Simulation in Product Development

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Agenda

- The Product Development Challenge
- Simulation to Meet the Challenge
- Embed Simulation in Product Development
- Value of Simulation in Product Development
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CATERPILLAR: OUR GLOBAL FOOTPRINT

PRODUCT LINE

Construction

Mining Equipment

Diesel & Natural Gas Engines

Industrial Gas Turbines

Diesel-Electric Locomotive

3 Million+ Products at Work Around the World

98,400 Full-time Employment*

We Provide Solutions that Help Our Customers Build a Better World

171 Dealers Serving 192 countries*

500,000+ Connected Assets*

*Based on 2017 year-end data
The Product Development Challenge

- **Time**
  - Product Introduction Rate

- **Cost**
  - Manufacturer
    - Development Cost
    - Production Cost
  - Customer
    - Owning & Operating

- **Quality**
  - Customer Perception: Performance, Reliability, Durability
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Simulation to Meet the Challenge

Drive decisions early in design

Opportunity To Optimize

Cost / Time to fix problem

Concept  Design  Build  Test  Production
Simulation to Meet the Challenge

1D/0D Example
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Embed Simulation in Product Development

A method that has worked for 1D/0D simulation
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Product Applications

Model Build

Design Exploration/Optimization

Virtual Validation

Concept Design Build Test Production

What to implement
Embed Simulation in Product Development

A method that has worked for 1D/0D simulation
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A method that has worked for 1D/0D simulation

1. Passionate Adopter

- Must have significant leadership role in Product Development
- Realizes old way isn’t working
- Looking for a new and better way
- Believes simulation could be the solution
- Willing to invest/risk dollars to make it succeed
Embed Simulation in Product Development

A method that has worked for 1D/0D simulation

2 Right Team

- Product development expertise
- Simulation expertise
- Test expertise
Embed Simulation in Product Development

A method that has worked for 1D/0D simulation

3 Right Deliverable

- Problem looking for answer…not answer looking for problem!
- Biggest perpetual design issue that simulation can reasonably solve
- Build core models to solve that issue
- Test data must be available for validation
- Validate core models against test data – drive adopter confidence
Embed Simulation in Product Development

A method that has worked for 1D/0D simulation

4 Commitment!

- Persistent leader…like a bulldog
- Team must be passionate about both “what” and “why”
- Adopter’s commitment to sustain the workflow
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Opportunity To Optimize

- Decreased warranty
- Eliminate carry-over issues
- Optimized design
  - Increased margins
  - Increased market share

Cost / Time to fix problem

- Avoid test redo
- Eliminate/reduce physical tests
- Avoid component redesign
- Avoid design recycle
- Avoid manufacturing retooling

Get adopter to calculate and agree on value – use as motivation for future adopters