Models, Methods and Data Behind Activated Economics

The methodology, costing models, cost updates, mapping and sizing in economics “activated” in Aspen Plus and HYSYS

Presenter:
Ron Beck, Director of Engineering Product Marketing
Aspen Technology, Inc.

August 20, 2013
aspenONE Engineering
Ongoing Series of Technical Webinars
Engineering Webinars for education and best practices

UPCOMING WEBINARS OF INTEREST:

- Perform Overpressure Protection Analysis in Aspen HYSYS - Sept 5th
- Optimize Acid Gas Cleaning in Aspen HYSYS - Sept 12th
- Portuguese: Modele Facilmente Processos com Solidos com o Aspen Plus - Sept 17th
- Modeling Fluidized Beds and Pneumatic Conveying of Solids – Sept 24th

ON DEMAND WEBINARS OF INTEREST:

- Optimize Midstream Process Modeling with aspenONE
- Optimize Economic Evaluation Throughout the Design Process

ADDITIONAL RESOURCES:

- Public Website: www.aspentech.com/products/aspen-economic-eval.aspx
Agenda

- Asset lifecycle economics in aspenONE engineering
- Inside the Aspen Economics methodology
  - Volumetric models ("model based")
  - Cost Updates (sources, frequency)
- What is “Activated Economics”
  - Mapping and sizing
  - Adjusting materials of construction
  - Templates
- Concept of indexing
- Workflow beyond conceptual design
- Brief Case Studies: PEMEX, Kuwait Oil
Economic Evaluation Product Family

Estimating Across Lifecycle

- Conceptual Design
- Basic Engineering
- Detailed Engineering
- Construction/Start-up
- Operations/Maintenance/Retrofit

Activated Economics

- Aspen Process Economic Analyzer
- Aspen Capital Cost Estimator
- Inplant Cost Estimator

←←← One Common Cost Model and Software Platform →→→
# AspenTech Economics Evaluation Family

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>New!</strong></td>
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</table>

- **Innovation to give process modeler continuous view of how costs are changing**
- Estimating system made easy to use for process engineers (Typically Class V, IV)
- Fast and accurate estimates with only 10% of engineering completed (Typically Class IV-II)
- Special version of system designed for modifying and expanding existing plants

<table>
<thead>
<tr>
<th>Process Modelers</th>
<th>Process Modelers</th>
<th>Estimators (Owner-operators, E&amp;Cs, contractors, fabricators)</th>
<th>Estimators Plant Engineering</th>
</tr>
</thead>
</table>
How AspenTech Economic Evaluation Works

- Uses built-in, industry-standard mechanical and construction design and cost models to prepare detailed lists of:
  - Quantities, costs, manhours, drawings, construction equipment
  - Mechanical designs of engineered equipment and bulks
  - Costs of process equipment and bulk materials
  - Construction equipment rental requirements
  - All phases of contractor engineering and field supervision
  - And more.....

- Estimate built from the bottom up in a visible manner
  - Equipment based approach
How the System Generates Quantity Based Estimates

- Based on key input parameters *(mapping and sizing)* Aspen Economics creates a volumetric model for an equipment component.

- Quantities are developed by the volumetric model.

- Man-hours and material costs are created from the volumetric model “take-offs”.
Volumetric Models:
Calculation of Installation Bulks

- Total installed cost estimated
- Quantities and costs for bulk materials based upon equipment specifications
- Volumetric models for process equipment:
  - Conceptual Volumetric P&IDs
  - Civil
  - Steel
  - Electrical
  - Insulation
  - Paint
The Volumetric Model for Typical Tower
The Volumetric Model

Instrument the Tower

Fabricate & Install Pipe

Install Instruments ♦

Add Lighting & Grounding

Add platforms & Ladders

Design & Build Foundation
Where Do the “Costs” Come From?

- **SOURCES:**
  - Combination of private and public sources are employed to continually keep cost information up-to-date
  - Includes materials, labor (i.e. welding, fabrication, etc.)
  - Location based costs
- **FREQUENCY:**
  - Annual “costing update” at end of each calendar year
  - Costing update represents Q1 costs
- **USER COMPANY STRATEGIES:**
  - Use “out of the box” or index based on company or client experience
Activation
Guides Better Decisions During Conceptual Design

Energy Savings Potential

Green House Gas Emissions

Installed Capital Cost

Net Process Utility Cost

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Activated Economic Analysis
Quickly Evaluate Relative Cost
Activated Economic Analysis
Quickly Verify Design

<table>
<thead>
<tr>
<th>Summary</th>
<th>Utilities</th>
<th>Equipment</th>
<th>C</th>
<th>DHE TEMA EXCH</th>
<th>DHT HORIZ DRUM</th>
<th>DRE U TUBE</th>
<th>DCP CENTRIF</th>
<th>DTW TRAYED</th>
<th>DAT REACTOR</th>
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Vessel capacity cannot be calculated. Please check stream flows.

