Scope of the LCCC-ACCESS Workshop on Model-Based Systems Engineering and Model-Based Engineering

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LCCC-ACCESS Workshop

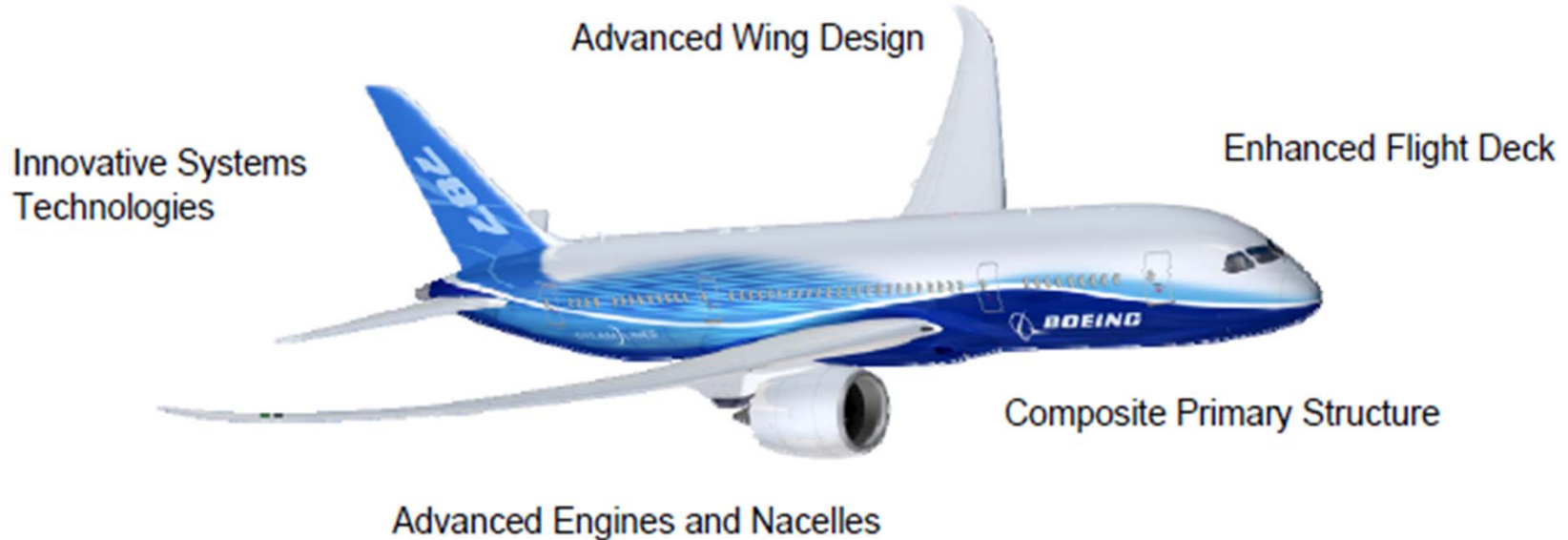**Lund, Sweden**

BOEING 787: CLEANER, QUIETER, MORE EFFICIENT

The 787 Dreamliner delivers:

