

Hydroprocess2019

11th International Seminar on
Process Hydrometallurgy

New Tools to Improve Certainty of Real Production Planning Estimates

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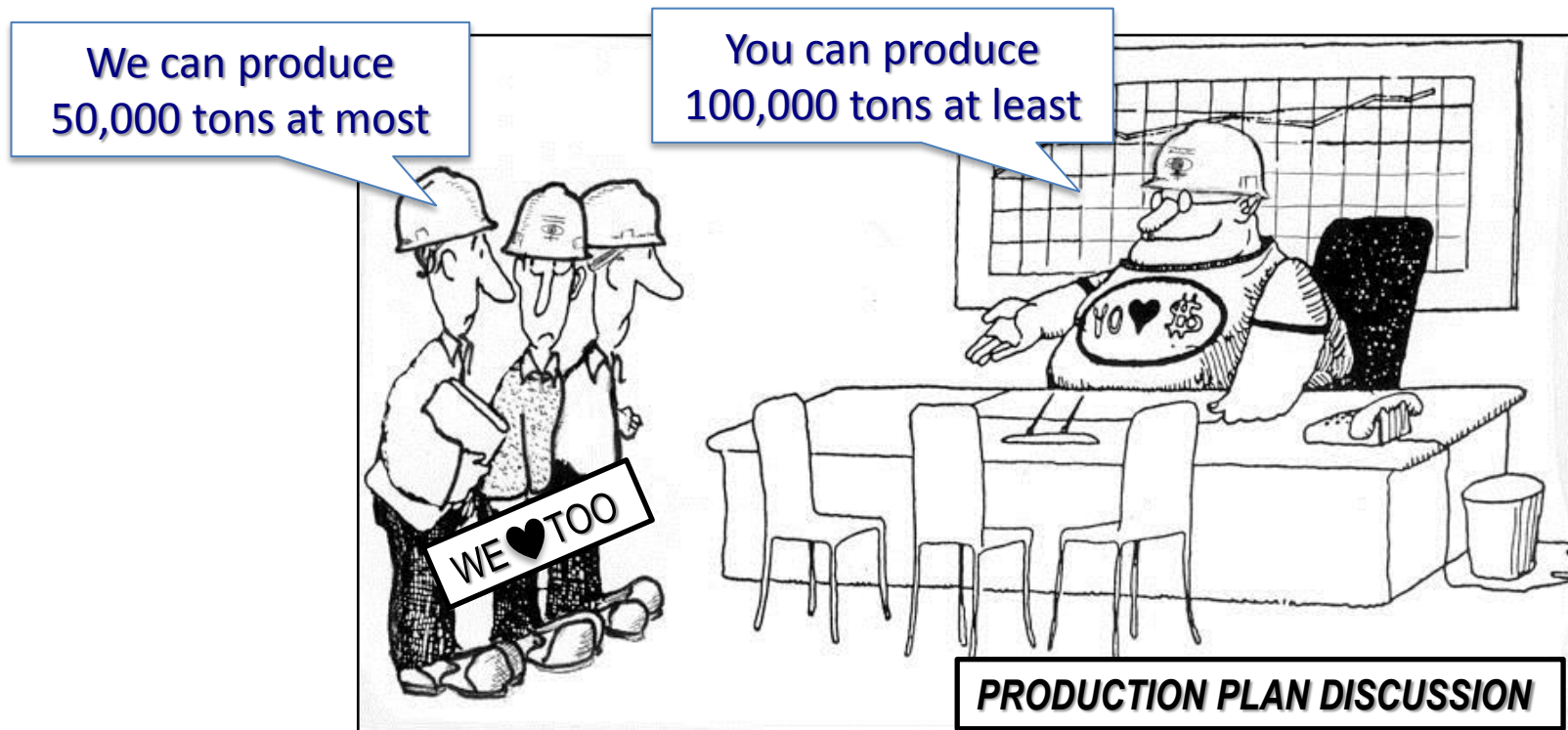
GECAMIN

Agenda

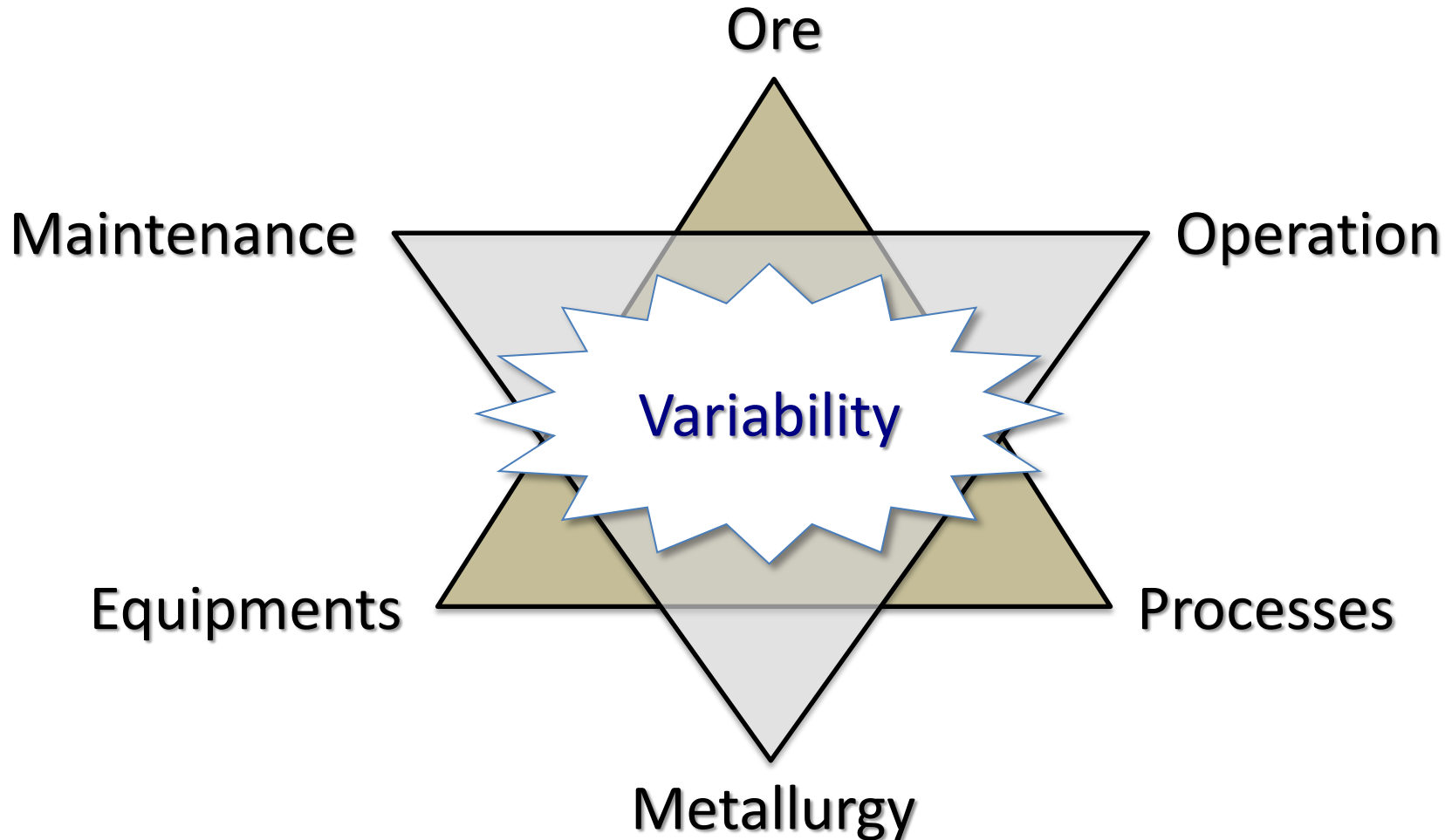
- ✓ Introduction
- ✓ Our Strategy
- ✓ Description of the Models
- ✓ Case Studies
- ✓ Remarks

