
Government as Integrator of a Large Scale Modernization Effort: A Systems Engineering Approach to Balancing Stakeholder Needs



Kevin M. Swanson, MITRE
Paul A. Forbes, AFLCMC/HBC
Dr. Mark A. Roth, AFLCMC/HBC

U.S. AIR FORCE



- **What is ISPAN and the ISPAN Increment 4 modernization?**
 - **Integrated Strategic Planning and Analysis Network**
 - **System of systems**
 - **Agile Strategies**
- **The Government as the Integrator**
 - **Development Approach**
 - **Integration Activities**
 - **Balancing Stakeholder Needs**
 - **Benefits of Integration**
- **Results**
- **Enablers**



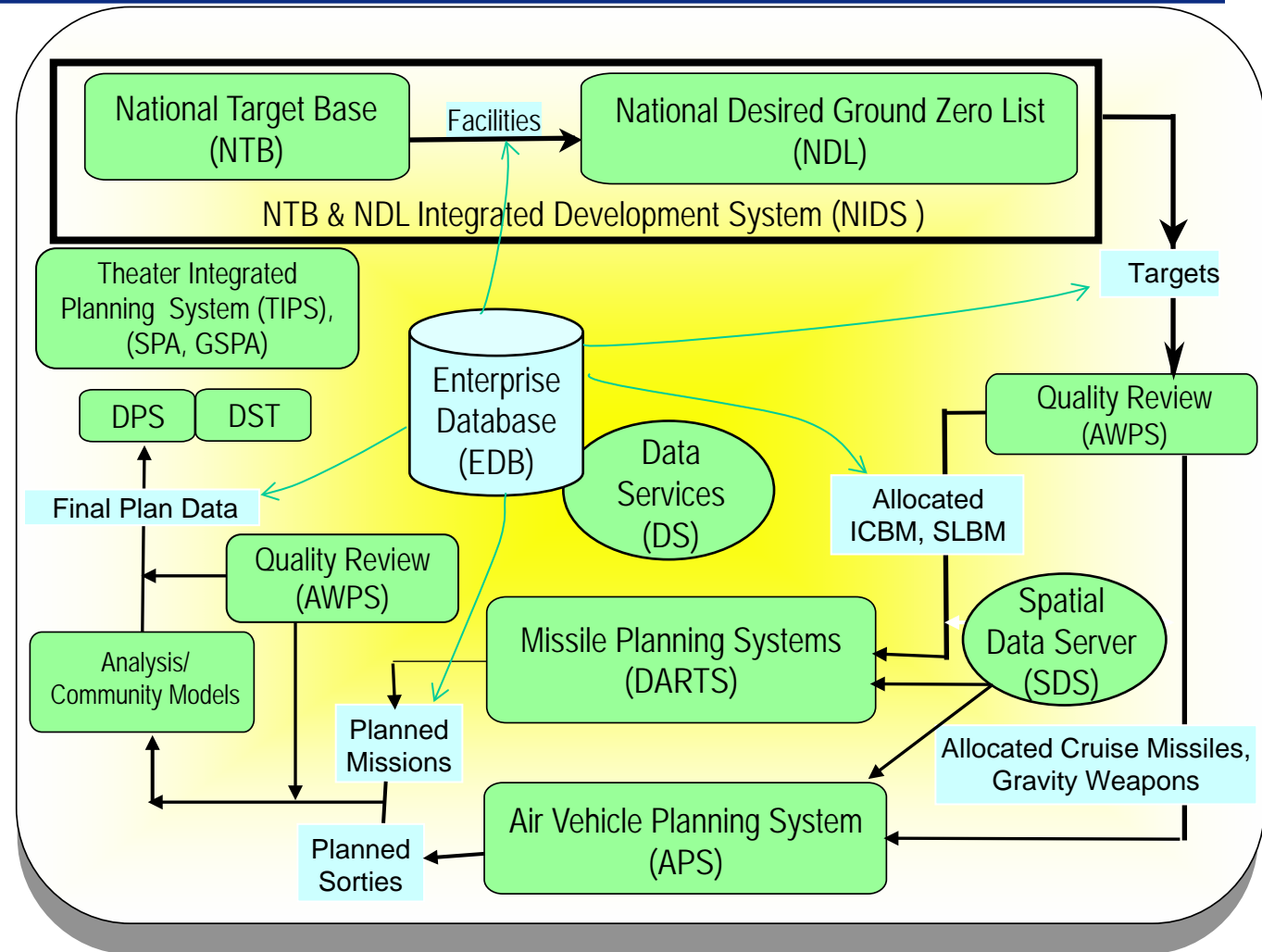
- **ISPAN Mission Planning and Analysis System (MPAS)**
 - **Increment 4: ACAT IAM, \$162M modernization of MPAS**
 - **MPAS supports USSTRATCOM's UCP responsibilities for strategic deterrence planning and Global Strike**
 - **Nuclear targeting and sortie development**
 - **Conventional kinetic and non-kinetic planning**
 - **Comprehensive system for developing "level 4" nuclear plans and options**



