Phoenix Integration and the Skunk Works®
A History of Success, A Path to the Future

Clif Davies

Senior Staff Aeronautical Engineer

Conceptual Design Tools & Process Lead

4/14/15

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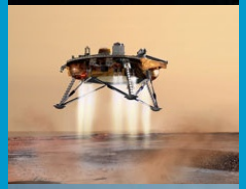
Skunk Works® Position Within The Corporation

Marillyn Hewson
Chief Executive Officer and President

Space Systems


Mission Systems & Training



Aeronautics

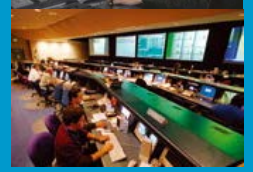


Missiles & Fire Control



Information Systems & Global Solutions





Who We Are

Orlando Carvalho
EVP, Aeronautics

Fort Worth

Marietta

Skunk Works/Advanced Development Programs

Rob Weiss
EVP & GM, ADP

- Jack O'Banion — VP, Strategy & Customer Requirements
- Steve Justice — Director, Advanced Program Pursuits
- James Dorrell — VP, Program & Technology Integration
- Greg Ulmer — VP, ADP Operations & Production Programs
  - Special Program
  - Major Program
  - UCLASS

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Skunk Works® – What We Do

Winning and Prototyping New Programs

Leveraging Investments in Game Changing Technologies

Development & Fielding Of Special Mission Aircraft To Meet Urgent National Needs

Improvements & Derivatives of Existing Products

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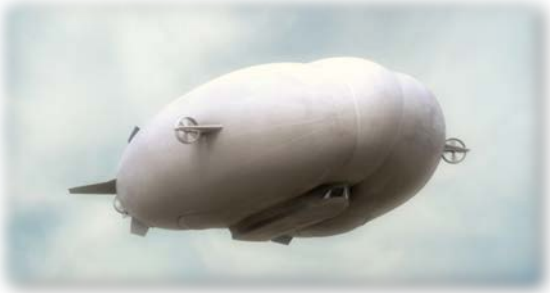
Wide Range of Advanced Programs





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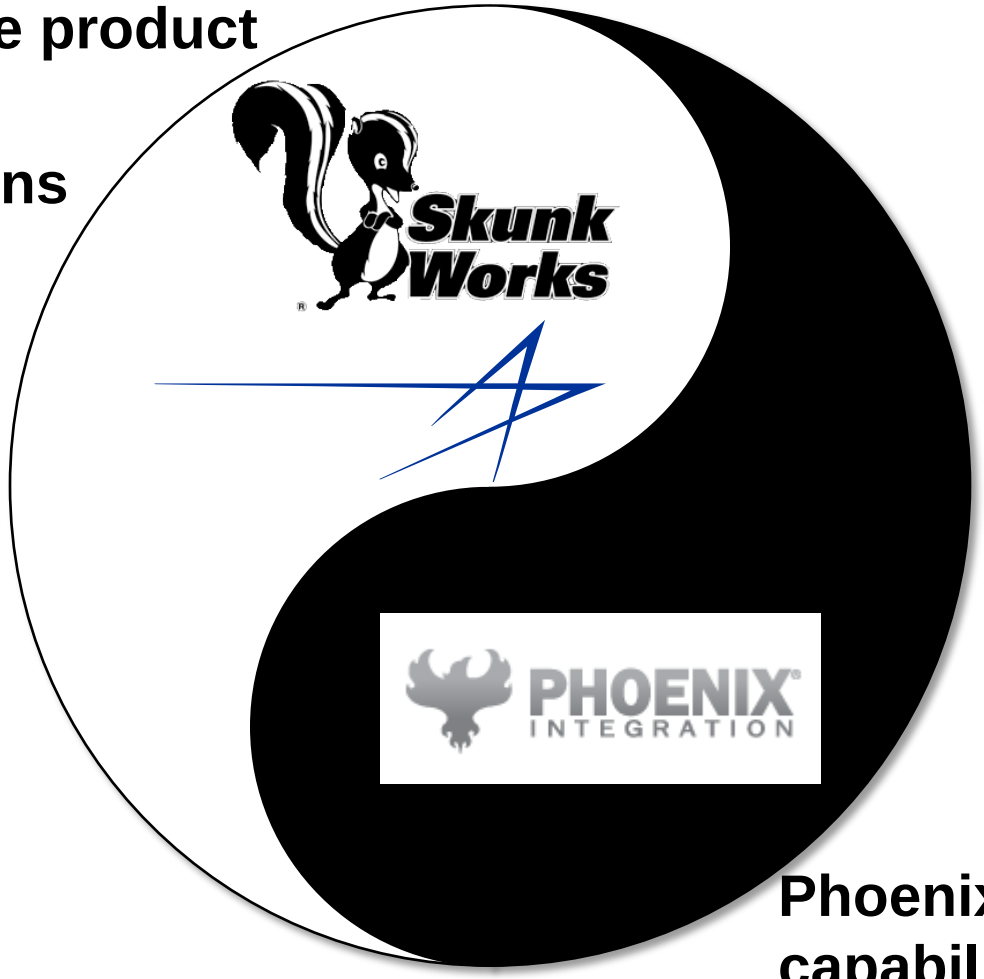
Early, Driven Partnership

