

**ASSESS** 

**Understanding and Enabling  
the Simulation Revolution**

# Engineering Simulation

---

**Engineering Simulation** as used by this presentation refers to Analysis, Simulation, and Systems Engineering software technology and usage in engineering applications.

# Understanding the Simulation Revolution



# Understanding the Simulation Revolution

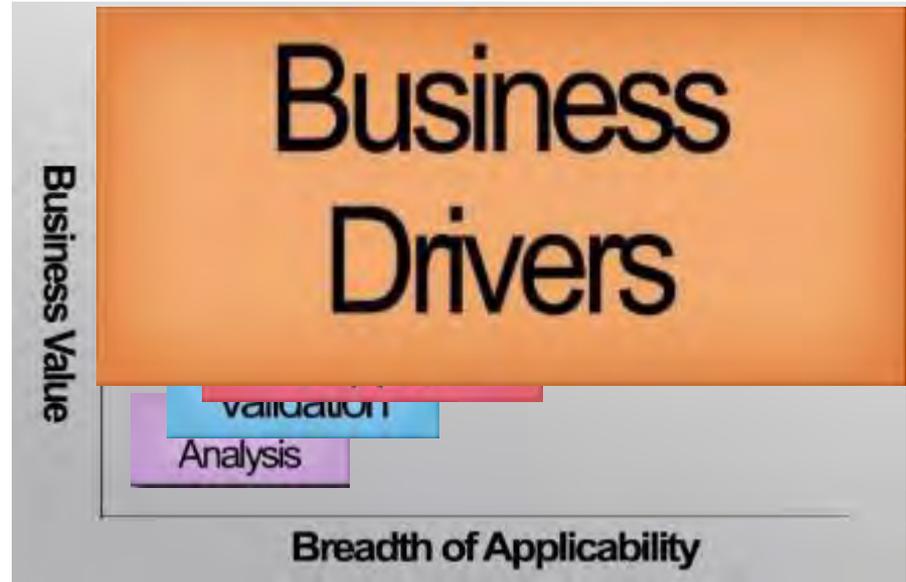
---

- The demand for software tools for Engineering Simulation are exploding to support the demand for increased competitiveness and to deal with the rapidly growing complexity of products, processes, and systems.
- At the same time, we are struggling to keep up with our current demand for experts who are able to use these tools effectively.

# Understanding the Simulation Revolution

The Changing Role of Engineering Simulation is really about becoming a major key to strategic goals for improving competitiveness

- Increase Innovation
- Increase Quality
- Reduce Risk
- Reduce Time
- Reduce Cost



**ASSESS** >>

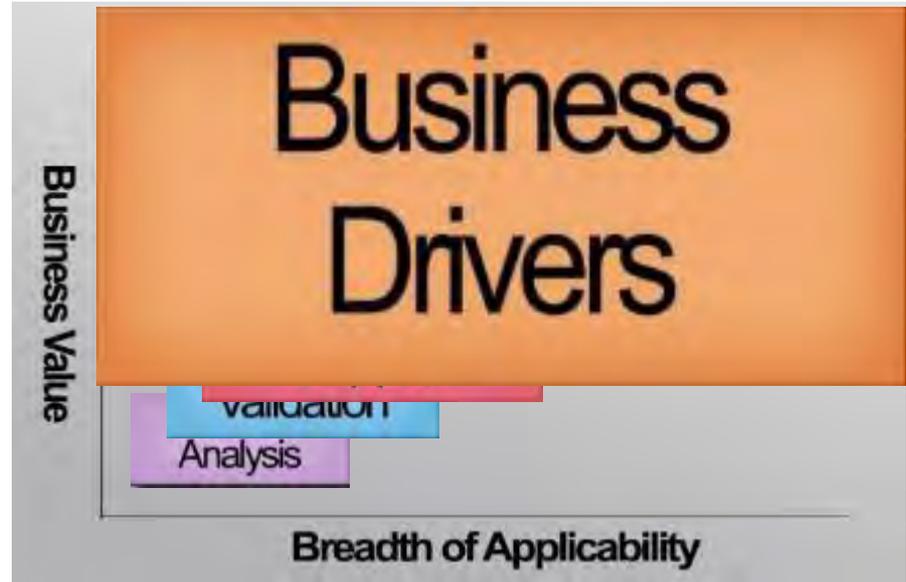
# Understanding the Simulation Revolution

---

- Growth of the Engineering Simulation market is tempered due to lack of expertise available
- **Engineering Simulation** is **still** done primarily **by specialized Analysts**