*Relative to the 767

20%* reduction in fuel and CO_2

28% below 2008 industry limits for NOx

60%* smaller noise foot print

Advanced Wing Design

Innovative Systems Technologies

Enhanced Flight Deck

Composite Primary Structure

Advanced Engines and Nacelles
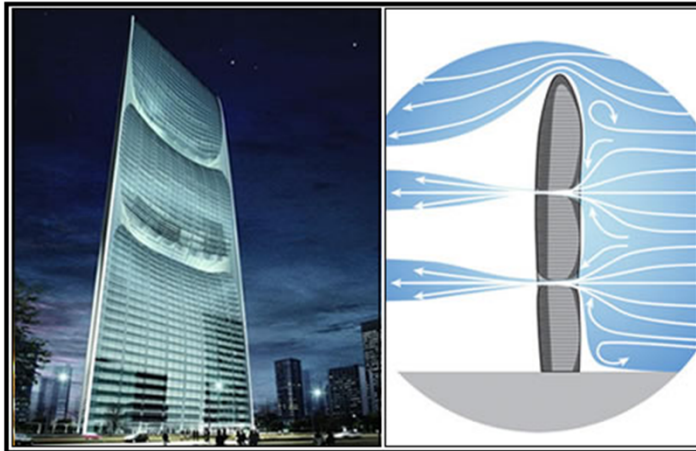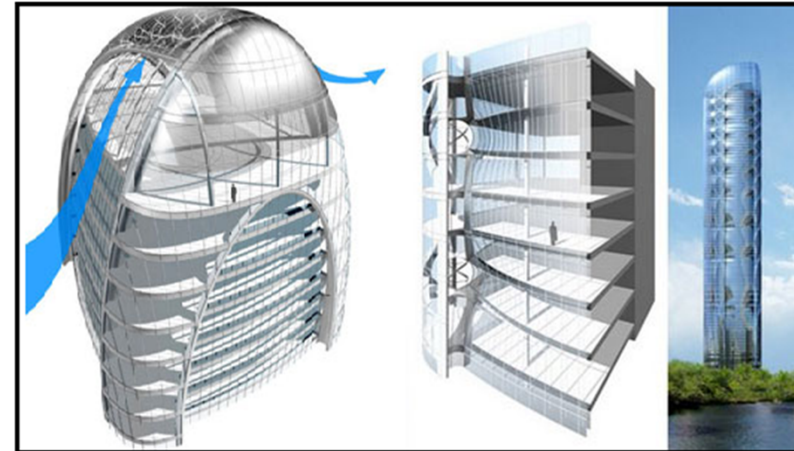
Boeing

Buildings as Cyber-Physical Systems

- **Research focus:** Platform-Based Design for Building-Integrated Energy Systems.

Pearl River Tower Complex
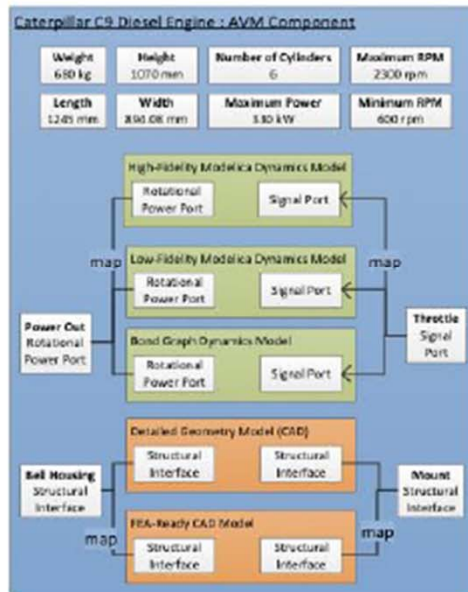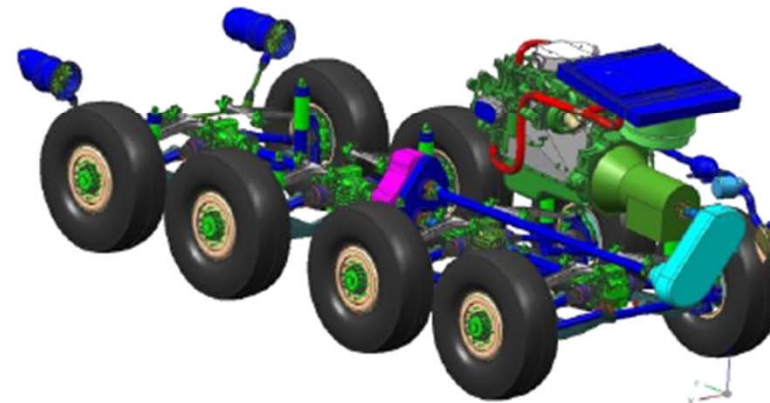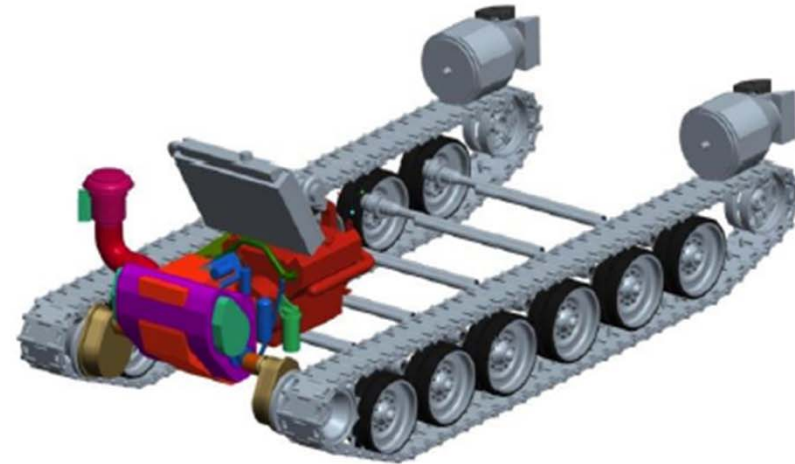
Green Technology Tower -- Architectural Proposal for Chicago