- **Problems we were trying to solve drove product development**
- **Unique Designs**



Phoenix Int. product capabilities enabled our unique solutions

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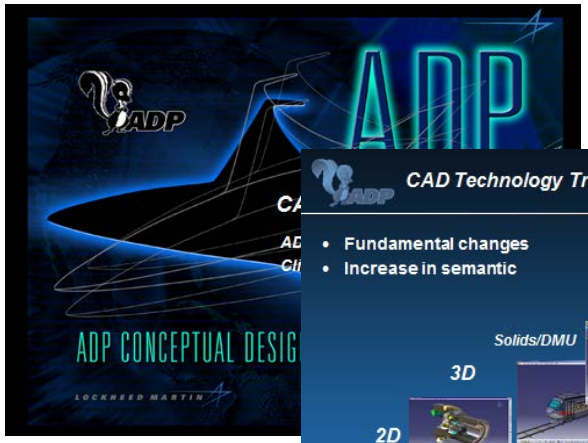
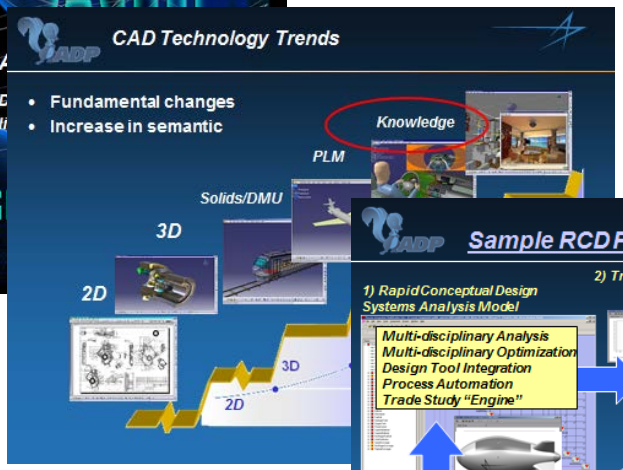
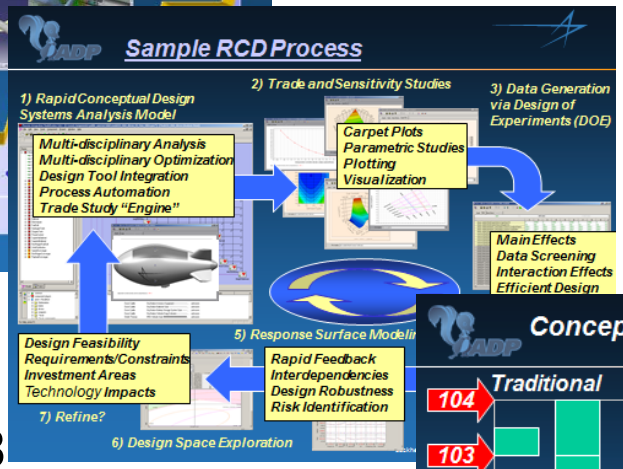
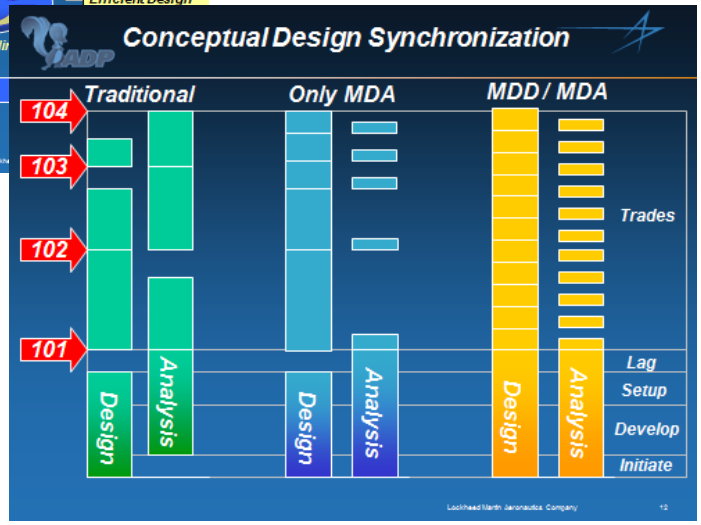
First Phoenix RCD Presentation - 2004









- Started Pre-Model Center 1.0
- Basic Analysis Server
- Wrapping FORTRAN codes
- File Wrappers

- Partnership started 1998
- First Contract in 1999
- First Program Implementation late ’90’s
- First Win!