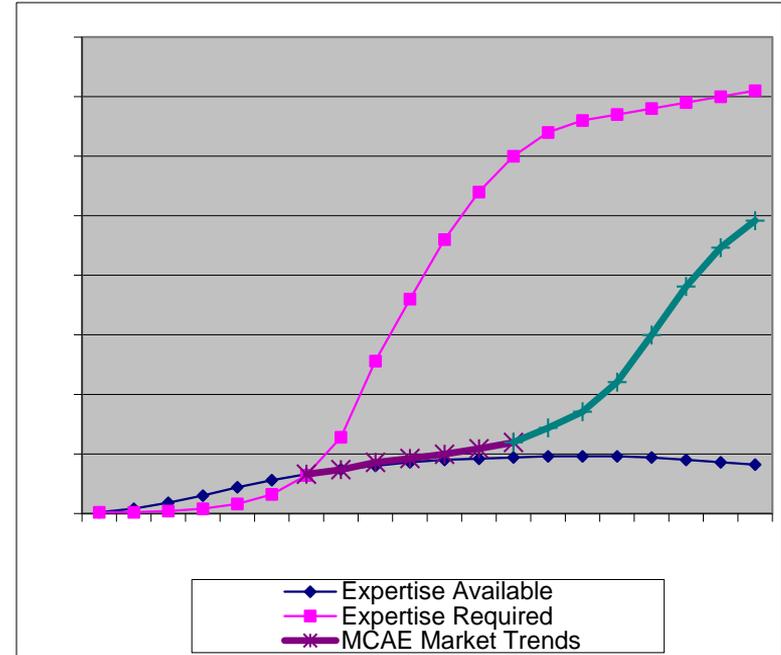
# Understanding the Simulation Revolution

- Business Drivers are going to force a “**revolution**” to overcome the expertise based limitation
- Engineering Simulation will be forced to find a way



# Understanding the Simulation Revolution

- The demand is not going away
- A **Simulation Revolution** will occur:
  - “Model-Based”
  - “Fit for purpose”
  - “Integrated”
  - “Smart”
  - “Transparent” / “Invisible”
  - “Generative”
  - “ . . . . ”
  - CULTURE CHANGE



# Understanding the Simulation Revolution

---

- **Engineering Simulation is rapidly being recognized as a key enabler to Increased Competitiveness**

# Understanding the Simulation Revolution

---

- The “**Digital Twin**” approach will dramatically increase the demand for Engineering Simulation
  - “What good is a digital twin if you cannot evaluate its performance virtually?” - Fouad El Khaldi, ESI Group

