MATLAB/Simulink Modeling for Aircraft Propulsion System Interactions

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Presentation Outline

- Motivation and Vision for Complex System Integration   - Dr. Jeff Dalton
  through Modeling and Simulation

- Development of Simulink Blockset for aircraft/engine
  thermal management systems

                                                          - Ernie Hodge

- Planned applications of new thermal management
  Simulink Blockset

- Example application ("Generic" Fighter Aircraft Model)
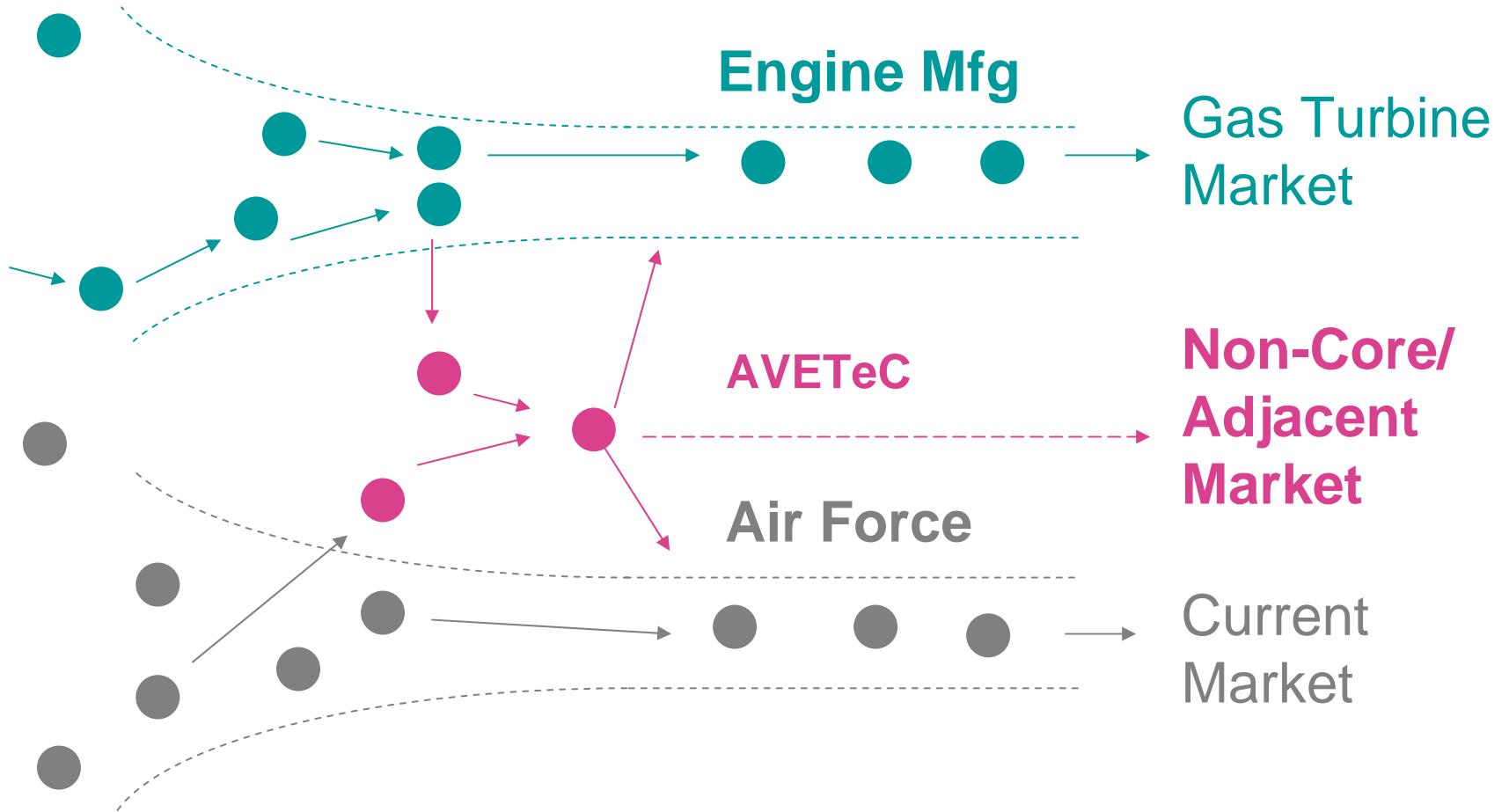
Strategic Vision