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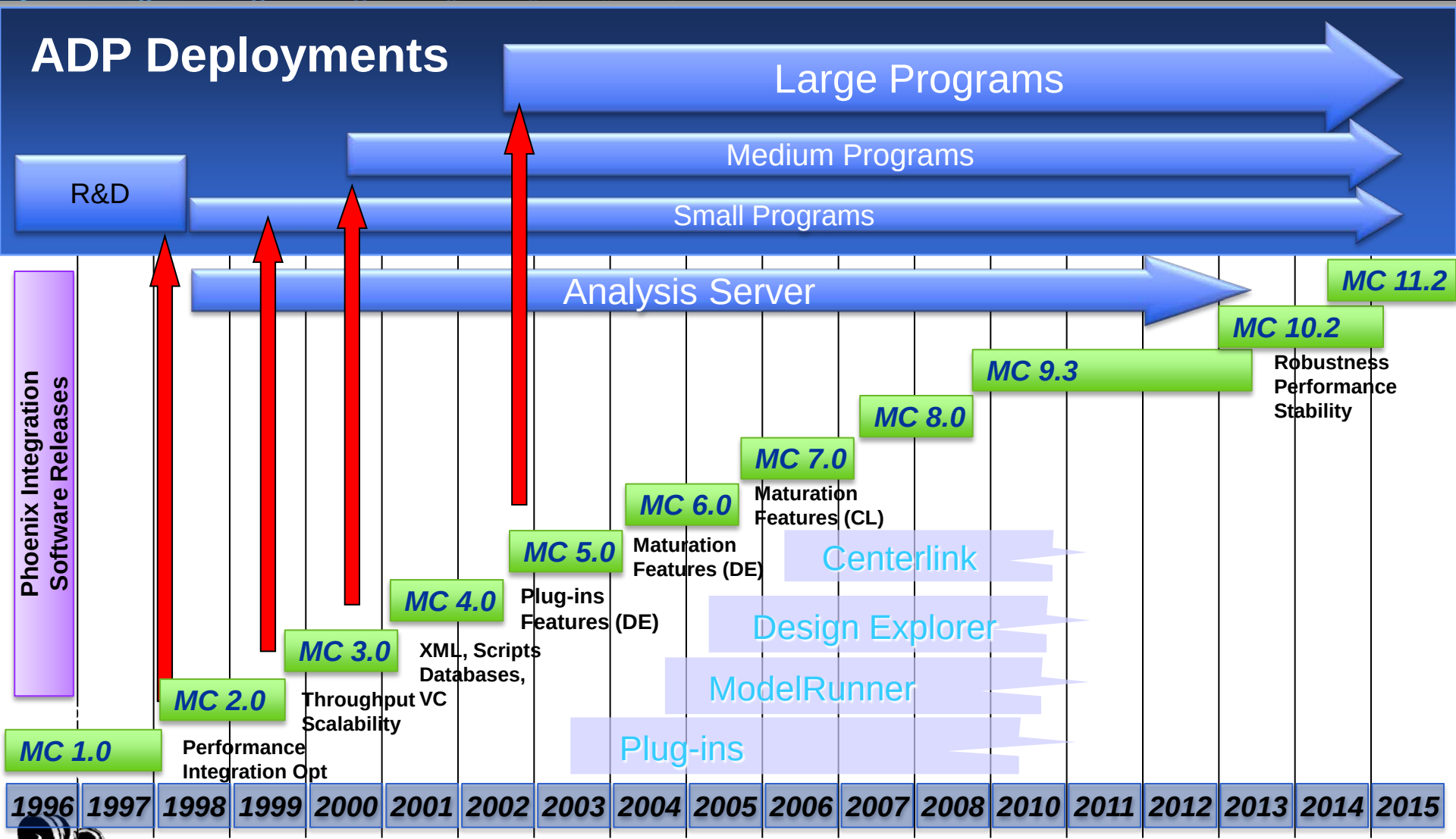
RCD Program Deployments



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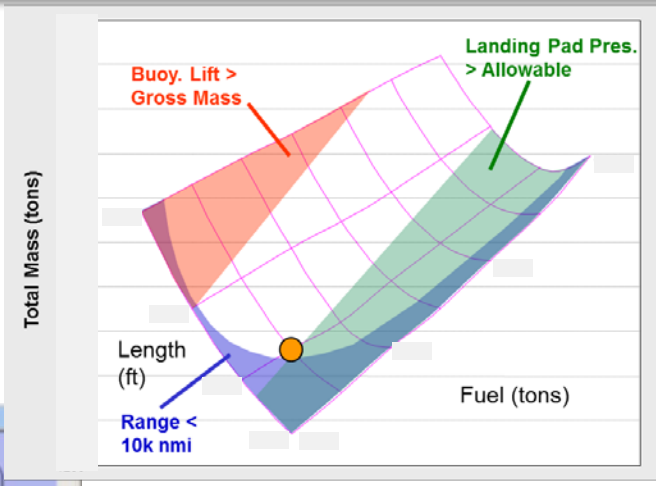
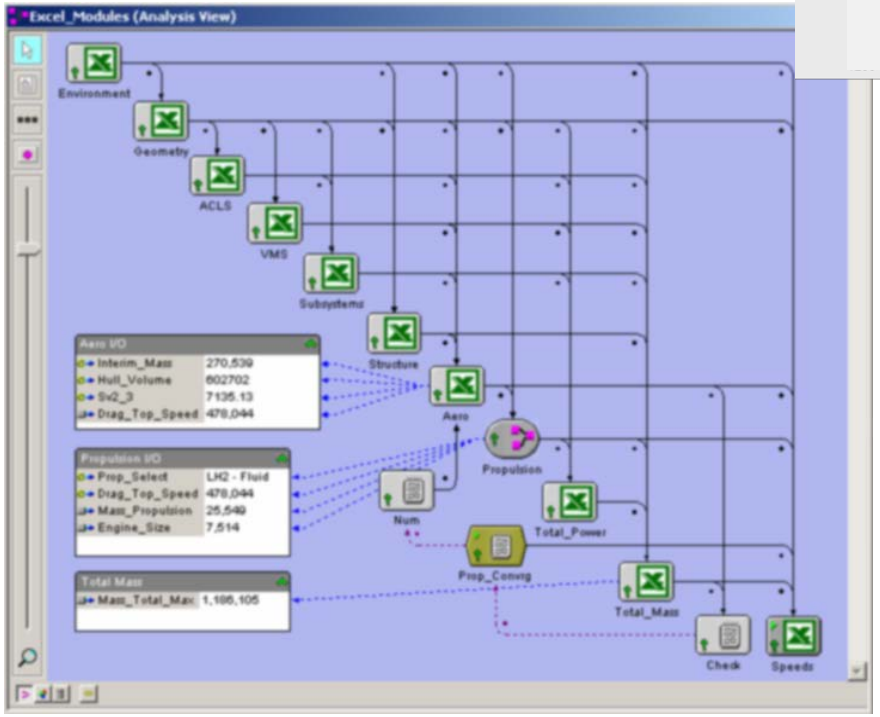
WALRUS Example



