Intelligent Systems Research and Development Support – 2 (ISRDS-2)

RFP NNA12424845R

Industry Day/Pre-Proposal Conference

February 26, 2013

Agenda

Welcome, Introduction & Procurement Information	Ms. Sarah Andrae, Contracting Officer
Intelligent Systems Division (TI) Overview	Dr. Michael Shafto, Acting Division Chief
RSE Technical Area Overview	Dr. Joseph Coughlan, Tech Area Lead
DaSH Technical Area Overview	Dr. Ann Patterson-Hine, Tech Area Lead
ASR Technical Area Overview	Dr. Kalmanje Krishnakumar, Tech Area Lead
CAS Technical Area Overview	Mr. Richard Papasin, Tech Area Lead

This Industry Day/Pre-Proposal Conference is intended to:

(1) Familiarize participants with the ISRDS-2 Statement of Work (SOW) requirements;

(2) Present the current status of the ISRDS-2 acquisition;

(3) Permit potential offerors an opportunity to network and discuss teaming or subcontracting arrangements; and

(4) Allow potential offerors an opportunity to submit questions regarding the recently posted draft Request for Proposal

(5) Allow industry representatives an opportunity to make a private presentation of corporate capabilities to the Government via one-on-one meetings.

General Guidance

- These slides shall not be interpreted as a comprehensive description of the Government's requirements. Please refer to the draft Statement of Work and draft Request for Proposal.
- If there are any inconsistencies between this presentation and the draft Request for Proposal, the draft Request for Proposal will govern.
- Nothing discussed at this pre-proposal conference shall be construed as a revision to the draft Request for Proposal, unless subsequently confirmed via the final Request for Proposal or an Amendment.

General Guidance

- A communication blackout will commence immediately upon the release of the final Request for Proposal.
- All communication from industry must be directed only to the Contracting Officer during this blackout period.
- The blackout period will continue until contract award.

Questions

- Following the presentations, all questions must be submitted in writing. At this time, the Government will not verbally entertain any questions. All questions will be answered in a timely manner. All questions and answers will be made available on the Federal Business Opportunities website.

- Index cards have been provided to submit your questions.

- All questions related to this pre-proposal conference or the draft Request for Proposal must be submitted to the Contracting Officer at **sarah.m.andrae@nasa.gov** no later than March 6, 2013.

Electronic Posting

- All documents pertaining to the ISRDS-2 Procurement can be found at the following links:
  - Federal Business Opportunities (FBO): https://www.fbo.gov/index?s=opportunity&mode=form&id=92c575ee1f17370545bcb19cd4d7d2cd&tab=core&_cview=1 OR
  - NASA Acquisition Internet Service (NAIS) Business Opportunities: http://prod.nais.nasa.gov/cgi-bin/eps/synopsis.cgi?acqid=154624

- This slide show presentation and the attendee list will be posted to these sites.

FOIA Requests

- Freedom of Information Act (FOIA) Requests may be submitted electronically to Lubna M. Shirazi at foia@arc.nasa.gov
- No proprietary information will be disclosed.
- The NASA ARC FOIA Electronic Reading Room can be accessed at http://www.nasa.gov/centers/ames/business/foia/elec.html.

ISRDS-2 Requirements Overview

This will be a follow-on contract to the existing ISRDS contract (NNA08CG83C), which has a performance period of September 29, 2008 through September 28, 2013.

This procurement is intended to provide cross directorate support for Ames Research Center organizations including, but not limited to the following:

Office of the Center Director (Code D)
Exploration Technology Directorate (Code T)
Aeronautics Directorate (Code A)
Engineering Directorate (Code R)
Programs and Projects Directorate (Code P)
Science Directorate (Code S)
New Ventures and Communications Directorate (Code V)
NASA Aeronautics Research Institute (Code A)
Office of Chief Scientist (Code D)
Office of Chief Technologist (Code D)

Brief Description

Multi-disciplinary requirements for enabling intelligent software technology research and development supporting all mission directorates, which includes the following: planning & scheduling, robotics, advanced controls, advanced collaboration environments, mobile computing platforms, data understanding, systems health, software engineering tools for verification and validation of software systems.

