

GSAW Working Group
Session 4E
Ground System
Acquisition Best Practices

Chairs

Nestor Peccia, European Space Operations
Center/European Space Agency;

Gail Johnson-Roth, The Aerospace Corp;

Mary-Jo Gura, The Aerospace Corp

Workshop Structure

- Representatives from acquisition agencies and functional area invited to discuss ground system acquisition best practices for each of their respective organizations
- Workshop attendees encouraged to ask questions during speaker presentations, and actively contribute to exercise to identify and capture remaining challenges we face in acquiring ground systems
- Goal of workshop was two-fold:
 1. Identify a set of best practices to provide a consistent and integrated approach to ground system acquisition throughout the acquisition life cycle
 2. Identify on-going acquisition challenges for these complex systems

Best Practices

- By definition are practices that have been identified through experience as being significant contributors to successful acquisition
- Targeted toward reducing downstream development risk and thereby improving mission success

Invited Speakers

- **Nestor Peccia**, Head of Data System Infrastructure Division
Ground Systems Engineering Department, European Space Agency
- **Suellen Eslinger**, Distinguished Engineer, Software Engineering Subdivision
- **David Eccles**, Principal Director, Missile Defense Division,
The Aerospace Corporation
- **Sherry Stukes**, Research Task Manger, Ground Software Systems Engineering, Jet Propulsion Laboratory
- **Christopher Knapp**, Principal Engineer, Directorate G,
Electronic Programs Division, The Aerospace Corporation

European Space Agency

Ground Acquisition Best Practices

- **Based on Consistent/Constant Policy of 25 Years**
 - Strict Separation of Space and Ground Segment Procurement
 - Ground Segment Procurement under full ESA/ESOC responsibility
 - Single Operations Concept and Methodology for Any Class of Mission/Orbit
 - Use of Common Areas for Any Class of Mission/Orbit
 - Customization of Reusable Infrastructure to Meet Mission Specific Needs
 - Data Systems Strategy
 - European Space Ground Software Companies Share Similar Business Model in Frame Contracts
 - Generic Statement of Work and Special Condition of Tender

Functional Area

Ground Acquisition Best Practices

- Software Product & Process Risk Reduction
- Software-Inclusive System Requirements
- Software-Inclusive System Architecture
- Contractor Capability Evaluation
- Realistic Software Size, Cost and Schedule Estimates
- Robust Software- Inclusive Technical Reviews
- Key Software Technical and Management Deliverable Data
- Software Inclusive Technical Reviews
- Contractually Compliant Software Standards
- Pro-Active Quantitative Management
- Robust Software Test Program
- Contract Enabled Introduction of Practices (SOW, Deliverables, Special Provisions, Compliance Docs, Award Fee)

Reducing Space System Acquisition Risk with Software Acquisition Best Practices

NSS Space Acq Policy 03-1

Pre-Systems Acquisition

Systems Acquisition

Sustainment

Key Decision Points:

PHASE A Approval
A

PHASE B Approval
B

PHASE C Approval
C

1st Launch

IOC

FOC

Pre KDP-A
Concept
Studies

PHASE A Concept
Development

PHASE B
Preliminary
Design

PHASE C
Complete
Design

PHASE D
Build & Operations

SRR

SDR

PDR

CDR

Software Product & Process Risk Reduction

Contractor Capability Evaluation

Software-Inclusive System Requirements

Software-Inclusive System Architecture

Realistic Software Size, Cost and Schedule Estimates

Robust Software Architecture

Key Software Technical and Management Deliverable Data

Software-Inclusive Technical Reviews

Contractually Compliant Software Standards

Robust Software Test Program

Pro-Active Quantitative Management

Agency

Ground Acquisition Best Practices

- Capability Based Acquisition
- Knowledge Points
 - Hardware/Software
- Competitive vs Non-Competitive Selection Process
- “Make or Buy” Decisions
- Capability Maturity Model Integrated
- Industry COTS
- Human Element Considerations