3

META – iFAB – AVM: Component Models

As of today:

- 131 component classes
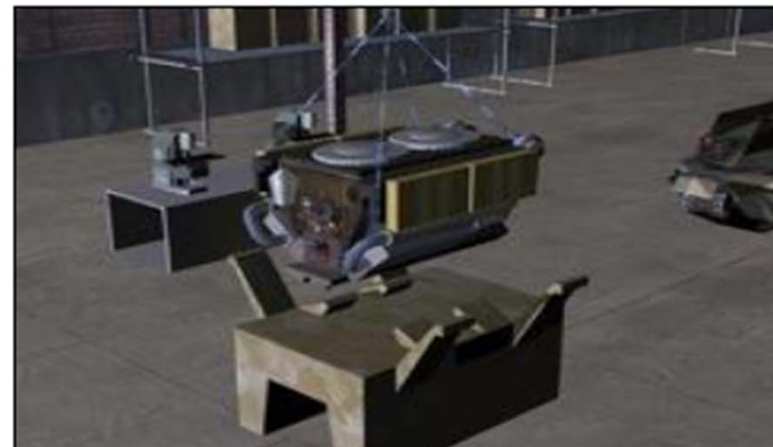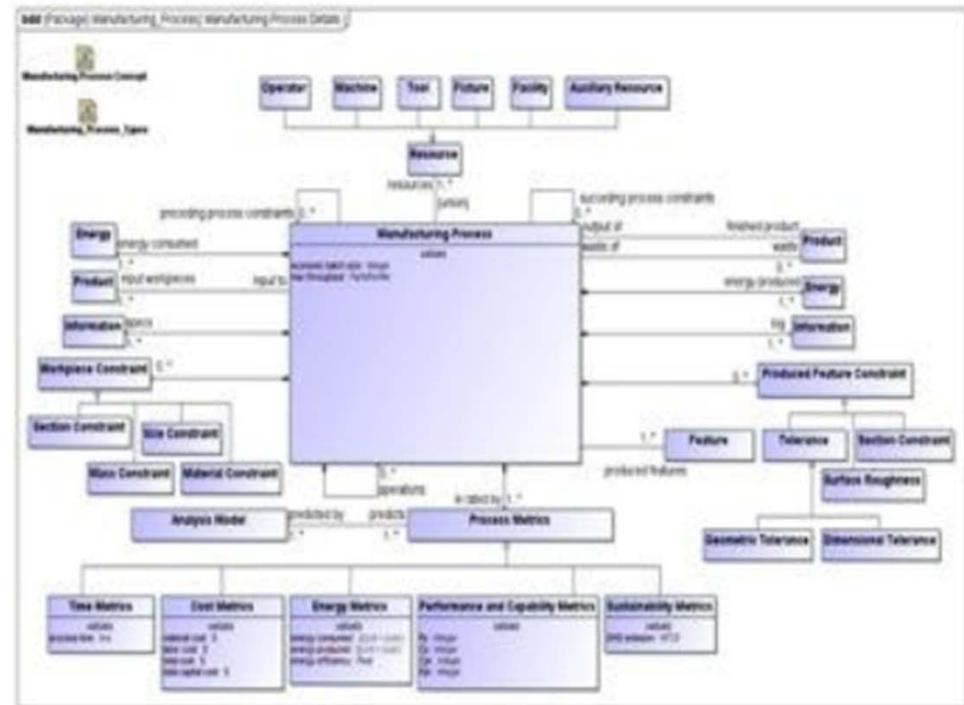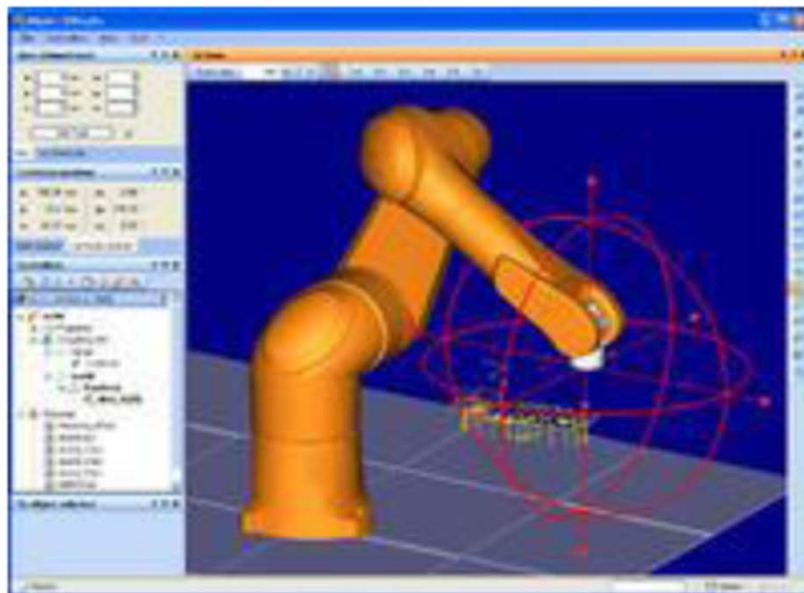- 469 component instances