Acquisition Description

- Cost Plus Fixed Fee (CPFF) Contract consisting of a definitive Core requirement and Indefinite Delivery, Indefinite Quantity (IDIQ) task orders
    - The Core is the known minimum support needed in the next five years of contract performance, and encompasses requirements within each of the key technical areas.
    - The IDIQ work includes the same functionalities and capabilities as the Core, but the task orders will address currently unknown, but expected, requirements. The IDIQ task orders will be issued to supplement support provided under the Core, and they will address complex and dynamic research and development requirements that span across several integrally-related technical areas.
- Five-year performance period consisting of a three-year Base and two one-year Options
    - A 60-day Phase-in Period will be included in the Base
- The majority of the work will be performed on-site at NASA Ames, but the multi-disciplinary nature of the work will require occasional support to be provided at other NASA Centers, principal investigator laboratories, and at such other locations as required by the mission.
- Installation-provided property includes access to office equipment, space, and supplies, and Center services (printing, reproduction, store stock, utilities, etc.)

Acquisition Strategy

- This procurement will be conducted through a full and open competition pursuant to FAR and NFS Part 15—Contracting by Negotiations.

- FAR 52.215-1 and NFS 1815.209 allow for an award to be made without discussions. The Government may award a contract based solely on the initial proposals received. The Government reserves the right to hold discussions if award on the basis of initial offers is determined not to be in the best interest of the Government. If discussions are necessary, then a competitive range will be set and negotiations will commence.

- NAICS code is 541712—Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)
  - Small Business Administration size standard is 500 employees

Small Business Goals

- All Offerors, except small businesses, must complete the portion of the instructions specific to the Small Business Subcontracting Plan. Small businesses are not required to submit Small Business Subcontracting Plans; however, small businesses are required to indicate the amount of effort proposed to be done by a small business either at the prime level or at the first tier subcontract level.

- The Government assessed the appropriate subcontracting goals for this acquisition.

- The small business goals for this procurement are as follows:
  - Overall Small Business Goal: 34%
  - Small Business (SB): 15%
  - Small Disadvantaged Business (SDB) Concerns 5%
  - Women Owned Small Business (WOSB) Concerns 7.5%
  - Veteran Owned Small Business (VOSB) Concerns 3%
  - Service-Disabled Veteran-Owned Small Business (SDVOSB) Concerns 2%
  - HUBZone (HBZ) Small Business Concerns 1.0%
  - Historically Black Colleges and Universities (HBCU)/Minority Institution (MI) 0.5%

Weighting and Scoring

- Solicitation evaluation factors will include: Mission Suitability, Past Performance, and Cost.
- **Of the evaluation factors identified above, Mission Suitability is of moderately greater importance than Past Performance, and Past Performance is significantly more important than Cost.** Evaluation factors other than Cost, when combined, are significantly more important than Cost. Offerors should note that items within any factor, if found to be unsatisfactory, may be the basis for rejection of an offer.
- The Mission Suitability sub-factors will be assigned adjectival ratings and numerical scores in accordance with the numerical system established in the final RFP. The overall Mission Suitability factor will only receive a numerical score.
- Past Performance will not be numerically scored. Past Performance is assigned a level of confidence rating in accordance with the criteria set forth in the final RFP.
- Cost will be evaluated for realism, a probable cost adjustment will be made if appropriate, and a confidence level rating will be assigned.
- The Source Selection Authority's (SSA) decision shall be based on a comparative assessment of proposals pursuant to source selection criteria prescribed in this solicitation. While the SSA may use reports and analyses prepared by others, the source selection decision shall represent the SSA's independent judgment.

Proposal Preparation

- Proposals shall be prepared in accordance with the Final RFP and subsequent written Amendments, if any.

- Ensure that all Amendments are acknowledged with the proposal submission.

- The evaluation of proposals shall be in accordance with the Final RFP.

Acquisition Status

Estimated Acquisition Milestones

• Issue Synopsis	December 19, 2012
• Issue Draft RFP	February 13, 2013
• Industry Day	February 26, 2013
• Issue RFP	March 2013
• Proposals Due (45 Day Response Time)	April 2013
• Evaluation of Proposals	June 2013
• Contract Award	July 2013
• Phase-In Period Begins	August 2013
• Contract Start Date	October 2013

Please note that these dates are subject to change. Updated milestones will be provided if necessary.

