

Anylogic User Conference 2013

Simulation used in Plant Capacity Planning and Operational Support

Case Study - GE Energy Storage Plant

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imagination at work

Durathon™ Factory – B66

GE has a new battery plant in Schenectady, New York.

- *New business launched in 2009*
- *The plant opened in 2012*



GE's revolutionary Durathon™ Batteries are manufactured there.

<http://geenergystorage.com/>

Prescriptive Analytics for a Facility

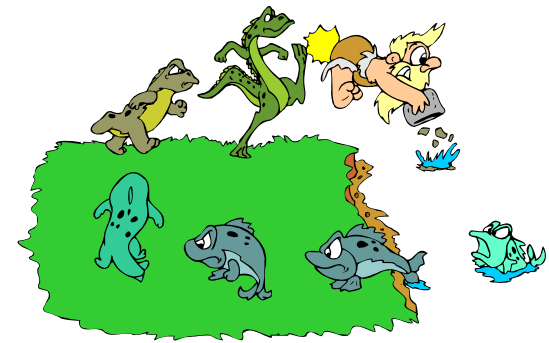
Challenges:

- Increase production throughput and yield under evolving processes and uncertainties.
- Reduce manufacturing costs to gain market share.

Data: GE tracks over 27,000 variables through the manufacturing process.

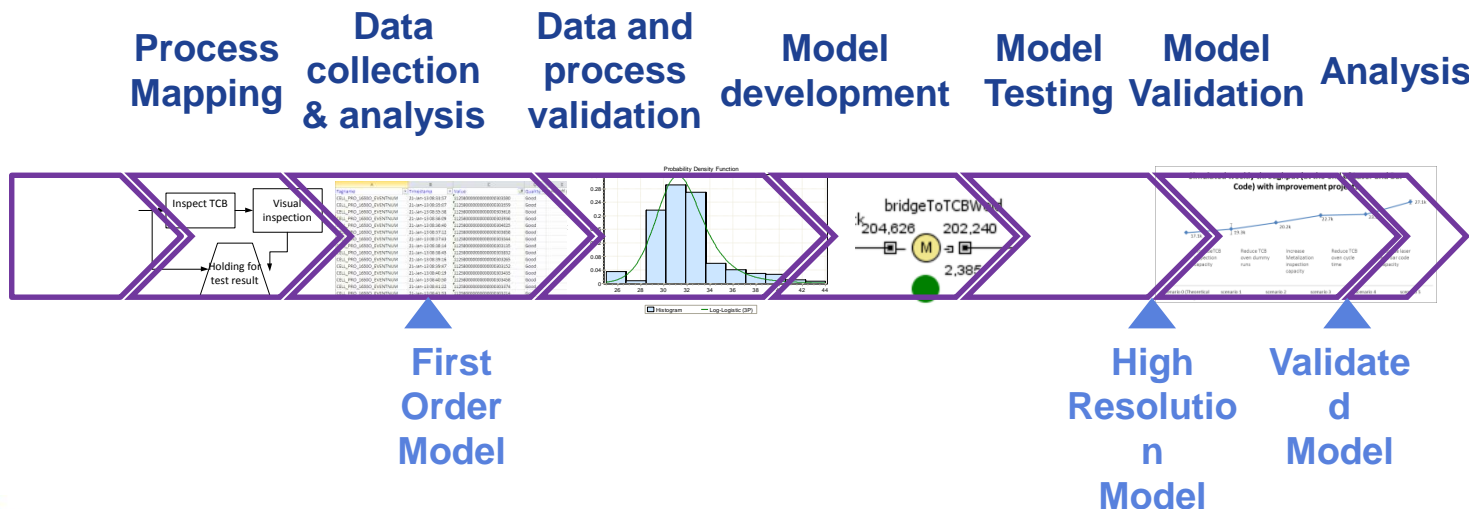
Questions to answer:

- *Can we make the production target?*
- *How do we get there?*
- *How do we sustain it?*
- *What to change? What to change it to?*
How to change?



