JOINT STRIKE FIGHTER
the next generation strike fighter

Generally Speaking, How's the Software?
(Tracking Program Wide Software Progress)

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Background

Challenge:

Ability to clearly and concisely capture the status of the software being developed for the F-35 Lightning II Joint Strike Fighter (JSF) for Program Management and external-to-the-Program consumption.

- There are numerous teams responsible for developing and integrating software
- There are differences in the software development processes being executed across the teams
- There is a wide variety of software metrics being collected, analyzed, and reported
- *The ability to successfully capture this status lies with the melding of the data from the numerous teams, processes, and metrics, along with the different domains of software (airborne and ground systems)*

The General's Four Questions

- **Getting It Done?**
  - AS Software Progress Summary and Block X Software Summaries
    - Software Effort by Block/Product Domain
    - Accomplishments (last 3 months) and Current Challenges
    - Block/Product Percent Complete (plan vs. actual)
  - AS Software and Block X Progress to Plan Charts
    - Track Percent Complete by CY Quarter (plan vs. actual)
- **Getting It Done Efficiently?**
  - Productivity metric for selected high risk products based on Effective Source Lines of Code (ESLOC)/hour
- **Getting It Done Right?**
  - Defect prediction metrics based on product-level defect profiles
- **Getting It Working (Fixing It)?**
  - Utilizing existing SPAR burn down/status metric charts

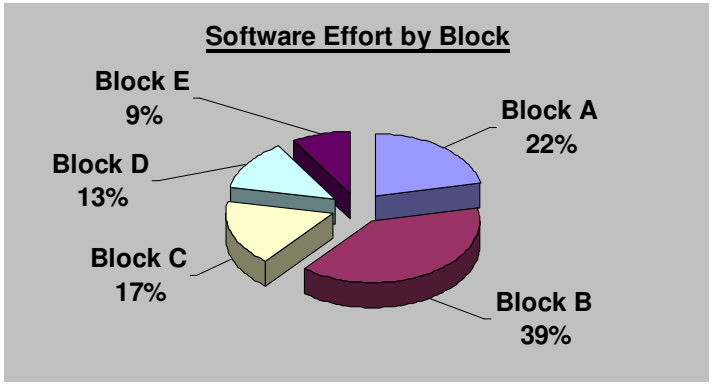
Technical Issues for Metrics

- **Significant Diversity in Development**
  - ***80+ Teams – Prime Team and Suppliers***
  - ***No common source of data for <u>all</u> developers***
  - ***Different methodologies, tools, base data***
- **Disparate schedules**
  - ***Air Vehicle schedules, blocks different than ground-based systems***
- **Expense of low level collection**
  - ***Discrete data collection required***
- **Different target audience**
  - ***Generals, Admirals, Vice Presidents***
  - ***Need to focus on "Big Picture"***
  - ***Existing metrics focused on detail at the Product Team levels***

Metrics Approach

- **Normalize around ESLOC**
  - ***Effective Source Lines of Code proportional to development effort***
  - ***Used with "% Complete", produces mathematically valid results***
  - ***Valid weighting factor for producing composite results***
- **Collect data from Product Domain Points of Contact**
  - ***Common data collection form with Product Domain summaries***
  - ***Life Cycle includes Requirements through Air System Integration***
  - ***Map everything to Air Vehicle Blocks for reporting***
- **Exploit existing summary reports**
- **Publish Quarterly Reports**
  - ***Driven by Executive briefings (Quarterly, Semi-Annual)***
  - ***Focus on big picture - hyperlink to details (optional usage)***
  - ***Provide significant detail in Notes pages***
- ***Examples of key charts with notional data follow***

