

Digitalization of Mineral Processing Plant at GTK Mintec

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Technology is now in place to evolve mineral processing practice

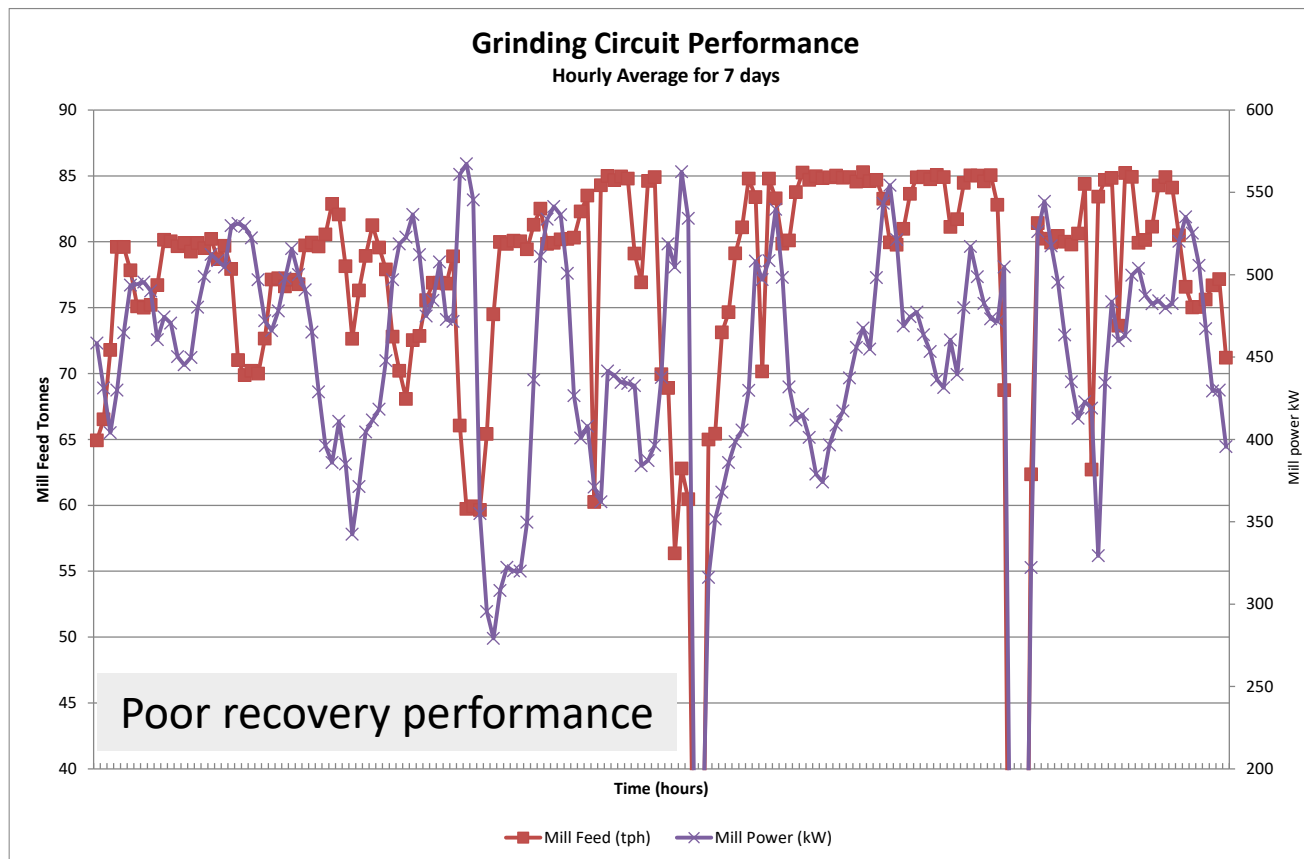
Process control not sophisticated enough
(digitization is the solution)

CAPEX blowouts

Project	Company	Feasibility budget cost	Actual/forecast cost overrun
Ravensthorpe/Yabilu Expansion	BHP Billiton	A\$1.4 billion	30%
Spence (Chile)	BHP Billiton	US\$990 million	10%
Telfer Mine	Newcrest	A\$1.19 billion	17.50%
Stanwell Magnesium	AMC	A\$1.3 billion	30%
Boddington	Newmont	A\$866 million	100%
Goro Project (Indonesia)	Inco	US\$1.45 billion	15%
Prominent Hill	Oxiana	A\$350 million	51%

Source: Noort and Adams 2006

Poor feasibility characterization
(geometallurgy is the solution)



At a mine site South of the North Pole

Objective: define Mineralogical based process behavior



Measurement based efficiency of each individual process in context of a family of ore types



We want to diagnose when and why recovery goes up or down



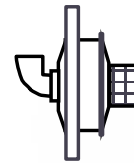
We want to be able to diagnose and isolate the exact causality origin of changes in recovery



Define an operational link between process units, the circuit as a whole, and optimized recovery



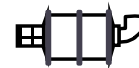
Crushers



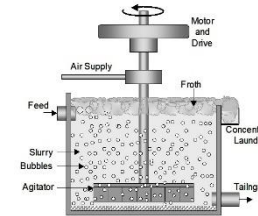
SAG/AG Mill



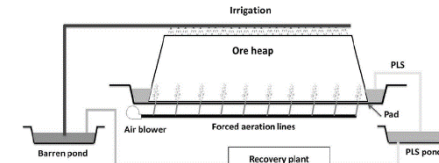
HPGR



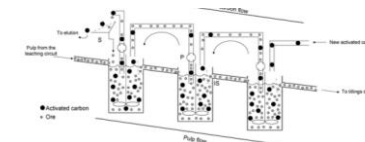
Ball Mill



Flotation



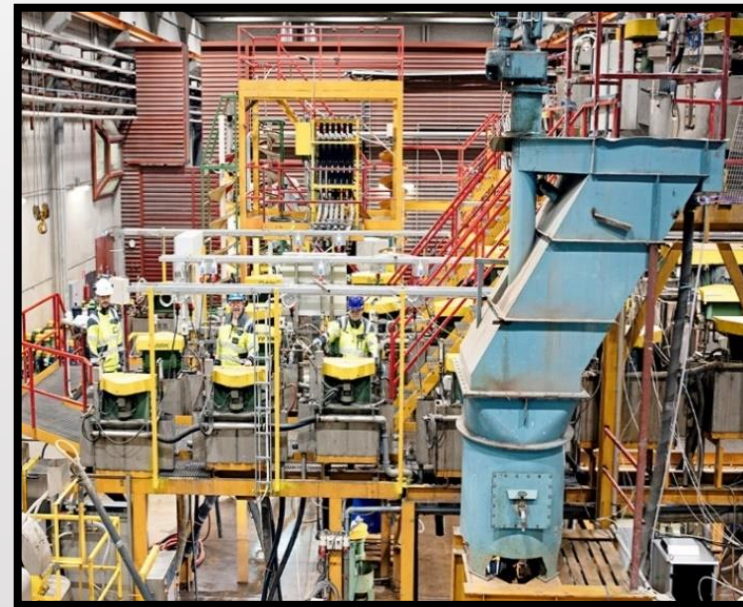
Dump Leach



CIL Leach Tank

Building the Virtual Pilot Plant

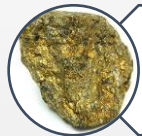
GTK is building a virtual Pilot Plant based on real one by using Digital Twins tool to **improve the operation of the installation** and for a **digitized customer experience**



