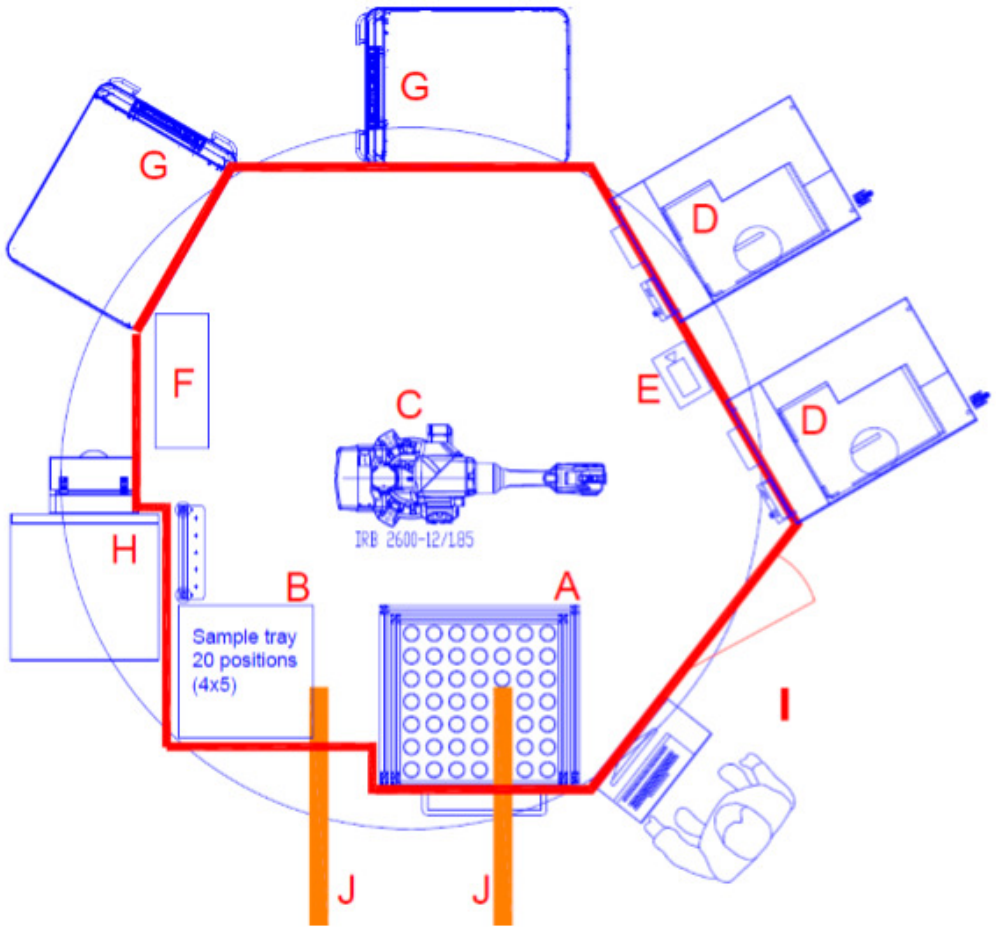
FROM THIS…


Digital Twin ”DigiTwinMin"
Process Modelling
Data
Customer
Crushing
Milling
Classification
Flotation
Chemicals
etc
Bench Scale
Laboratory
MiniPilot
Pilot
Plant
Process Automation
Customer
Mineralogy
Data
Filtering
etc
Tailings
etc
Concen
trate
Data
Chemical
analysis
”SMART” Tailings Facility
Customer
Research
Dry
stacking
Other: 3D

TO THIS!


Digital Twin
Customer
Customer
Data
MiniPilot
Crushing Milling Classification
Flotation Chemicals etc
Pilot Plant
Filtering etc
Tailings etc
Concen trate
Process Automation
Data
Mineralogy Geometallurgy
Crushing Milling Classification
Flotation Chemicals etc
Pilot Plant
Concen trate
Filtering etc
Tailings etc
Customer
”SMART” Tailings Facility
Chemical analysis
Research
Dry stacking
Other: 3D
Technology suppliers, Universities, research centers

FULLY AUTOMATED LABORATORY



- Sample throught put to empty system: Milling sequence 5-6min total, XRF: 15 min, XRD 10-15 min
- Stardized way of making sample
- 24/7
- Ores, Industrial Minerals, Geomaterials, Side Streams, Circular Materials
- Battery Minerals

SMART TAILINGS AREA: SOLUTIONS FOR THE TAILORED WASTES

- Sensor / probes - technology enables short and long term studies
- ”SMART” tailings facility – feeds Digital Twin with Data
- Re-mining studies
- Dry stacking research
- Bottom and cover structures
- Water recycllability - collaboration and research
- Morecovery – Water recovery for recycling – valuables
- Technology supplier collaboration