Introduction

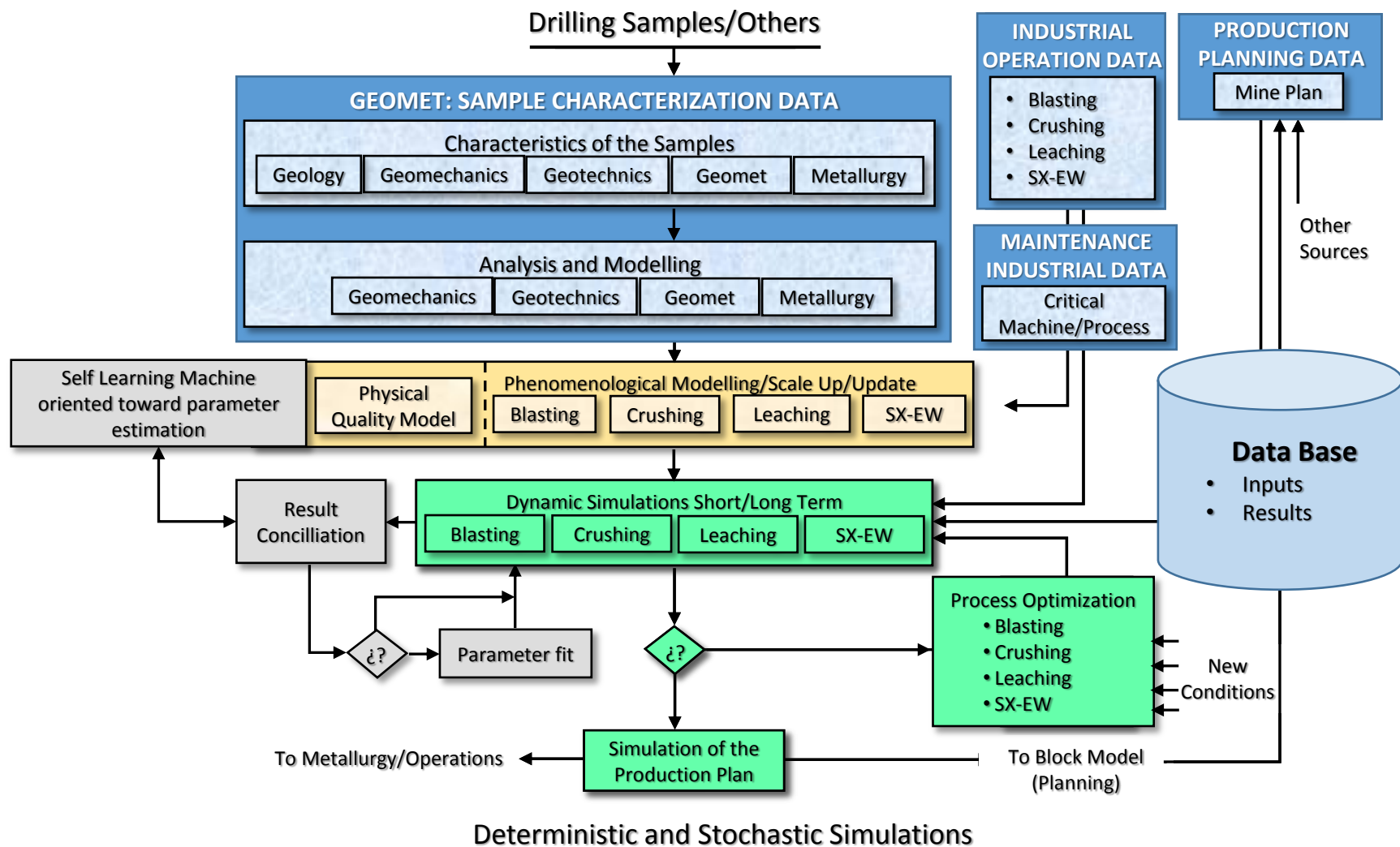
- ✓ Production Plans have often limited reliability.
- ✓ Current forecast tools have low predictive capacity.
- ✓ It affects the two sides of the negotiating tight rope
- ✓ Better approach is strongly needed.