Virtual model (on the left) and real Pilot Plant (on the right) at GTK Mintec

GTK Mintec Pilot Plant

GTK Mintec is the Mineral Processing pilot plant for



Minerals



Ores



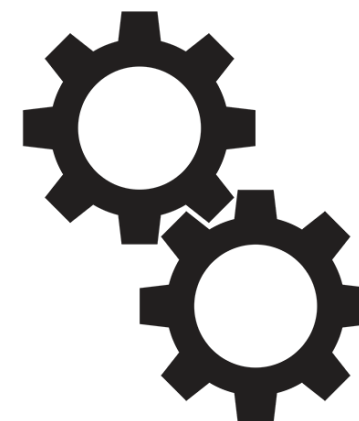
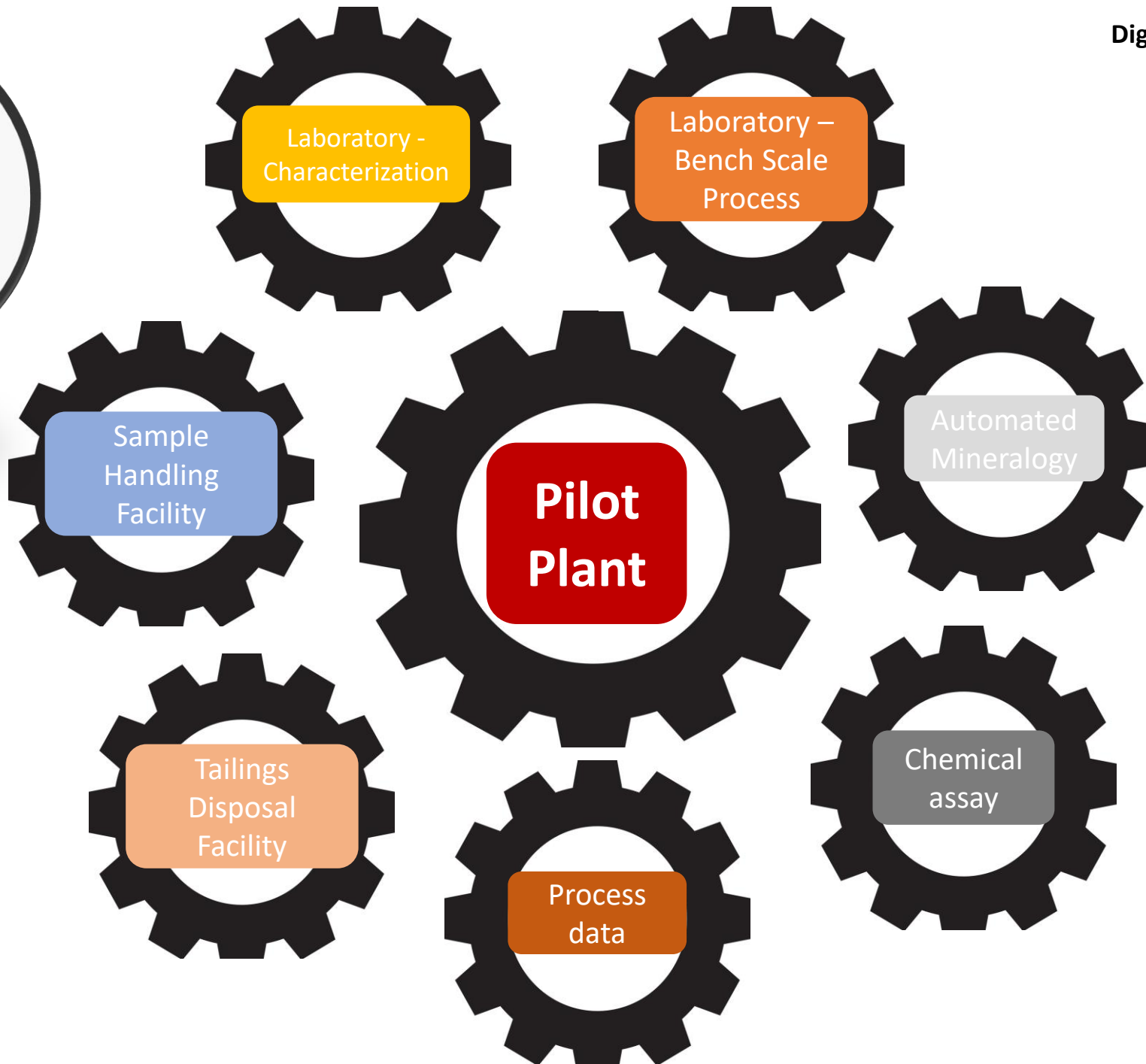
Geomaterials



