Hatch Digital Solutions in Phosphates

CRU Phosphates 2021

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Carlo Cristofari
Edward DeRose, PE
Ali Vazirizadeh, Ph.D.

HATCH

Who is Hatch?

Roots over **60** Years

Experience in **150** Countries

65 Offices

Over **9,000** Great People

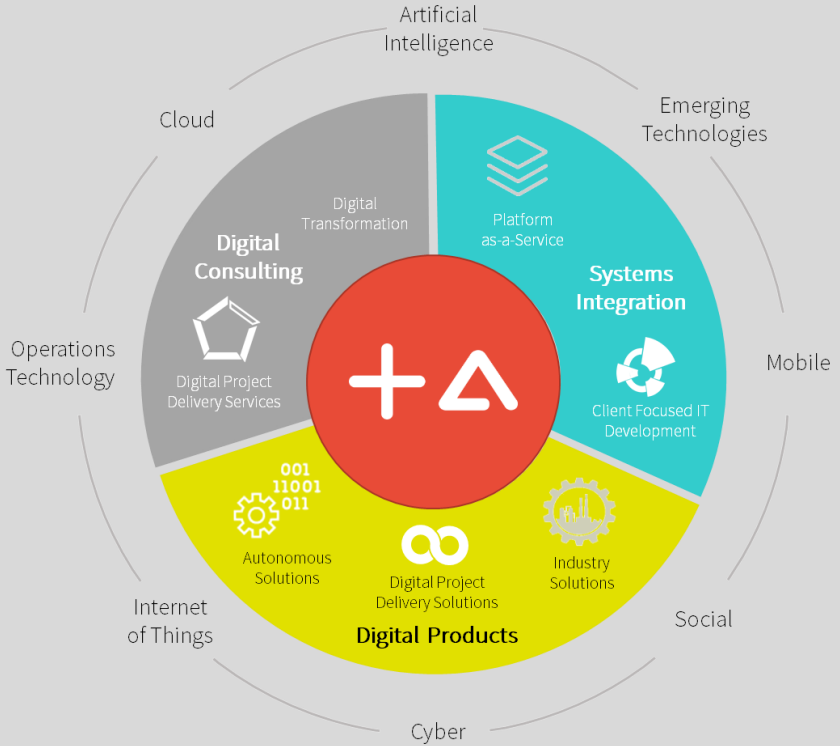
Project Delivery – Advisory – Digital – Operational Services

Hatch Phosphate Center of Excellence

Hatch Phosphate Engineers Have Many Years of Practical Industry Experience

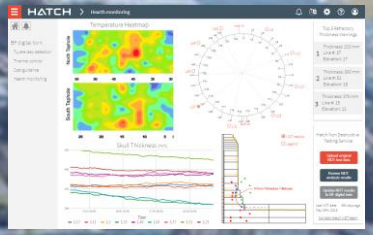
- Phosphate Mining and Beneficiation
- Rock Receiving, Grinding and Storage
- Sulfuric Acid
- Phosphoric Acid
- Ammoniated Phosphate Fertilizers
- Ammonia and Related Processes
- Water, Steam and Power Balances
- Phosphate Chemical Plant Utilities
- Equipment Specification and Design
- Material Handling

Digital Capabilities



20+ Years delivering Digital Solutions for Industry Clients	350+ Staff dedicated to Digital Solutions, Machine Learning & Data Analytics
40+ Years delivering Control, Automation & Electrical Solutions	650+ Staff dedicated to Control, Automation & Electrical
20+ Years delivering Advisory Services and Business Improvements	40+ Disciplines related to Business Improvements
60+ Years of Technologies & Innovation	