Ground Acquisition Issues

- **Challenge is Building the Software for Ground Systems**
 - Executability
 - Mission Assurance
- **Need to Identify Knowledge Points**
 - TRLs do not apply well to software
- **Lack of realistic schedules/budgets**
 - Lack of realistic planning for ramp up of program personnel and resources
 - Contention for development and test resources
 - Overworked staff resulting in increase in defects/ decrease in performance
 - Bidding programs with less than 80% cost/schedule confidence
- **Lack of clear requirements**
 - Failure to identify and control requirements baseline, adding new/changed requirements without ECPs
 - Lack of active and early user involvement
- **Lack of a disciplined development methodology/ process for contractor and sub-contractors - and support and on-going monitoring thereof**

Ground Acquisition Issues (cont)

- Lack of active and early internal and external (between ground and space) interface identification
 - Lack of full testing of interfaces across stovepipes
- Lack of risk management / open communication of risks
 - Lack of PRDA and on-contract risk reduction money to focus on critical path technical risks prior to starting a full-scale development
- Lack of requirement for End-to-End performance modeling or other means of analyzing / allocating performance requirements
 - Lack of development of information models, performance models, and data models early in the program
- Lack of early planning for a detailed integration plan
- Lack of acquisition structure and policy on COTS, GOTS, Open Source software

Working Group Chairs and Speakers Bios and Abstracts



Gail Johnson-Roth
Director, Acquisition and Risk Management
Systems Engineering Division
The Aerospace Corporation

Ms. Johnson-Roth has more than 25 years of experience in aerospace engineering at The Aerospace Corporation. Her initial career was in the laboratories with focus on research and analysis of space related materials. She then worked for the Corporate Chief Engineer in the development of acquisition strategies in the changing environment of acquisition reform and documented the process to mitigate components or risk as applied to cost, schedule and performance. Ms. Johnson-Roth transitioned to ground systems programs with focus on spacelift range systems issues. Other assignments include technical staff to the Office of the Executive Vice President, and Systems Director in Civil and Commercial Operations. Ms. Johnson-Roth holds a BS, Ohio University, MS in Materials Engineering, and MS in Systems Architecture and Engineering, University of Southern California.



Mary Jo Gura
Senior Engineering Specialist
Software Engineering Subdivision
The Aerospace Corporation

Ms. Gura joined The Aerospace Corporation in August 2005, after 27 years of experience as a software engineer and software manager at Hughes/Raytheon Company. Her areas of expertise include all aspects of the software development lifecycle. At Aerospace she divides her time providing support to SMC and NRO program software acquisition activities and numerous Concept Design Center studies in the role of Software Lead. She earned a BS in Mathematics from the University of Illinois.



Nestor Peccia

Mr. Peccia is Head of the Data Systems Infrastructure Division, Department of Engineering, Operations Centre of the European Space Agency (ESA / ESOC), Darmstadt, Germany. He is also the Deputy Chairman, CCSDS Engineering Steering Group and Mission Operations and Information Management Services Area Director, and Chairman of the European Technology Harmonisation on Space Ground Software Systems.

Abstract

Ground System Acquisition Best Practices at ESA

Ground System Acquisition Best Practices at ESA are the consequence of 25 years of applying the same approach for the procurement of Space Ground Software Systems.

What does this mean?

- Clear Policy**
 - Common Business Model**
 - Frame Contracts (FFP and FUP)**
 - Streamline Process and harmonized Programme**
 - Ensure competitiveness across Europe**
 - Market ESA technology and experience as products and services**
 - Develop once, use many**
 - "Best-in-Class" European Common Infrastructure**
 - Software reuse**
 - Operational Software**
 - Open source a la "european"**
 - Generic Request for Proposal**
- Details to be discussed during and after the presentation**



**Distinguished Engineer
Software Engineering Subdivision
The Aerospace Corporation**

Suellen Eslinger is a Distinguished Engineer at The Aerospace Corporation with 40 years' experience in software engineering and the acquisition of software-intensive systems. During her 22 years at Aerospace, she has supported numerous Air Force and NRO space programs. She is the Principal Investigator for software acquisition research and also leads curriculum development and delivery of software acquisition training courses for The Aerospace Institute. Previously, she worked at Computer Sciences Corporation and General Research Corporation, where she developed software and managed software development projects for DoD and NASA ground systems. Ms. Eslinger is widely published and has given numerous conference presentations and tutorials in the fields of software engineering and software acquisition. She has BS and MS degrees in mathematics, from Goucher College and University of Arizona, respectively.

