Aspen Capital Cost Estimator Overview

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The *Aspen Economic Evaluation* product family is based on Aspen Icarus technology. Unlike other approaches, the technology does not rely on capacity-factored curves for equipment pricing, nor does it rely on factors to estimate installation quantities and installed cost from bare equipment. It follows a unique approach where equipment, with associated plant bulks, is represented by comprehensive design-based installation models.
Agenda

- Aspen Capital Cost Estimator (ACCE) overview
- Design and cost basis
- Data input in ACCE
- Available models
  - Process equipment
  - Bulk quantity models
- Additional modules
  - Project scaling and relocation
  - Utility systems
  - Scheduling interface
- Recent software enhancements
- Q & A
Aspen Capital Cost Estimator (ACCE) Overview

- Formerly known as Aspen Kbase
- ACCE is a model based, E-P-C cost estimating tool for process project work
- ACCE allows for minimum scope definition in conceptual phases of project
- For preliminary/conceptual estimates, volumetric models estimate bulk and infrastructure requirements (based upon sized equipment list)
- ACCE accommodates thorough definition of scope and execution plan as project definition increases
  - Process equipment (vessels, heat exchangers, etc.)
  - Bulks (pipe rack, utility piping, etc.)
  - Process control and power distribution
  - Areas (process structures, modules, etc.)
  - Contractors and workforces
How Aspen Capital Cost Estimator Works

- Uses built-in, industry-standard mechanical and construction design and cost models to prepare detailed lists of:
  - Quantities, costs, man-hours, 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
ACCE Design and Cost Basis
Cost Basis

- Cost basis updated annually by AspenTech
- Five base locations
  - US Gulf Coast
  - Middle East
  - EU
  - UK
  - Japan
- Chinese design basis introduced in 2012
- Base locations reflect typical commodity pricing, labor rates, and design code rules
- Material and labor specifications can be adjusted to represent site-specific conditions
Levels of Data Input in Aspen Capital Cost Estimator

- **Project**
- **Area**
- **Component**
- **Installation Bulk**
How Input Specifications Flow through ACCE Processing

Inputs
- Project (P)
- Area (A)
- Component (C)
- Installation (I)

Processing
- Component Design
  - Cost
- Installation Bulks Design
  - Cost
- Construction Labor
- Rental Equipment
- EPC Schedule
- Engineering

Outputs
- Designs, ratings, sizes, quantities, costs
- Designs, ratings, sizes, quantities, costs
- Work items, crews, craft mhrs, costs
- Types, sizes, durations, costs
- Activity network, crew sizes, durations, float...
- Work items, crews, M-hrs, and costs
Project Level Specifications

**Design and Cost Basis**
- Design Basis
- Code of Account names
- Material/Man-hour Indexing
- Escalation
- Contingency and misc. costs

**Execution Plan**
- Contracts
- Engineering/Construction workforces
- Equipment Rental
- Project Schedule
Area Types in Aspen Capital Cost Estimator

- GRADE (default)
- PAD
- OPEN (open steel structure)
- EXOPEN (existing steel structure)
- MODULE
Equipment in Open Steel Structure

Skirt or leg height = 0
ACCE Equipment and Bulk Models
Component Models

AspenTech Models

- Process equipment
- Buildings

User Models

- Equipment model libraries
- Unit cost data
- Quoted equipment
- Custom models

Plant bulks
Site development
Mechanical Design and Cost Procedure

PROJECT SPECS:
- Mechanical design specs
- Project components specs

MECHANICAL DESIGN:
Develop physical dimensions using:
- Design code procedures
- Industry standard methods

FABRICATION LABOR:
- Shop [+ Field]
- Labor
- Man-hours

Equipment FOB cost estimated

VESSEL COST:
- Mat’l cost of parts
- Shop [+ field] fab labor
- Labor overheads
- G and A
- Profit

Equipment design generated
Estimate bulk quantities and costs associated with each piece of equipment

Volumetric models automatically develop:

- Equipment Setting
- Volumetric P&ID
- Civil Designs
- Steel Designs
- Electrical
- Insulation
- Paint
Volumetric P&IDs Model Piping and Instrumentation in ACCE
Sources of Quantities in ACCE

- Key equipment list parameters govern quantity estimates:
  - Size/dimensions, metallurgy, temperature, pressure

- Volumetric modeling:
  - Provides consistent approach for piping, instrumentation, civil/structural, electrical, insulation and paint associated with equipment items

- Adjusting quantities during calibration process:
  - Compare historical results with default ACCE parameters
  - Parameters can be calibrated to achieve quantity predictability

\[ y = \sum_{i=1}^{n} C_i + \sum_{i=1}^{n} f_i C_i = \sum_{i=1}^{n} C_i (1 + f_i) \]
Civil Volumetric Model Example: Impact of Wind Speeds

<table>
<thead>
<tr>
<th>Wind Velocity (mph)</th>
<th>Vessel Weight (lbs)</th>
<th>Foundation Size (CY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>58,300</td>
<td>18</td>
</tr>
<tr>
<td>100</td>
<td>62,100</td>
<td>22</td>
</tr>
</tbody>
</table>
ACCE Additional Modules
Additional Modules