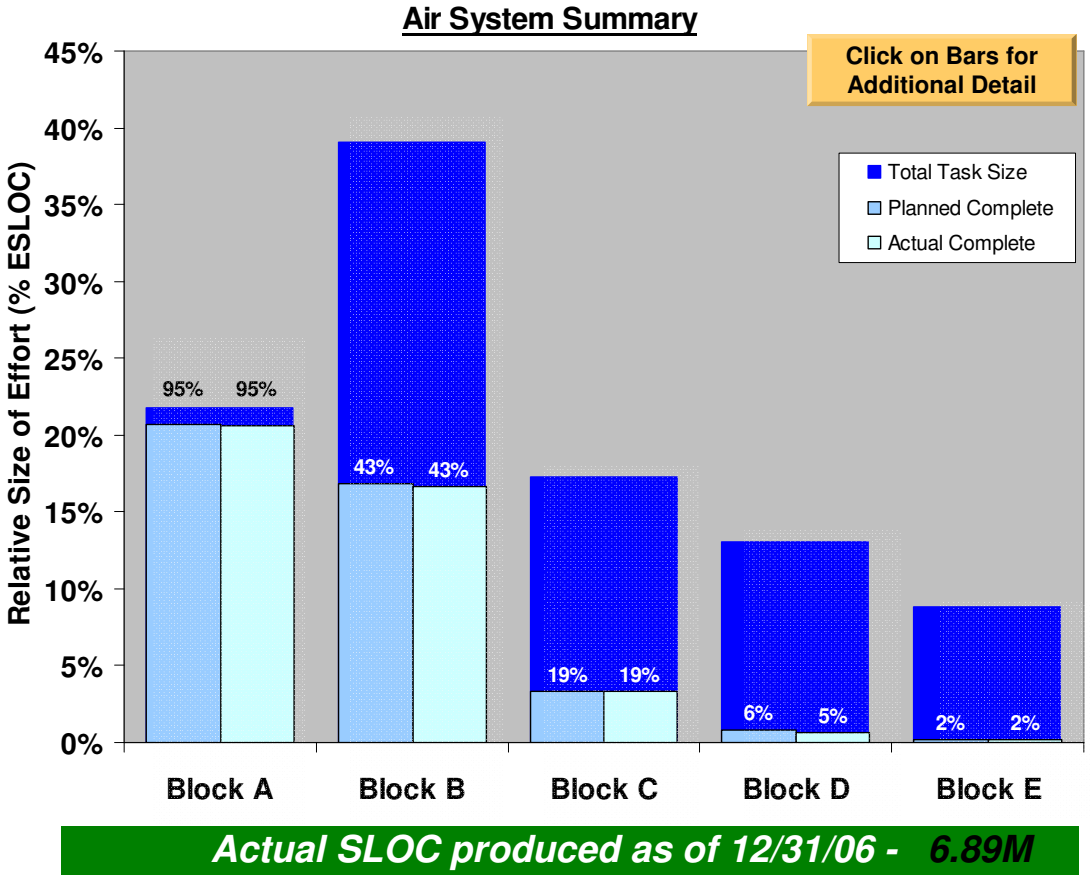
Progress Chart - Summary



- **Accomplishments (last three months)**
  - ***Flight Test Update 1 (FTU 1) delivered to AA-1 to support second phase of flight test***
    - Helmet-Mounted Display (HMD) software flight certified
  - ***Beginning work on software for AF-1, CF-1***
- **Current Challenges**
  - ***Continuing to balance resources between Block A and B efforts***

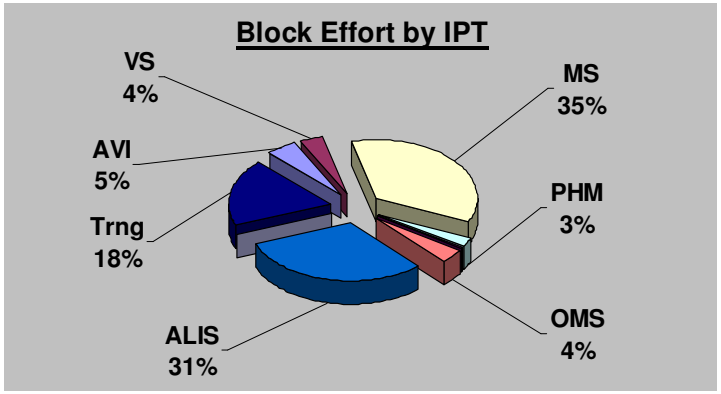
AS Composite Percent Complete (Planned) 42.0%