Simulation

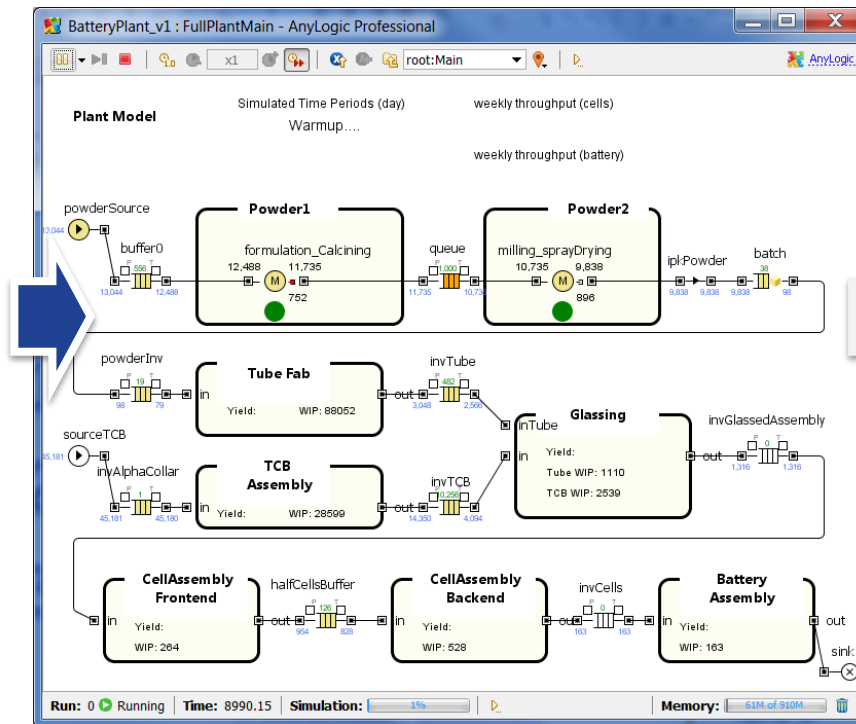
1. Determine baseline capacity including variability
2. Simulate system dynamics and identify bottlenecks
3. Plan production ramp-up & guide expansion
4. Facilitate continuous improvement & evaluate P&E investment
5. (on-going work) achieve real-time production optimization



Full-Plant Simulation

Model manufacturing flow, capacity and operations constraints, bottleneck analysis

- Process flow
- Type of machine (continuous, batch, single machine, special machines – tube press, kiln examples)
- Machine cycle time
- Yield
- Machine MTBF/MTTR
- Staffing plan
- Setups, cleaning or special non-std work
- IPK's
- Others as required