ERROR: AT-22 QUESTION MARK FOUND IN NUMERIC DATA ERRORS: AT-22 EITHER CAPACITY OR DIAMETER+HEIGHT MUST BE SPECIFIED
Economics Ribbon to Facilitate Workflow

Status indicators for clarity

Auto-evaluate mode – automatically calculate costs after each simulation run
Activated Economic Evaluation Step-by-Step
Enter Cost Options & Activate

Use your company standard practices:
- Use templates to ensure consistency and to customize sizing and costing
Activated Economic Evaluation
Maps Unit Operations to Equipment

Unit Operation

Radfrac

Equipment

Condenser

Column Vessel

Packing Section 1

Packing Section 2

Reflux Pump

Exchanger

Receiver

Pump

Reboiler
Activated Economics Mapping
Easily Over-ride the “Default” Mappings
Activated Economic Evaluation
Size Equipment Based on Simulation Results
Activated Economic Evaluation
Enter Equipment Specifications

Enter geometry, material of construction, etc.
Easily Change Materials of Construction

Materials are a Major Capital Cost Driver

<table>
<thead>
<tr>
<th>Name</th>
<th>DHE TEMAX</th>
<th>DHE TEMAX</th>
<th>DHE TEMAX</th>
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<td>Equipment ma</td>
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Activated Economic Evaluation
Size Equipment & Evaluate Costs

The equipment tab shows weights and costs for each equipment item.
Activated Economic Evaluation
Size Equipment & Evaluate Costs

The summary tab provides an overview of operating and capital costs.

These relative estimates are sufficient for comparing conceptual alternatives.
# Equipment Summaries
Easily Sorted to Identify Cost Drivers

![Economic Evaluation Equipment Summary Grid](image)

<table>
<thead>
<tr>
<th>Name</th>
<th>Equipment Cost [USD]</th>
<th>Installed Cost [USD]</th>
<th>Equipment Weight [LBS]</th>
<th>Installed Weight [LBS]</th>
<th>Sizing Errors</th>
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Business Benefits of Lifecycle Solution

- Conceptual design scenario trade-offs for CAPEX and OPEX
- Optimize design for energy, OPEX, CAPEX, yield
- Rigorous cost model embedded in conceptual design
- Collaborative work flow between process engineering and estimating
- 4:1 productivity improvement in estimating
- Improve estimating accuracy and predictability
PEMEX
Evaluation and Selection of Technology Using ACCE

Challenge

- Need to find balance between the technical criteria of a process and the economic criteria of the project
- Need to find balance between operational reliability and energy and production costs
- Limited scope during the conceptual design phase

Solution

Result

Operational reliability

Energy and Production cost

Ref: Olga Marta Monterrubio, PEMEX
AspenTech OPTIMIZE, Boston, MA, May 2013
PEMEX
Evaluation and Selection of Technology Using ACCE

Challenge

- Used Aspen HYSYS & Aspen Economic Evaluation Suite to:
  - Account for equipment and material market rates
  - Determine the number of engineering man hours required
  - Forecast inflation
  - Easily transfer equipment data from process simulator to cost estimate

Solution

Result

Ref: Olga Marta Monterrubio, PEMEX
AspenTech OPTIMIZE, Boston, MA, May 2013
PEMEX
New Refinery Cost Estimation

Challenge

- Evaluated the cost of the new refinery macro project with an expected deviation of 10%
- Reduce the time spent coming to an estimate resulting in fewer man hours needed
- Compared with other Macro Projects using ACCE:
  - 23 Projects with ±15% Deviation (2006-2013)
  - 10 Projects with ±10% Deviation (2009-2013)

Ref: Olga Marta Monterrubio, PEMEX
AspenTech OPTIMIZE, Boston, MA, May 2013
Kuwait Oil Company
Optimize Revamp Profitability

Challenge

- Solve plant unit functional failure
- Identify technical alternatives
- Select optimal capital, operating cost and maintainability strategy
  - Minimize project duration
  - Maximize revenues

Revamp problem definition

Solution

Result

Kuwait Oil Company
Optimize Revamp Profitability

Challenge

- Model alternative design cases in Aspen HYSYS
- Use activated economics to identify capital and operating cost implications
- Analyze maintainability and reliability of cases
- Compare profit and revenue impact of alternatives

Solution

Result

Economic Comparison of Conceptual Design Cases

Techno-Economic Evaluation: Comparison of Cases

Kuwait Oil Company
Optimize Revamp Profitability

Challenge

- Save $23 million in total project costs
- Improve annual maintenance cost 20%
- Improve annual spare parts cost 30%
- Reduce insurance premium for unit 20%

Solution

Business Results and Benefits

- Cost savings in maintenance policies
  - Up to 20% reduction in annual savings cost
- Cost savings in spare parts cost
  - Up to 30% reduction in annual costs of spare parts inventory
- Reduction in insurance premium (highly critical for company OPEX)
  - 20% reduction in annual premium cost with new package
- Customer satisfaction is a top priority and with new package units
- Downstream facilities (transport pipelines, LPG plant) integrity ensured
- Project life cycle time (1 year) optimized by selecting the right process at the right time
- Ensures reliability and the availability of the production process

Tangible & intangible benefits

Questions?


http://www.aspentech.com/ACCE_tutorials.aspx

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Dan.McCarthy@aspentech.com