- Environment
- Geometry
- Landing System
- VMS
- Subsystems
- Structure
- Aerodynamics
- Propulsion
- Power Requirements
- Total Mass



CONVENTIONAL OPT.

	μ	μ +/- 2σ
Total Mass (tons)		
Range (n mi)	10,000	8,280
L_{buoy} / M_{gross}	0.91	0.93
P_{land} / P_{hull}	0.75	.92

DAKOTA SBOUU
(CD_0, η_{prop} uncertain)

	μ	μ +/- 2σ
Total Mass (tons)		
Range (n mi)	11,700	9,960
L_{buoy} / M_{gross}	0.95	.97
P_{land} / P_{hull}	0.46	.62

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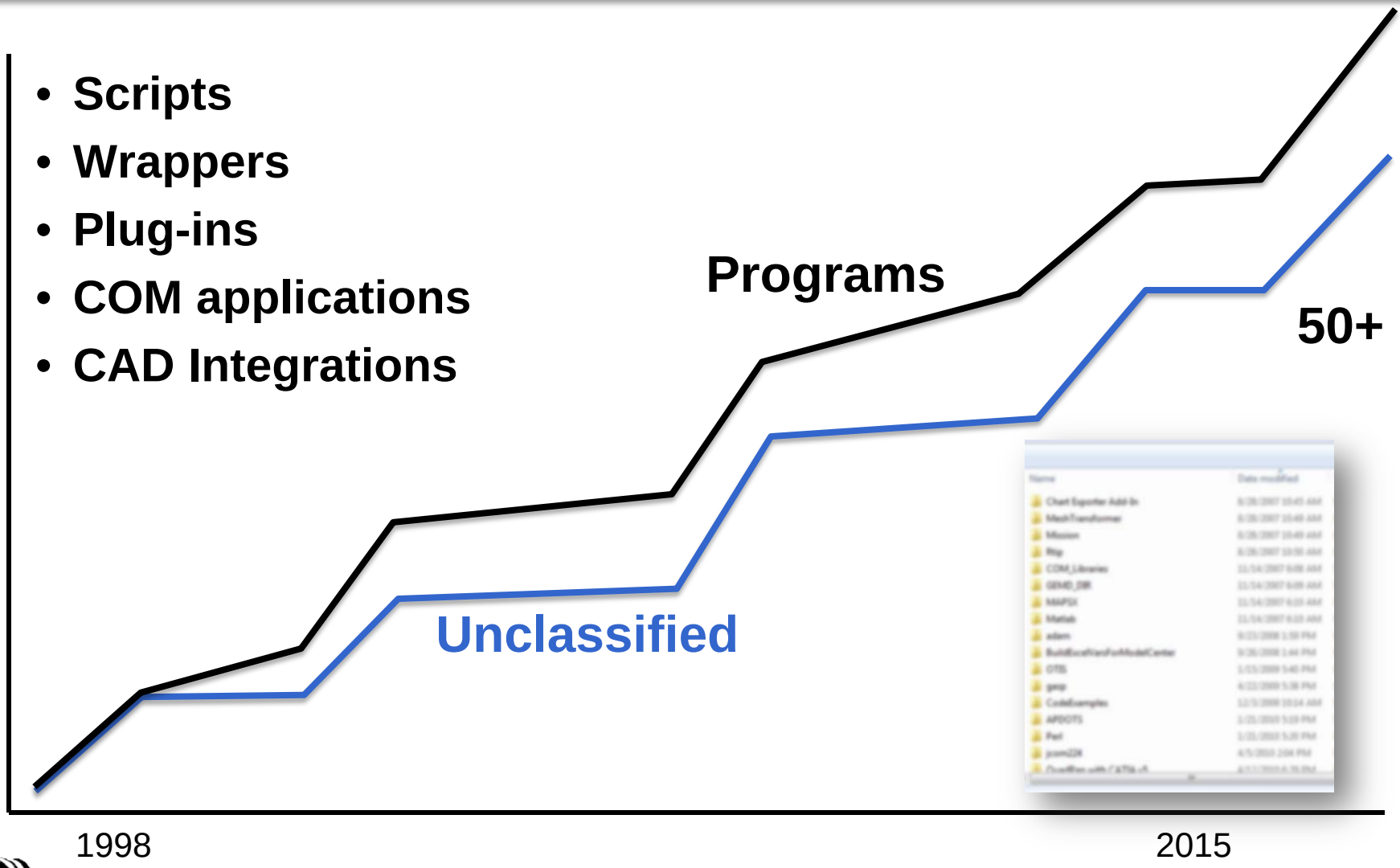
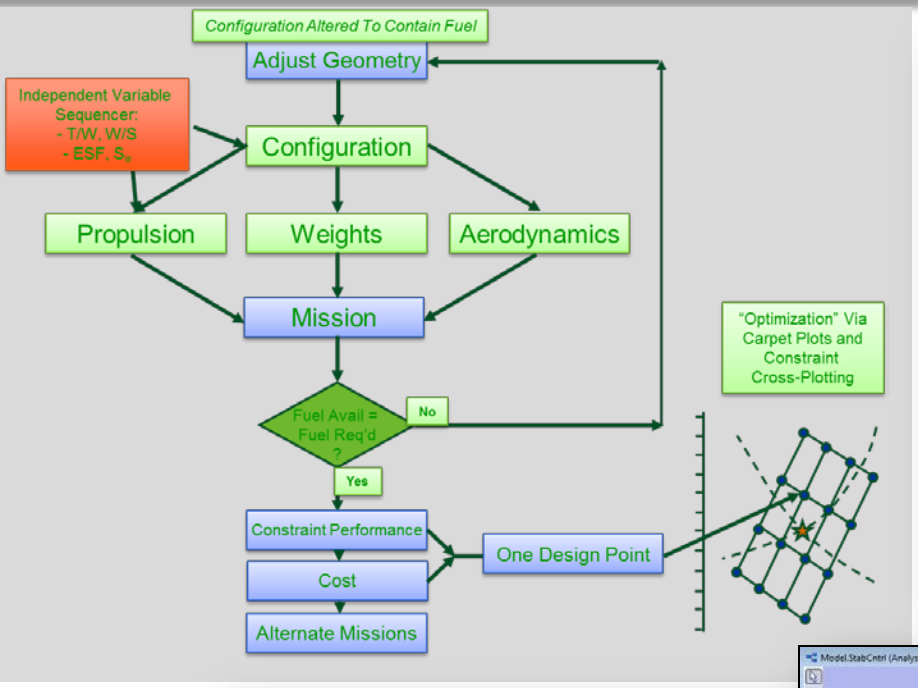
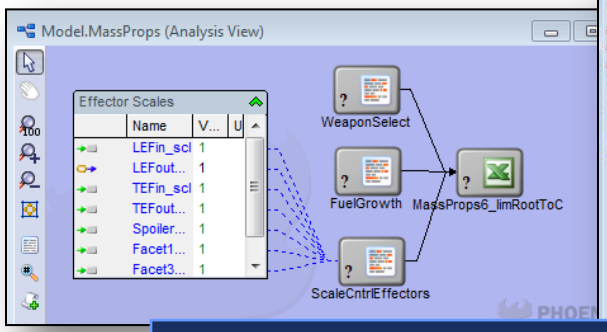
ADP Customizations