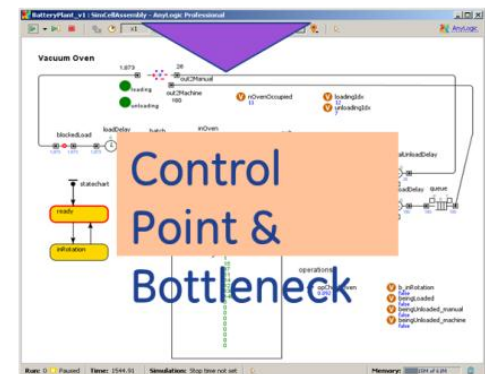
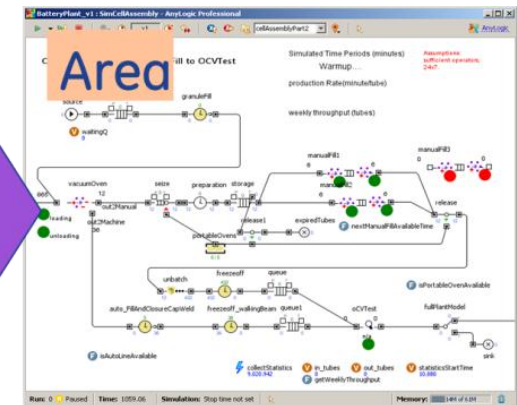
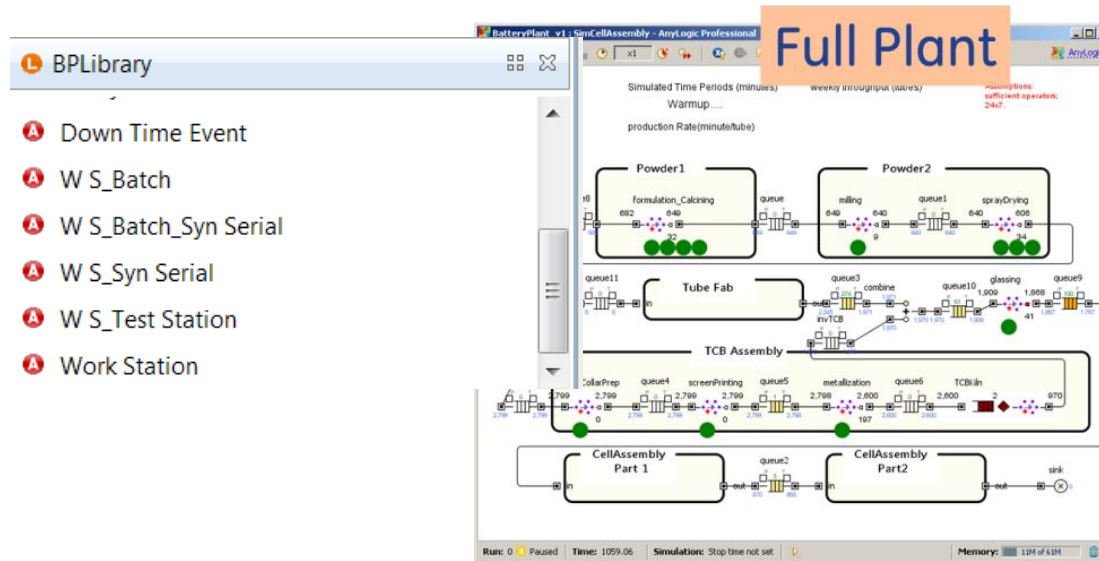
Estimates of the following metrics by process step by time period.. (Average and standard deviation)

- Throughput
- Yield
- machine utilization
- WIP

Cost

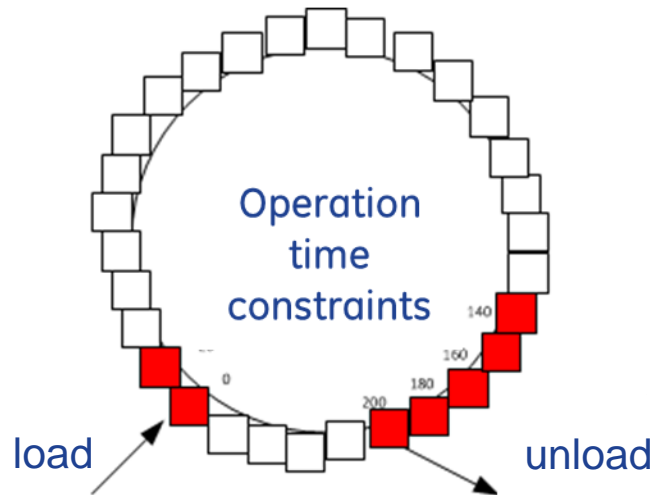
Simulation Design

- Varied details based on analytical needs
- Loosely coupled modules for data and model ownerships
- Switchable components for new process
- Customized libraries for reusable codes