MPAS Current Infrastructure

U.S. AIR FORCE

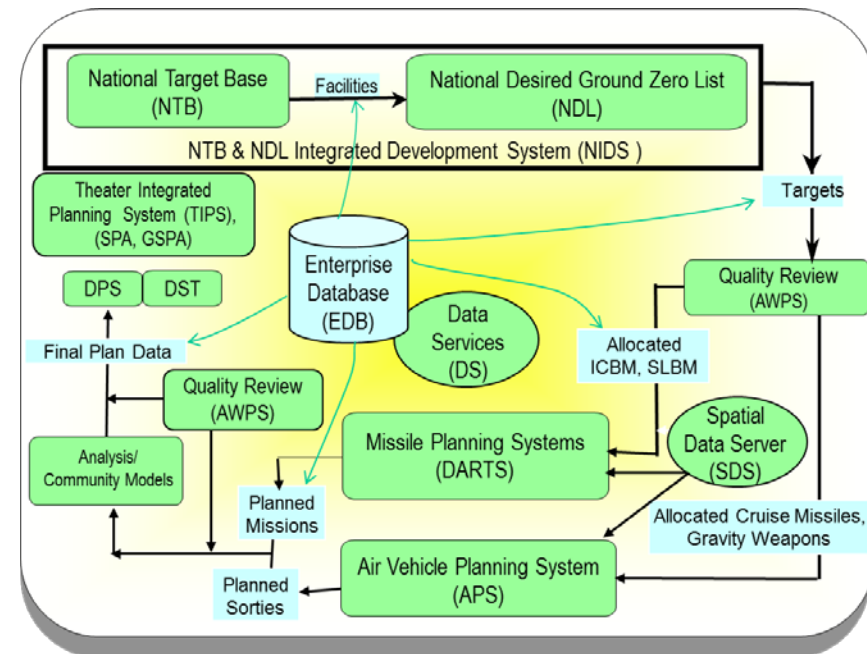
- Large, aging, costly to maintain system
- Inflexible, cutovers cost 6-8 days/year, ~20 emergency patches/year, 35% backlog of software deficiencies
- Over 1.5M lines of Ada and Fortran (over 10%)
- Manpower intensive, 6-18 months to train APS planner, 4 FTE Pro-tool operators, \$135K/year for contractor training (just for APS)
- Support provided by five competitively awarded IDIQ/CPIF contracts





System of Systems

- The top-level requirements describe system level capabilities
- Coordinated development across contracts
 - Five software development contractors
 - Infrastructure contractor
- Some legacy systems
 - Undergoing development - 5
 - Continuing in sustainment - 3
- Some new systems - 4
 - Plan Manager
 - Attack Structure Manager
 - Analysis Tool Service
 - Data Federation Service