- 43 parametric components
- 112 ITAR protected models
- 357 non-ITAR protected models

Source: Ricardo PLC

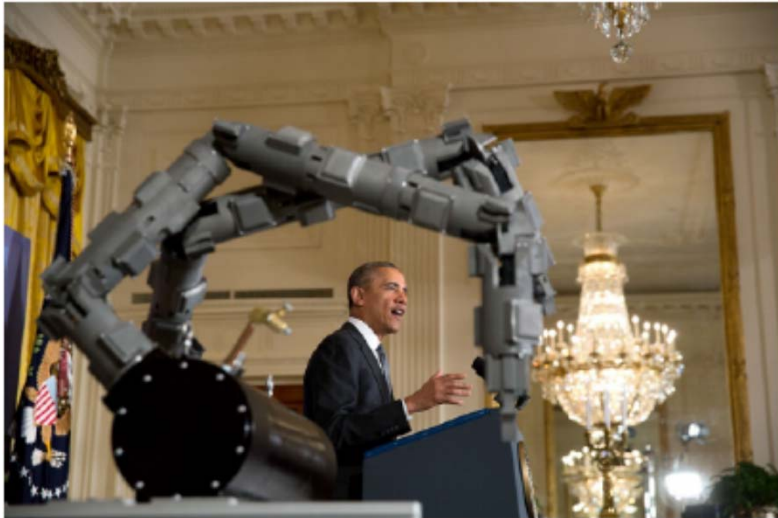# META – iFAB – AVM: Manufacturing Process Models Semantics Across Domains