**ASSESS** >>

# Understanding the Simulation Revolution

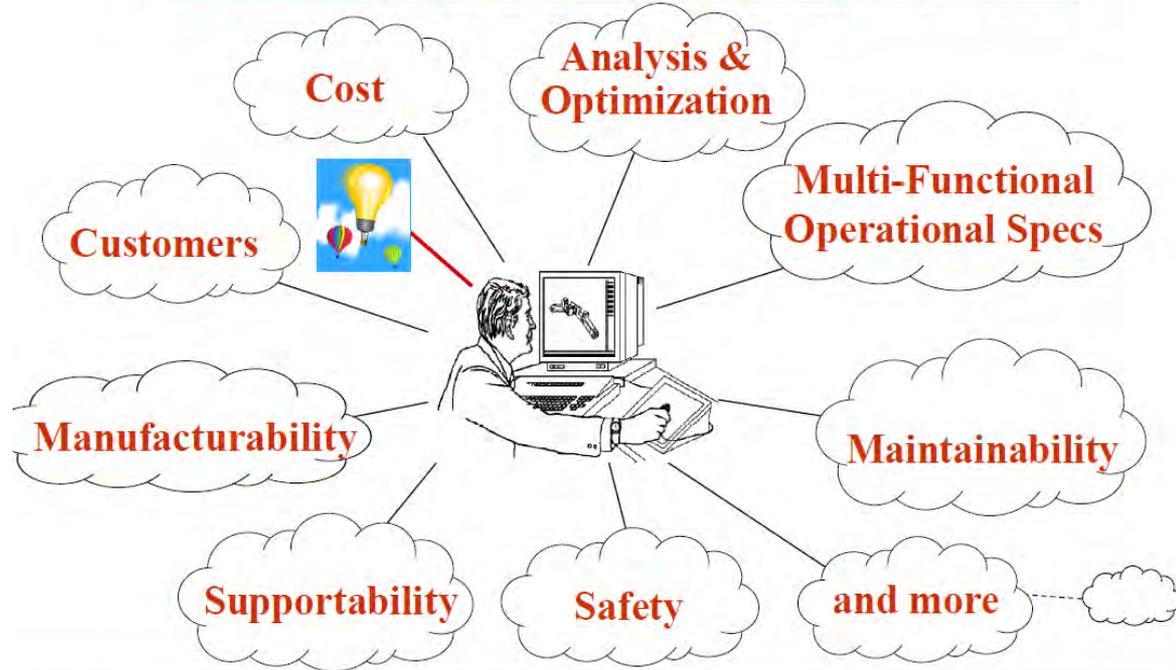
---

- The Simulation Revolution is about making **Engineering Simulation widely available & appropriate** to support improved decision making throughout the entire life-cycle of engineered products and processes

# Understanding the Simulation Revolution

- Rod Dreisbach (formerly of Boeing) set the goal for the Simulation Revolution at the ASSESS 2016 Congress

**Strategic Direction: Revolutionizing the Future is Now!**  
**--- An Immersive Design Environment ---**



**...through Realistic Digital Simulation of Multi-Physical Phenomena at the Speed of Human Thought!**

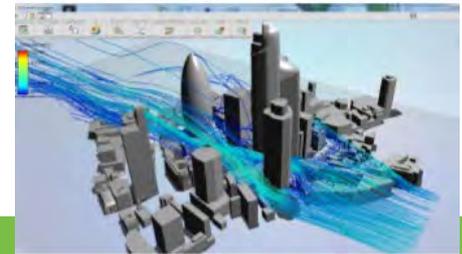
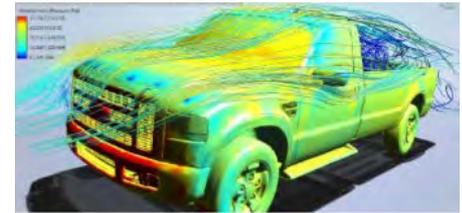
# Enabling the Simulation Revolution



# Enabling the Simulation Revolutio

## • Technologies

- Increased emphasis on purpose built applications
- Model Based Systems Engineering
- Emergence of simulation knowledge capture & reuse (KARREN)
- Emergence of near real time / near physics approaches
- Emergence of Generative Design
- IoT access to “real” data

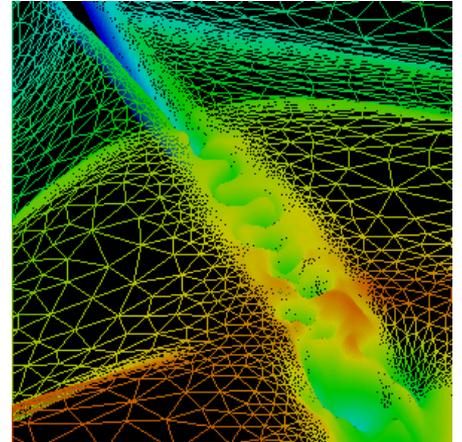


# Enabling the Simulation Revolution

---

- **Approaches**

- Focusing on automation for appropriate accuracy for effective decision support
- Focusing on accuracy driven methods
- Focusing on application rather than physics
- Increasing the emphasis on Model Based Systems Engineering