Quantitatively Analyze Bottlenecks & Evaluate Improvement Options

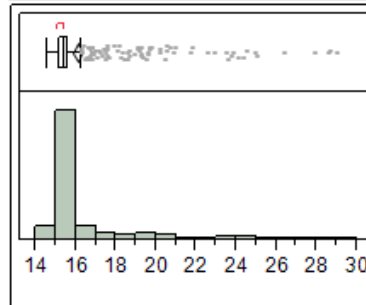
Machine



granuleFillStatusRec
busy

Simulation snapshot of bottleneck machine utilization in baseline scenario

pure oven loading time



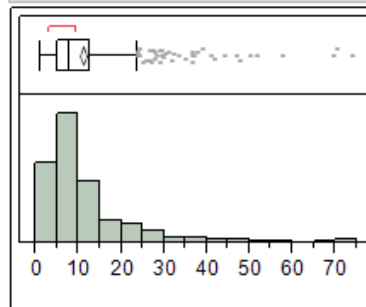
Quantiles

100.0%	maximum	29
99.5%		28.606
97.5%		23.7258
90.0%		18.2067
75.0%	quartile	15.6083
50.0%	median	15.3833
25.0%	quartile	15.1833
10.0%		15.1
2.5%		14.8333
0.5%		14.597
0.0%	minimum	14.5667

Summary Statistics

Mean	16.068122
Std Dev	2.1050145
Std Err Mean	0.0959804
Upper 95% Mean	16.256716
Lower 95% Mean	15.879528
N	481

waiting time_between loads

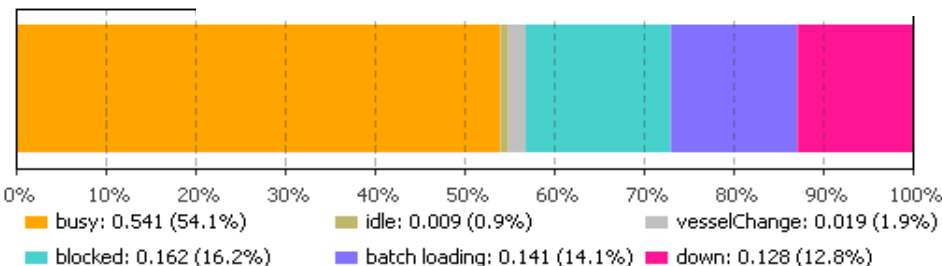


Quantiles

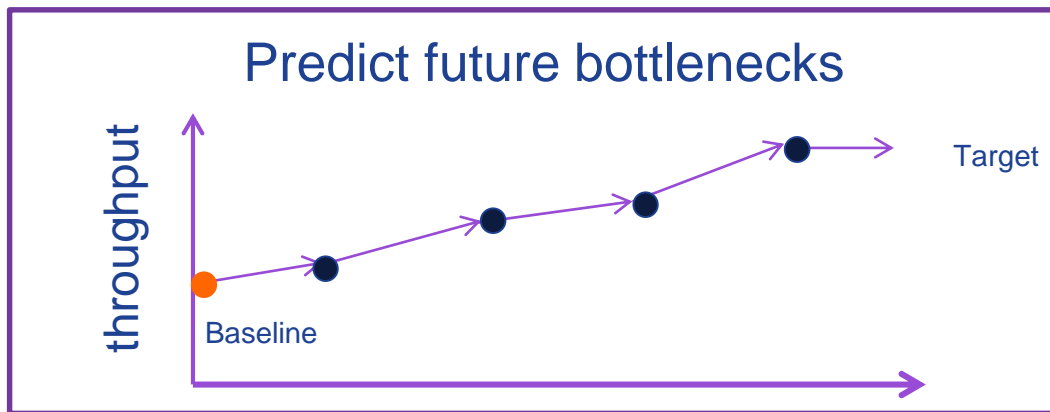
100.0%	maximum	73.9
99.5%		69.9034
97.5%		38.8821
90.0%		23.2283
75.0%	quartile	12.6125
50.0%	median	7.85833
25.0%	quartile	5.1375
10.0%		3.085
2.5%		1.60292
0.5%		1.22342
0.0%	minimum	1.13333

Summary Statistics

Mean	10.992778
Std Dev	9.9273139
Std Err Mean	0.4531178
Upper 95% Mean	11.883122
Lower 95% Mean	10.102434
N	480