As of today:

- 7 material shaping processes
- 19 general processes
- 231 machine instantiations
- 64 manual labor units
- 3,212 tools

Sources: Penn State ARL; GM Research

Digital Manufacturing and Design Innovation

- DMDI Announced February 25, 2014, 2014 by President Obama

President Barack Obama delivers remarks announcing two new public-private Manufacturing Innovation Institutes, and launches the first of four new Manufacturing Innovation Institute Competitions, in the East Room of the White House, Feb. 25, 2014. (Official White House Photo by Lawrence Jackson)

- Headquartered in Chicago
- Academic-Industry-Government "Mega Project" $320M co-funding, 5 years
- **Goal**: Revitalize manufacturing – "Society of Makers"

- "Infinite number of virtual factories and an open-source manufacturing platform"
- Germany – Industrie 4.0
- Industrial Internet

Crowdsourcing Manufacturing

- ***Google's Project ARA***: Smartphones are composed of modules (of the owner's choice) assembled into metal frames

- ***Ubundu Edge Project***: crowdsourcing the most radical smartphone yet "Why not look for the best upcoming tech and throw it together to stay ahead of the competition?"

- ***Crowdsourcing*** the development and manufacturing of ***small unmanned aerial vehicles***
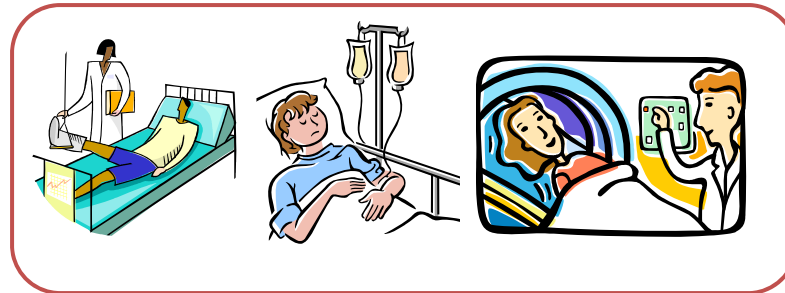
AUTONOMOUS SWARMS – NETWORKED CONTROL

- *Component-based Architectures*
- *Communication vs Performance Tradeoffs*
- *Distributed asynchronous*
- *Fundamental limits*