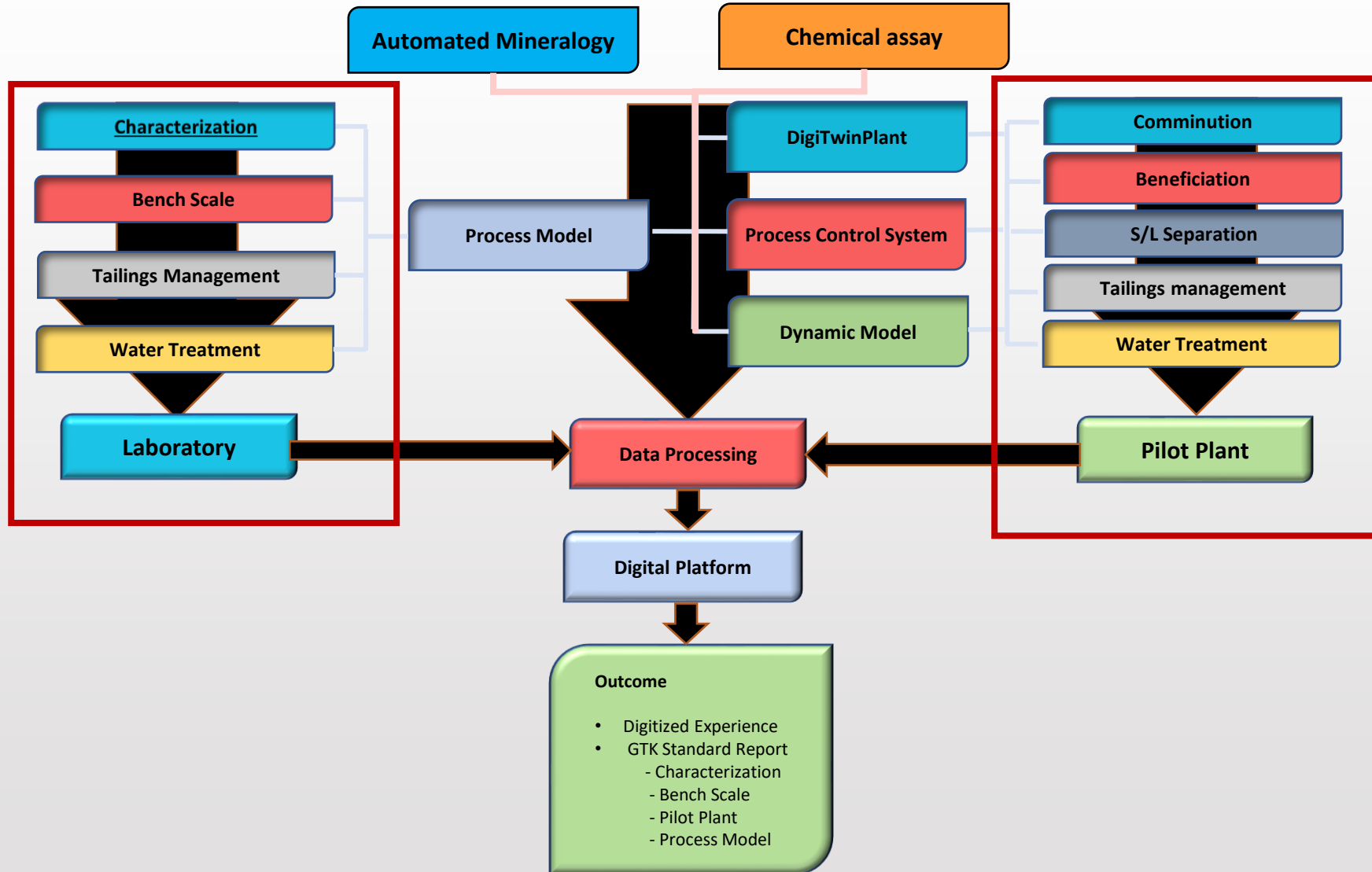
Circular economy materials

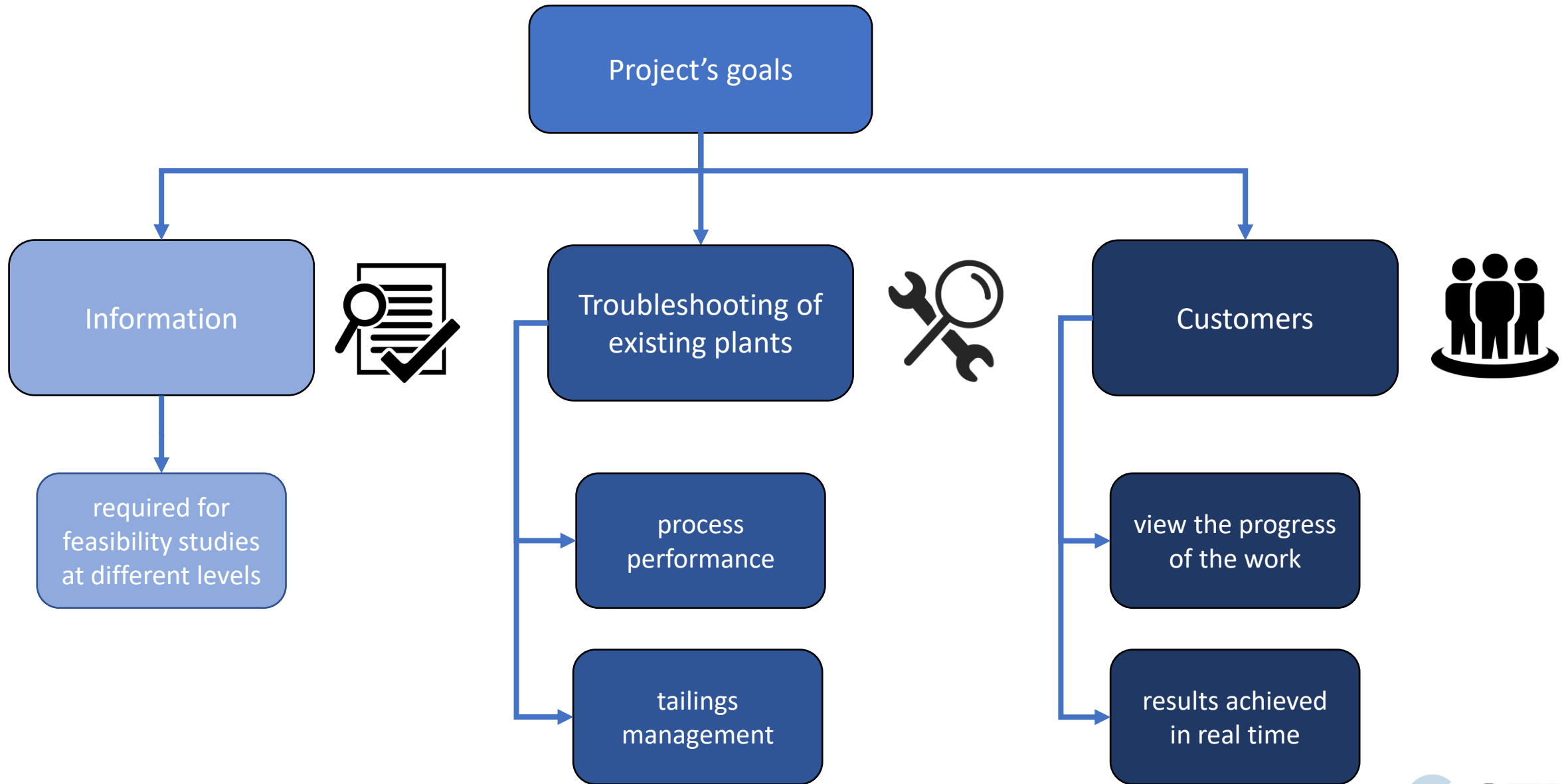


A world class process pilot plant with a capacity up to 5 tonne per hour



GTK Mintec Standard

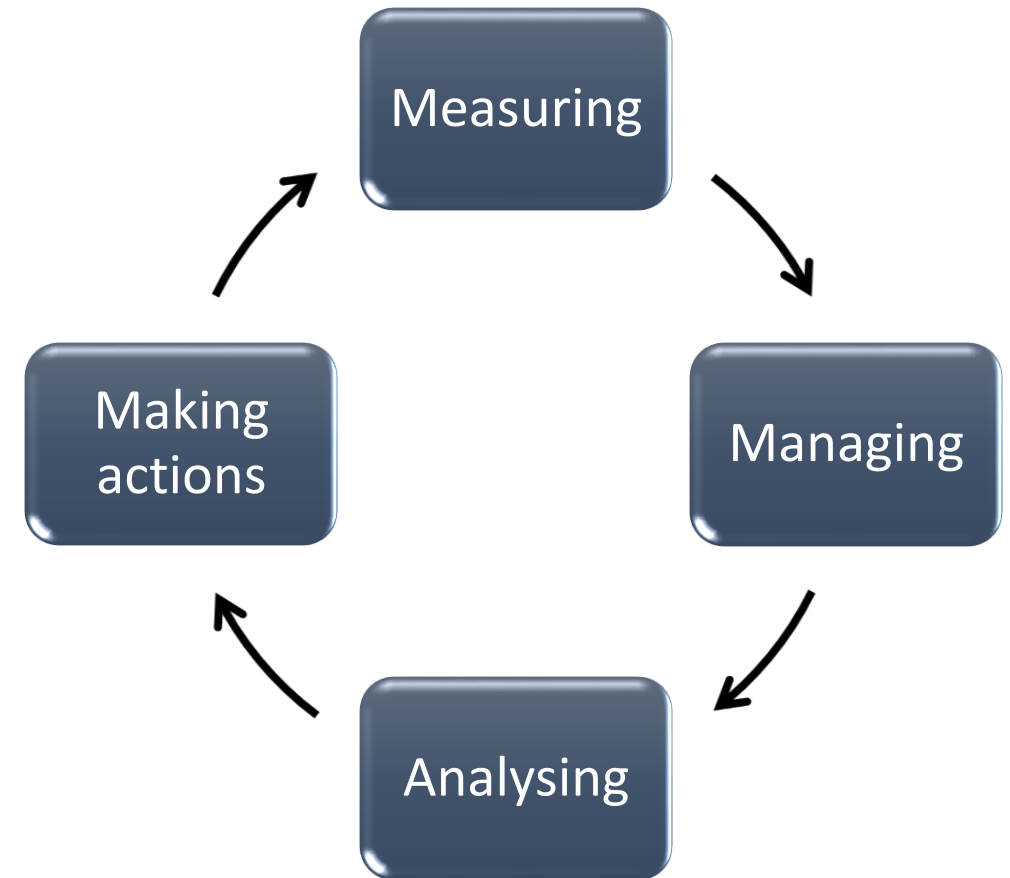


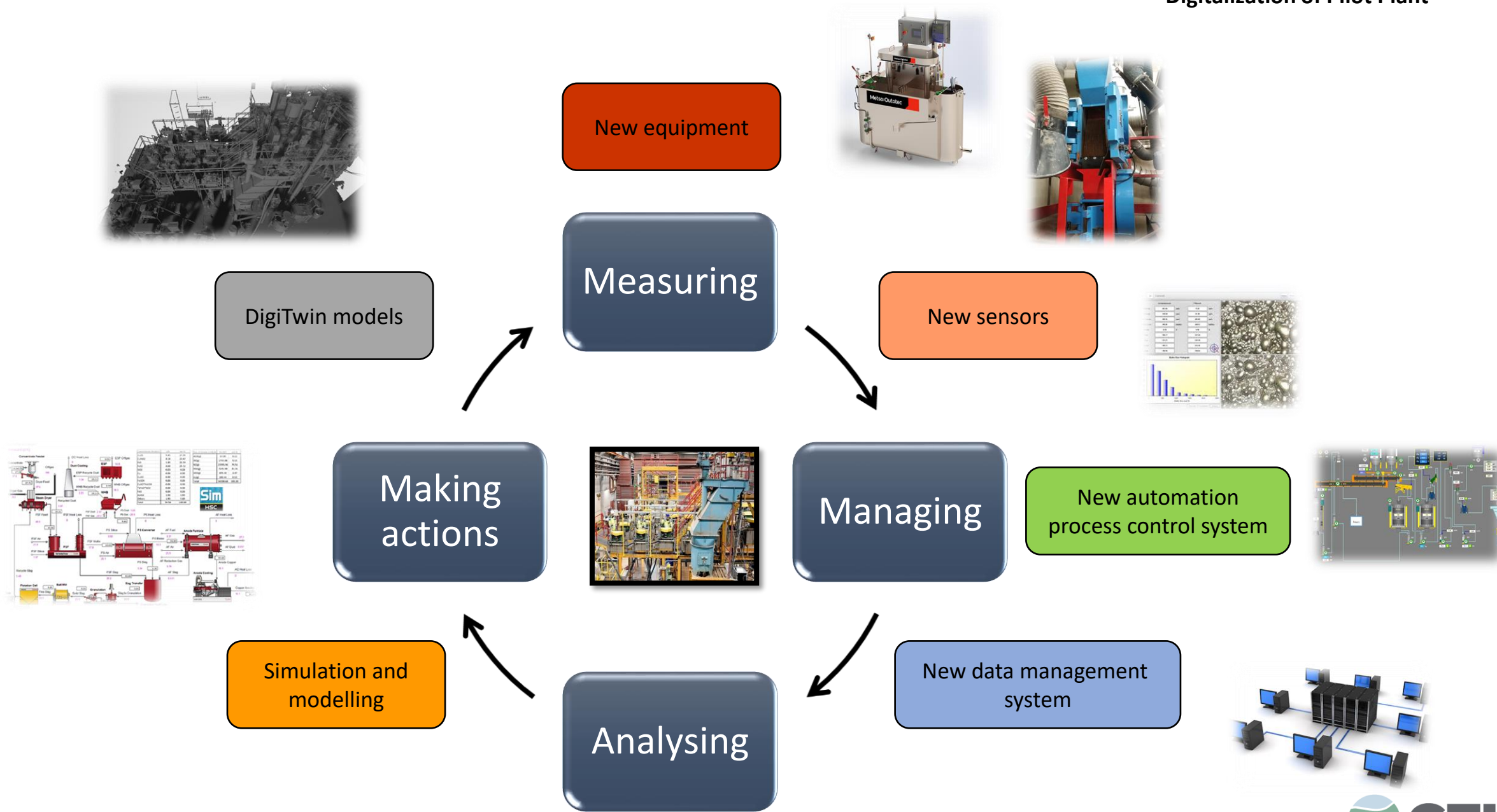


Project Conception

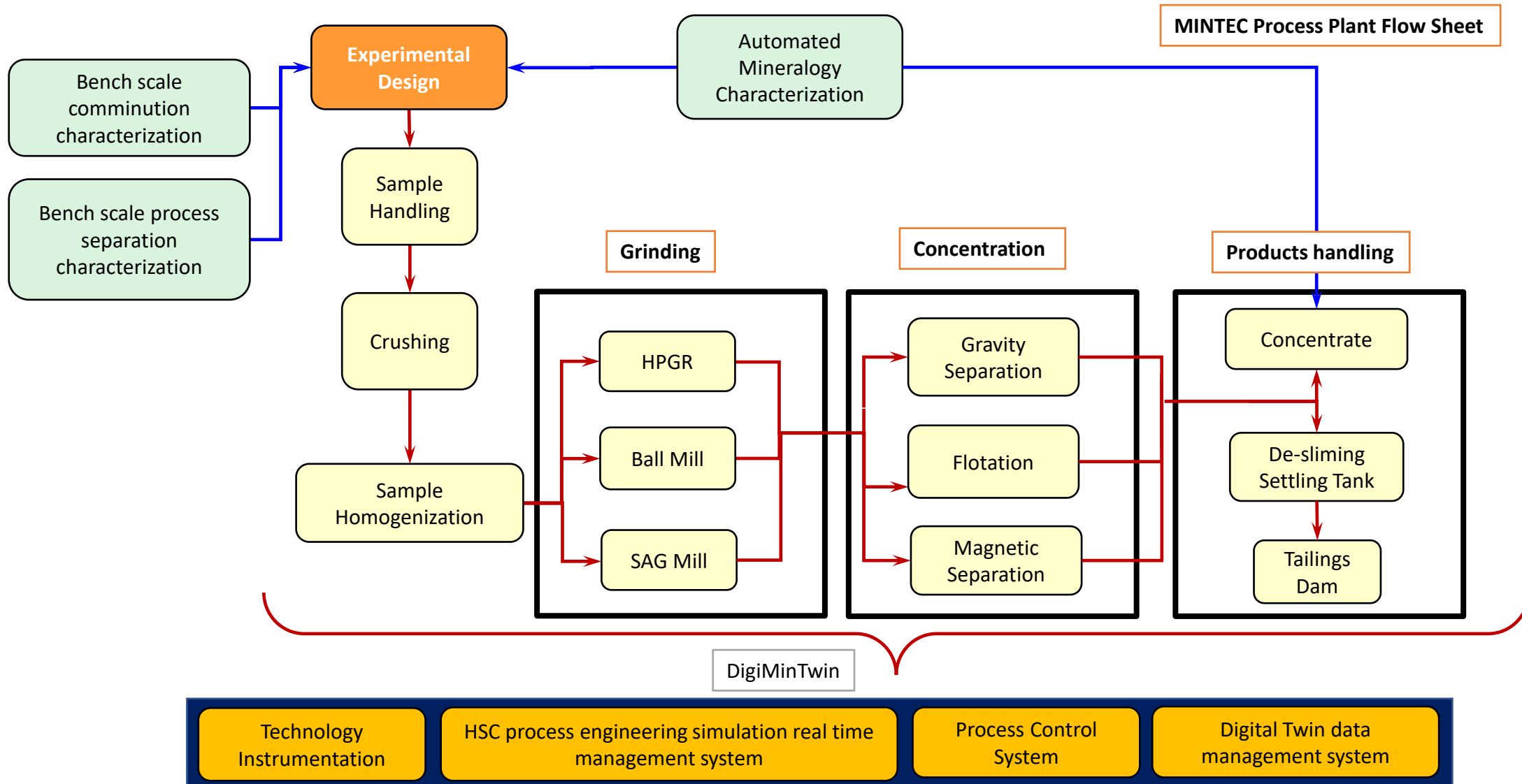
The digital mineral processing solutions are based on:

- ✓ **measuring** the phenomena with instrumentation at several stages of the mineral processing circuit,
- ✓ **managing** the data in real-time,
- ✓ **analyzing** collected data by using machine learning artificial intelligence to develop the next generation of process control
- ✓ **making actions**.