Algoma
Blast Furnace Digital Twin



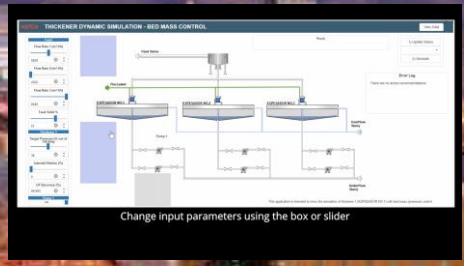
Scope: Study and Implement

Benefit: Operator Guidance

Complexity: Blast Furnace

2nd Benefit: Process Improvement

Copper Mining Major
Dynamic Simulation & Decision Support



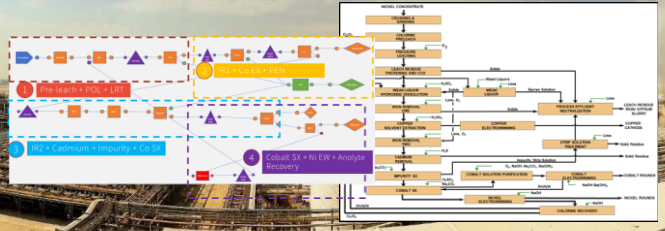
Scope: Study and Implement

Benefit: Simulation Planning

Complexity: Real-time data

2nd Benefit: Operating Training

Diversified Mining Major
Integrated Production & Maintenance Scheduling



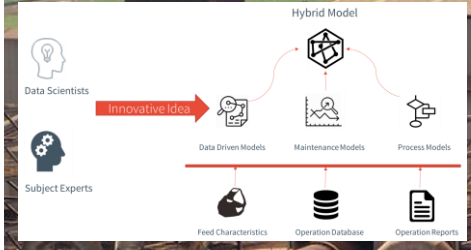
Scope: Study

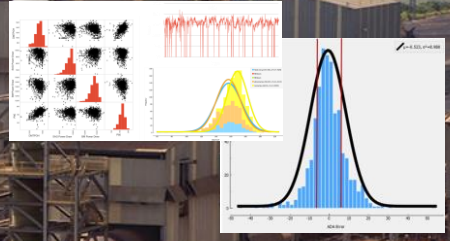
Benefit: Coordinated Planning

Complexity: Multiple Systems

Challenge: Optimized Production

Gold & Copper Mining Major – Case Study#2
Soft Sensor Development





Scope: Study

Benefit: Predict P80 Particale Size

Complexity: Hybrid ML Model

2nd Benefit: 95% within 6 microns

Case Study #1:
Railcar Loading Optimization

Problem Statement:

Overloading phosphate rock into railcars resulting in surcharges and penalties in excess of **millions** of dollars per year imposed by railroad company.

Constraints:

+ Dynamic loading, constant & variable motion
+ Variable railcar type & rock mixture
+ Limited capital

Solutions:

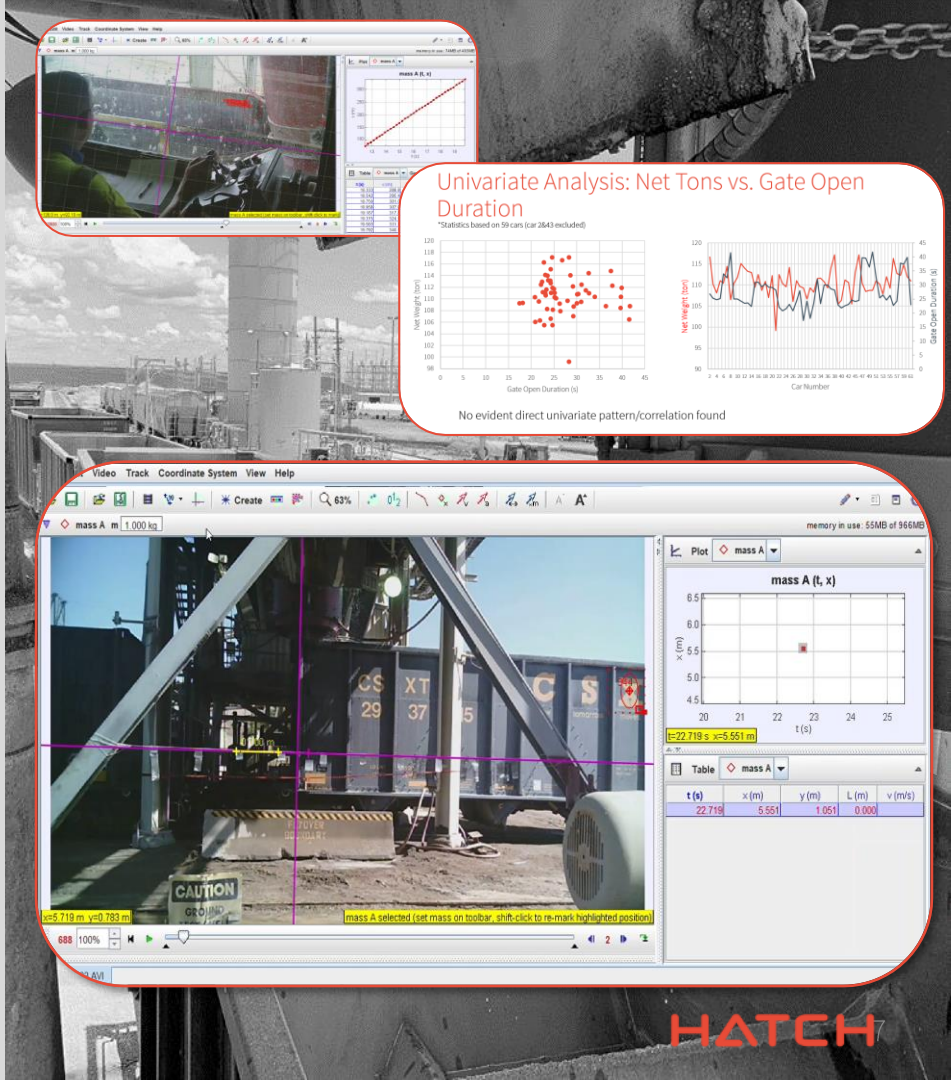
+ Retrofit loadout system
+ Install a new loadout system
+ Use data and digital technology to increase control during railcar loading with existing system