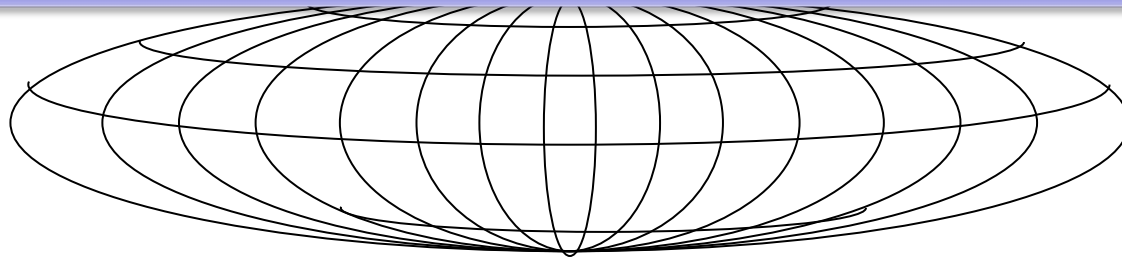
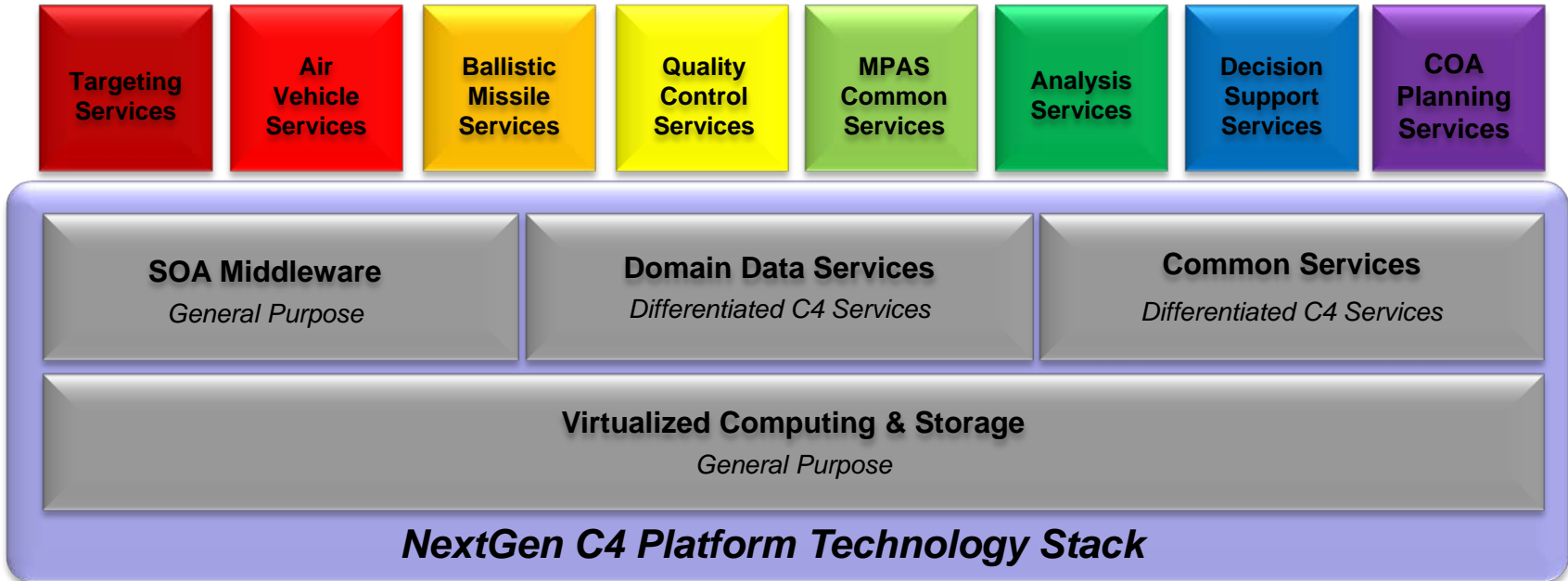