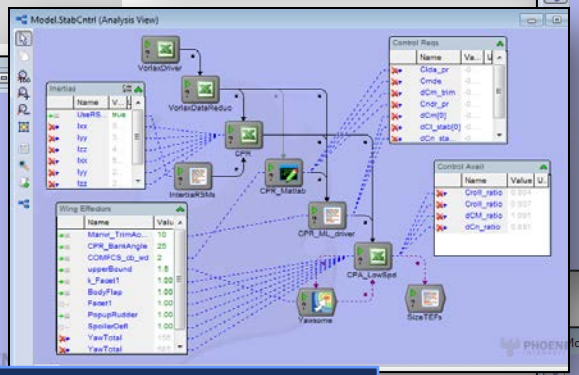
- Scripts
- Wrappers
- Plug-ins
- COM applications
- CAD Integrations

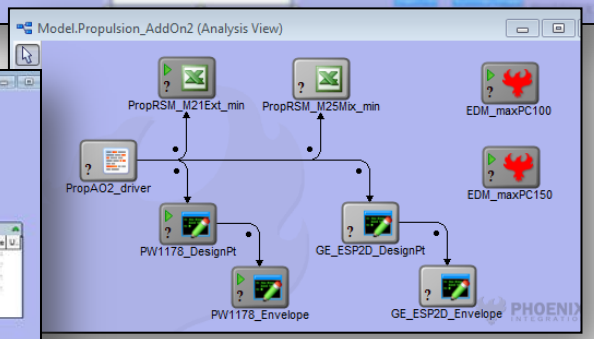


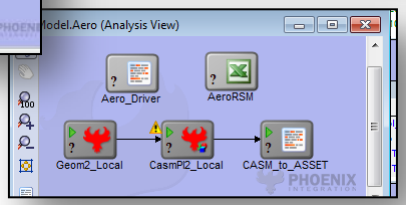
Expanding Dimensions, Disciplines, and Fidelity