Case Study #1:
Railcar Loading Optimization

Approach:

Completed FEL1 Conceptual Study to evaluate all potential solutions. Ultimately, the client chose to advance studies for a digital, data-driven solution

- Data collection
  - Video camera, data historian, train manifest
- Data extraction & data cleansing
  - Car position
  - Car velocity – dynamic & always changing
  - Gate opening/closing times
  - Chute position
  - Bin level
  - Loadout sequence timing
  - Loaded length of the railcar in each loading stage
- Data alignment

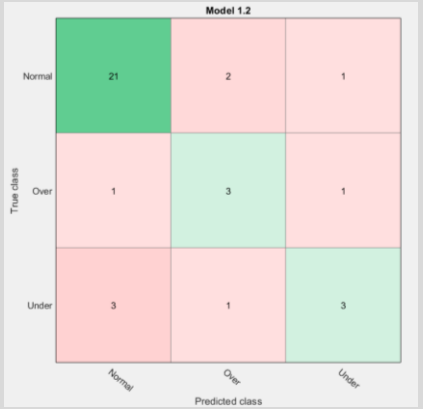


Case Study #1:
Railcar Loading Optimization

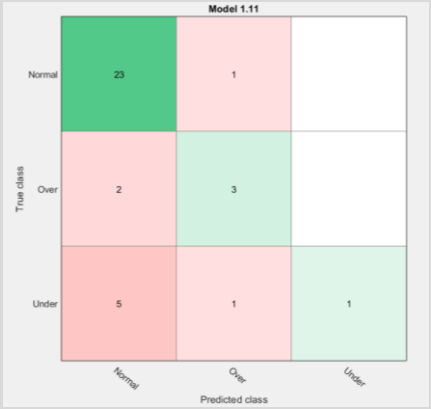
Results and Next Steps:

- Improve data historian data granularity
- Set a laser sensor to measure car velocity and integrate into historian
- Collect data for 3-5 month time period
- Add variables to improve model accuracy (moisture, bulk density, etc.)
- Validate the model performance
- Model deployment and Beta testing
- Model revision
- Deliver a monitoring system

Model: Classification Tree
Accuracy: 75%



Model: Ensemble
Accuracy: 75%



True/False Analysis

Case Study #2:
Soft Sensor development of Hydrocyclone P80

Problem Statement:

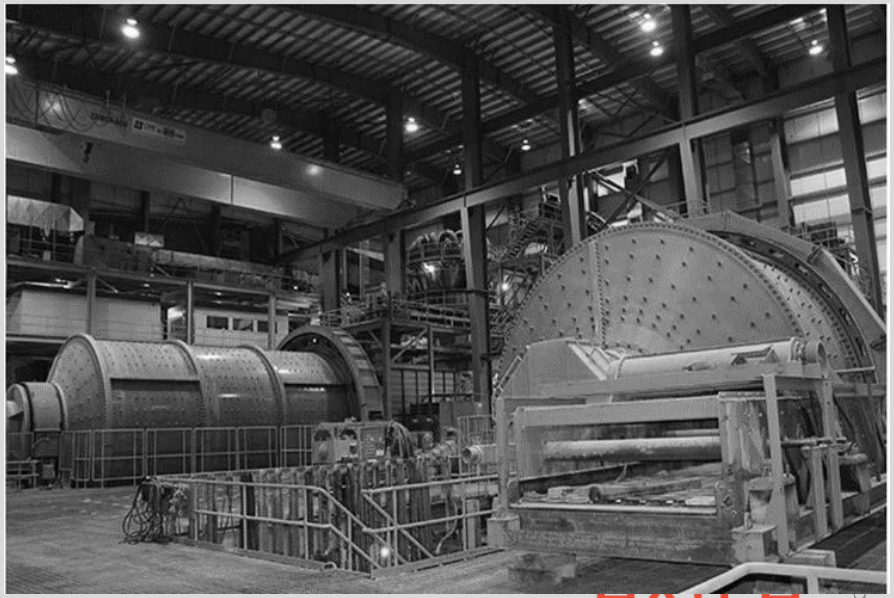
Accurate measurement of Hydrocyclone overflow P80 is challenging. This variable is required to calculate the grinding circuit efficiency and to model the operation performance.