AS Composite Percent Complete (Actual) 41.5%



Actual SLOC produced as of 12/31/06 - 6.89M

Progress Chart – Product Domain



Accomplishments

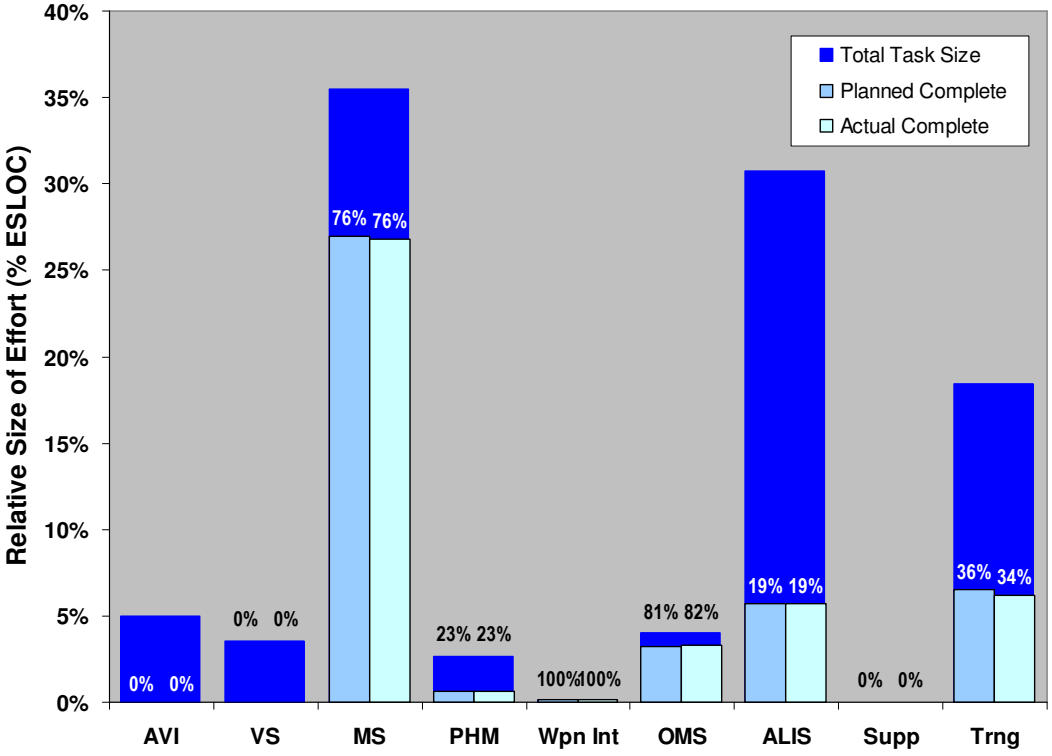
- *MS variance further reduced to 1%*
- *OMS released increment 3 for integration and test*