Abstract

As part of the Aerospace Corporation's software acquisition research effort, a comprehensive set of software acquisition best practices has been defined, based on experience with numerous software-intensive space system acquisitions over 20 years. These best practices cover the entire National Security Space acquisition life cycle, including both pre- and post-contract award activities. This talk will present highlights from this set of software acquisition best practices, with particular emphasis on their application to ground systems acquisition.



David Eccles
Principal Director, System Engineering and Integration
Missile Defense Division
The Aerospace Corporation

Mr. David Eccles has been employed by The Aerospace Corporation for 23 years and leads the Federally Funded Research and Development Center's engineering team for the Missile Defense Agency's Systems Engineering Directorate. His group also provides technical support to the C2BMC Element Program Office and the Joint National Integration Center in Colorado Springs. Previous positions at Aerospace include Director of the Modeling and Simulation and Computer-aided Engineering Departments, and a stint in the Program Executive Office for Space working with the Space-based InfraRed System. He holds BS and MS degrees in Civil Engineering from Brigham Young University.

Abstract

Capabilities-based Acquisition and Knowledge Points: System Acquisition Approaches at the Missile Defense Agency as Applied to Ground System Acquisition

This talk will discuss the current acquisition approach used by the Missile Defense Agency to acquire the Ballistic Missile Defense System (BMDS). Many BMDS elements have major software components similar to large spacecraft ground systems. The Space Tracking and Surveillance System (STSS) is planning ground systems to be located at the Joint National INtegration Center (JNIC) at Shriever AFB in Colorado Springs. The Command, Control, Battle Management, and Communications program is also acquiring major ground software systems with nodes located at Combatant Commander and other locations around the world. These systems will be described at a high level to provide context. The acquisition approaches used for these systems will also be discussed focusing on two concepts: Capabilities-Based Acquisition and the use of Knowledge Points as milestones for program decisions. These approaches will be contrasted with more traditional acquisition strategies.



Sherry Stukes

**Senior Cost Estimator/Analyst, Jet Propulsion Laboratory
Task Manager for NASA Headquarters software research task**

In her senior cost estimator/analyst position, Ms. Stukes specializes in ground data systems software estimating, data collection, and analysis in support of JPL's Software Quality Improvement project. Some of Ms. Stukes' prior accomplishments include development and maintenance of two large databases for the Air Force Space and Missile Systems Center (Operations and Support Database and the Software Database); instructor for the Army Logistics Management College Software Estimating Models course; and advisor to Air Force Institute of Technology students conducting thesis projects in the area of software model calibration. Ms. Stukes was the 1997 International Society of Parametric Analysts Parametrician of the year. Ms. Stukes holds a BS degree in Business Administration from California State University, Long Beach and an MBA from California Lutheran University.

Abstract

The acquisition and subsequent maintenance of Ground Data Systems (GDS) is a diverse and complex issue. To understand the composition of a GDS, the content, extent, number of locations, number of users, and their requirements must be identified. This presentation will describe JPL's experience with our Multi-Mission Ground Station System (MGSS). The presentation will also discuss challenges and opportunities that we face in supporting our unmanned space exploration projects and missions. The following topics will be addressed:

- JPL's Multi-Mission approach to support one-of-a-kind missions as well as project families such as the Mars explorers**
- Funding sources and challenges to ensure adequate capability**
- "Make or buy" decisions to determine best value**
- Maintaining a skilled workforce with unstable funding levels**
- Providing high quality service in a "low cost operations" environment**
- Benefits of CMMI certification**

The presentation will conclude with lessons learned and possible approaches for responding to future challenges.



Christopher T. Knapp
Principal Engineer/Scientist, Directorate G
Electronic Programs Division
The Aerospace Corporation

Mr. Knapp is responsible for providing technical support and leadership to senior customer personnel in the NRO's Ground Systems Office and the System Operations Office in defining, acquiring, operating and maintaining SIGINT ground processing and infrastructure systems. Mr. Knapp joined The Aerospace Corporation in 2003 where he provided acquisition and technical support to the GPS program office supporting modernization of GPS III and GPS Security. Prior to working at Aerospace, Mr. Knapp worked at Computer Sciences Corporation, providing technical engineering, architecture and integration support for ground system development for DoD and NASA. Mr. Knapp has a BS in Physics from the University of Maryland at College Park, MD.