Open Innovation Business Model

Engine Mfg

Gas Turbine Market

AVETeC

Non-Core/ Adjacent Market

Air Force

Current Market

Product Conceptualization

Virtual Integration Testing

Propulsion System Trades

Turbo Machinery Design

Complex System

Engine Health Management

Modeling and Simulation

Data Driven Computing

Small Engine Development

Industrial Research & Development

Data Management & Mining

Virtual Product Development & Test Laboratory

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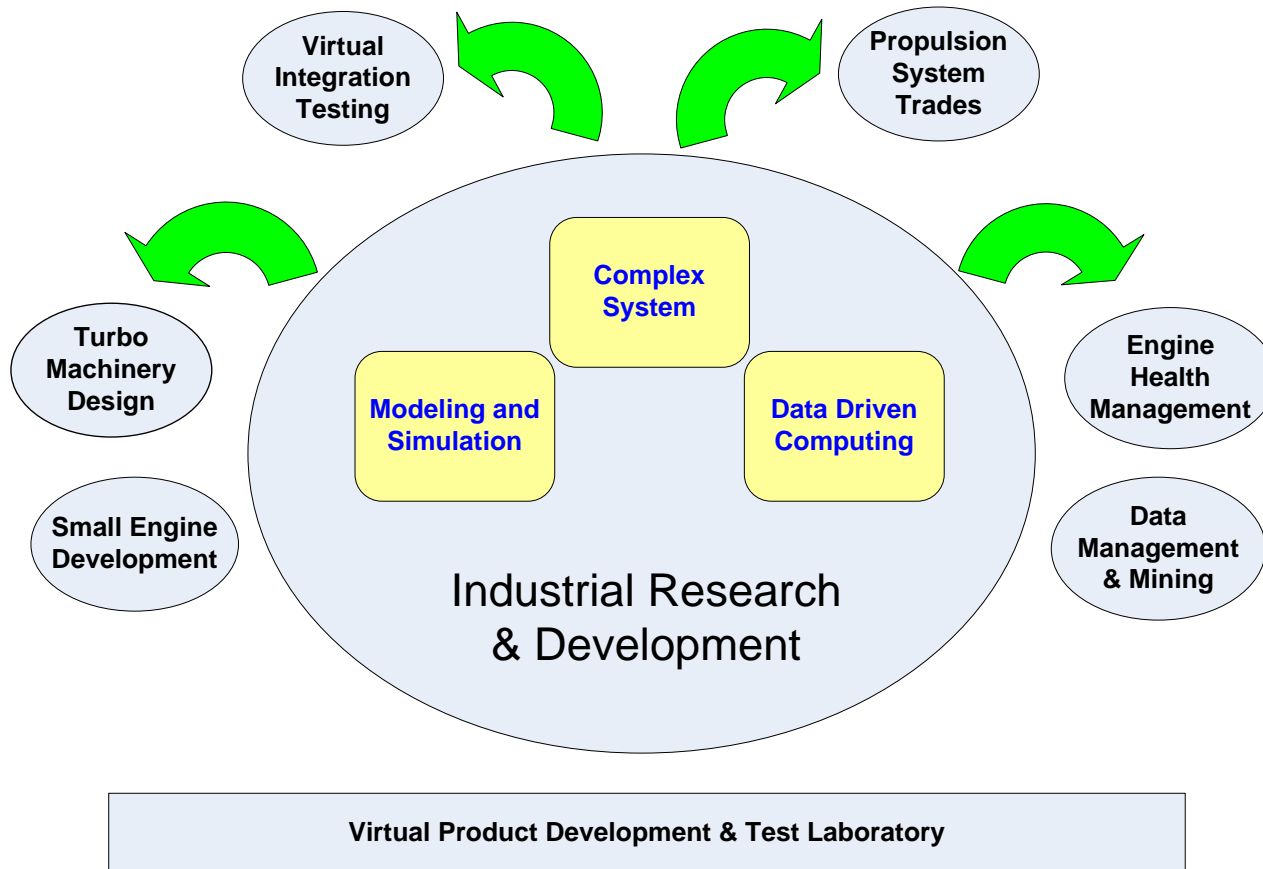
Development of Simulink Blockset

For Aircraft/Engine Thermal Management Systems

Project Summary

- Completed conversion of all Model Engineer (ME) components (as necessary) from Visual Basic (VB) to MATLAB/Simulink
  - ➢ ~50 components converted in 2006-2007

- Verified all components by comparing VB results with Simulink results

- Completed two aircraft system models using the Simulink ME Libraries
  - ➢ Vapor Cycle System
  - ➢ Air Cycle System

- Integrated GE Engine Cycle and GE Engine TMS models with ME aircraft
  - ➢ Supported integration of these models with Lockheed Long Range Strike transient Simulink model, as part of a separate contract with Lockheed Martin

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New Simulink Blockset Developed