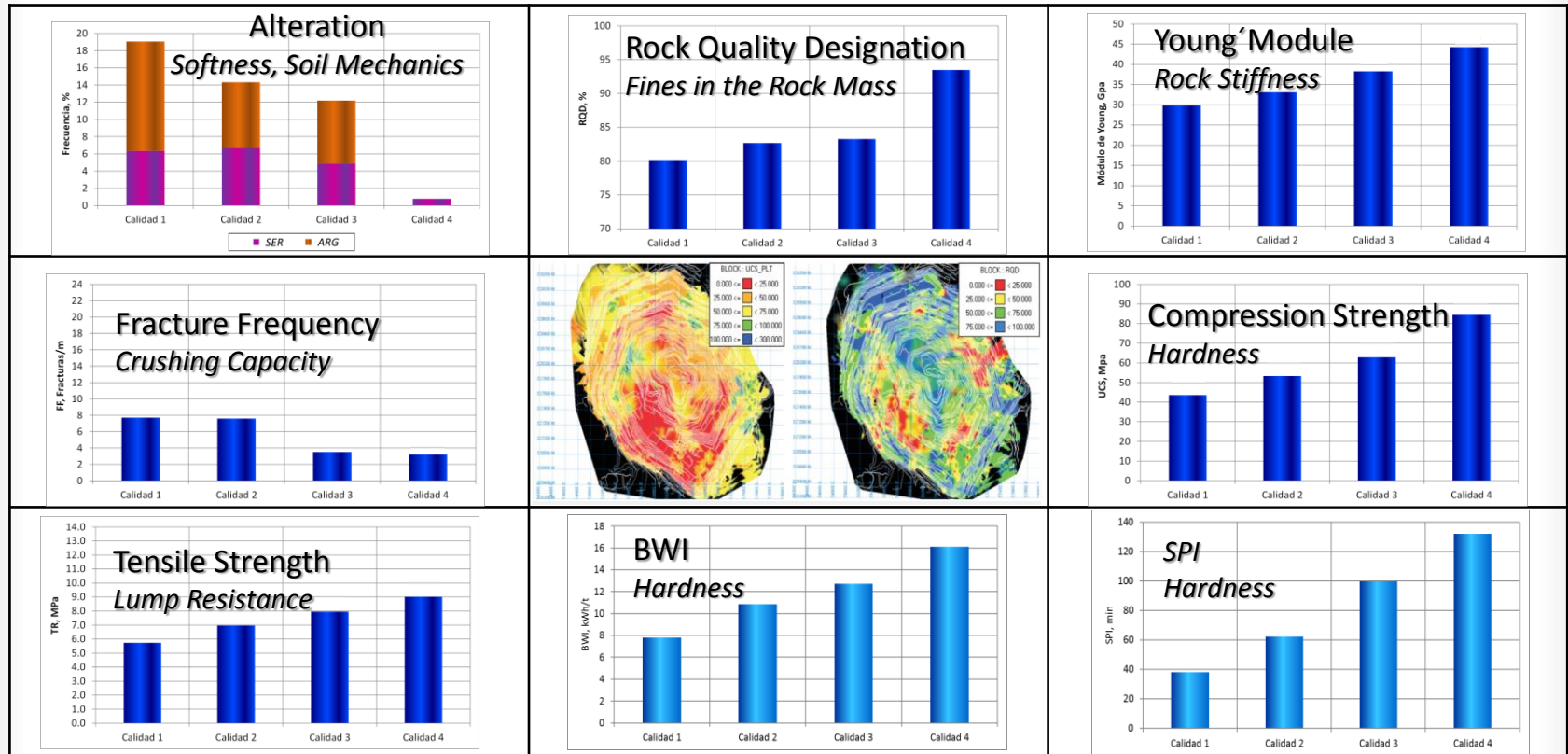
Integral Technical Approach



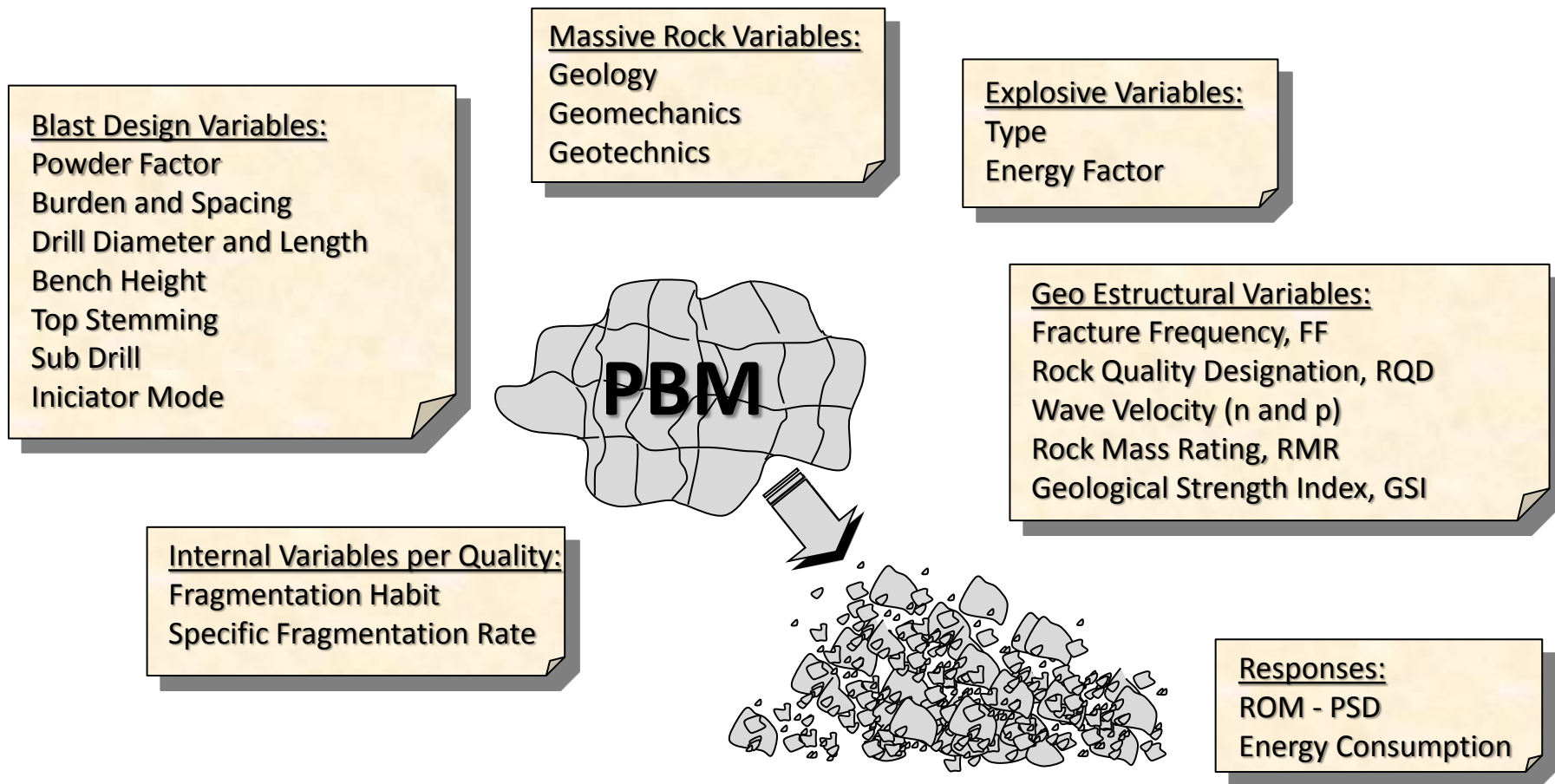
“Matrix Modelling”



The DRM “Q-Model”