- **Decision Analyzer**
  - Analyzer Scale-Up Module (ASM)
    - Estimate quantity-based, conceptual costs of re-sized project (based upon existing sized equipment list)
  - Analyzer Relocation Module (ARM)
    - Generate conceptual costs for relocation of a base case project to any of 89 international locations

- **Utility Models**
  - Generate utility systems based upon project scope
    - Instrument and plant air systems
    - Cooling water systems

- **Project scheduling interface (Primavera)**
Data Flow From ACCE to Primavera

Aspen Capital Cost Estimator

Estimate data

- Resources
- Area & Contract definitions
- Engineering & Procurement activities
- Construction activities
- Delivery times
- Logic

Schedule data

Primavera
ACCE Recent Enhancements
Spreadsheet Overview

- Introduced in late 2011
- Offers alternative to conventional Graphical User Interface (GUI) for data input and review
- Data entry template exported to Excel
  - Model-specific data (min/max, defaults, metallurgy, etc.) included in spreadsheet
- Data imported back into Aspen Capital Cost Estimator
  - Equipment Lists
  - P&ID data from various sources (Vendor neutral)
- Online Tutorials
Export Empty Spreadsheet

Options
- Create empty spreadsheet
- Export data from project

Select component models to be included in data entry spreadsheet
Export Data Spreadsheet

Automatically generates spreadsheet with component classes already defined in selected project areas

Allows user to select component models for which data will be exported to spreadsheet
Aspen Capital Cost Estimator for Offshore Oil and Gas

- Aspen Capital Cost Estimator (ACCE) is widely used across the oil and gas industry by Global integrated companies, Nationals, and E&Cs

- ACCE has many strengths for producing estimates early and accurately for offshore which include:
  - Ability to estimate weights accurately
  - Handling of modular construction
  - Handling of multiple workforces and fabrication methods

- As a consequence ACCE has traditionally been used in topsides estimating

- We have now added several key capabilities to complete the ability to use ACCE for offshore structures (especially steel jacketed)
Overview of ACCE Capability for Offshore

- In the Upstream Estimating space AspenTech is introducing new innovative capability to address a market gap.

- New capabilities specifically tailored to Upstream estimates include (Introduced in 2013):
  - Safety Instrumented Systems (SIS) models
  - Offshore jacket and tubular steel models

- Other recently introduced capabilities include:
  - Bargeable modules estimates
  - Weight estimates in addition to costs
  - Specific upstream equipment models
    - Cryogenic Double Wall Full Containment Storage Tank
    - Crude Oil Desalter
    - Sediment Removal Filter
    - 3-Phase Separator (Oil-Gas-Water)
Offshore Jackets

- Shallow water jackets
- 3 or 4-leg jackets maximum of 140ft (42.6m)
- 8-leg jackets maximum of 292ft (89m)
- Includes option for piling and anodes
- Choice of tubular steel metallurgy
Offshore Jackets
Bargeable Module

Can also be used to model topsides for offshore projects
**Bargeable Modules Shipping Acceleration**

<table>
<thead>
<tr>
<th>Name</th>
<th>Units</th>
<th>Item 1</th>
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<tr>
<td>Area type</td>
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<td>MODULE</td>
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<tr>
<td>Area length</td>
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<tr>
<td>Area width</td>
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<tr>
<td>Area height</td>
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<tr>
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<td>Number of floor levels</td>
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<tr>
<td>Distributed load per level</td>
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<td>Slab thickness</td>
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<tr>
<td>Bay length</td>
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<tr>
<td>Bay width</td>
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<tr>
<td>Floor grade - percent area</td>
<td>PERCENT</td>
<td></td>
</tr>
<tr>
<td>Floor slab percent of area</td>
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<tr>
<td>Elevated floor slab thickness</td>
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<td>Number of stairways</td>
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<tr>
<td>Sliding type</td>
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<tr>
<td>Sliding - percent of wall area</td>
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<td></td>
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<tr>
<td>Low ambient temperature</td>
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<td>High ambient temperature</td>
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<td>Module type</td>
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<td>Beam option</td>
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<td>Bracing option</td>
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<td>Insulation type</td>
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<td>Paint structure option</td>
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<td>Paint siding option</td>
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<td>Casing side relief devices</td>
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<td>TRUCKABLE/BARGEABLE PROC. MODULE</td>
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<td>Shipping route</td>
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<td>Trans. shipping acceleration</td>
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<td>Long. shipping acceleration</td>
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<td>Vert. shipping acceleration</td>
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<td>Equipment Bracing Allowance</td>
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<tr>
<td>Number of modules</td>
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15 shipping routes available with preset accelerations
# Module Summary

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Direct Costs</th>
<th>Material (K-$)</th>
<th>Manhours</th>
<th>Manpower (K-$)</th>
<th>Weight (LBS)</th>
<th>Total Amount ($)</th>
<th>Percent of Purchased Equipment (%)</th>
<th>Percent of Total Cost (%)</th>
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<td>10. Module Total</td>
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<td>40624</td>
<td>347500</td>
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</table>
Cryogenic Double Wall Full Containment Storage Tank

Typical Design of a Full Containment LNG Tank
Questions?