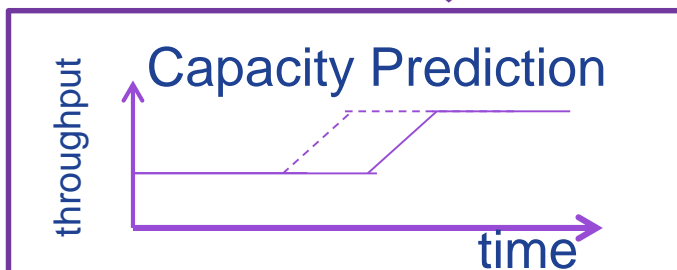


Capacity Planning: Identify, Evaluate and Prioritize Projects



Project plans

Impacted process step	Projects	owners	Start Date	Effective Date	Focused Metrics	Changes in Std Work, Yield Availability



Optimized project priority
 Non-optimized project priority

Adjust estimate of order delivery date if needed

Operational Decision Support (2014 project)

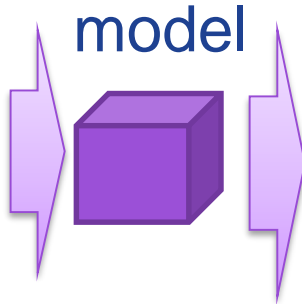
Example: Do I need extra operator(s) in the next 8 hours?

process flows,
cycle times, # of
machines

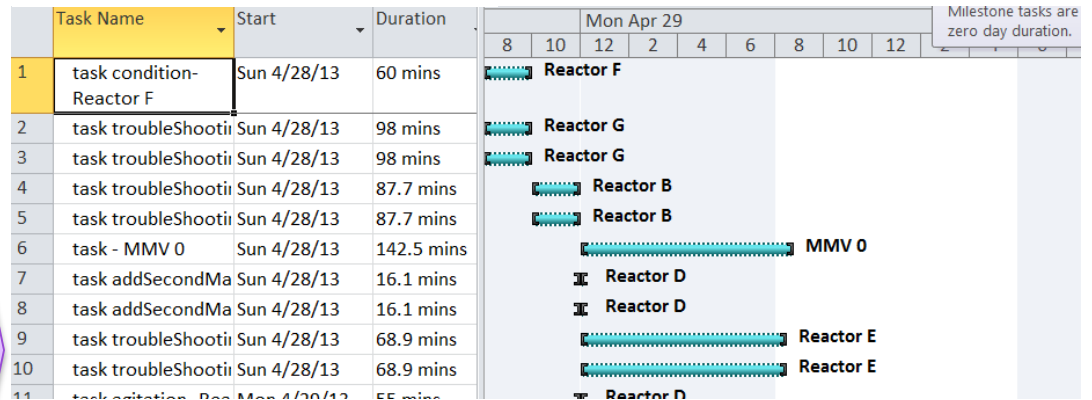
of operators,
job priority rules

Current status of
machines

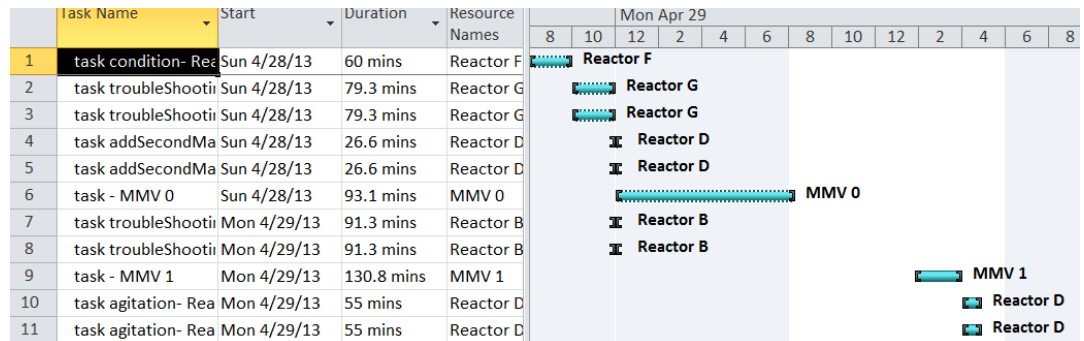
WIPs, Inventory



What if 3 operators..



