SYSML MODELING IN THE AUTOMOTIVE DOMAIN

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THE MPD PROGRAM

Master of Science Product Development

at the University of Detroit Mercy

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MS Product Development (MPD) at the University of Detroit Mercy

- The MPD program was launched in 1999 and is cohort-based (including a "January Experience")
- It resulted from collaboration via PD21 – the Educational Coalition for Product Development Leadership in the 21st Century
  - Massachusetts Institute of Technology
  - Naval Postgraduate School
  - Rochester Institute of Technology
  - University of Detroit Mercy
- These programs have since diverged to serve their markets.

MPD Focus

- The goal of the MPD program is to develop individuals capable of *leading* product development efforts.

- Most students are mid-career engineers from automotive OEMs in the metropolitan Detroit area.

- Product Planning and Development, Systems Architecture, and Systems Engineering are required courses.

- As of 2017, the systems engineering content is now offered as a certificate program with an option to complete as the MS degree; SysML is now a dedicated course offered in parallel with Systems Architecture.

MODEL-BASED SYSTEMS ENGINEERING IN MPD

MBSE in MPD

- MBSE has been introduced into MPD to address skill gaps and provide practical, hands-on experience with system modeling.

- Initial introductions used the Department of Defense Architecture Framework (DoDAF) and the system modeling language (SysML).

- Subsequent classes dropped DoDAF to focus on developing students' SysML skills.

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Thesis Teams

- After exposure to SysML, several thesis teams have chosen to use system modeling/architecture as the basis for their theses:
  - Parametric modeling
  - Variant modeling
  - New product development
  - Process development
- Two teams are presenting today (all of them were inducted into Sigma Theta Mu, the Systems Honor Society, at graduation)

Other Resources

- All NDIA, INCOSE, ASEE presentations:
  - http://udmercy.academia.edu/MichaelVinarcik
  - Including 2017 ASEE Best Paper (Systems Engineering Division) "A Pragmatic Approach to Teaching Model Based Systems Engineering: The PRZ-1"
  - *Systems Architecture Guild* YouTube channel
- A colleague recently developed a reliability analysis tool 100% in MagicDraw (reliability calculations always 100% in synch with the architecture); contact me for details

An Abstract View of Product Development
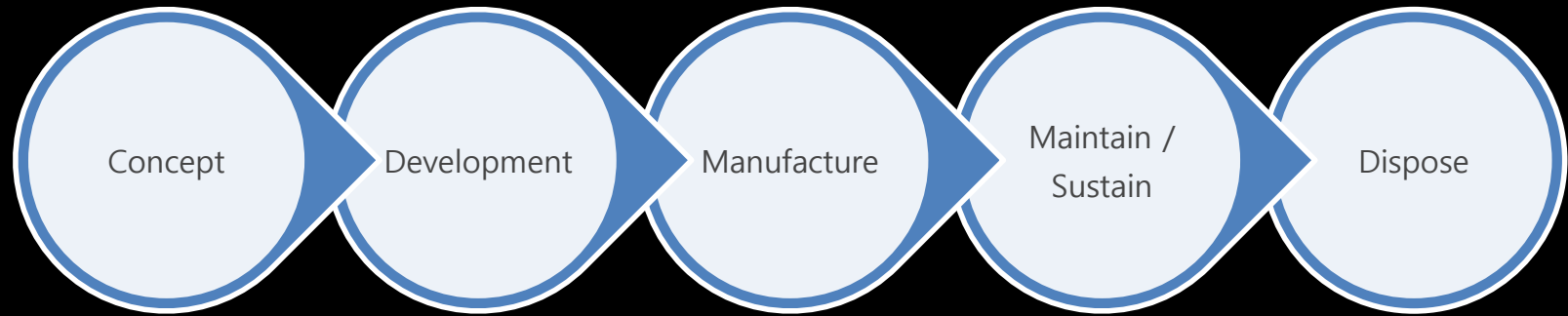
Air Gaps
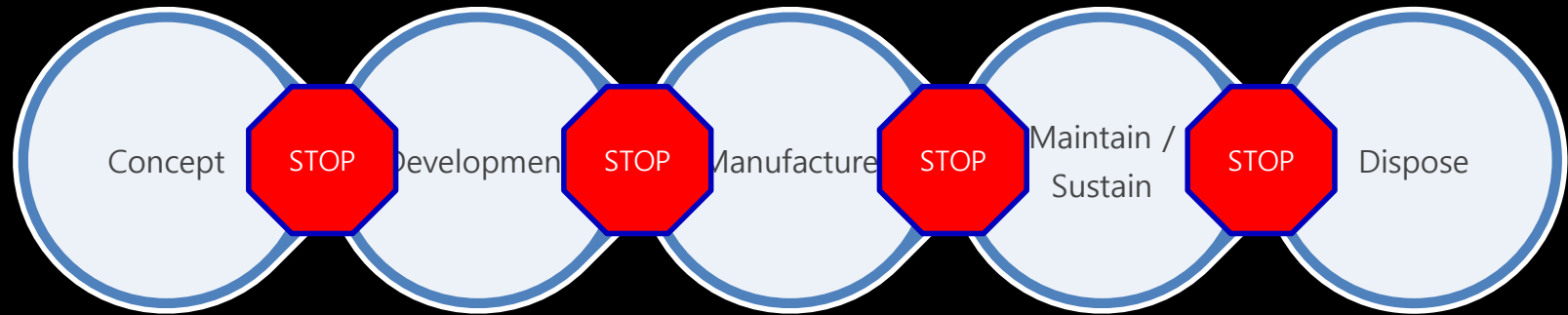
Fidelity and momentum is lost every time there is a handoff; this is caused by the "air gaps."

