The Benefits and Value of Dynamic Simulation in the MMM Industry

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MMM Industry Common Challenges

**COSTS**
- How can I minimize capital expenditure by reducing equipment over/under design?

**TIME**
- How can I test and validate my PLC/DCS/SCADA prior to commissioning so as to prevent a delayed start up?

**QUALITY**
- How can I conduct engineering studies to try and improve product quality, plant throughput and yield without upsetting the live plant?

**PERFORMANCE**
- How can I train operators to effectively handle critical transient operations such as plant start-up, upset conditions and shutdown in a risk-free environment?
DYNSIM: Commercial Dynamic Simulator

- A **UNIFIED** process plant modelling environment that utilises First Principle based equipment models, rigorous thermodynamics and fluid/solids flow calculations; to accurately simulate the time dependant behaviour of simple and complex industrial processes within a graphically intuitive interface.
One Tool with Multiple Benefits: DESIGN to TRAINING

- **DESIGN**
  Process Engineers/Metalurgist

- **CONTROL CODE VALIDATION**
  Control/Automation Engineer

- **OPERATOR TRAINING**

- **ENGINEERING STUDIES**
  OPERATIONAL ANALYSIS
  WHAT-IF SCENARIOS
## DYNSIM M3 Library

### Phase 1 Models
1. Conveyor
2. Primary Crusher
3. Ball & SAG Mill
4. Screen
5. Vibrating screen
6. Fluid Bed Roaster & Cooler
7. Hydro cyclone
8. Floatation cell
9. Floatation column
10. Air Cyclone
11. Particle Size Distribution Sub Totals & Plot
12. Mixer, Splitter, Hopper Bin, Header Objects

### Phase 2 Models
1. AG Mill & SAG Mill – UAM
2. Flash furnace - UAM
3. Smelting Furnace - UAM
4. Acid Plant Reactor – Development

### Future Possibilities
- Chemical Chill System
- Compressors
- Controllers
- Desuperheaters
- Eductors
- Exhausters
- Gas Feed Systems and Accessories
- Gas/Leak Detectors
- Heating Systems
- Inorganic Removal Systems
- Leaching Bed
- Electrolytic Cells
- Fusion oven
- Magnetic Separator
- Membrane Filtration Systems
- On-site Sodium Hypochlorite Generation Systems
- Suspended electromagnets
- Filters
- Gravity concentrators
- Scrubbers & Mills
- Vibrating feeders
- Vibrating motors
- Metal detectors & eddy current separators
- Gas meters & valves
- Screens
- Filters
- Classifiers
- Baghouse – Simple
- Dust Precipitator (ESP) – Better Fidelity
Control Code Validation
@ Rio Tinto Cape Lambert Expansion Project

Case Study 1
**Rio Tinto Cape Lambert Expansion: Control Code Validation**

**Business Drivers:**

- Rio Tinto expansion of its Cape Lambert Iron Ore offloading site to a 100 million tons per annum facility.
- The EPC behind the expansion project, required the PLC control system to be tested and validated in advance of the commissioning phase i.e. up to and including FAT.
- Reduction in commissioning time of the control system would mean a quicker start up which translates into time and cost savings for both end Rio Tinto and EPC.
Rio Tinto Cape Lambert Expansion

The Solution:

- SimSci simulation group used the standard Unit Operations in Dynsim’s M3 Library to simulate the actual Load Out Process/Station i.e. from the point at which ore is deposited into the Car Dumper facility by train to the point at which ore is discharged into a ship’s hatch.

- Conveyor
  Expanded to include functionality for the extreme and diverse situations of the offloading site.

- Hopper
  Accounts for void fraction for accurate volume.

- Screen
  Calculates lump and fines separation.
Rio Tinto Cape Lambert Expansion

The Solution:

• The simulated process model of the load out station was connected to an emulation of the PLC Control System via OPC thus providing a virtual platform to test control logic against an accurate process model thus giving confidence to the control system before actual implementation.

• The system lead the development of many systems of the controls – SKM’s controls engineers tested their logic at every stage leading up to and including Factory Acceptance Testing (FATs).

• Users are able to operate simulated equipment (e.g. start and stop drives) from dynamic simulator interface, with the equipment responding to operation commands in a realistic yet safe manner, which familiarized personnel on process and control philosophies prior to start-up.
Control Code Validation Solution

RS LOGIX EMULATOR

OLE for Process Control
Results

• Controls Checkout - Project Justification
  • Reduced time for controls checkout at startup
  • Original estimate = 4 days at 50% production
  • Original Estimated Savings = $1.8 Million

• Controls Checkout – Actual Results
  • Reduced time for controls checkout at startup
  • Actual Results = 6.5 days at 100 % production
  • Actual Estimated Project Savings = $2.9 Million
Operator Training Simulator
@ Codelco Copper Smelter

Case Study 2
Codelco Overview

- Codelco is the world’s main copper producer.
- Codelco has the largest copper base reserves.
- Codelco is 100% state owned.
- Codelco has 8 mining divisions, in Chile.
Codelco Copper– Operator Training Simulator

Business Drivers:

• Retain experienced operator knowledge

• Improve new operator training

• Improve safety and environmental performance

• Teach operators how to handle transient conditions in as close to real life as possible environment
The Solution:

- A high fidelity OTS system of their smelting process (Flash Furnaces) that mimics the real process and will use the same version of control system and graphics.

- A "trainer" can put each operator through a number of scenarios and observe the operator.

- Many MPC controllers were also implemented and operators were trained on the advanced process control strategy using the simulator.

- The OTS system can automatically monitor and score trainee performance and allows trainers to deem operators competent or not.
Operator Training Simulator Solution

<table>
<thead>
<tr>
<th>Real</th>
<th>PLANT</th>
<th>PLC/DCS/ESD</th>
<th>Control Room HMI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Simulation</td>
<td>Dynsim</td>
<td>Control System Emulation</td>
</tr>
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</table>

Dynsim
Results

• **Actual Operator Training Savings**
  
  • Reduced operator Training time significantly (weeks rather than months)
  
  • 36 Operators trained and deemed competent to date
Thank You