The Future ISPAN Platform

U.S. AIR FORCE

Complementary Developer Components



Integrity - Service - Excellence



Guiding Principles/Values

U.S. AIR FORCE

- **Own the Technical Baseline - No shortcuts**
- **Prepare for Change**
 - **Create options for decision makers to consider**
- **Engage users throughout development**
 - **Revector as needed and as early as possible**
- **Create mechanisms to manage the baseline**
 - **Structuring and aligning work is key**
- **Create transparency**
 - **Make recommendations in an observable/reviewable manner**
- **Create feedback**
 - **Create opportunities and value the problems found early**



Agile Strategies

Applied at a higher level of abstraction

- Each spiral includes design, code, integration
 - Each spiral targets a viable product
- Requirements elicitation capturing user stories
 - Adds life into requirements and realism into verification
- Create feedback opportunities
 - During design – interface design processes
 - During development – opportunistic checkout

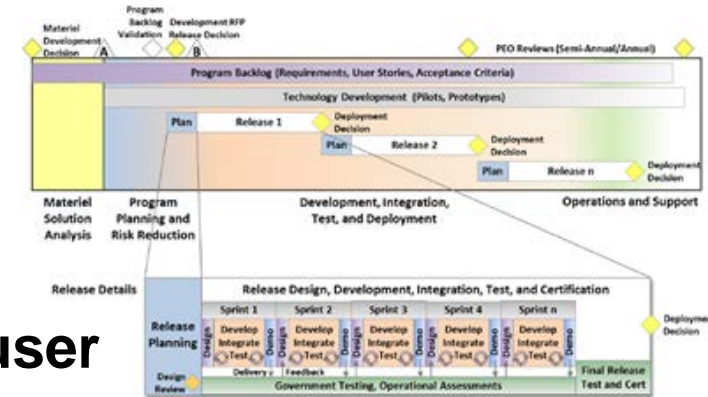


Figure 8: Potential Agile Development Model

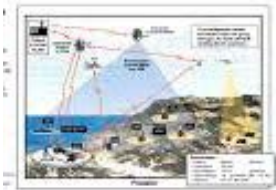
We are executing a hybrid approach drawing from traditional and agile methods



Development Approach

U.S. AIR FORCE

Leverage Enhanced CONOPS

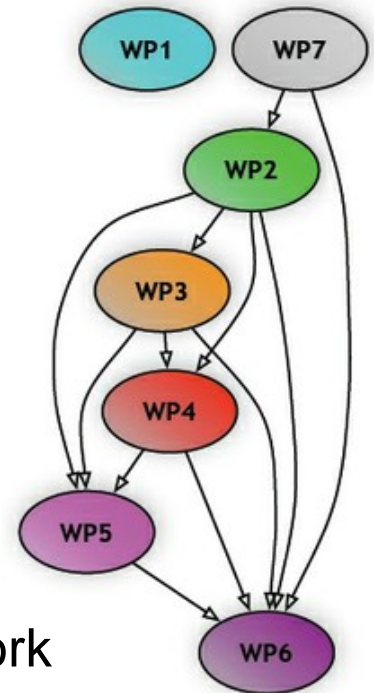


Elicit User Stories

As a (USER)
I want to (DO THIS)
so that I can (ACHIEVE THAT)