Current Challenges

- *Resource contention between blocks is continuing challenge*

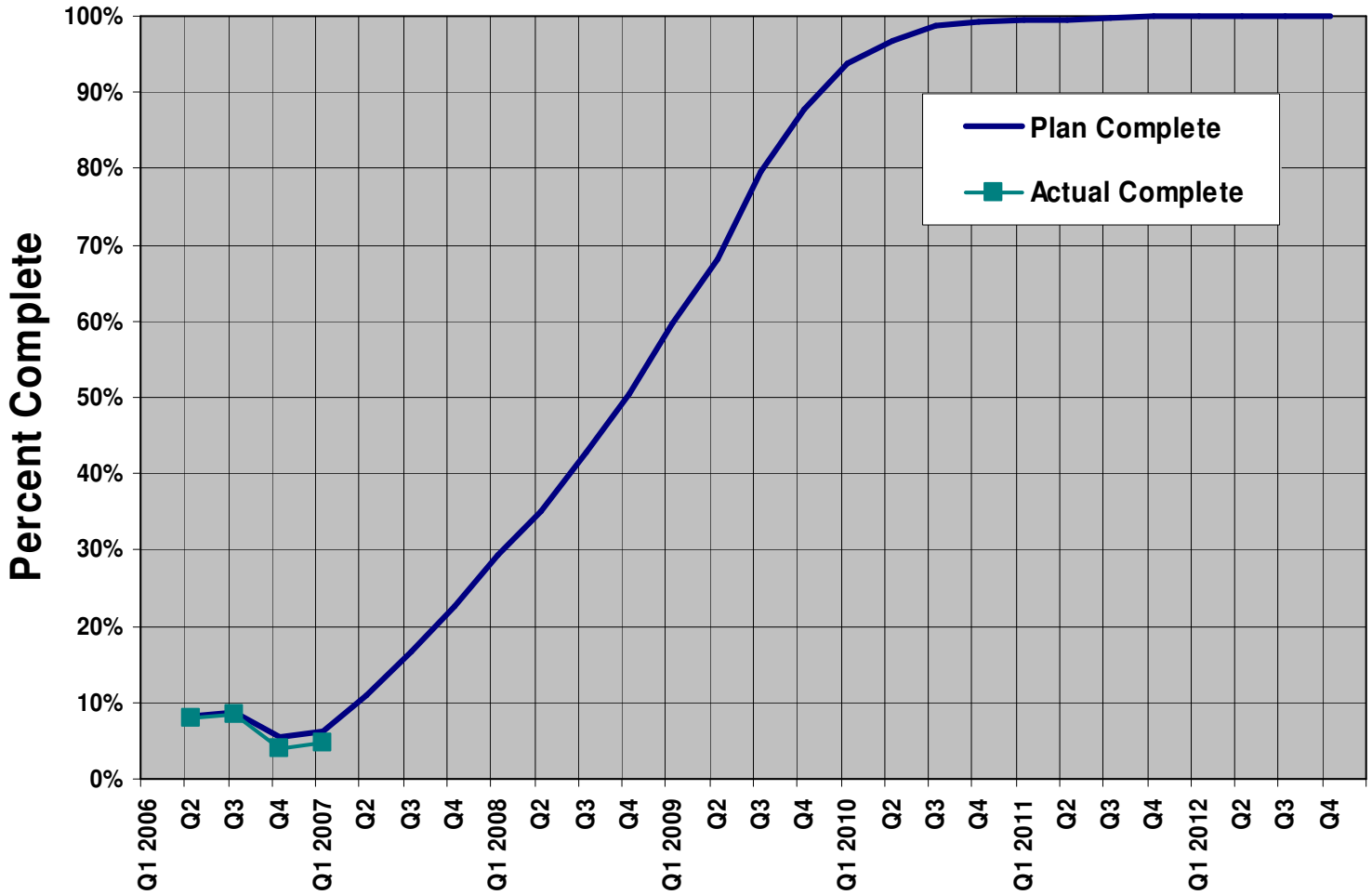
Block Composite Percent Complete (Planned)	**37%**
Block Composite Percent Complete (Actual)	**37%**