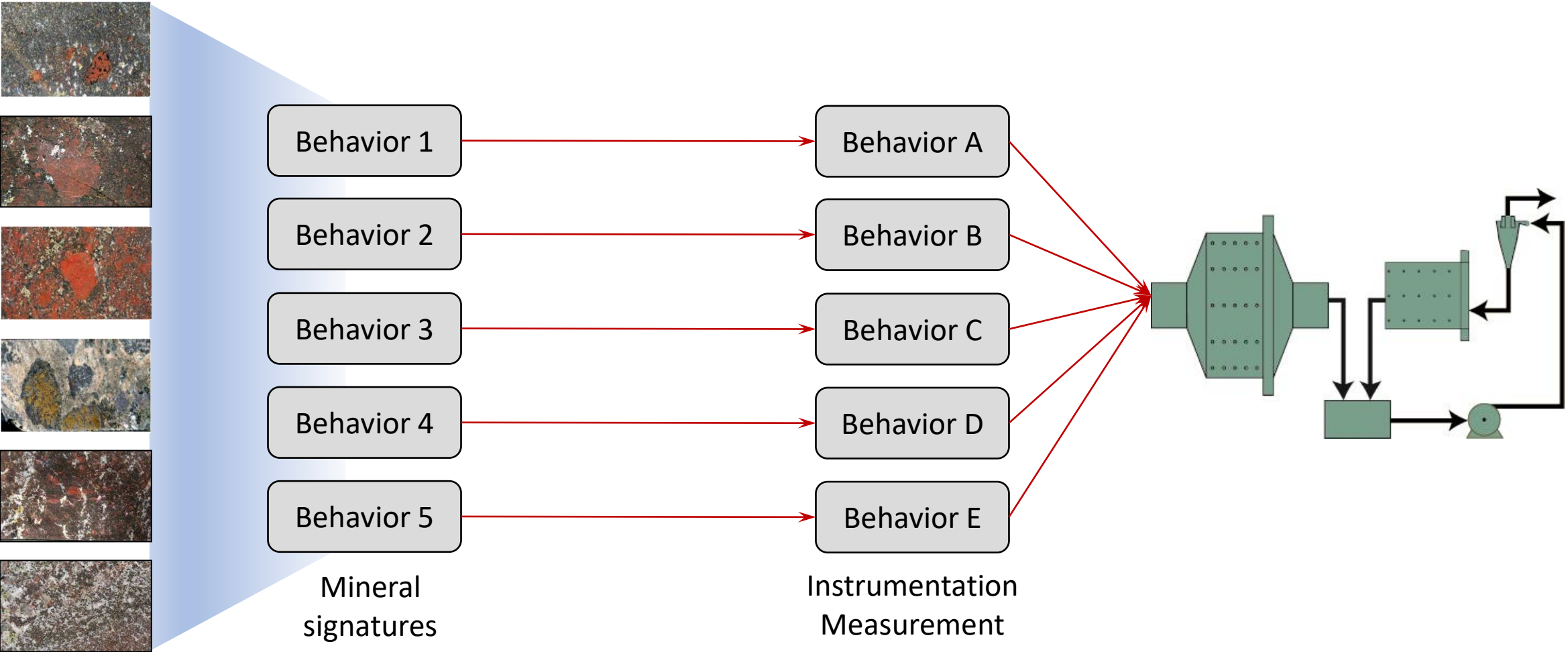
MINTEC Process Plant Flow Sheet



Geometallurgy to operation

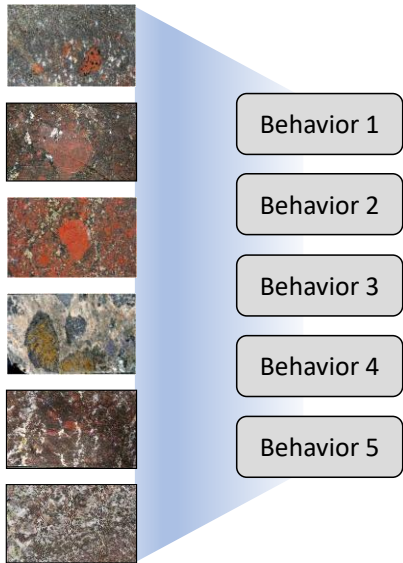
Geometallurgy Laboratory scale

Pilot Scale/Production scale

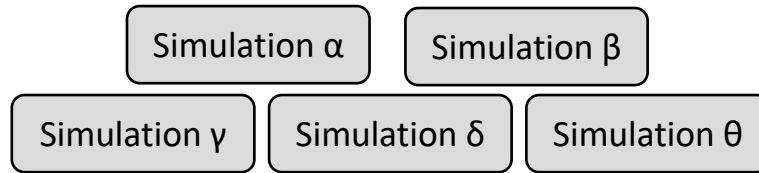


Geomet to operation

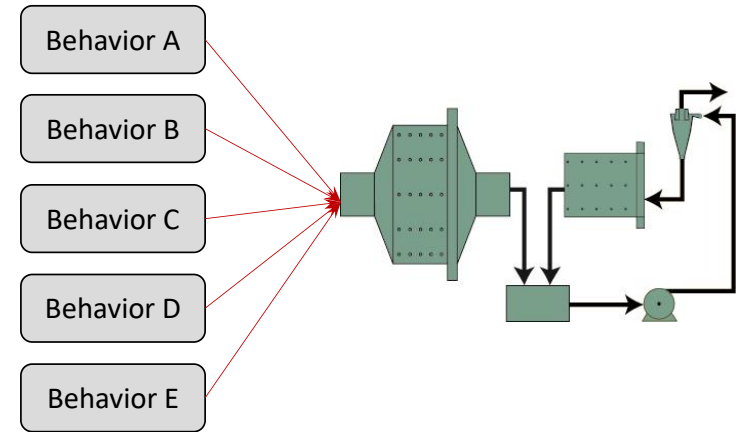
Geometallurgy Laboratory scale



Mineral signatures

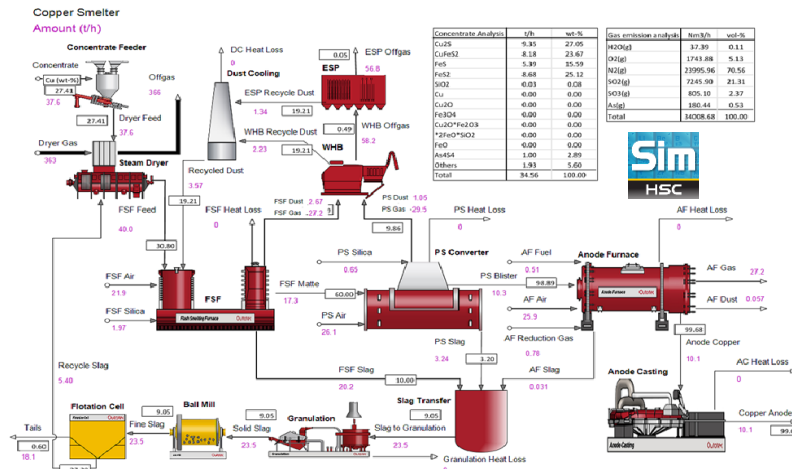


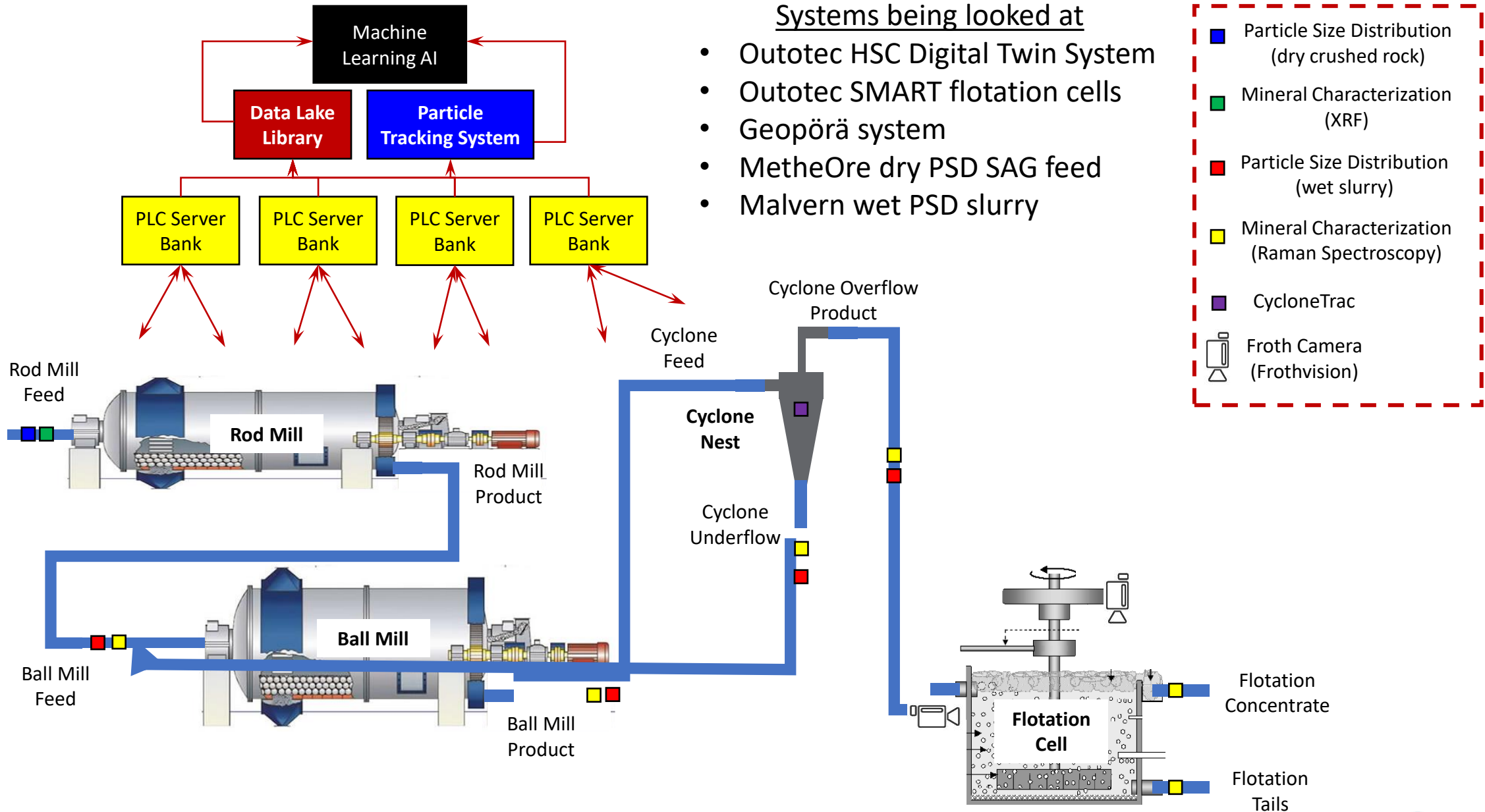
GTK-Mintec Pilot Run



Instrumentation Measurement

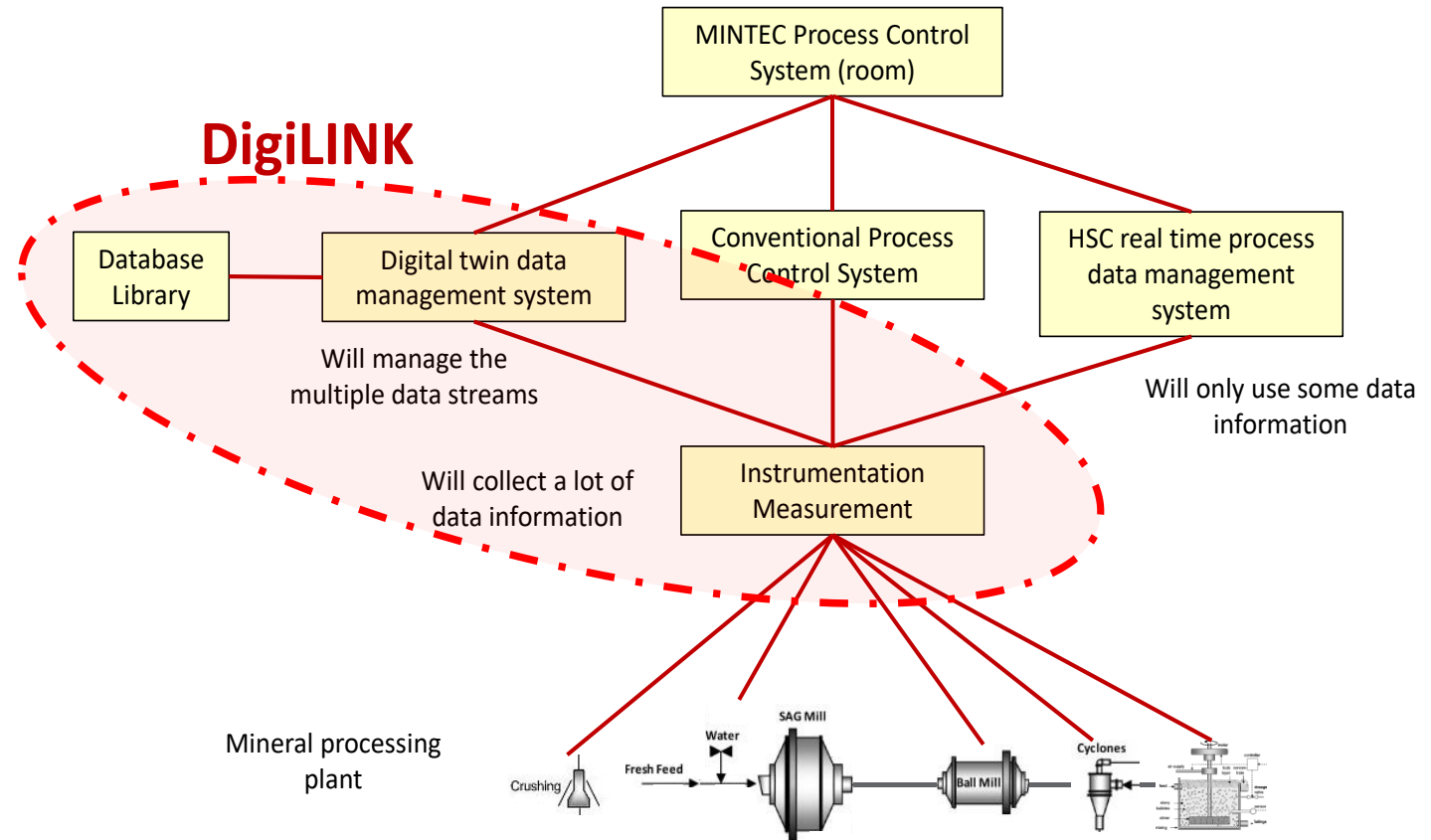
This is the interesting part





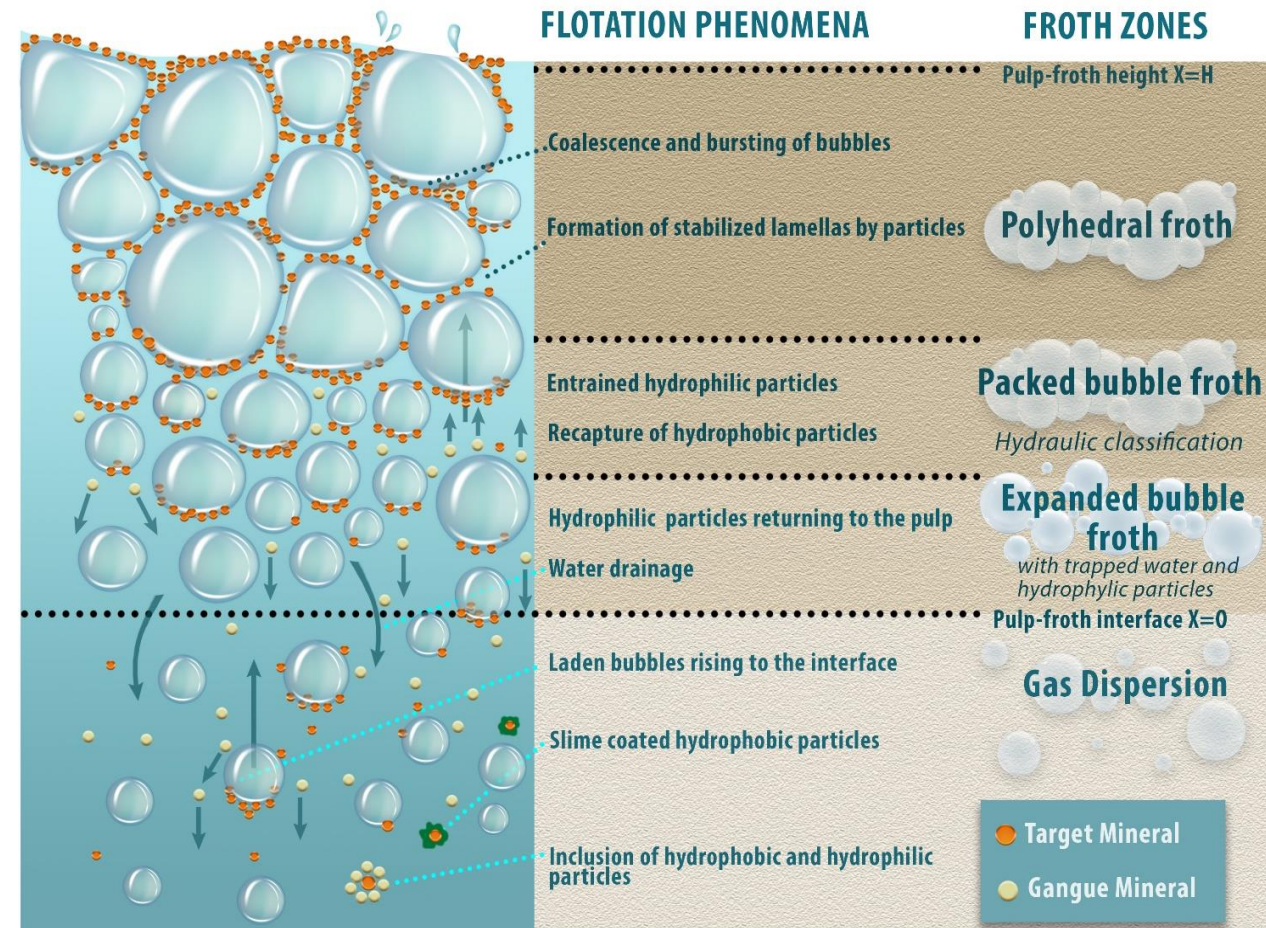
DigiLINK

- Efficiency enhancement
- Capability of performing effective cost/worth analysis for investing in future technologies and/or new instruments