Create Work Packages



Frequent Integration



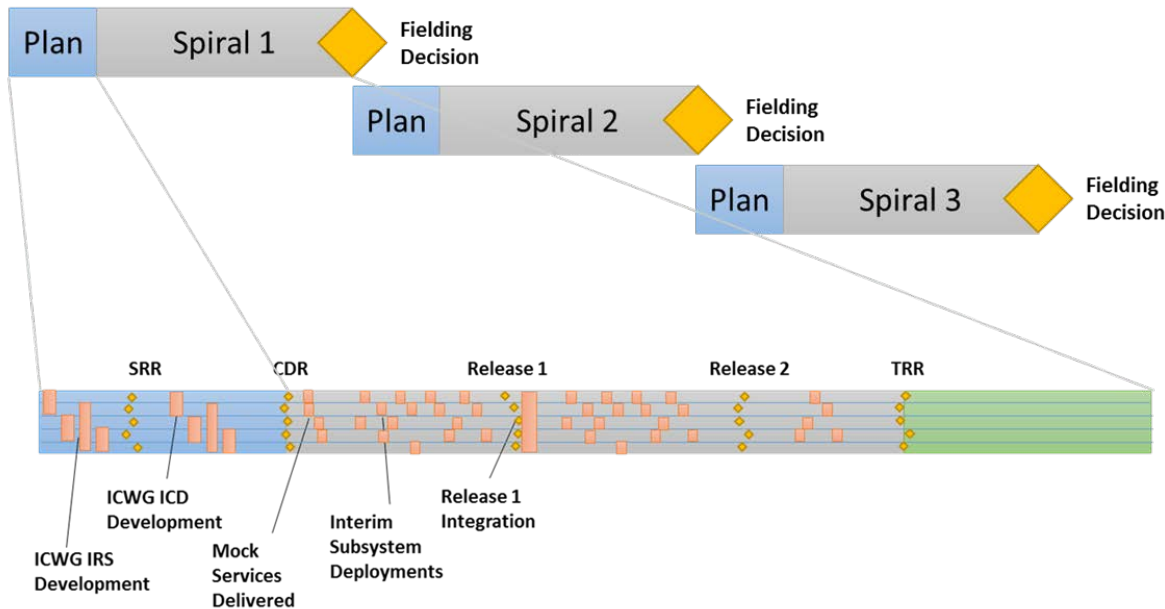
Phase Work Packages



Integration Activities

U.S. AIR FORCE

- Interface Control Working Groups
- SRRs/CDRs
- Use of Mock Services
- Opportunistic Interface Checkout
- Release 1 User Engagement Integration Event
- Developer Exchange
- Release 2 User Engagement Integration Event



Program invested in the NIF to support development, integration, and test without operational network limitations



U.S. AIR FORCE

Balancing Stakeholder Needs (5 years is a long time)