For Thermal Management Systems

Simulink Libraries

- Thermal System Library

- Vapor Cycle Library

- Tools Library

- Sources Library

- Sinks Library

- Utilities Library

- Example model Library

  ➤ Vapor Cycle

  ➤ Air Cycle System

Planned Applications of New Blockset

Focused on Thermal Management Systems

- Aircraft programs – JSF, LRS, UAV
- Technologies – Laser, UAV, Modeling

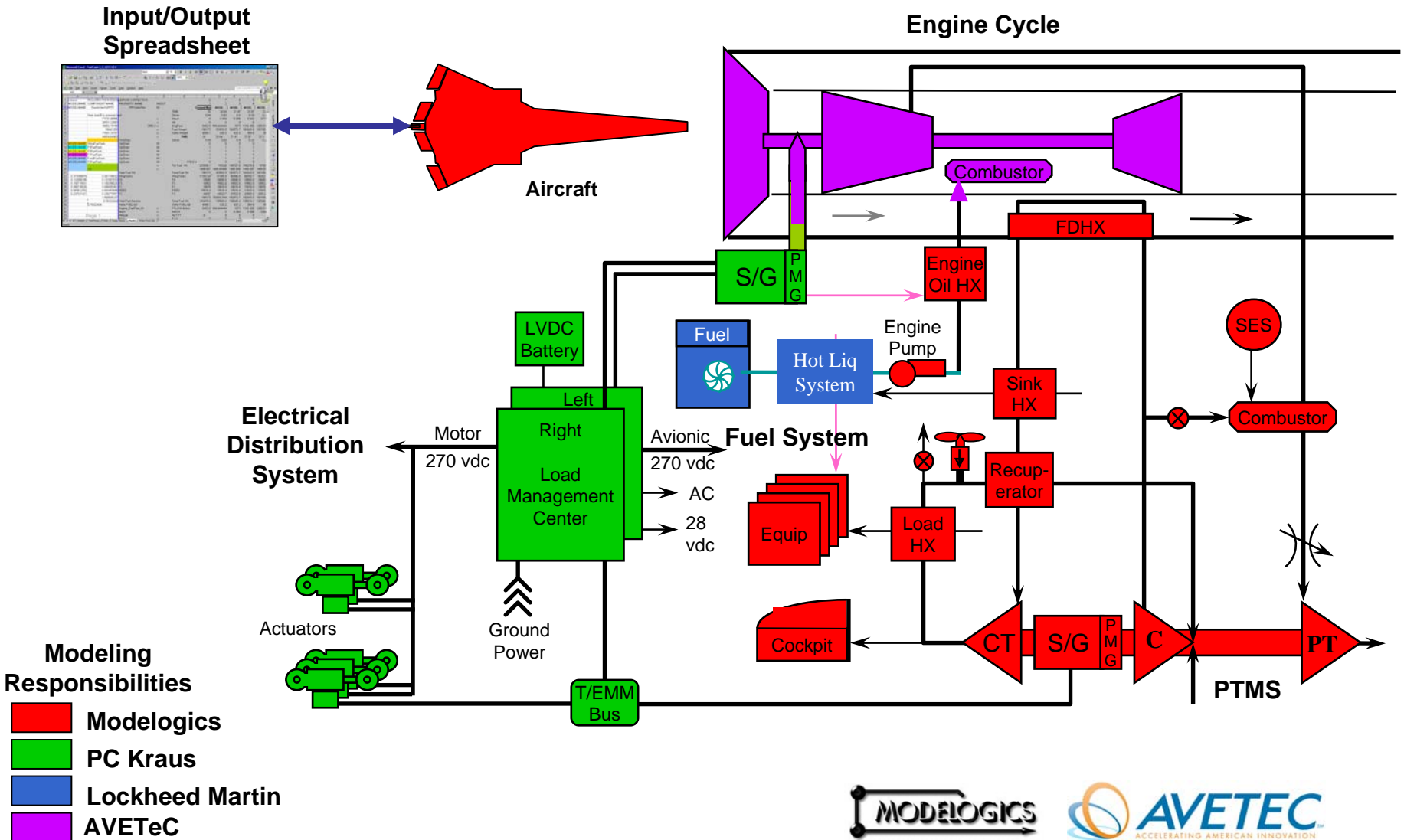| Lead Contractor	Aircraft	Technology	Program Description	2007	2008	2009
Lockheed/GE	JSF	JSF	JSF Modeling Thermal - Proprietary	■		
AVETEC/Lockheed/PC Kraus	JSF	JSF	JSF Modeling Thermal/Electrical - Non Proprietary	■	■	
Modelogics		Modeling	Add Transient Capabiliity	■		
Northrop/GE/LibertyWorks	ADVENT	LRS	ADVENT Trade Studies-Simulink	■	■	■
Lockheed/GE/LibertyWorks	ADVENT	LRS	ADVENT Trade Studies-Simulink	■	■	■
Northrop	AUAV	UAV	Advanced UAV Phase 2 Trade Studies-Simulink	■		
Boeing		Modeling	Real Time Simulation/Testing/Validation	■	■	

Date (Year)

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Integrated Engine and Aircraft Architecture Thermal and Electrical Systems

Modeling Responsibilities

Input/Output Spreadsheet

Aircraft

Engine Cycle

Combustor

FDHX

S/G PMG

Engine Oil HX

SES

Electrical Distribution System

LVDC Battery

Fuel

Engine Pump

Hot Liq System

Sink HX

Combustor

Left

Right

Load Management Center

Motor 270 vdc

Avionic 270 vdc

AC

28 vdc

Fuel System

Recuperator

Equip

Load HX

Actuators

Ground Power

Cockpit

CT

S/G PMG

C

PT

PTMS

T/EMM Bus

Modeling Responsibilities

🟥	**Modelogics**
🟩	**PC Kraus**
🟦	**Lockheed Martin**
🟪	**AVETeC**

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