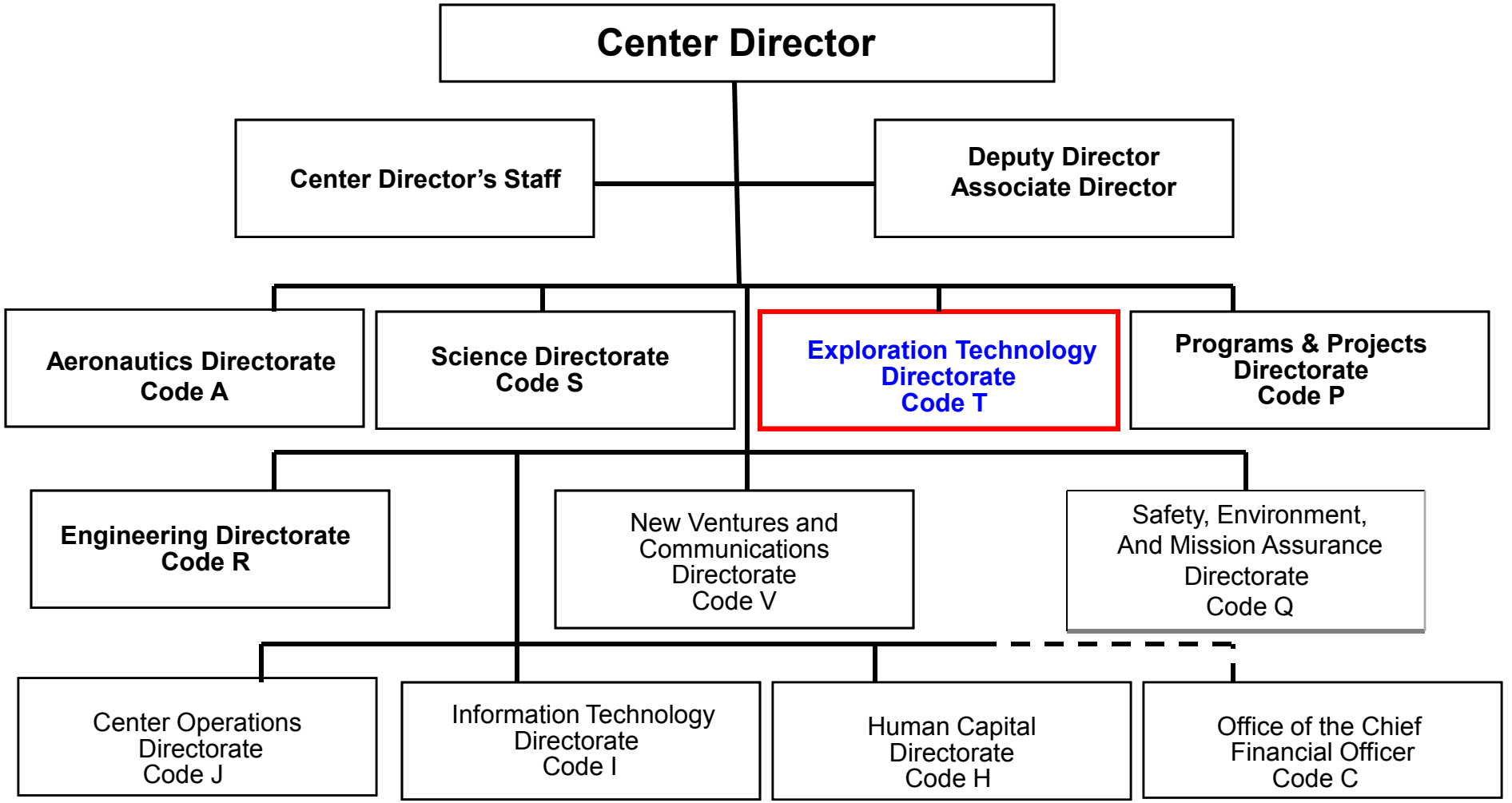
Additional Information

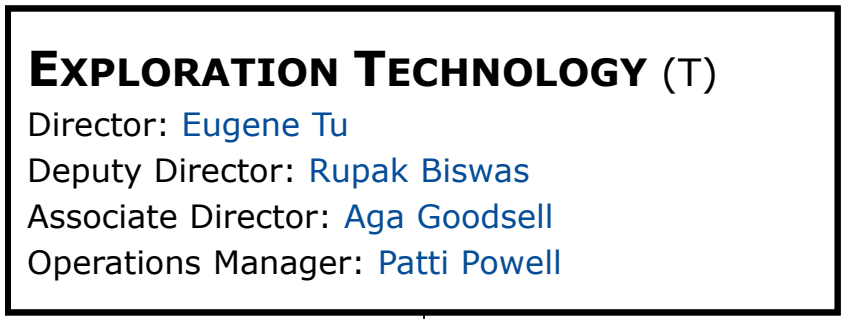
Contracting Officer: Sarah M. Andrae
650-604-3136
sarah.m.andrae@nasa.gov