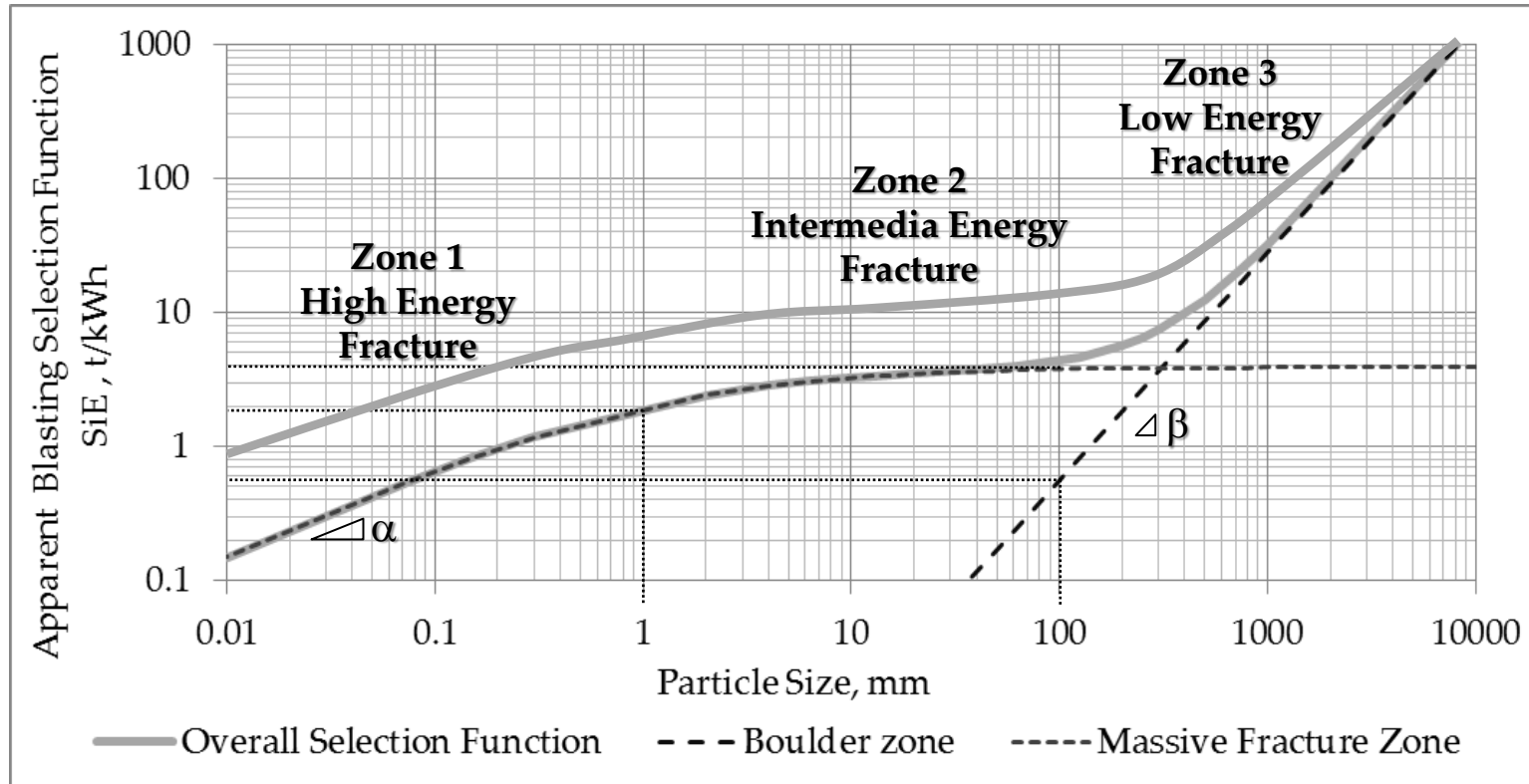


The DRM Blasting Model

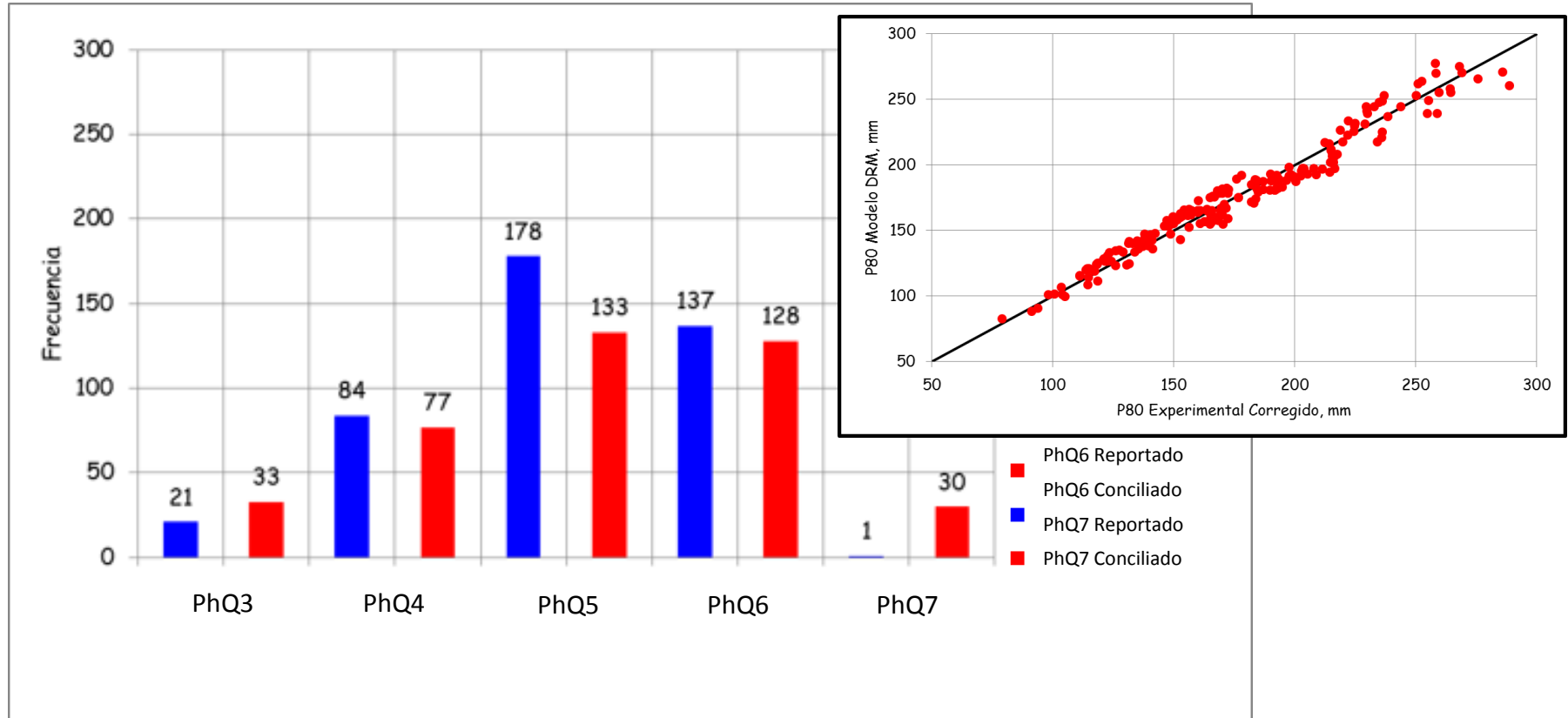


Menacho, J.M., L.A. Verdugo and G.E. Vega, New predictive blasting model oriented to optimum production planning, PROCEMIN 2018.

The Apparent Blasting Selection Function



Inverse Simulation Strategy for Conciliation Issues



The DRM Crushing Plant Model

Input Data:

- Throughput to Primary Crusher
- ROM PSD
- Physical Quality Mix
- Settings and Openings
- Circuit configuration

Internal Parameters:

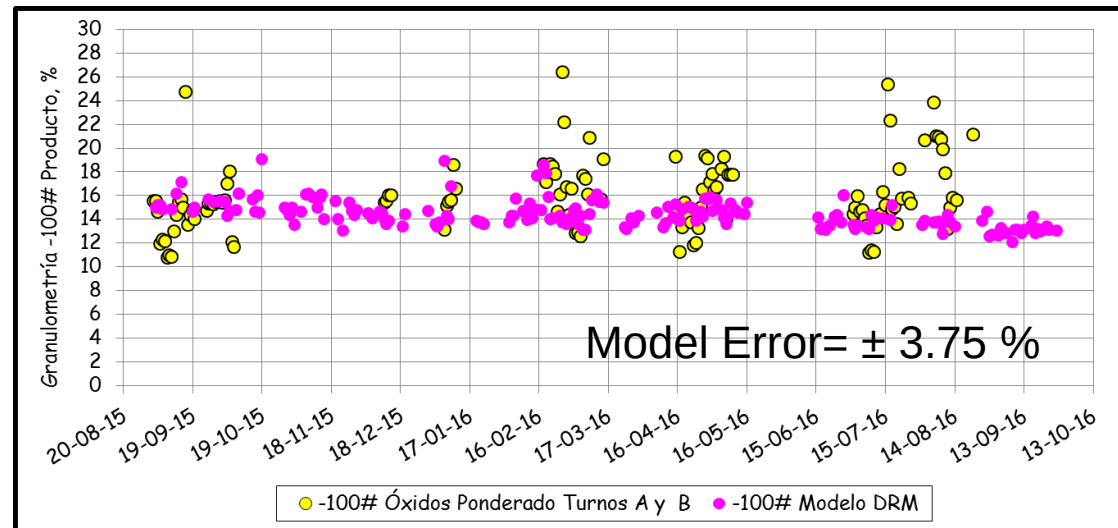
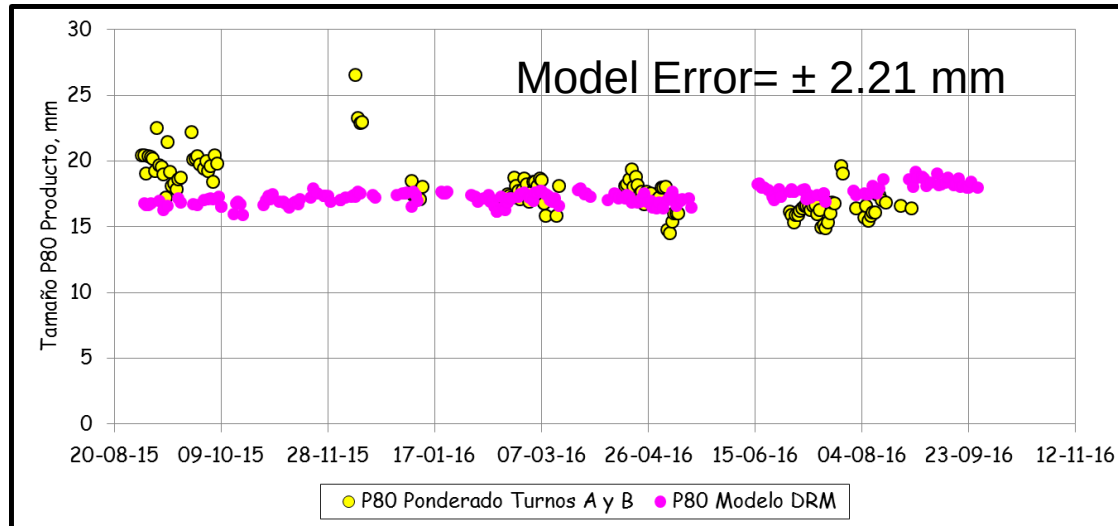
- Crusher Models
- Screening Models

**PBM
Approach**

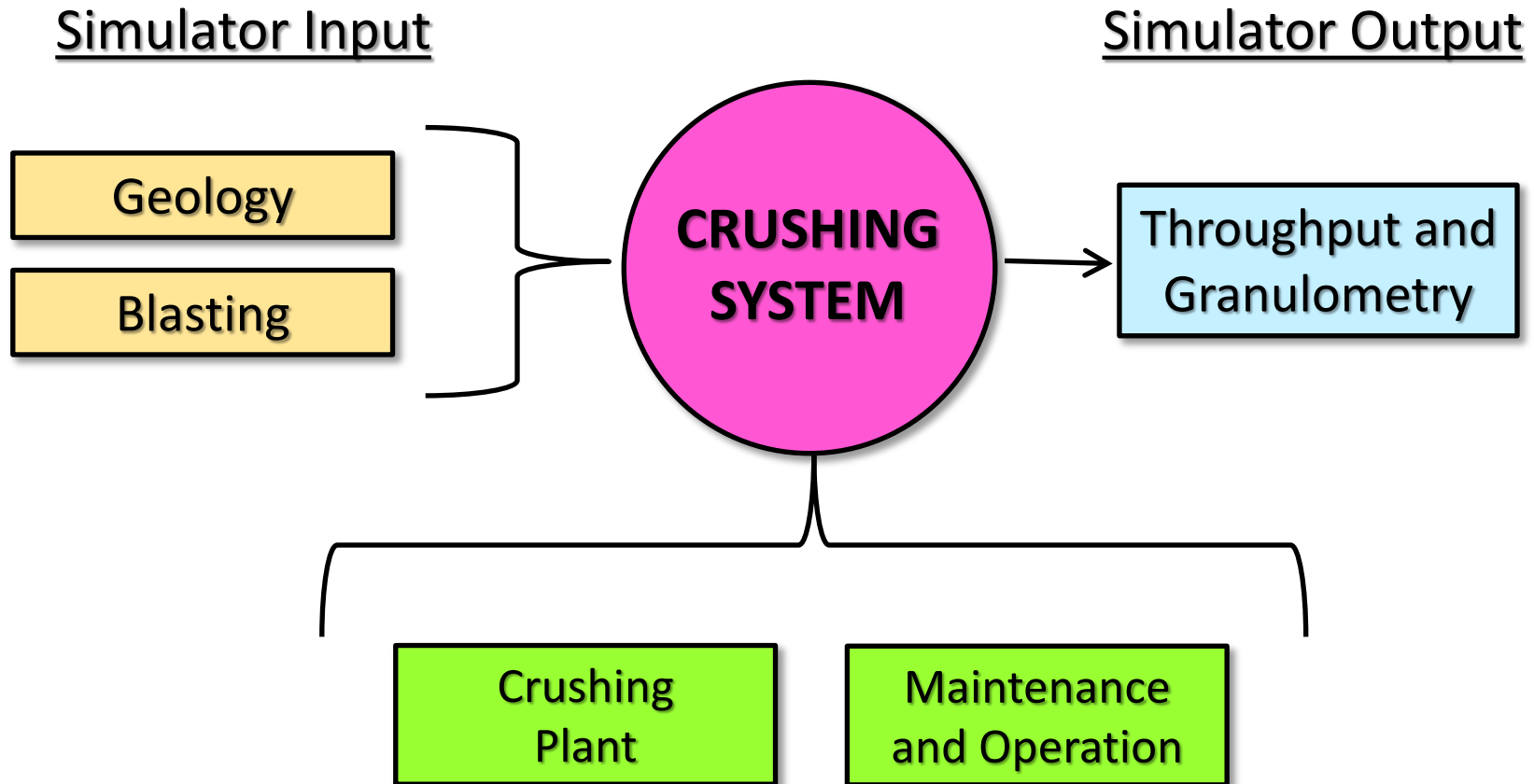
Output Data:

- Plant PSD and Tonnages
- Overall Energy Consumption
- Electrical Current at Each Crusher
- Efficiency Indices