- Better asset management
- Fault detection and diagnosis
- Improving safety



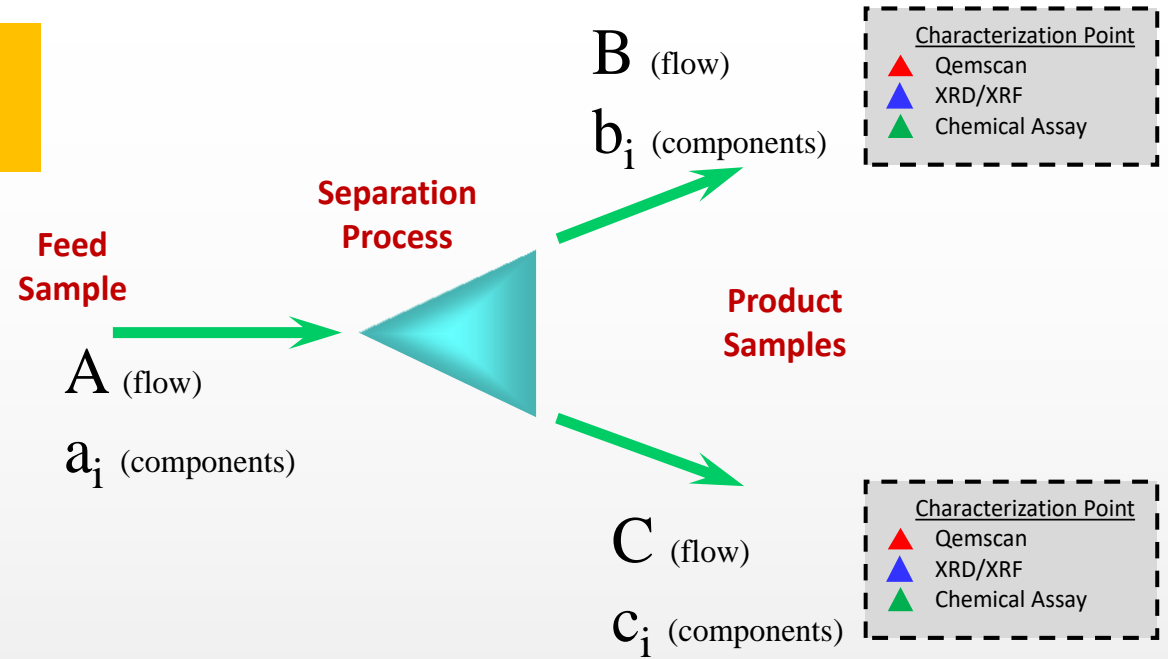
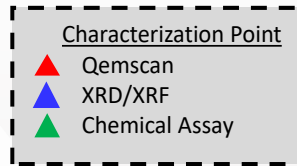
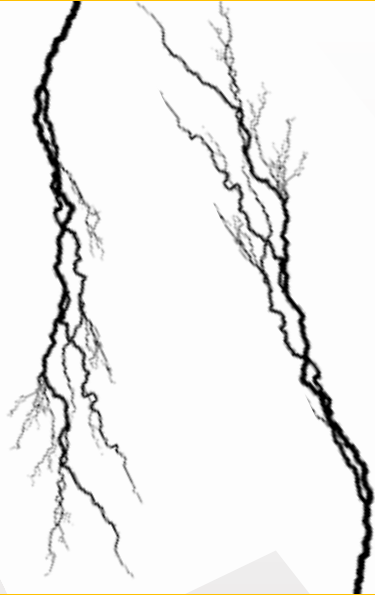
Machine Learning

- What controls the metrics for good flotation performance at the ball mill metrics?
- How does the cyclone nest interact with the ball mill?
- What are the implications of the feed to the SAG mill being too coarse (or at the critical size fraction)?
- How does the SAG mill interact with the ball mill?
- What controls the metrics for good flotation performance at the crusher metrics?
- How does mineralogy influence the whole circuit?



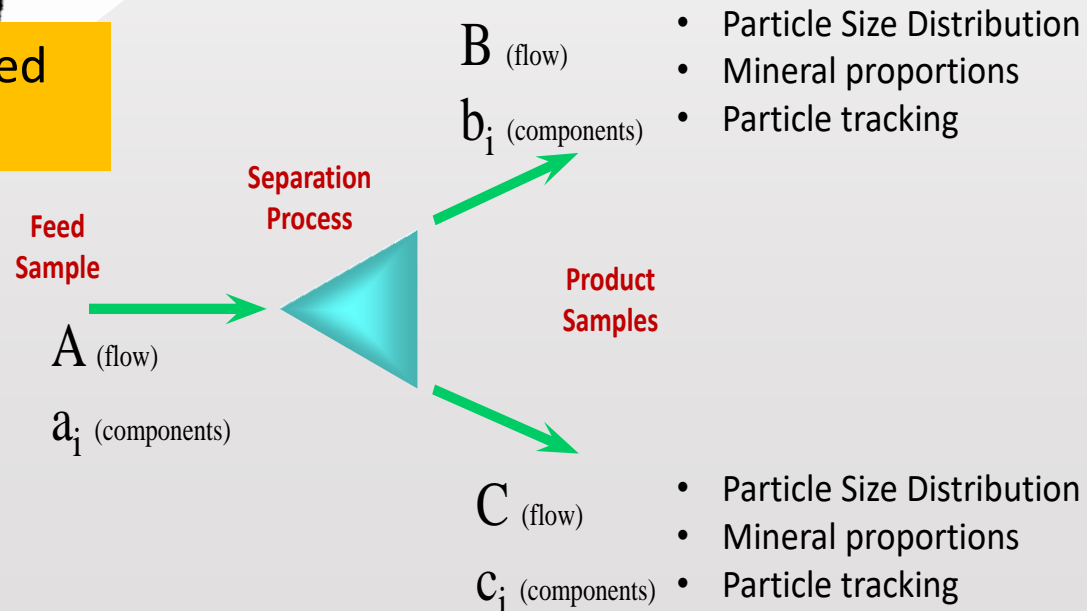
How does this change with each geometallurgical orientation sample signature