Block Summary

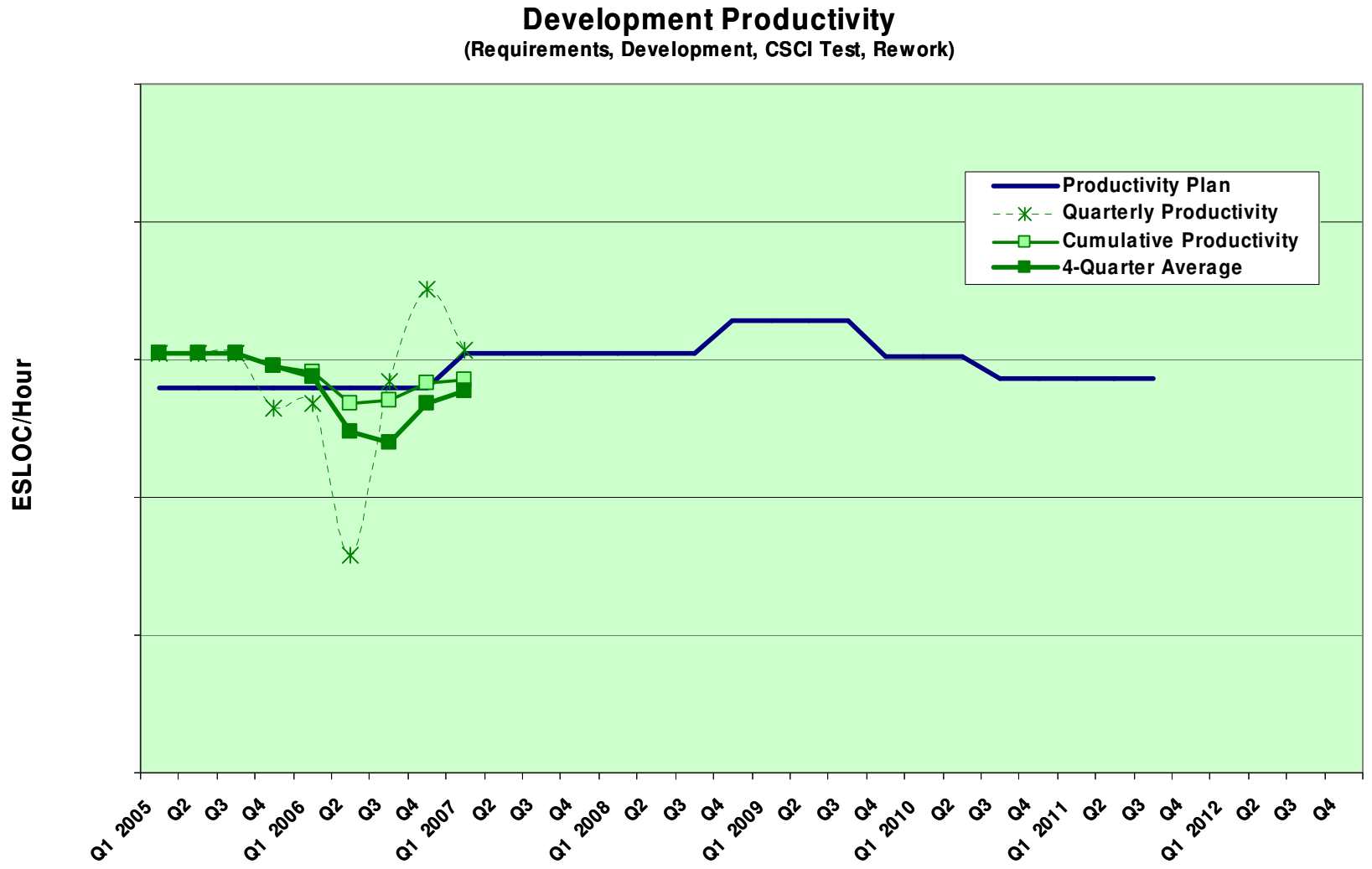


Actual SLOC produced as of 12/31/06 - 3.07M

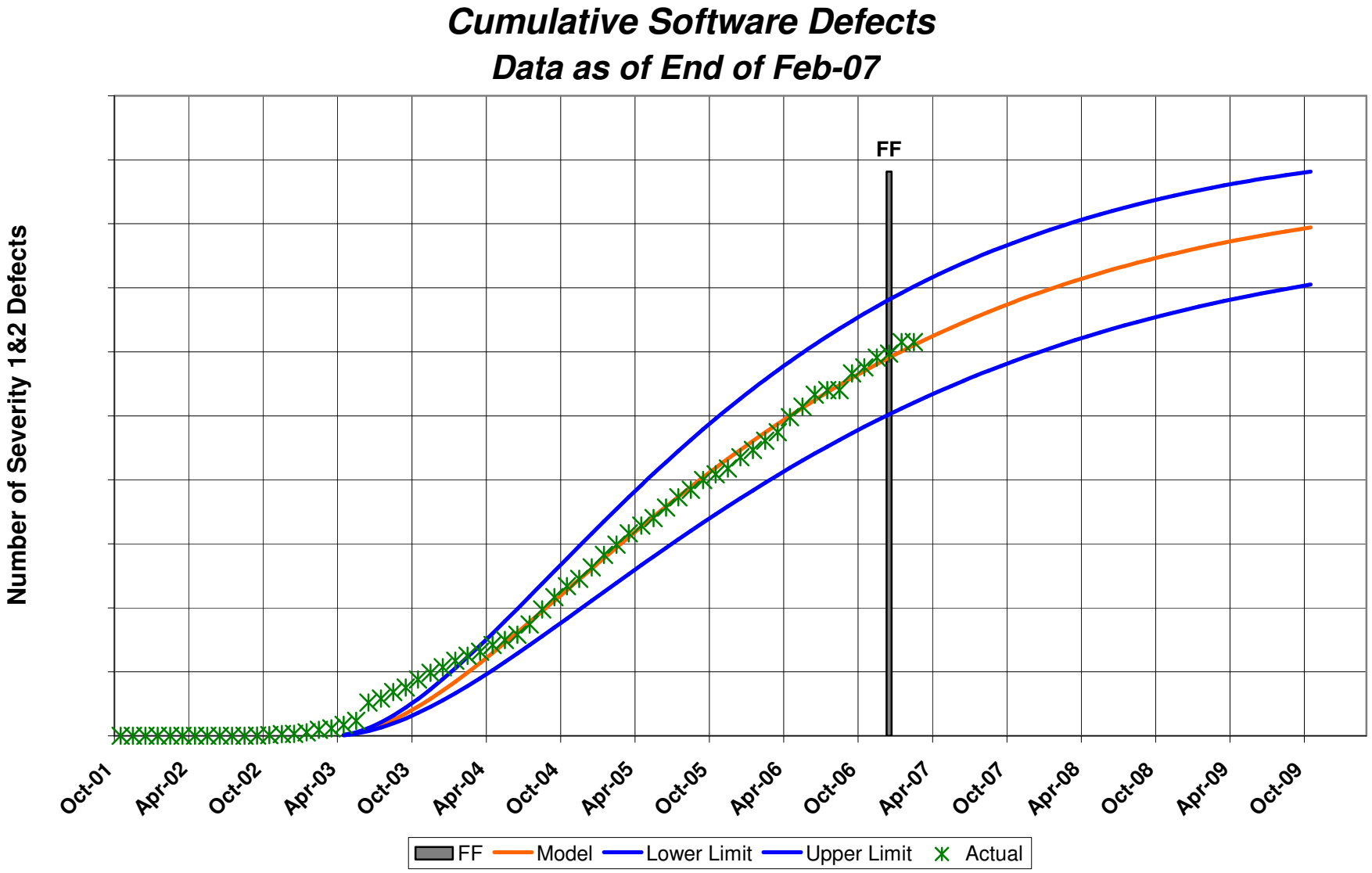
Block-Level Progress Plan Chart



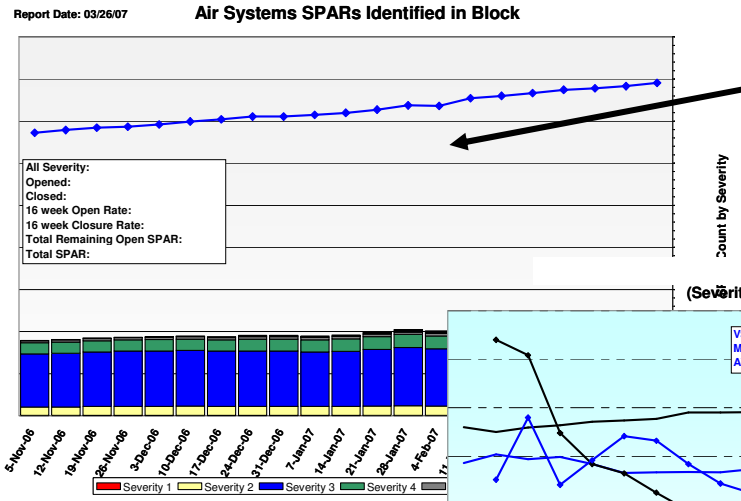
Sample Productivity Chart



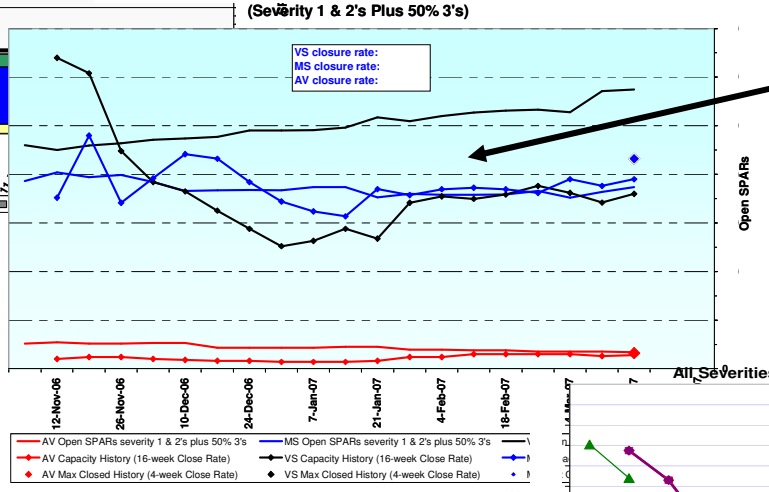
Sample Defect Prediction



Sample Defect Resolution Charts

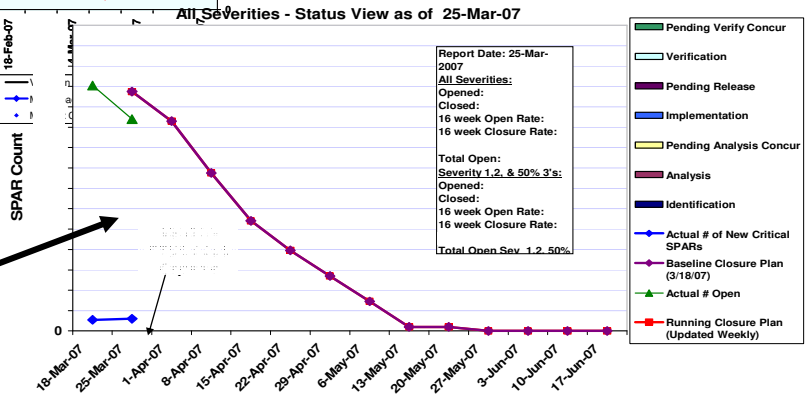


Block Level SPAR Charts to assess open/close rates



Release-Level SPAR Charts assess capacity to close

Three levels of Defect Resolution metrics are used, depending on time-to-release



Release-Level SPAR Charts to track burndown plans

Satisfied Customers

- **The Air System Software Roll-Up Metrics Package is being developed per Program Management (Government and Prime Contractor) direction**
- **The Package successfully produced for last five quarters.**
- **The Package has matured over time and the metrics contents will continue to evolve as the Program evolves.**
- **Each Package has been successfully briefed to Program Management (Government and Prime Contractor).**
- **Contents of each Package has been used as input to executive briefs**
  - ***Chief Executive Officer (CEO) Conferences***