Methods

- Sampling and lab analysis
- Online particle size analyzer
- Soft sensor

Soft sensor development Constraints:

- Availability of good quality data
- Variable operational conditions and ore types
- Enough representative sample for modeling



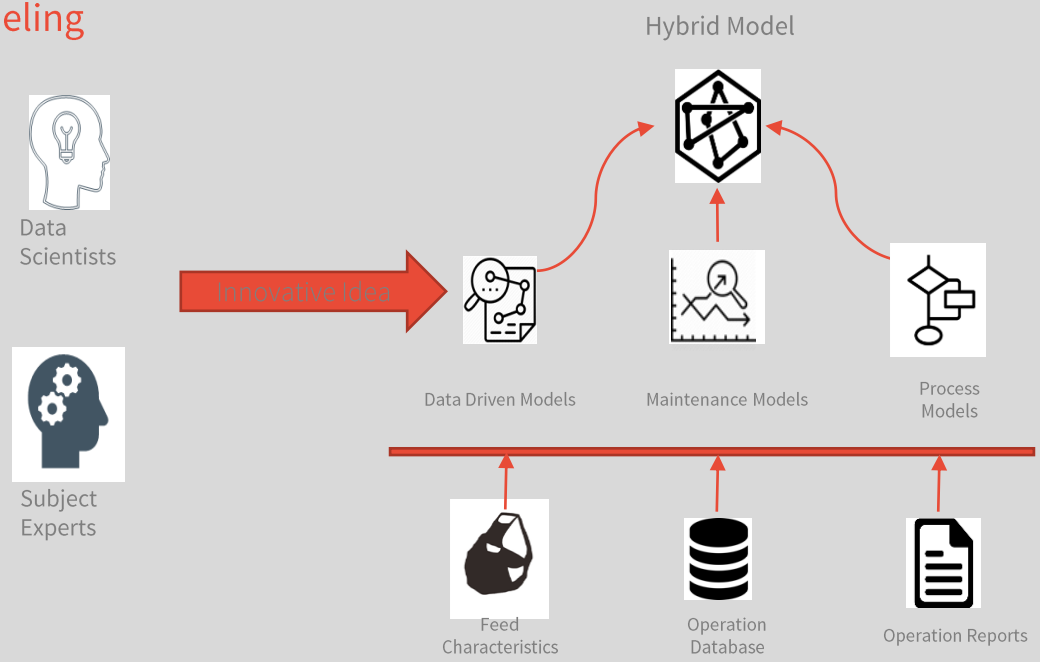
Case Study #2:
Soft Sensor development of Hydrocyclone P80

Approach:

Soft sensor development through hybrid modeling

Steps:

- Data Collection
- Data pre-processing and exploration
- Hybrid modeling
- Model validation
- Deployment