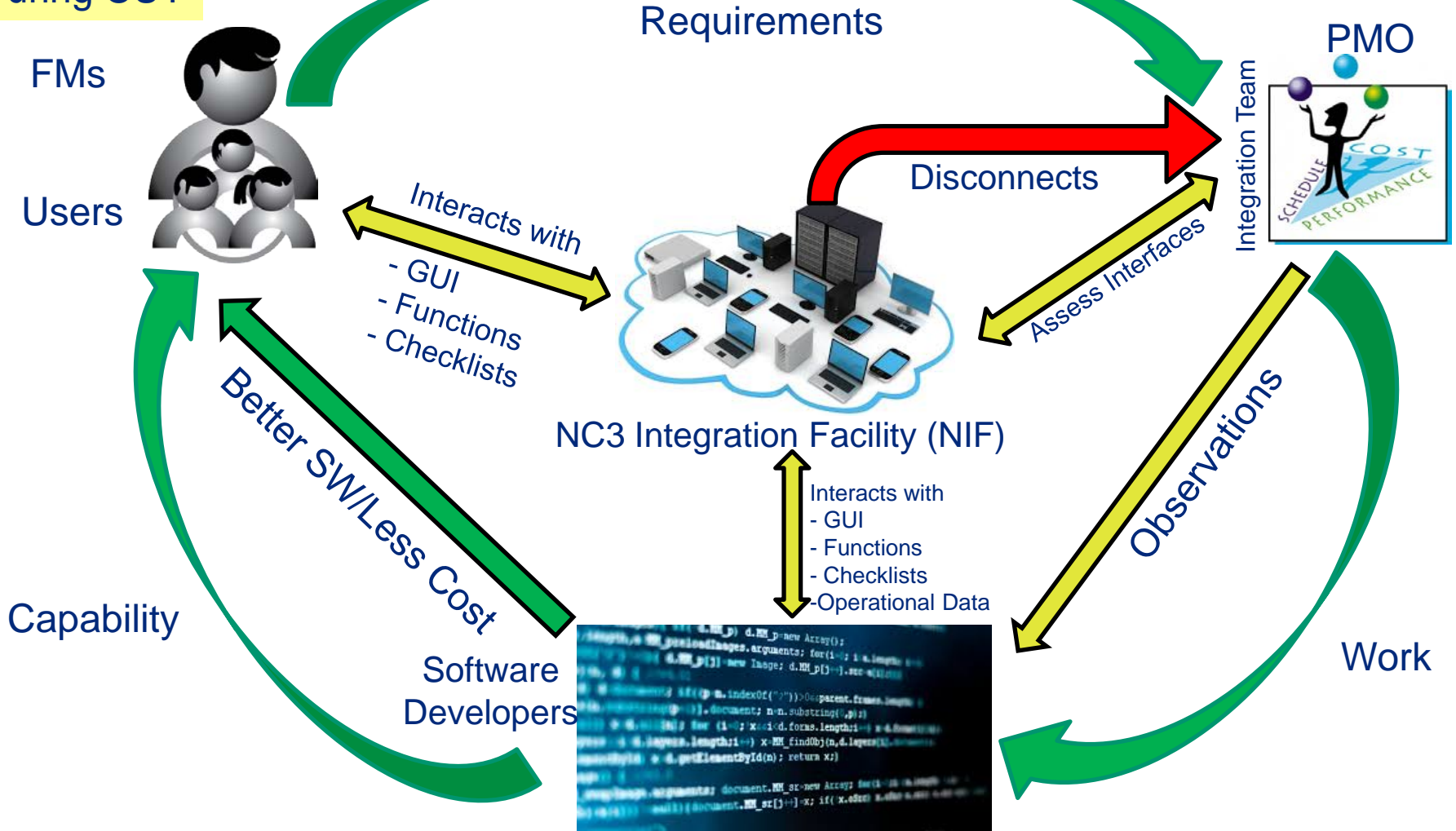
- **Must own the baseline**
- **Take advantage of “new” approaches (IT Box, DoD 5000.02, etc)**
- **FMs must retain the ability to tradeoff capabilities**
- **PMs must retain the ability to efficiently react to changes**
- **Engineers need to enable the programmatic options**



Integration with Benefits

U.S. AIR FORCE

During CUT





- **Surrogate deployment environment for partially developed code**
 - **98% of observations in NIF resolved with next deployment**
- **Low-Threat environment for developers to interact with other developers, FMs, and Users—unprecedented contractor collaboration**
- **Demo space for users to view and interact with capability releases of code in development**
- **NIF is key component of actual/expected 73% reduction in DRs**
 - **Rework/future work avoidance of ~\$7.5M based on avg DR cost**

MPAS Inc 4	DR*	Contract Incentive	DR Reduction	Avg DR Cost (\$K)	Will Cost (\$M)	Should Cost (\$M)	Savings (\$M)
Spiral 1	70 Actual	339	269	9.8	24.3	21.7	2.6
Spiral 2	78 Predicted	330	252	9.8	27.0	24.5	2.5
Spiral 3	74 Predicted	332	258	9.8	25.8	23.3	2.5
PIE	24 Predicted	117	93	9.8	8.4	7.5	0.9