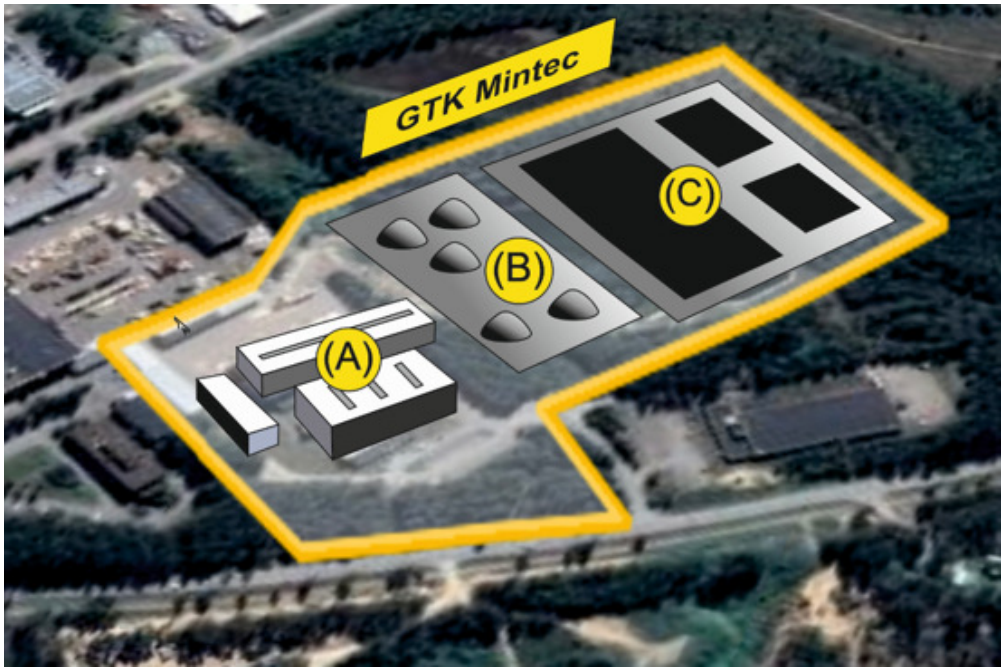
NUMBER #1 IN THE WORLD

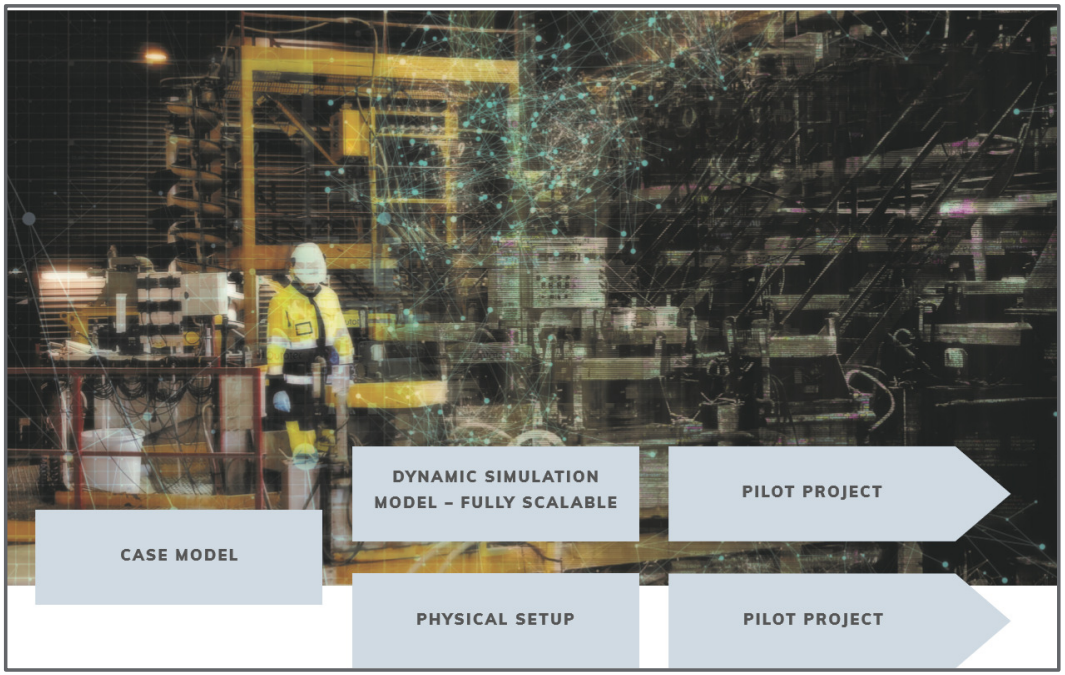
GTK Mintec will be #1 Mineral Processing Pilot Plant globally, having non-parallel competence processin know-how on:

- Primary minerals, geomaterials, ores, metals, etc
- Circular Economy meterials
- Re-mining of old tailings
- Digitalization and Automation
- Tailings research
- Mine environment/Mine Closure
- Technology collaboration

Conversion to a test platform and facility for technology partners e.g., startups, universities, research centers

OUTCOME: GTK MINTEC 2.0 AT OUTOKUMPU MINING CAMP, FINLAND





jouko.nieminen@gtk.fi

LinkedIn: https://www.linkedin.com/in/joukonieminen/

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