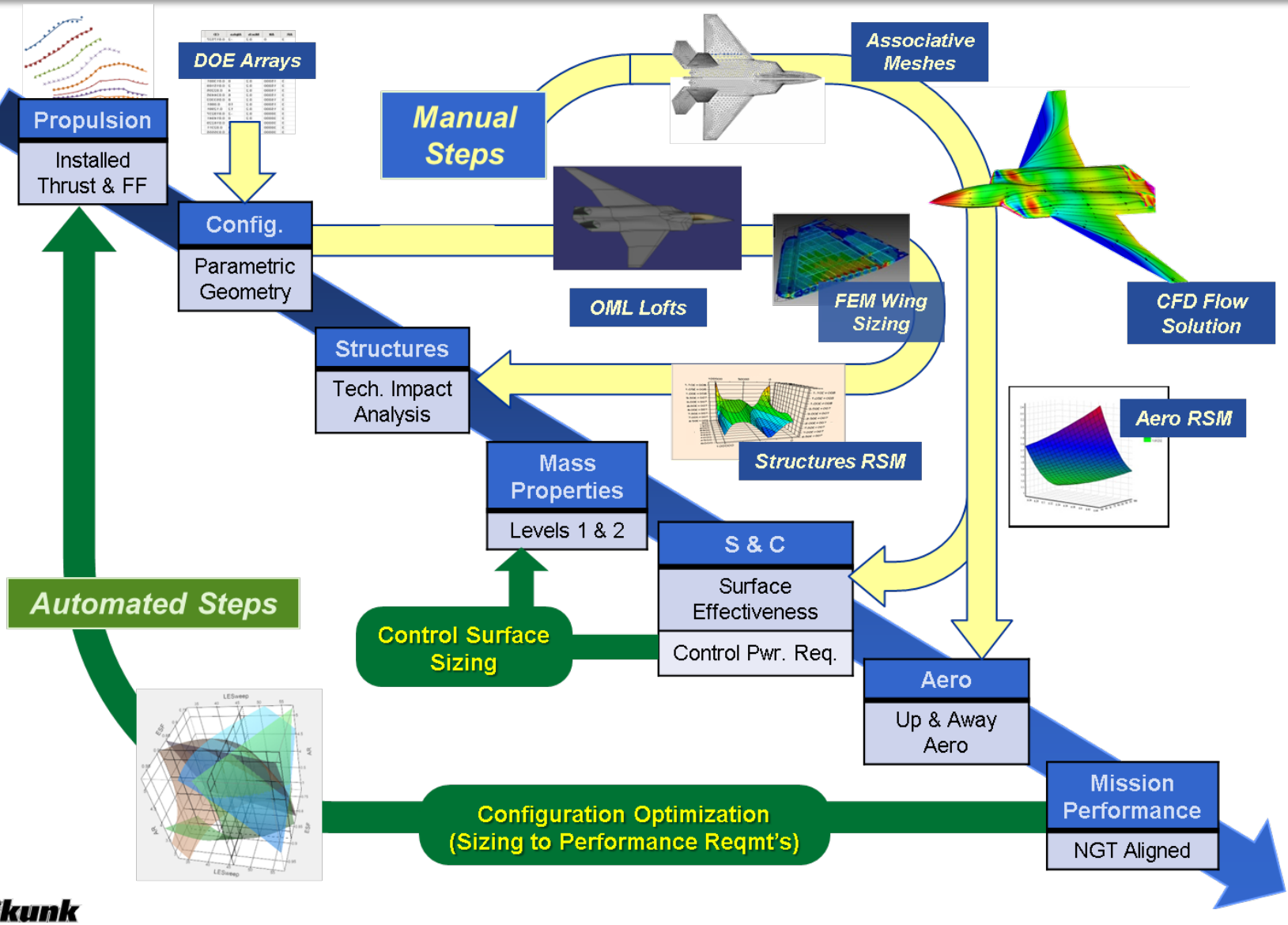




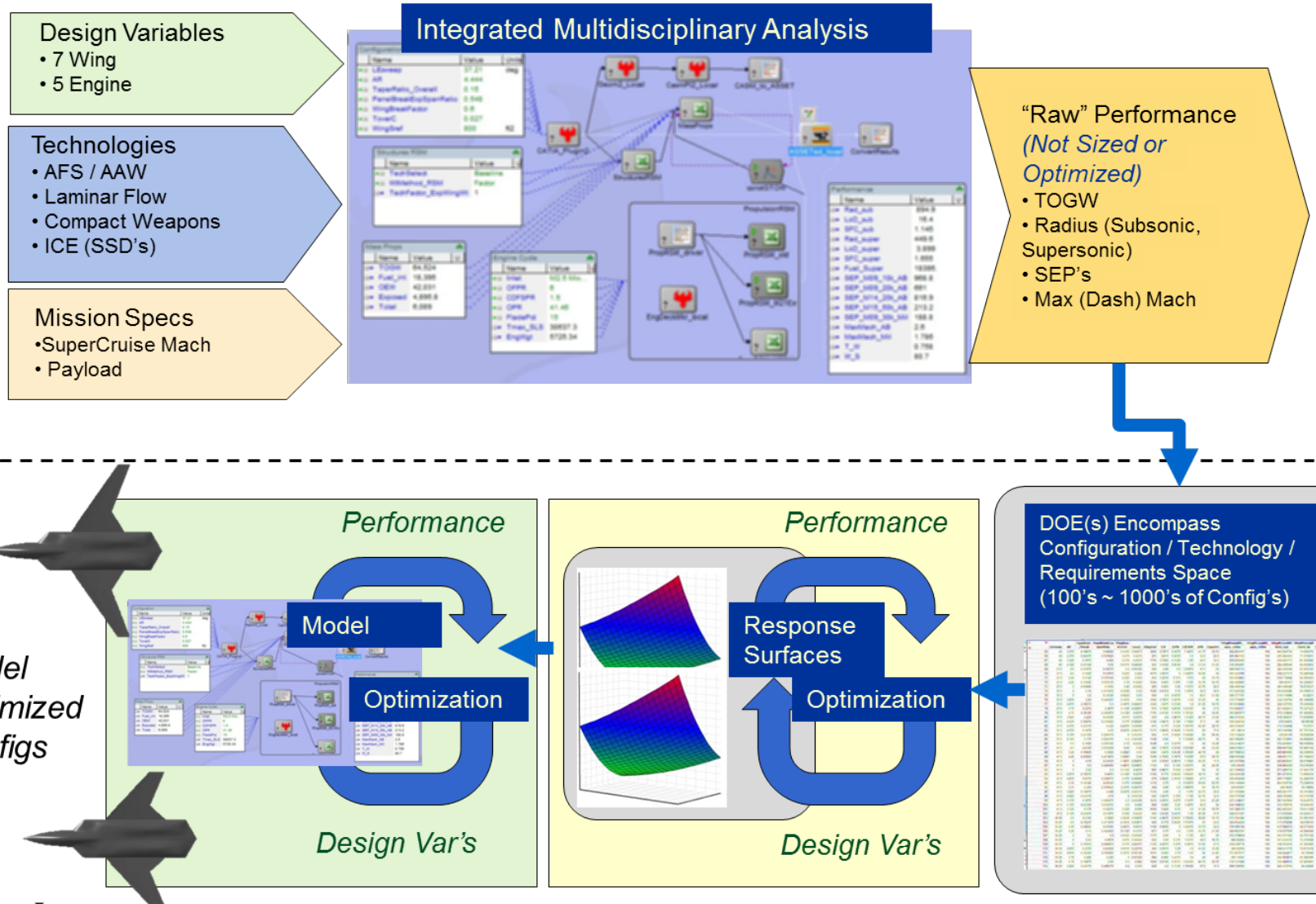


Discipline and model