JSF – Many Programs in One

Interoperability

Global Sustainment

Domestic / International Suppliers

Autonomic Logistics

3 Flight Test Facilities

Training

P&W F135
GE/RR F136

3 Services

8 International Partners

2 Security Cooperation Participants

Team JSF
LM Aero
NGC
BAES

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JSF Enables True Joint / Coalition Operations

Domestic and UK:
- F-16
- A-10
- F/A-18
- F/A-18
- AV-8B
- Sea Harrier
- Harrier GR7

International:
- Israel
- Denmark
- Norway
- Netherlands
- Italy
- Turkey
- Singapore
- Australia
- Canada
- Australia
- Canada
- AMX
- Harrier
- Tornado

F-35 Joint Strike Fighter

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A Highly Integrated Best Value Team

NORTHROP GRUMMAN

- Center Fuselage
- Weapons Bay Door Drives
- Arresting Gear
- CV Control and Test
- Radar
- Software
- LO Support System
- Training Courseware and Management Systems

BAE SYSTEMS

- Aft Fuselage
- CV Wing Fold
- Fuel System
- Crew Escape
- Life Support
- EW System
- U.K. Support Center
- Throttle/Side Stick
- Horizontal/Vertical Tails
- Flight Control Computer
- STOVL Control and Test
- U.K. Rqts/Stores/SW

LOCKHEED MARTIN

Prime Contractor
- Air System Verification
- System Integration
- Mate Through Delivery
- Edges & Control Systems
- Autonomic Logistics
- Mission Systems
- Vehicle Systems
- Training System
- Forward Fuselage
- Wing

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We build large, complex software systems

- Long life spans
- 19 MSLOC across multinational sites – over 60 on-aircraft computers
- Safety and Mission Critical Software
- COTS and legacy reuse

Application types
- On-aircraft
- Lab simulations
- User training
- Aircraft logistics

Multi-Service
- Common SW
- Vehicle-specific SW

Multi-National
- Customer-specific SW
## F-35 Schedule Through Initial Operations Capability (IOC)

### Program Phases

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### International

- **First Flights & Test Completion**
  - CTOL FF
  - STOVL FF
  - CATB FF
  - CATB MS FF
  - CV FF
  - Blk 1 DT&E
  - Blk 2 DT&E
  - Blk 3 DT&E
  - Blk 3 IOT&E
  - DT Complete
  - OT Complete

### Production

- **LRIP I** Full Lead
- **LRIP II** Full Lead
- **LRIP III** Full Lead
- **LRIP IV** Full Lead
- **LRIP V** Full Lead
- **LRIP VI** Full Lead
- **LRIP VII** Full Lead
- **MYP 1**
- **EOQ**
- **MYP**

### Initial Operating Capability (IOC)

- IOC USMC
- IOC USAF
- IOC USN

### International Deliveries

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The JSF Software Development Organization is large and complex

- **Multi-Company & International**
  - Partners & Suppliers
  - The sun never sets on JSF software development

- **Collaborative software development**
  - We have moved from an era of specialization to an era of collaboration
  - We recognize the power of the JSF team

- **What is software collaboration to JSF?**
  - An essential core set of tools and processes defined and refined
  - Processes, plans, and requirements are defined, communicated, & controlled
  - Detailed technical schedules are established and maintained
  - Software quality goals are established, communicated, and actively managed
  - These are to allow us to leverage off of each team’s demonstrated strengths
JSF Software Team

Producing Quality . . .

• Quantitative Software Metrics are tracked by each team (monthly)
  – *Thresholds are used to indicate if actions need to be taken by the individual software team*
  – *Stoplights are rolled up and analyzed for lingering and/or systemic issues*

• Provides an excellent method of identifying issues
  – *Process definition & tool usage*
  – *Team training & performance*

• Areas of improvement have been in re-work estimation and defect prediction

• Active area of focus is using defect prevention techniques to meet cost challenge targets
The JSF Software Team produces safety critical software that will be deployed world-wide

- US & International safety assurance is critical
- The JSF approach - aircraft level hazards are explicitly linked to hardware and software components
- Hazards allocated to
  - Software products are closed through verification
  - Software processes are closed via evidence of compliance with process requirements
    - The MathWorks has worked to ensure that generated C code is safety compliant

JSF software team recently published a C++ Safety Critical coding standard (with Bjarne Stroustrup)
- This is now public domain and being implemented by industry tools
• Common process, tools, and requirements are defined with the specific intent of
  – *Allowing each teammate to help us achieve success*

• Our collaborative vision of the JSF software team extends to those developing our vital tools – specific goals include
  – *Integration with UML & test coverage tools*
  – *Expansion into new domains and C++ code generation*
  – *Automated checking of compliance to standards*
• The JSF software team enterprise is a world-wide alignment of focused expertise

• The JSF software team is progressing the state of the industry through leading processes and infusion of critical tools

• JSF is committed to using the latest tools and techniques to develop its software products

• Collaborative Engineering is working to provide the best value for the JSF program

• JSF is positively motivating and influencing software quality