Industrial Age vs. Information Age

"Our current defense acquisition system applies industrial age processes to solve information age problems."

- LtGen Robert D. McMurray, AFLCMC/CC
  Keynote address
  2017 Wright Dialogue With Industry conference,
  Dayton OH, 18 July 2017

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Digital Engineering

- The Department of Defense is developing a strategy to transform its end-to-end acquisition process.

- It is expected to be released for use by 2019.

- The following four slides are extracted from a presentation given next week at the National Defense Industrial Association Systems Engineering Conference

DoD Digital Engineering Strategy

Ms. Philomena Zimmerman

**Deputy Director, Engineering Tools and Environments
Office of the Deputy Assistant Secretary of Defense
for Systems Engineering**

Digital Engineering Strategy: Five Goals

1. Formalize the **development, integration and use of models** to inform enterprise and program decision making

2. Provide an enduring **authoritative source of truth**

3. Incorporate **technological innovation** to improve the engineering practice

4. Establish supporting **infrastructure and environments** to perform activities, collaborate, and communicate across stakeholders

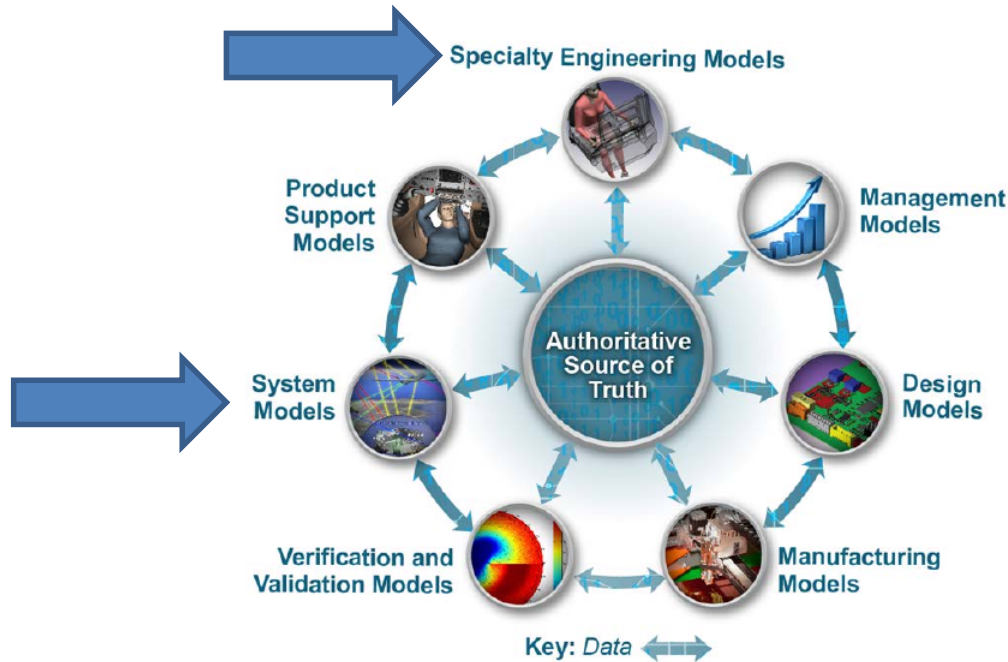5. Transform a **culture and workforce** that adopts and supports Digital Engineering across the lifecycle