complexity growing quickly!

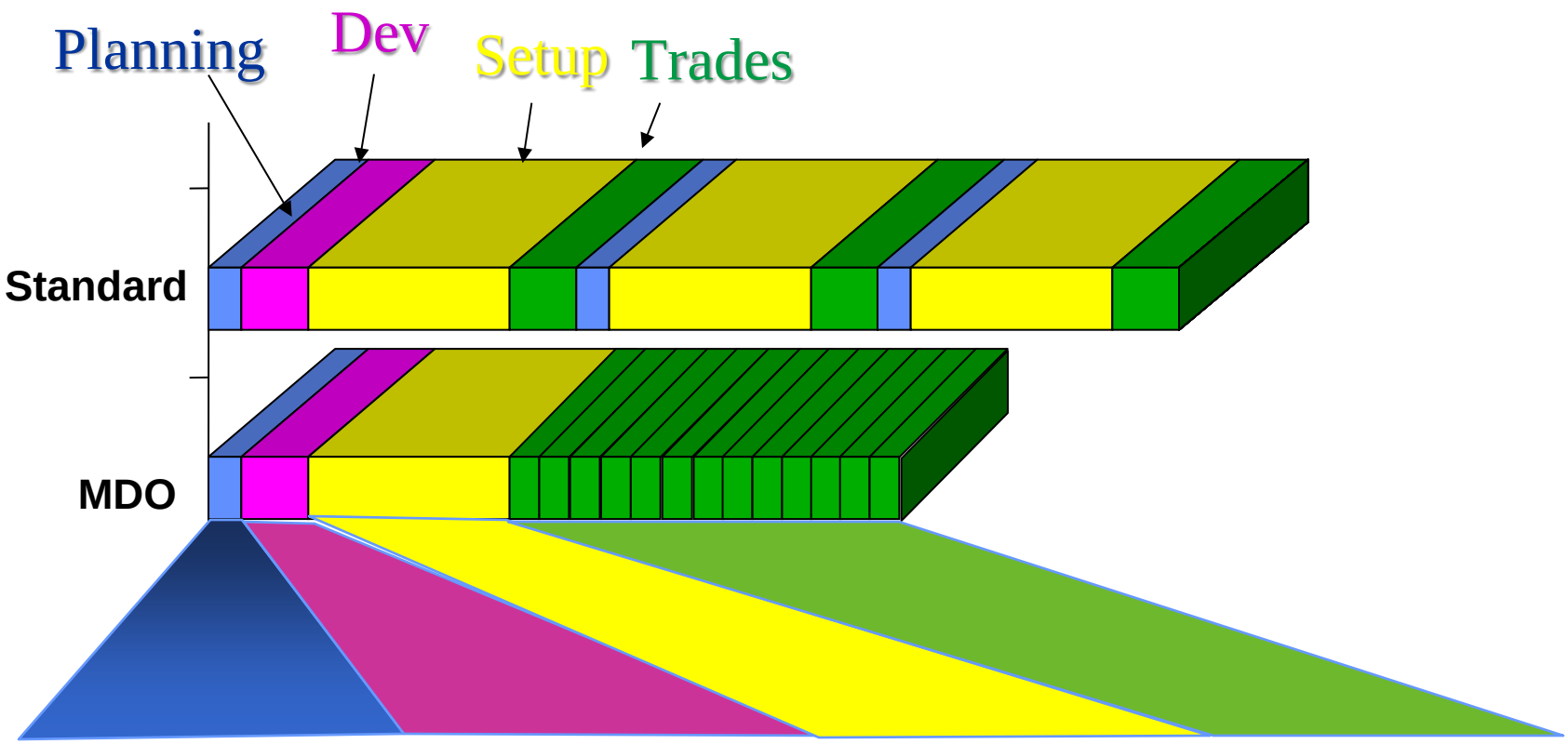
Modelcenter Process Changes – ESAVE Program