Geometallurgy signatures around each laboratory scale process unit

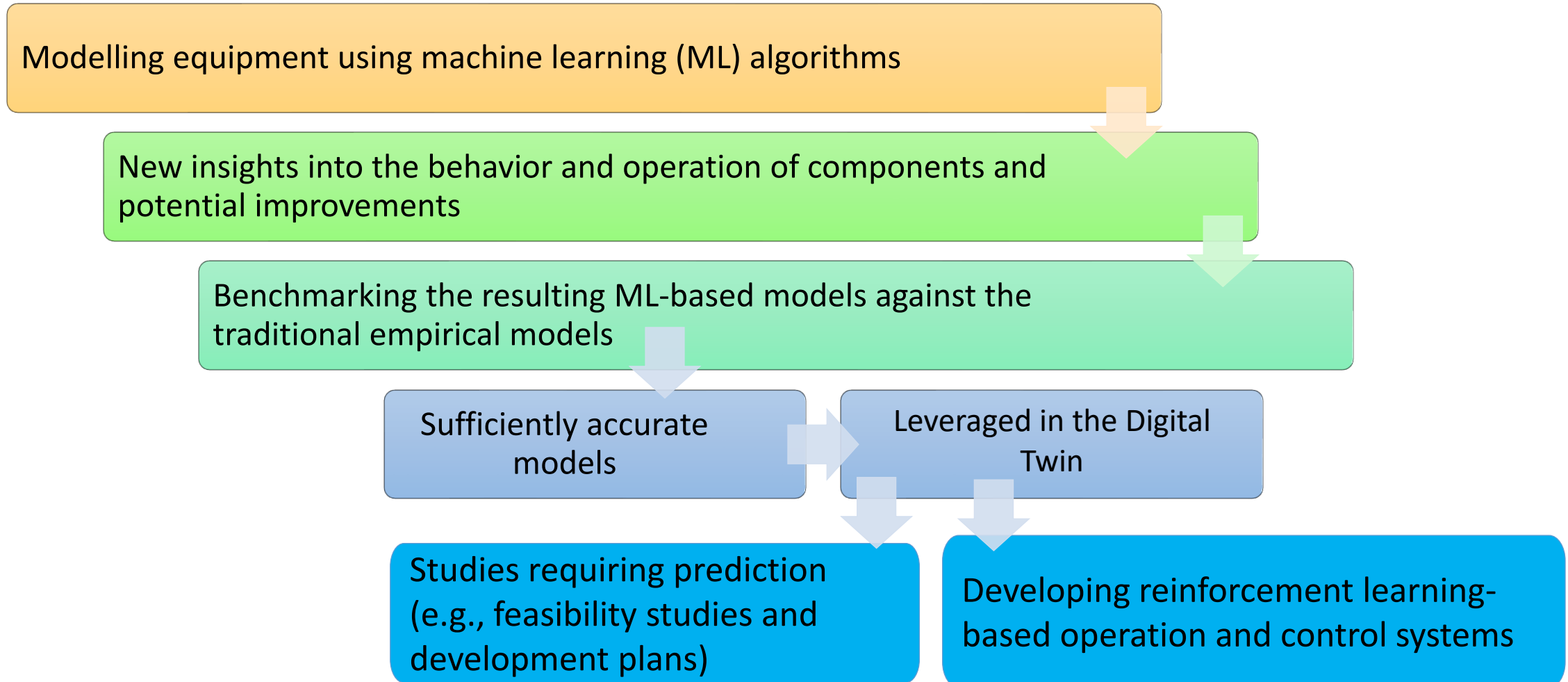


Instrumentation data collected around each pilot scale unit

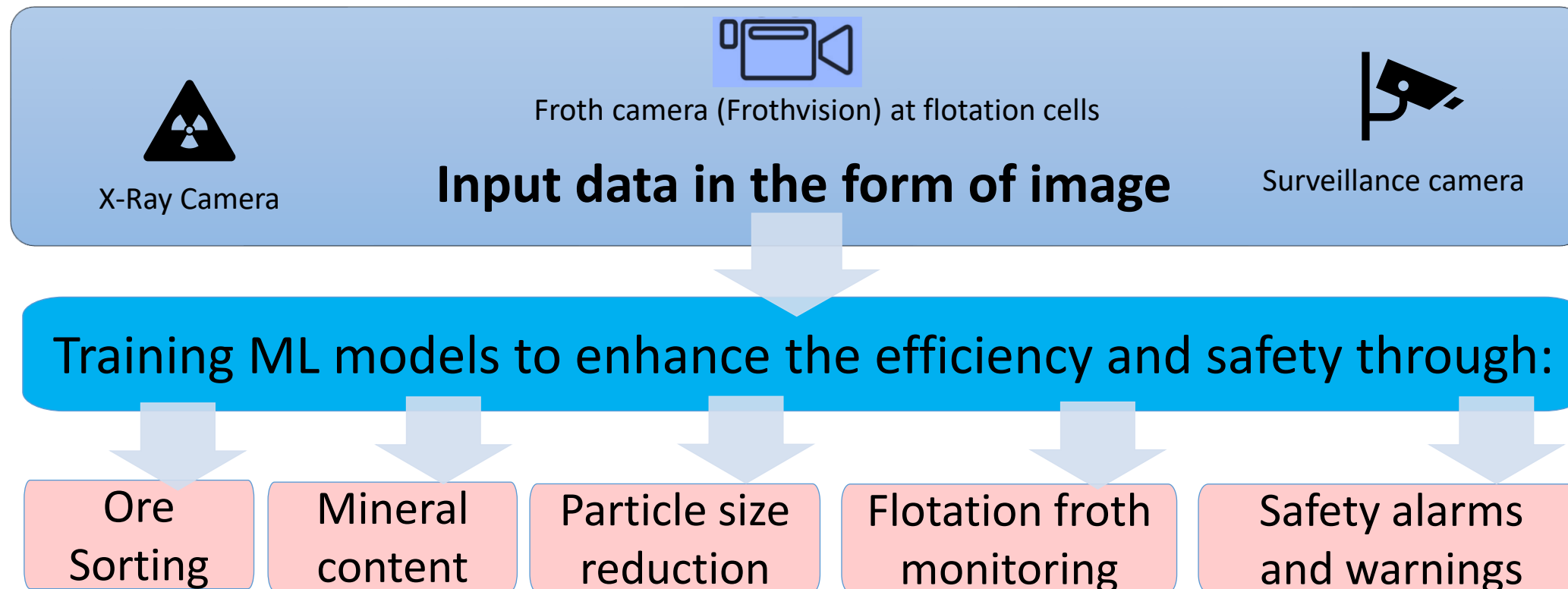
- Particle Size Distribution
- Mineral proportions
- Particle tracking