Crushing Plant Model Performance

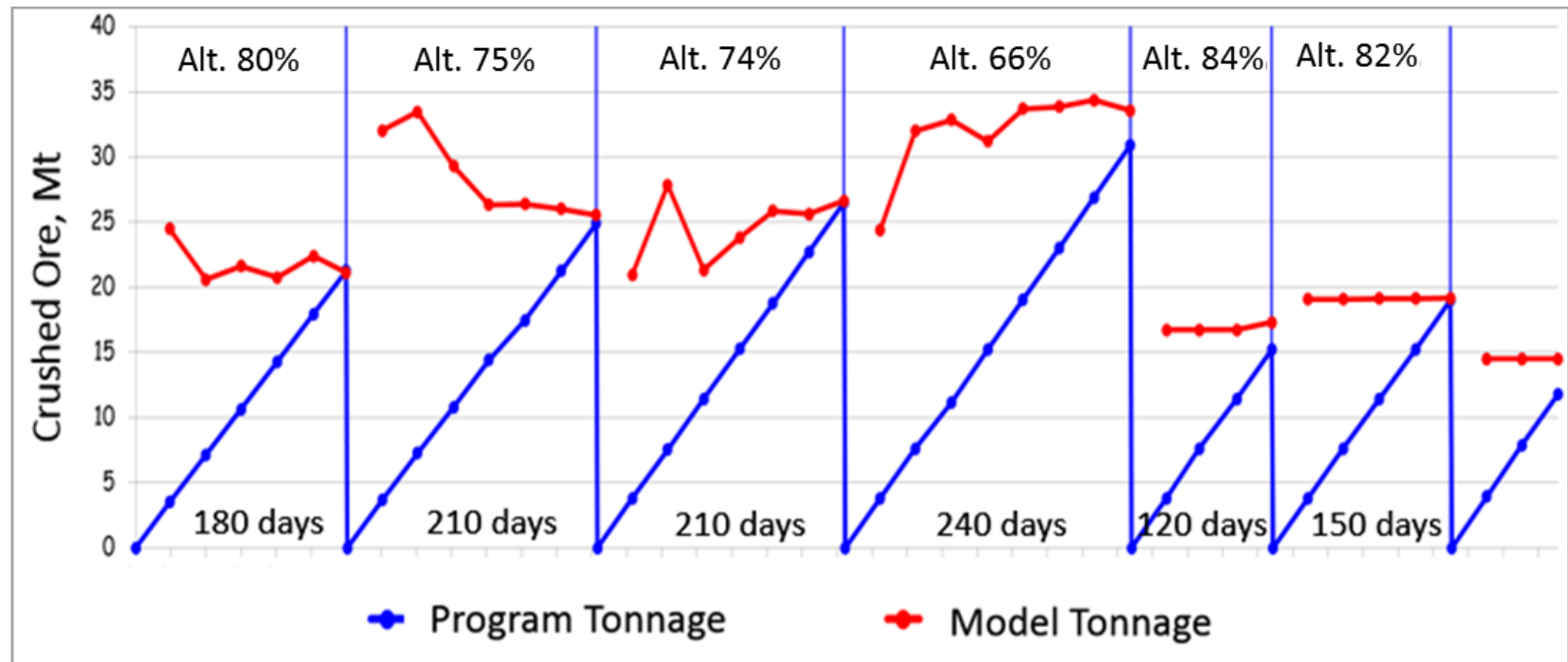


Case Study: Feasibility of the Production Plan

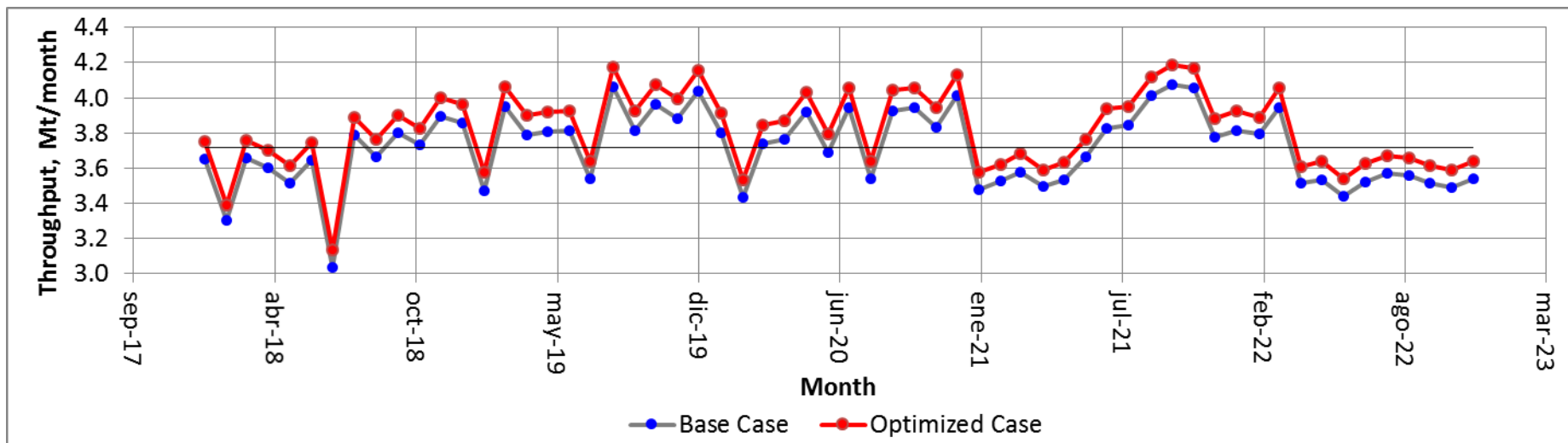


Planning with “Matrix Modelling”

Example: Prediction of concave change in the primary crusher from geological data and process modelling.