**ASSESS** »

# Enabling the Simulation Revolution

---

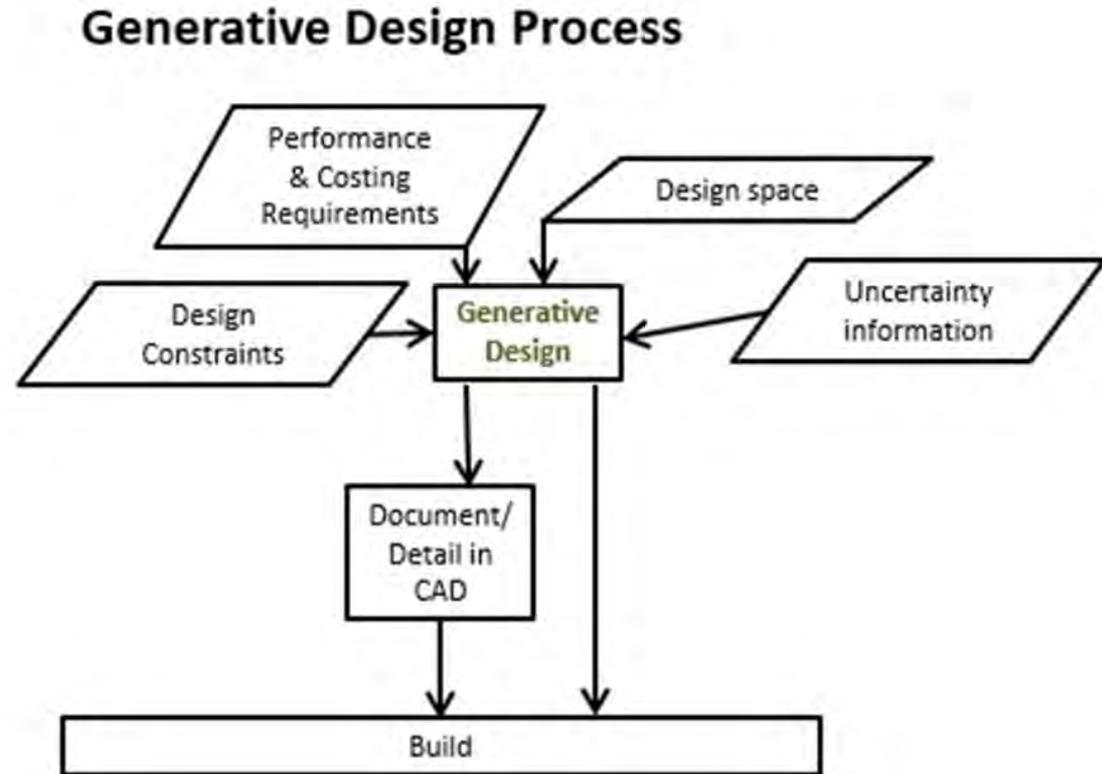
- **Approaches**

- Accounting for Variability and Uncertainty
- Leveraging Surrogate Models
- Coupling Systems Models with more detailed models for better system level decisions
- Optimizing the system rather than the components
- Spawning simulations from “real-time” data automatically
- Enabling a viable business model

# Enabling the Simulation Revolution

- **Approaches**

- Driving design from requirements and available design space – Generative Design



# Enabling the Simulation Revolution

---

- **We need a broad multi-industry initiative to raise awareness and develop/promote strategies to enable the Simulation Revolution**
  - **Analysis, Simulation, and Systems Engineering Software Strategies (ASSESS) Initiative**

**ASSESS** »

# The ASSESS Initiative



# The ASSESS Initiative

---

The **ASSESS Initiative** was formed to bring together key players to guide and influence strategies for software tools for model-based analysis, simulation, and systems engineering.

# The ASSESS Initiative

---

## Key drivers behind the ASSESS Initiative

1. Growing demand on “How to be more competitive”
2. Exponentially growing complexity of products & processes
3. Available computing power is rapidly removing the computing bottlenecks
4. New world of 3D printed objects and light weighting
5. Entirely new applications are creating a rapidly growing demand for simulation to enable breakthroughs
6. Simulation is used almost exclusively by a limited number of expert analysts
7. Simulation efforts have three key but disjointed vectors – Commercial / Government / Research

**ASSESS** >>

# The ASSESS Initiative

---

## The ASSESS Vision

“To significantly expand the use and benefit of software tools for model-based analysis, simulation, and systems engineering in the engineering applications domain.”

# The ASSESS Initiative

---

- ASSESS will interact and collaborate with multiple activities and organizations including: NAFEMS, INCOSE, DMSCO, IEEE, CIMdata, Revolution in Simulation, and others.



**CIMdata**



IEEE  
**SMC**  
Systems, Man, and Cybernetics Society

**ASSESS** >>

# The ASSESS Initiative

---

- ASSESS Advisory Committee
  - 57 Industry Thought leaders
  - 8 Working Groups focused on defining the future directions, activities and deliverables of the ASSESS Initiative
  - 5 Working Groups aligned with “actionable” themes

# The ASSESS Initiative

---

- Current ASSESS Themes
  - Democratization of Engineering Simulation ([DoES](#))
  - Engineering Simulation Confidence & Governance ([Confidence](#))
  - Integration of Systems and Detailed Sub-System Simulations ([Systems](#))
  - Alignment of Government / Research/ Commercial Activities ([Align](#))
  - Engineering Simulation Business Challenges ([Business](#))
- New ASSESS Themes
  - Generative Design (**Generative**)
  - Engineering Simulation and the Digital Twin ??