ESAVE MDO Approach: RSM-Based Optimization



Changing MDAO Process



Problem Formulation	Hi-Fi Development	Hi-Fi Integration	Visualization
Hi-Fi Processes	RSM Development	RSM Integration	
HPC Planning	Offline Execution	Data Reduction	
Test Planning	Physical Testing		

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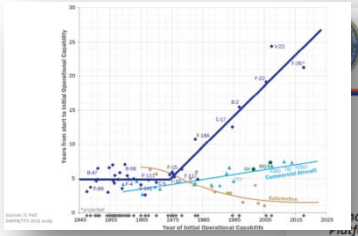
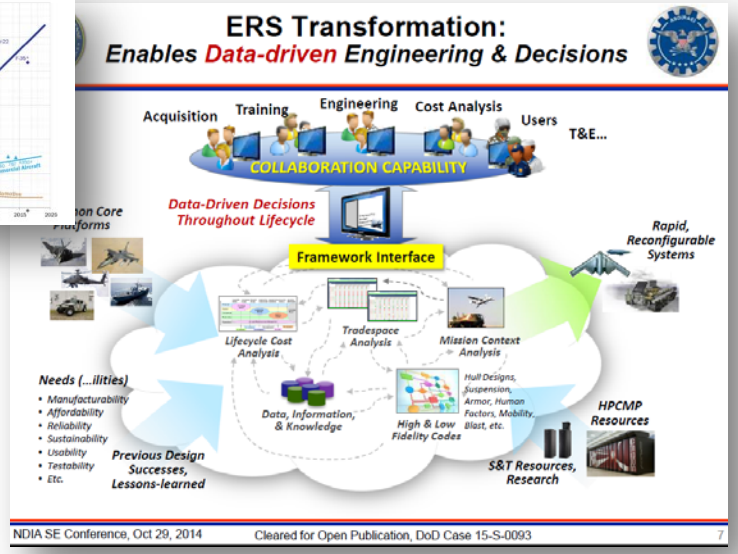
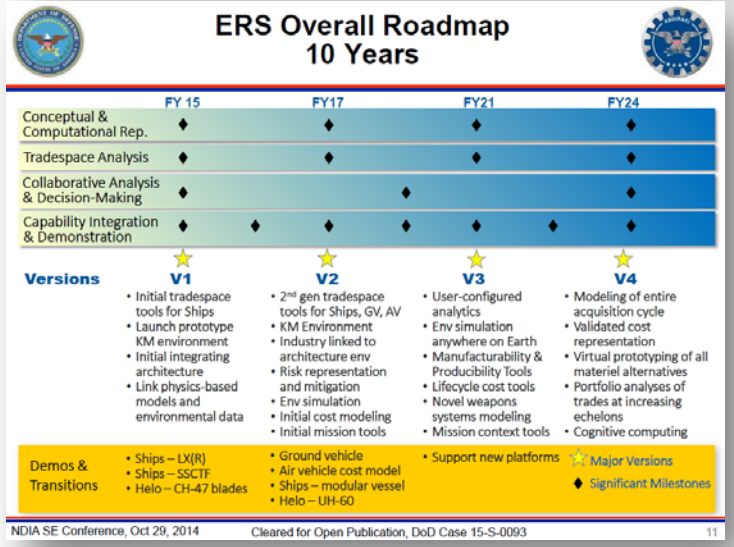
USA DoD Customer Directions

- Bend The Cost Curve
- Better Buying Power 3.0
- Own The Technical Baseline
- Modular Open System Architecture
- Digital System Model
- Digital Thread
- Engineered Resilient Systems
  - CREATE
  - HPC.mil
- Joint Security Implementation Guide







Model and Data Exchange Methods and Standards

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Where is ADP Going With Phoenix/MDAO

- **Model Discipline Growth**
  - **Increased model complexity**
  - **Increased DV's, constraints and objective functions**
  - **RSM methodology**
- **High Performance Computing**
  - **Higher fidelity earlier in programs**
  - **New Physics**
  - **Increased discipline coverage**
- **Pervasive MDOA**
  - **Web based MDAO**
  - **Server/Cluster based computing**
  - **Service/Agent based computing**

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Questions?

PHOENIX INTEGRATION

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