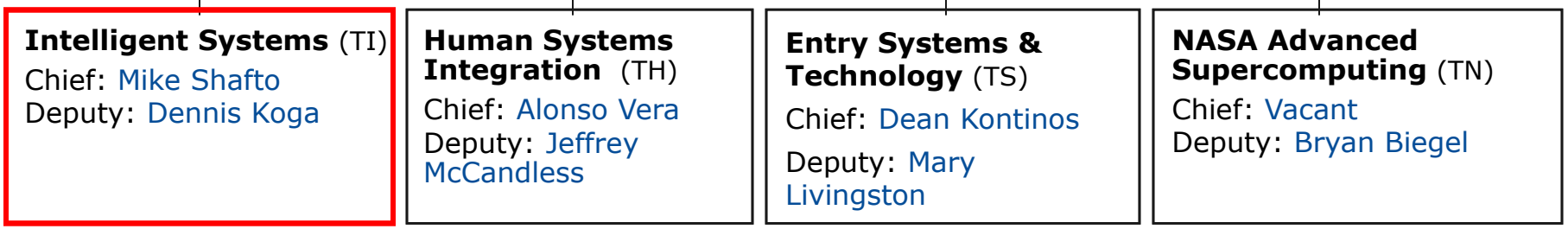
Location of current information can be found online at the Federal Business Opportunities or NASA Business Opportunities websites. Please search using either the solicitation number **NNA12424845R-SMA** or the procurement title **ISRDS2**.

Intelligent Systems Division
(Code TI)

Organizational and Technical Overview


Center Director
Center Director's Staff
Deputy Director
Associate Director
Aeronautics Directorate
Code A
Science Directorate
Code S
Exploration Technology
Directorate
Code T
Programs & Projects
Directorate
Code P
Engineering Directorate
Code R
New Ventures and
Communications
Directorate
Code V
Safety, Environment,
And Mission Assurance
Directorate
Code Q
Center Operations
Directorate
Code J
Information Technology
Directorate
Code I
Human Capital
Directorate
Code H
Office of the Chief
Financial Officer
Code C


EXPLORATION TECHNOLOGY (T)
Director: Eugene Tu
Deputy Director: Rupak Biswas
Associate Director: Aga Goodsell
Operations Manager: Patti Powell


Intelligent Systems (TI)
Chief: Mike Shafto
Deputy: Dennis Koga
Human Systems Integration (TH)
Chief: Alonso Vera
Deputy: Jeffrey McCandless
Entry Systems & Technology (TS)
Chief: Dean Kontinos
Deputy: Mary Livingston
NASA Advanced Supercomputing (TN)
Chief: Vacant
Deputy: Bryan Biegel

Division Chief
(Acting) Dr. Michael Shafto

Deputy Chief
Dr. Dennis Koga

Asst. Chief, Operations
Ms. Sonie Lau

Software Management Office
Mr. Bob Duffy

Prog Assoc. (Aero)
Mr. Joe Totah

Prog Assoc. (Expl)
Mr. Dave Alfano

Tech Areas:

Robust Software Engineering
Dr. Joe Coughlan
Asst: Dr. Guillaume Brat

Groups:

- Advanced Verification and Validation Techniques
- Model-based Software Engineering &Applications
- Safety Assurance Technologies

Discovery and Systems Health
Dr. Ann Patterson-Hine
Deputy: Dr. Kai Goebel

- Intelligent Data Understanding
- ISHM Technology Maturation
- Physics-based Methods
- Prognostics and Diagnostics

Autonomous Systems and Robotics
Dr. Kalmanje Krishnakumar
Deputy: Dr. Kevin Wheeler