Drives the engineering practice towards improved agility, quality, and efficiency, which results in improvements in acquisition

Goal #1: Formalize Development, Integration & Use of Models

Models as the cohesive element across a system͵s lifecycle

A Required Mindset Shift

- To successfully leverage SysML, any user must understand that it is not "about" the diagrams.
- What is truly important is:
  - Elements and their properties
  - Relationships, their properties, and what they connect
- Once you see analyses in these terms, representing them in a system model is much easier.
- The collection of elements (including logic/branching elements) permits a rich description of system behavior, structure, interfaces, and parametrics.

A FEW THOUGHTS FROM ADM HYMAN G. RICKOVER

Good Ideas

"A good manager must have an unshakable determination and tenacity. Deciding what needs to be done is easy, getting it done is more difficult. **Good ideas are not adopted automatically. They must be driven into practice with courageous impatience.**"

-- ADM Hyman G. Rickover
   (photo from U.S. Naval Historical Center)

Meeting Resistance

"Everything new endangers something old."
-- ADM Hyman G. Rickover
    (photo from U.S. Naval Historical Center)

Why Model?

"The devil is in the details,
  but so is salvation."

-- ADM Hyman G. Rickover
  (photo from U.S. Naval Historical Center)

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MY FINAL THOUGHTS

Final Thoughts

- System complexity is growing exponentially; system modeling is the only method with any hope of managing it.

- SysML is the most viable modeling language currently available.

- Multiple automotive OEMs, medical device manufacturers, defense and aerospace contractors have already embraced system modeling.

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MBSE in the Wild: Valuable Resources

MBSE Wiki:

- http://www.omgwiki.org/MBSE/doku.php

OMG SysML News:

- http://www.omgsysml.org/news-articles.htm

No Magic Blog:

- https://blog.nomagic.com/

Vitech Corporation Blog

- http://community.vitechcorp.com/

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INCOSE Working Groups

Analytic Enablers
- Affordability
- Autonomous Systems Test and Evaluation
- Competency
- Complex Systems
- Cost Engineering
- Human Systems Integration
- Natural Systems
- Product Lines
- Reliability Engineering
- Resilient Systems
- System of Systems
- System Security Engineering
- Training

Application Domains
- Anti-terrorism International
- Automotive
- Critical Infrastructure
- Defense Systems
- Global Earth Observation System of Systems
- Healthcare
- Infrastructure
- Oil and Gas
- Power & Energy Systems
- Space Systems
- Transportation

Transformational Enablers
- Agile Systems & SE
- Lean Systems Engineering
- MBSE Initiative
- MBSE Patterns
- Model Based Concept Design
- Object-Oriented SE Method
- Very Small Entities (VSE)
- Systems Science
- Tool Integration and Model Lifecycle Management
- INCOSE-NAFEMS Collaboration
- Ontology

Process Enablers
- Architecture
- Enterprise Systems
- Knowledge Management
- Life Cycle Management
- Measurement
- Requirements
- Risk Management

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