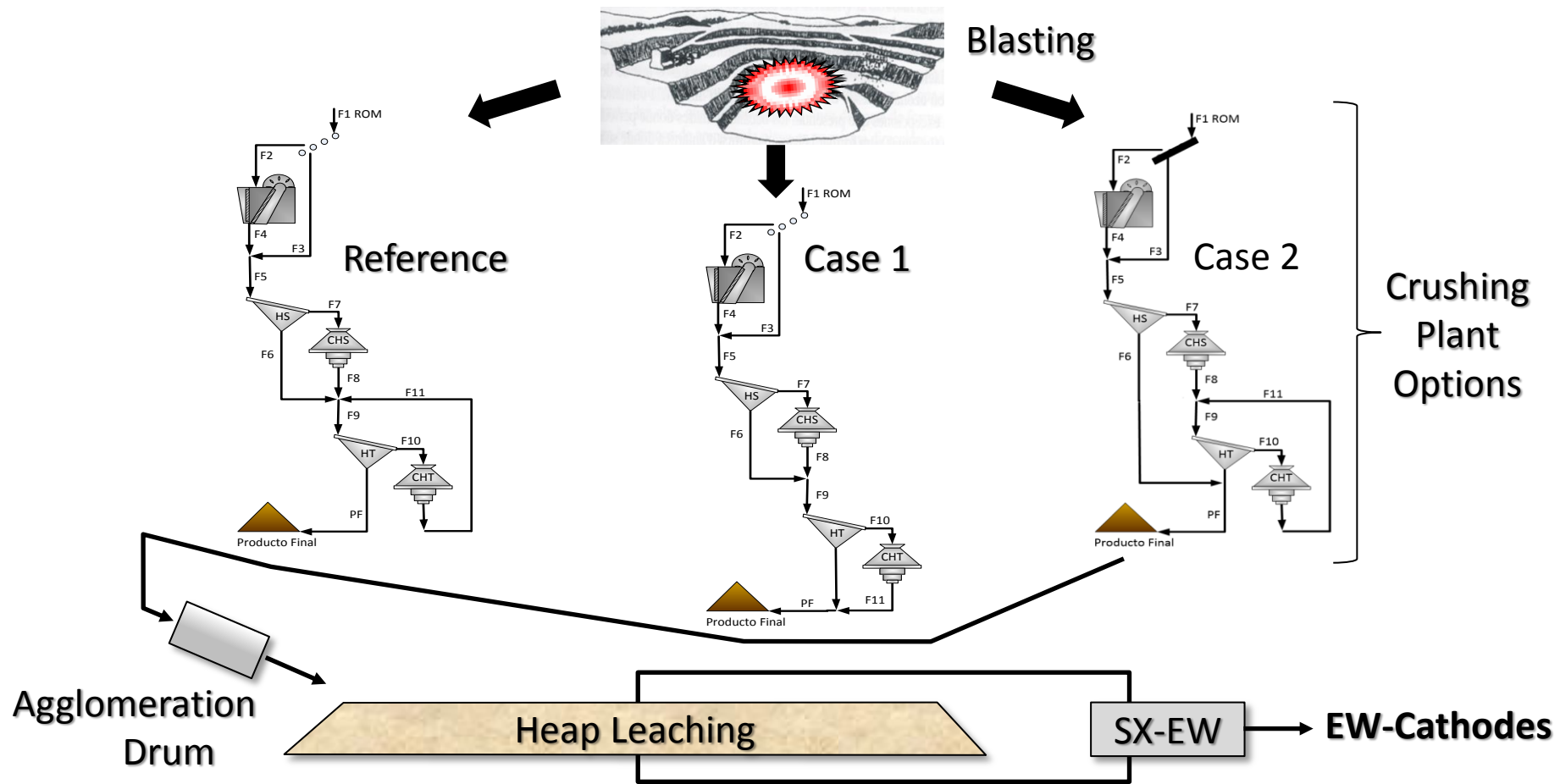


Feasibility of the Production Plan



Year	Target	Base Case	Comply	Optimized Case	Comply
2018	44,000,000	43,300,443	NO	44,490,581	YES
2019	46,000,000	46,000,098	YES	47,324,171	YES
2020	46,000,000	45,539,355	NO	46,853,694	YES
2021	46,000,000	44,875,389	NO	46,136,352	YES
2022	44,000,000	43,257,011	NO	44,470,706	YES
	226,000,000	222,972,296	NO	229,275,504	YES

Case Study: Mine-to-Leach Optimization



The DRM Hydro-Metallurgical Heap Leach Model

DRM Heap Leach Model has been development using:

A variable-saturation liquid infiltration through porous beds to respond to Dynamic inventory and Effluent flowrate.

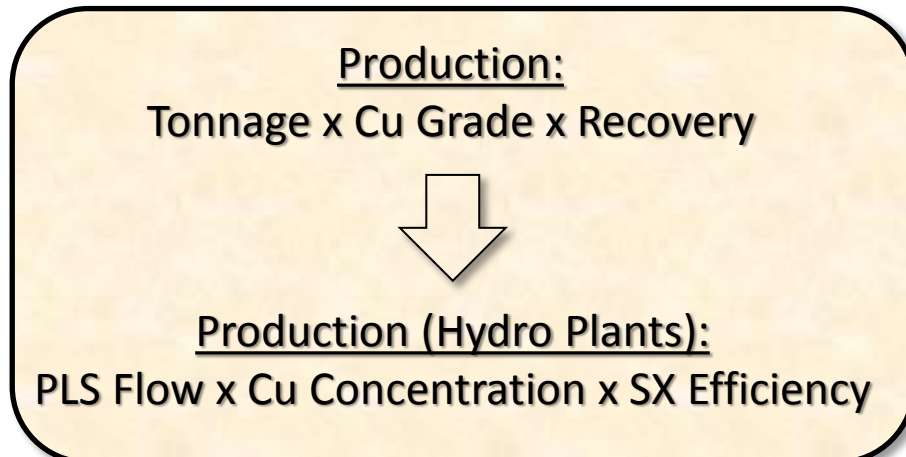
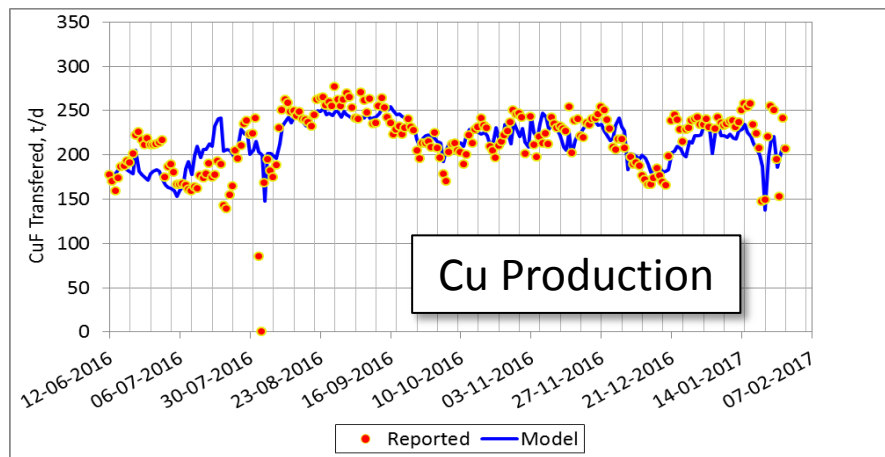
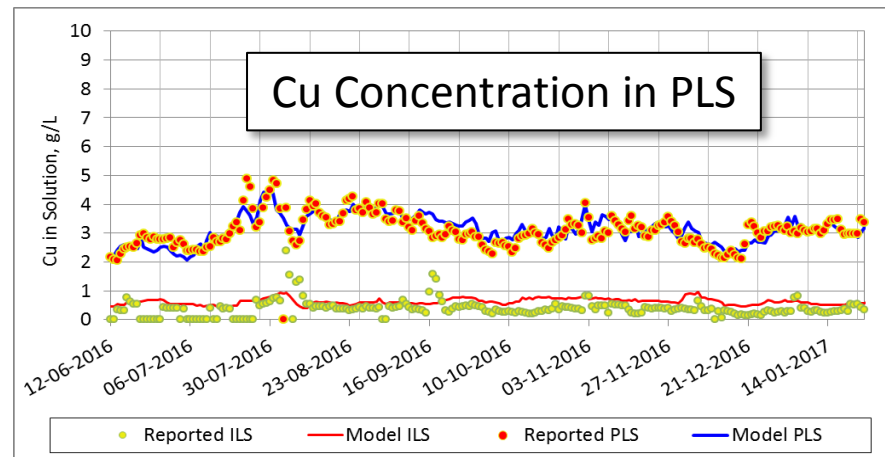
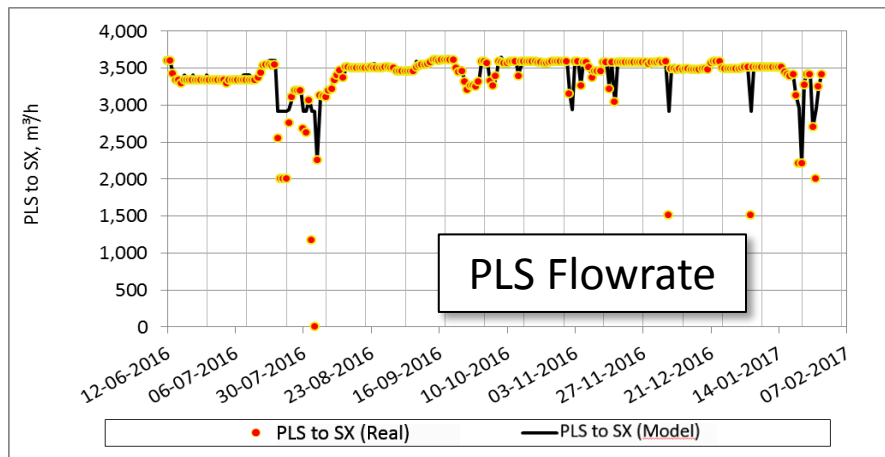
An advection-dispersion model to describe the reactive transport of Copper.