Model-Based Systems Engineering for Health-Care Management

Healthcare operations

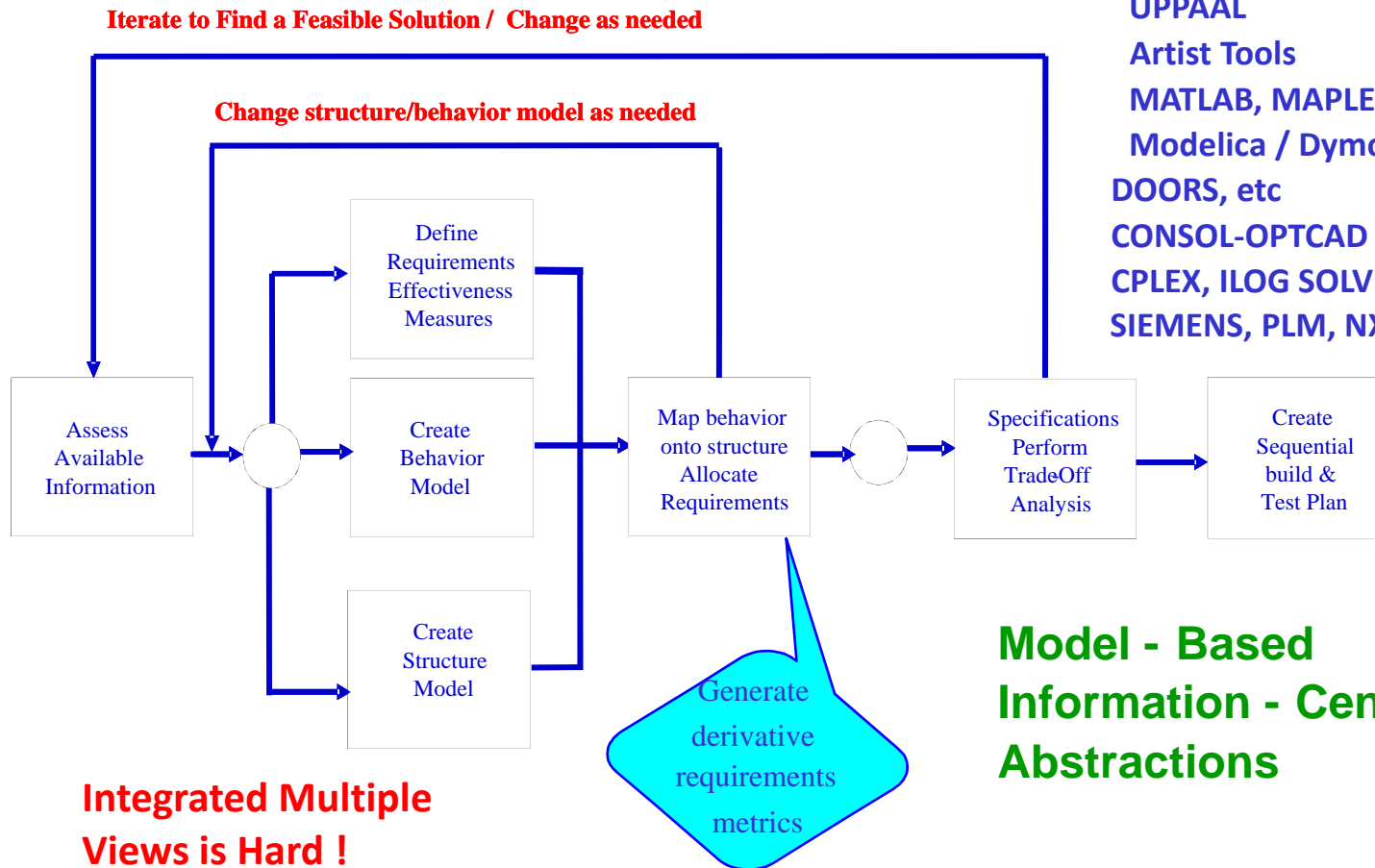Monitor performance, generate ideas, implement changes

Build models, analyze operations, predict changes

Integrated System Synthesis   Tools   -
& Environments missing

Model-   - based
  UML - SysML - GME - eMFLON
  Rapsody
  UPPAAL
  Artist Tools
  MATLAB, MAPLE
  Modelica / Dymola
DOORS, etc
CONSOL-OPTCAD
CPLEX, ILOG SOLVER,
SIEMENS, PLM, NX, TEAM CENTER

Iterate to Find a Feasible Solution / Change as needed

Change structure/behavior model as needed

Define
Requirements
Effectiveness
Measures

Assess
Available
Information

Create
Behavior
Model

Map behavior
onto structure
Allocate
Requirements

Specifications
Perform
TradeOff
Analysis

Create
Sequential
build &
Test Plan

Create
Structure
Model

Generate
derivative
requirements
metrics

Model - Based
Information - Centric
Abstractions

Integrated Multiple
Views is Hard !

Scope of Workshop on MBSE and MBE

- **Interact**

- **Summarize where we are**

- **Identify and summarize what we need**

- **Describe key and fundamental challenges, approaches**

- **Establish collaborations**

- *Modeling heterogeneous CPS – Uncertainties*

- *Design Space Exploration and Tradeoffs*

- *Requirements Engineering --*

- *Testing Validation Verification*

- *From MBSE to MBE – remember Xerox CoLab and IPPD*

- *Make it affordable and "Easy"*

Thank you!

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Questions?