  - ***Configuration Steering Board/Software Acquisition Executive meetings***
  - ***Joint Executive Steering Board meetings***

Lessons Learned

- **Generals, Admirals, and Vice Presidents have different information needs**
  - ***Shape a metrics package that will addresses their needs***
  - ***Be flexible - make changes in response to Executives desires***
- **Use a mechanized and consistent method to generate metrics to eliminate man-in-the-loop effects on the data.**
- **Identify data providers from each development area and train them on the data collection/metrics generation process.**
  - ***Data providers must take ownership of the data that they provide and provide backup data, when requested.***
- **Plans Change, Estimates Change – be prepared to explain**
- **Avoid mixing data with different frequencies.**
- **Summing up productivity masks information.**
- **Extrapolation has risks.**

Next Topic

Monday, June 18, 2007, track 2

- **2:40-3:25 – JSF Software Program**
  - ***Overview and Status (Branyan/Willis)***
  - ***Tracking Program Wide Software Progress (Evers/Willis)***

- **3:35-4:20 – System/Software Design**
  - ***Implementing F-35 System Architecture using UML (Clauss)***
  - ***Deploying C++ For Use In International Safety-Critical Applications (Carroll)***

- **4:20 – 4:35 – Break**

- **4:35 – 5:20 – JSF Software Safety Process**
  - ***Deploying Safety Critical Standards Internationally (Eccles)***
  - ***Providing Developmental Assurance (Bridges)***

- **5:30 – 6:15 – Software Quality Improvements /JSF Software Sustainment**
  - ***Focused Software Quality Improvements (Robb)***
  - ***F-35 Software Life-cycle Planning: Performance-Based Software Sustainment (Novak)***

Acronyms

Acronym	Definition
AA-1	First Flight Test aircraft nomenclature
AF-1	First Air Force variant aircraft nomenclature
ALIS	Autonomic Logistics Information System
AVI	Air Vehicle Integration
CEO	Chief Executive Officer
CF-1	First Carrier (Navy) variant aircraft nomenclature
CSCI	Computer Software Configuration item
CY	Contract Year
ESLOC	Effective Source Lines of Code
FF	First Flight
FTU	Flight Test Update
HMD	Helmet Mounted Display
JPO	JSF Program Office
JSF	Joint Strike Fighter

Acronym	Definition
MS	Mission Systems
OMS	Off-Board Mission Support
PHM	Prognostic Health Management
SLOC	Source Lines of Code
SPAR	System Product Anomaly Report
VS	Vehicle Systems