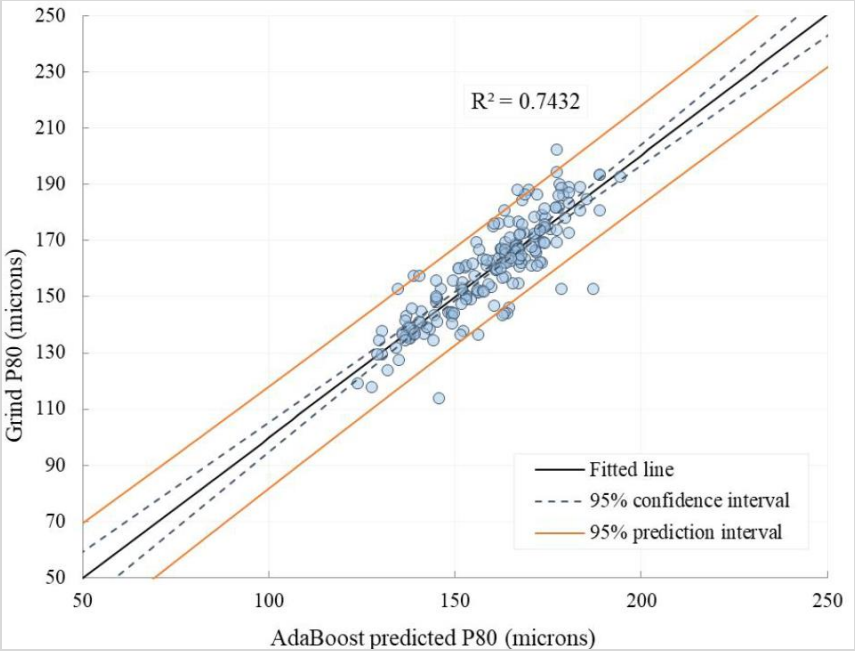
Case Study #2:
Soft Sensor development of Hydrocyclone P80

Results:

- Average Error: 3-5%
- 95% of estimations are within 6 microns of the true value
- Hybrid modeling presents better results than analytical modeling

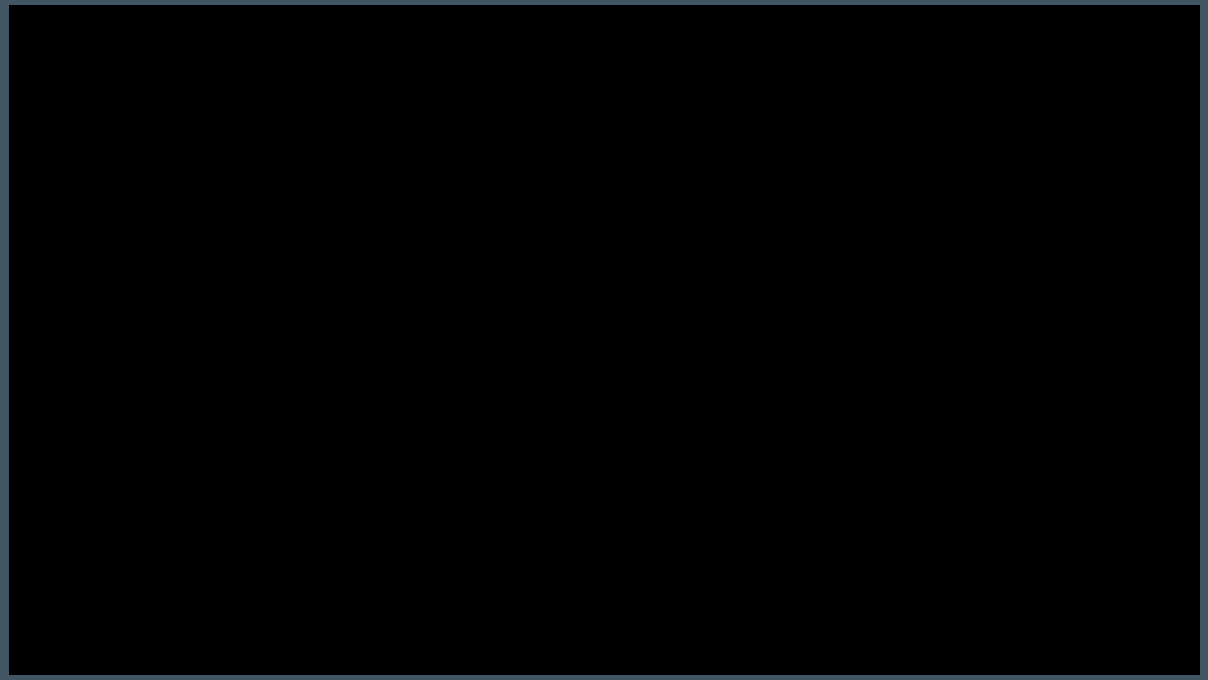
Next step

- Soft sensor deployment
- Optimize operational modes
- Operator training



Method	MSE	RMSE	MAE	R2
Analytical	135.163	11.626	8.127	0.489
Hybrid	81.054	9.003	6.418	0.731

Hatch Digital Technology in Action



Thank you.

For more information,
please visit www.hatch.com