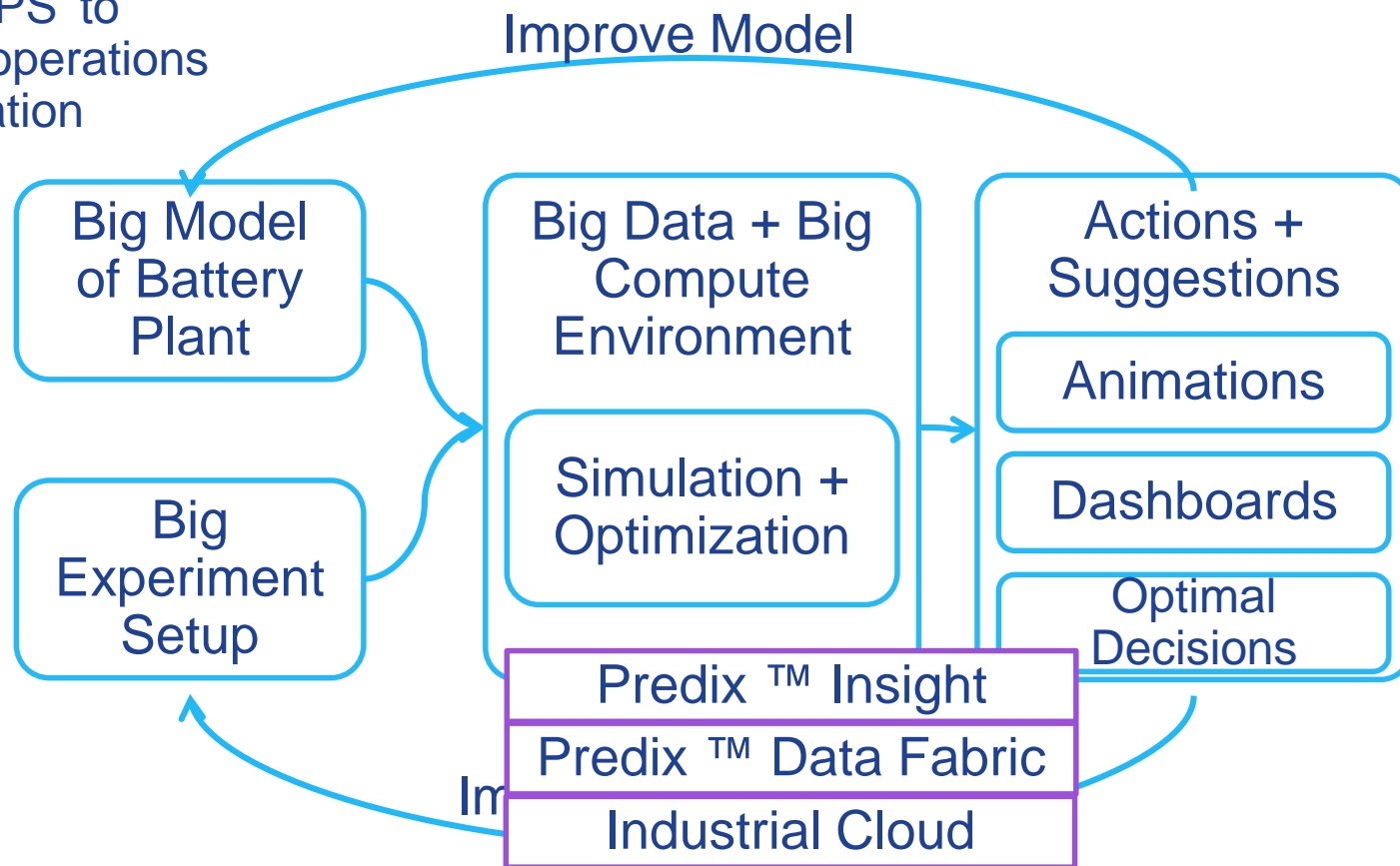
What if 2 operators..



Potential Integration with GE Predix™

- Experiment speed up (e.g. 500 x speed, using ~1500 cores on Vesuvius)
- Enable user-friendly analytics, improve user experiences
- Enable real-time plant 'GPS' to enable operations optimization

Common GE services lower IT ownership cost



Q&A

Thank you.