**ASSESS** 

# The ASSESS Initiative - DoES

---

## Mission statement for DoES Working Group

*“To advocate for a significant expansion of the use of Engineering Simulation by all users, for whom access to the power of Engineering Simulation would be beneficial. This group’s advocacy is aimed at broader accessibility and use of Engineering Simulation, and includes education; understanding of technologies, methods, processes, organizational impacts; promotion of successes; identification of challenges; facilitation of partnerships; and providing access to resources.”*

**ASSESS** 

# The ASSESS Initiative - DoES

---

- **DoES Goals**

- Make it possible for people who could benefit from using Engineering Simulation to be able to use Engineering Simulation
- Get Engineering Simulation into the hands of current non-users
- Address Engineering Simulation ease of use issues
- **Grow Engineering Simulation use by 10x in 5 years**

**ASSESS** »

# The ASSESS Initiative - DoES

---

- **DoES Working Group Next Step**

- **ASSESS Research Paper**

Understanding the different forms of Implementation for Democratization of Engineering Simulation (DoES) and their related benefits, activities, requirements and issues

- Different levels (scope) of Democratization
      - Product-Project / PD Process / Enterprise / Industry
    - Different types of organizations
      - Large company / SMB / Industry Consortium
    - Consumer Centric or Vendor Centric

**ASSESS** 

# The ASSESS Initiative - Confidence

---

- **Confidence Working Group Scope**
  - Appropriate Model Fidelity
  - Verification & Validation
  - Uncertainty Quantification
  - Risk Management
  - Deployment & Governance
  - Unsexy stuff (hygiene)

# The ASSESS Initiative - Confidence

---

- **Confidence Working Group Next Steps**
  - **ASSESS Research Paper and tri-fold**
  - Understanding why/how to develop an Engineering Simulation Risk Management Model
    - Sensitivity determines Importance
    - Probability determines Uncertainty
    - Risk defines Consequence
    - Quantifying results in Confidence
    - Managing results in Governance
    - Governance results in ROI

# The ASSESS Initiative - Confidence

---

- “All Engineering Simulation is done to support a design decision made or to be made”
- No good metrics today for target or actual model appropriateness
- Engineering Simulation is done as “good” as the Analyst thinks he can do in a given timeframe
  - Decisions are being made without knowing appropriateness of simulations or models – heavy reliance on experts experience
  - Not transferrable to new users
  - Not scalable for DoES

# The ASSESS Initiative - Confidence

---

- DoES increases the need for Governance to maintain Confidence
  - Organizations must understand the role and place for simulation
  - Non-expert users need guidance and control
    - Applicability of models
    - Problem definition
    - Uncertainty
    - Risk assessment & management

# The ASSESS Initiative - Systems

---

- **Systems Working Group Goals**
  - Explore & improve integration methods
  - Incorporate VV&A, UQ (component-based)
  - Move toward libraries of accredited components
  - Aspire to find a well-integrated approach to support a broad range of models

# The ASSESS Initiative - Systems

---

- **Systems Working Group Next Step**

- **ASSESS Research Paper**

Understanding why integration of Systems and detailed Sub-System simulations is not easy and how to move forward

- Starting with classification of Engineering Simulation Models

# The ASSESS Initiative - Align

---

- **Align Working Group Next Step**

- **ASSESS Research Paper**

Understanding the current status of alignment (or lack thereof) across Government / Research / Commercial Engineering Simulation

# The ASSESS Initiative - Business

---

- **Business Working Group Key Factors**
  - Value proposition of Engineering Simulation
  - Communication with non-technical executives
  - Role of untapped Subject Matter Experts (SMEs)
  - Addressing the Small-Medium Business (SMB) Market
  - Business impact of web cloud/mobile
  - Licensing models

# The ASSESS Initiative - Business

---

- **Business Working Group Next Step**

- **ASSESS Research Paper**

Understanding and explaining the Engineering Simulation value proposition

- All other Business Challenge issues are a function of clear understanding of achievable and realistic Engineering Simulation value propositions
    - Varies by customers
      - Large company / SMB / Industry Consortium

**ASSESS** >>

# The ASSESS Initiative – Generative Design

---

- Generative Design is the use of algorithmic methods to transform requirements into product geometry and design
- Generative Design includes one or multiple optimizations within design/  
Manufacturing/fabrication/assembly/cost/...  
constraints

# The ASSESS Initiative – Generative Design

---

“Integrated performance-driven generative design systems are aimed at creating new design processes that produce spatially novel yet efficient and buildable designs through exploitation of current computing and manufacturing capabilities.”

Kristina Shea (2005)

<http://www.edac.ethz.ch/>

**ASSESS** 

# The ASSESS Initiative

---

- **ASSESS 2017**  
**Congress (November 1-3**  
**2017, Potomac, MD)**
  - 150 industry leading participants
  - 2 Keynote presentations
  - 8-10 Technology Briefings
  - 8-10 Working Groups focused on the ASSESS related themes with 2 sessions each



**ASSESS >>**