And Leach kinetics given by:

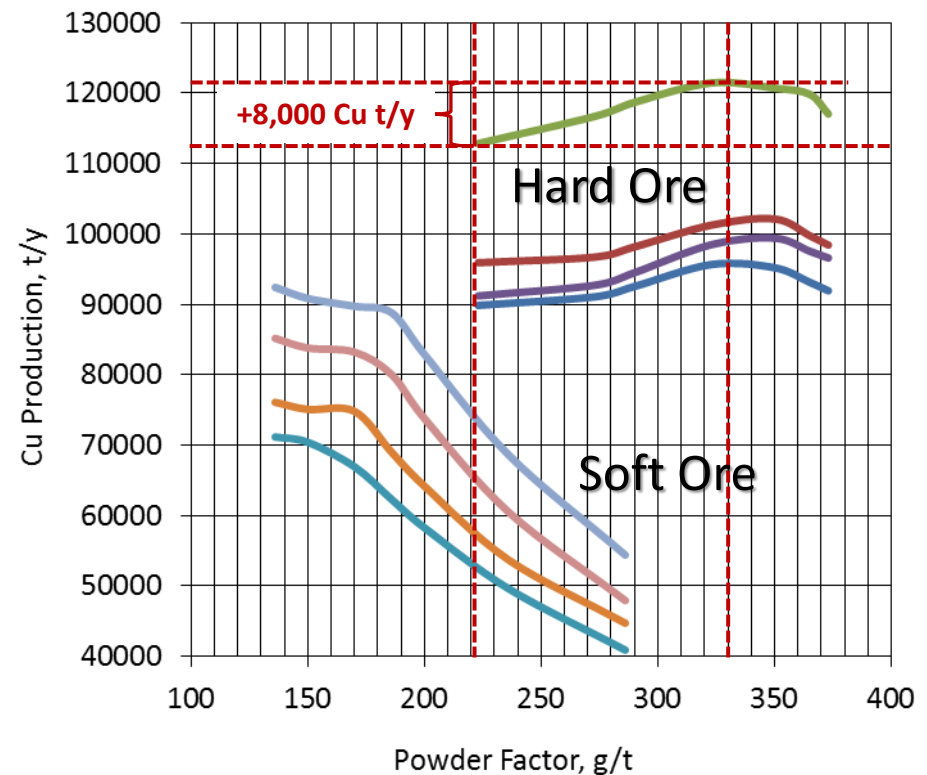
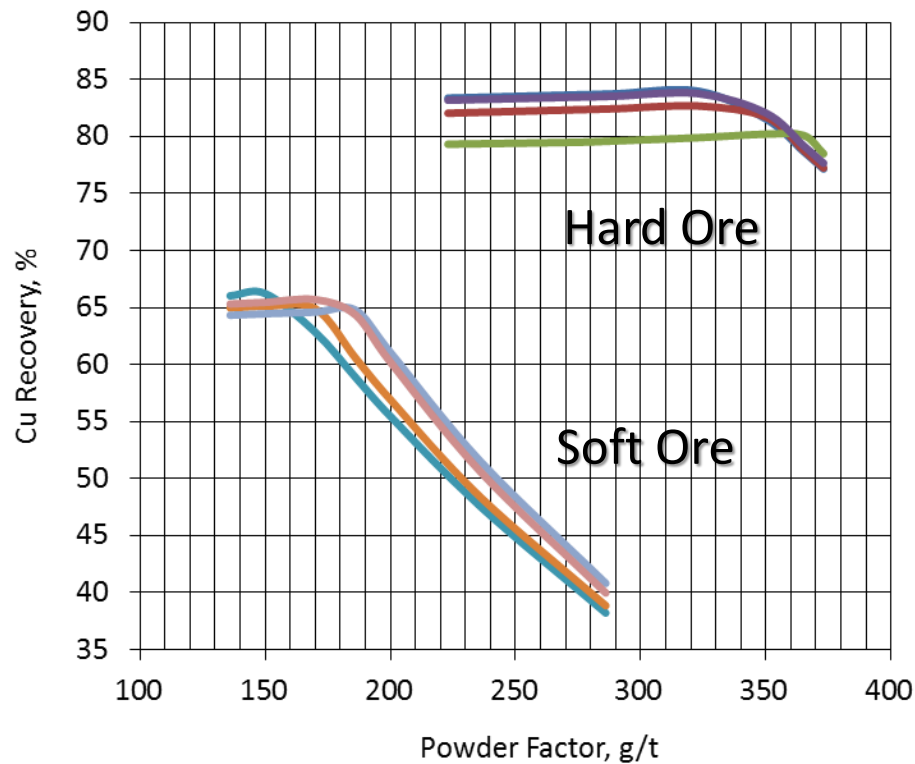
$$\frac{\partial c_s}{\partial t} = -(\lambda_0 + \lambda \frac{q}{\rho z})(c_s - c_{SM})$$

Where λ_0 and λ are specific rate parameters and c_{SM} is the lowest copper grade in the leached ore (residual grade).

Performance of the DRM Heap Leach Model



Case Study: Optimal Mine-to-Leach



- 1) Increase in Powder Factor
- 2) Id 1 + 3ry Screen from 12.7 mm to 15 mm
- 3) Id 2 + 3ry Circuit Open
- 4) Id 1 + 2ry Screen U/F to Final Product

Final Remarks

- ✓ A matrix modelling approach has been developed aimed to increase predictive capacity of the production plan. Maintenance, operation and metallurgy variables are crossed with orebody characteristics, equipments and processes throughout the production chain from blasting, crushing, leaching and SX-EW.
- ✓ Applications include:
 - ☐ To test the feasibility to comply the existing production plan
 - ☐ To optimize the production plan
 - ☐ To estimate impact of variability on the production plan
- ✓ This approach has been tested at least partially at Minera Spence from BHP, Minera Antucoya and Centinela Óxidos from AMSA, Minera Gaby and Radomiro Tomic from Codelco and also in greenfield projects such as Polo Sur from AMSA and Rajo Inca from Codelco Salvador.