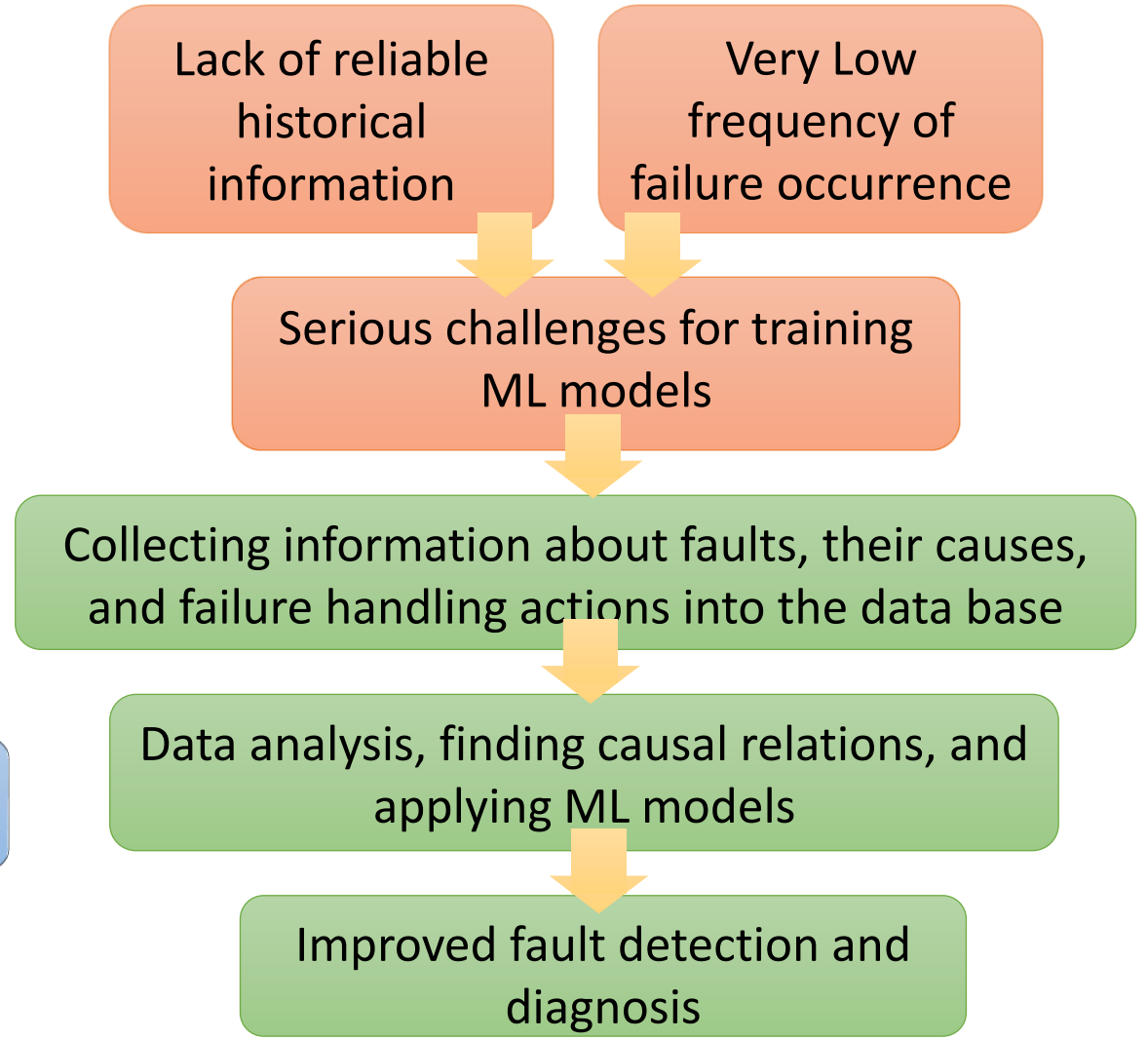
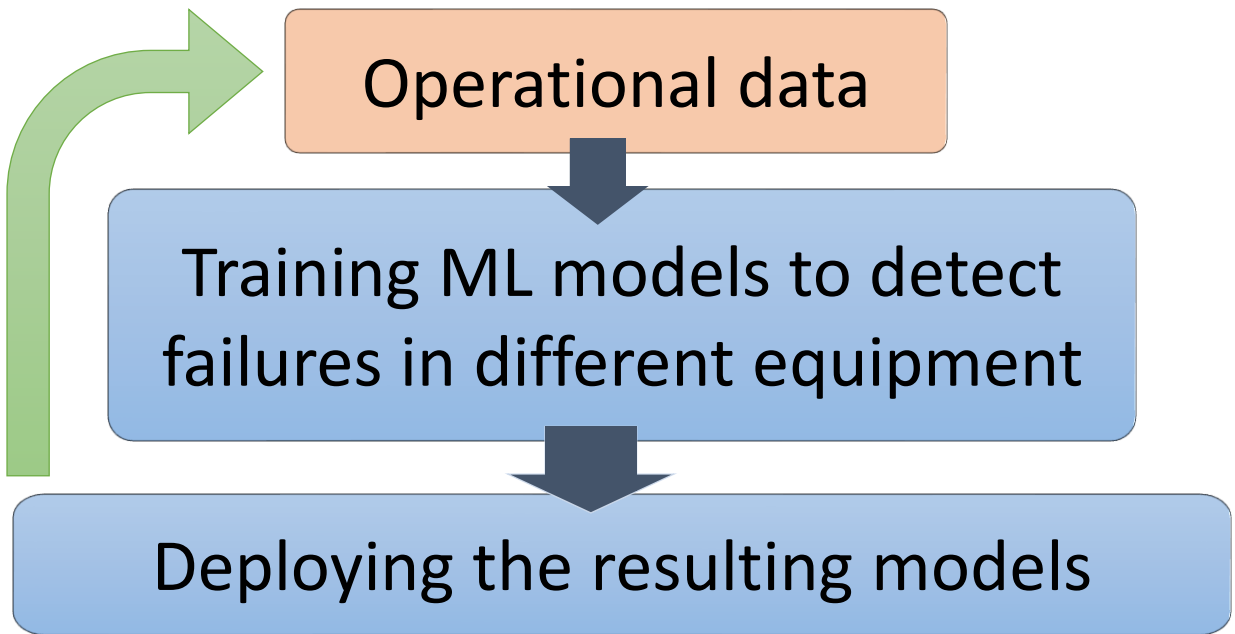
Data-driven equipment modelling



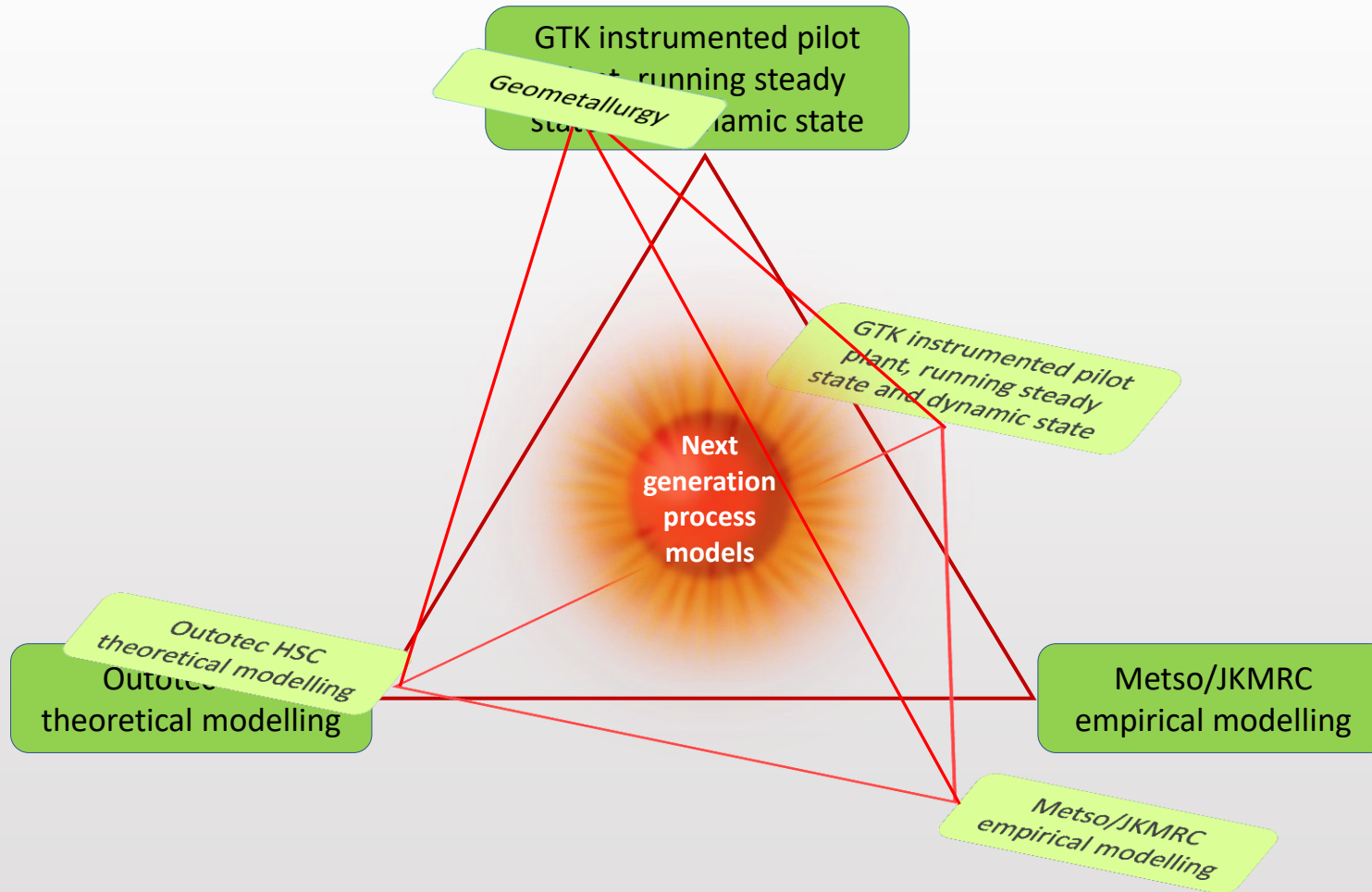
Machine vision



Fault detection



Integrate Four paradigms



Conclusion – Mitigate risk for the client

- At the feasibility stage(s), CAPEX closely resembles the final commissioning reality
 - Deliver a pilot run that delivers the best and most effective recovery procedure
- A clear operational understanding of why recovery improves or deteriorates is developed
- Diagnose the ore types that will be more challenging for recovery in a fashion where the plant can respond in time with an optimized response
- Diagnose the relationship between recovery at the flotation cells and performance of individual units like the ball mill
- An optimized circuit response and individual process unit response to each ore type
- A link between tailings management and plant performance