* CAT I Emergency, CAT I Urgent, CAT II Urgent



- **Stakeholders are in one building/location**
 - **Functional Management Office**
 - **End Users**
 - **Program Management Office**
- **Most developers are within 5 miles**
 - **Most in local area – face-to-face short-notice engagement possible**
- **NC3 Integration Facility (NIF)**
 - **Government-owned facility to support system integration during software development**
- **Strong backchannel opportunities – transparency**
 - **Open communications**
 - **Immediate feedback and corrective actions**
 - **Responsive to changes**



U.S. AIR FORCE

Contacts

Kevin M. Swanson
Senior Systems Engineer
kswanson@mitre.org
402-294-2689
MITRE

Paul A. Forbes
Lead Engineer
paul.a.forbes2.civ@mail.mil
402-294-7806
AFLCMC/HBC

Dr. Mark A. Roth
Chief Engineer
mark.a.roth1.civ@mail.mil
402-294-4874
AFLCMC/HBC

AFLCMC/HBC
901 SAC BLVD, STE 1H11
Offutt AFB, NE 68113-7500



U.S. AIR FORCE

BACKUP

Integrity - Service - Excellence



Purpose of the NIF

Environment enabling government/developer collaboration

- Provide a production-like environment to verify deployment procedures
- Allow developers to run subsystems in conjunction with other subsystems (prior to formal test) to discover issues in time to take cost effective action
- Verify ICD compliance (prior to formal test) to gain early feedback
- Provide the testers with an early look at the software as it is being developed to improve test readiness
- Provide early deployment opportunities to improve likelihood of smooth transition into test



Teaming approach in the NIF

U.S. AIR FORCE

■ **NIF administrators**

- Focus on providing a production-like environment
- Ensure availability for Integration Team and Developers

■ **MPAS Integration Team**

- Host deployment, software and functional integration activities
- Provide observations to the developers
- Identify integration opportunities across subsystems

■ **Developers**

- Deploy to gain experience and to receive feedback
 - Minimal deployments required by PWS
 - Additional deployments encouraged to further reduce risk

■ **Product IPTs**

- Coordinate of integration activities
- Receive observations
- Host user community for user story demos



Government as Integrator

U.S. AIR FORCE

- **Risk Reduction**
 - Encouraging Contractor Collaboration
- **Direct and Indirect Contractor Collaboration**
 - **Direct**
 - Interface Control Working Group processes
 - Interface requirements, design, change management
 - Informal, direct backchannel among developers
 - **Indirect**
 - Developers' subsystems benefitting from early interaction with others' subsystems during CUT
 - Awareness of system progress to highlight integration opportunities
- **Demonstration of operational functionality**
 - Gaining feedback on the integrated system from actual users
 - User validation that the development is on track (visualization, design features)
 - Leveraging subsystems in development phase



Observations

What are they and how do they work?

- **Feedback provided by the Integration Team prior to formal testing**
 - Observations routed from Integration Team to Developer via IPT
- **Observations are not DRs**
 - Idea is to provide a source of feedback with no strings attached
 - Observations that are not addressed could be captured as DRs by testers during formal test
- **Observations following a deployment activity (Infrastructure Integration) may address procedures and compatibility issues with the integration baseline**
- **Observations following interface verification (System Integration) may address compliance with the ICD or other compatibility issues with other subsystems**
- **Observations following a user story demonstration (Functional Integration) may address user feedback regarding user interfaces and other user facing design features**



Benefits to Date

- **Sharing best practices**
 - **Automated deployment tools**
- **Early verification of ICDs and ICD compliance**
 - **Two subsystems from different developers gaining actionable feedback from an integration activity during CUT**
 - **Precipitated needed ICD revisions early**
- **Allows the developer and the IPT to get early feedback, enabling cost-effective corrective actions to improve system functionality**
- **Provided developers with a preview of what it takes to deploy onto computing resources shared by multiple subsystems**
- **Developers found out that their subsystems will be deployed to the same managed server, so they need to adjust their deployment scripts to accommodate**
- **Fail fast, meaning learn lessons early before they become a crisis**