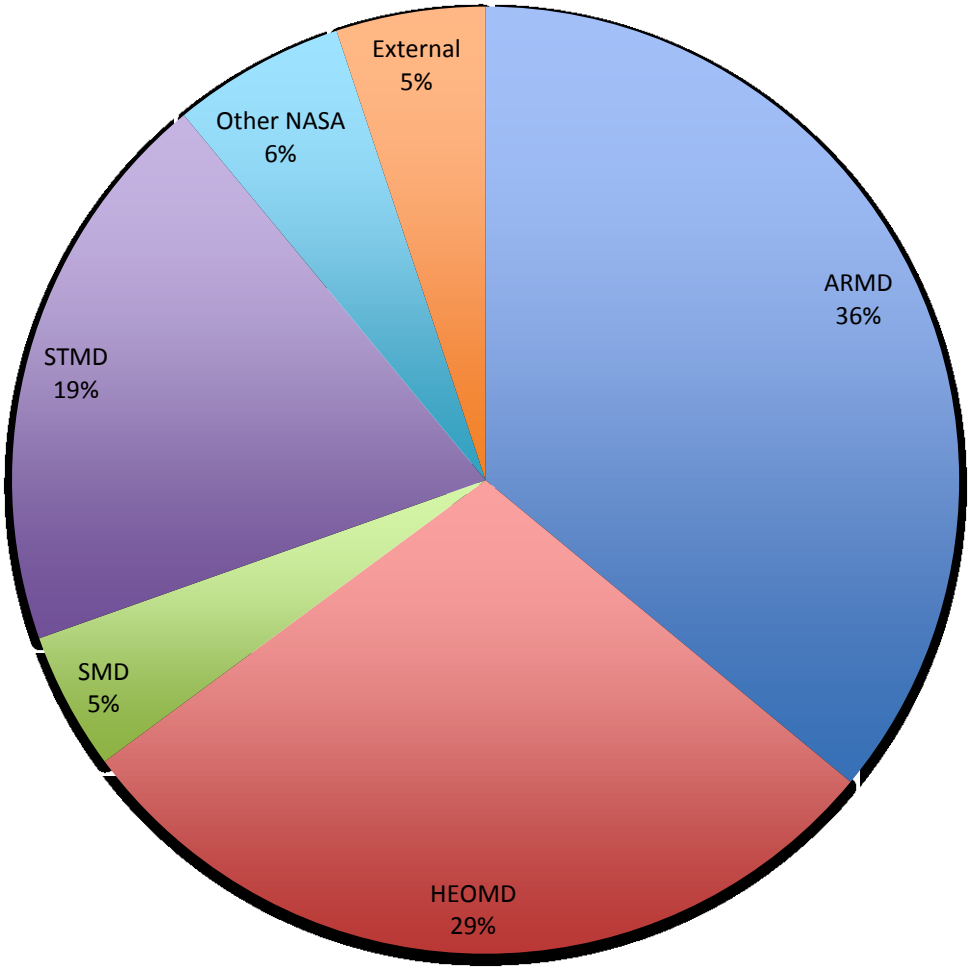
- Applied Avionics Software
- Advanced Control and Evolvable Systems
- Deployable Automation Technologies
- Intelligent Robotics
- Planning and Scheduling

Collaborative and Assistant Systems
Mr. Richard Papasin
Deputy: *open*

- Aeronautics Assistant Systems
- Agency Information Technologies
- Collaborative Exploration Systems Development
- Human Spaceflight & Research Systems
- Multi-Mission Operations and Tools
- Science Mission Support

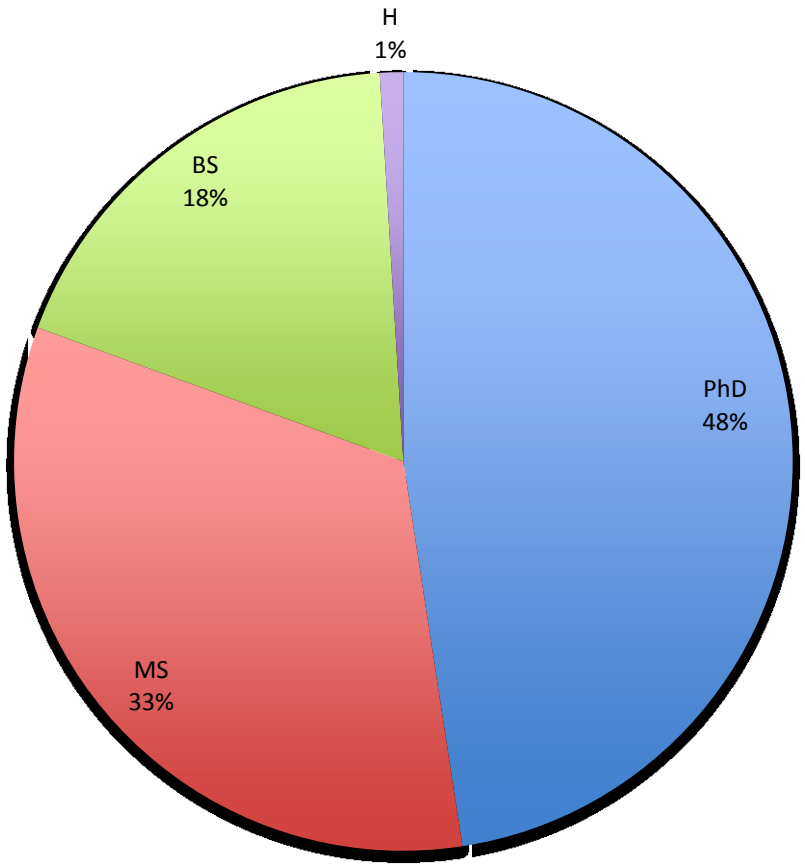
Internal Use Only

Code TI FY'13 Total Budget (~$50M)



Internal Use Only

Code TI – Education Degree Levels (103 CS)



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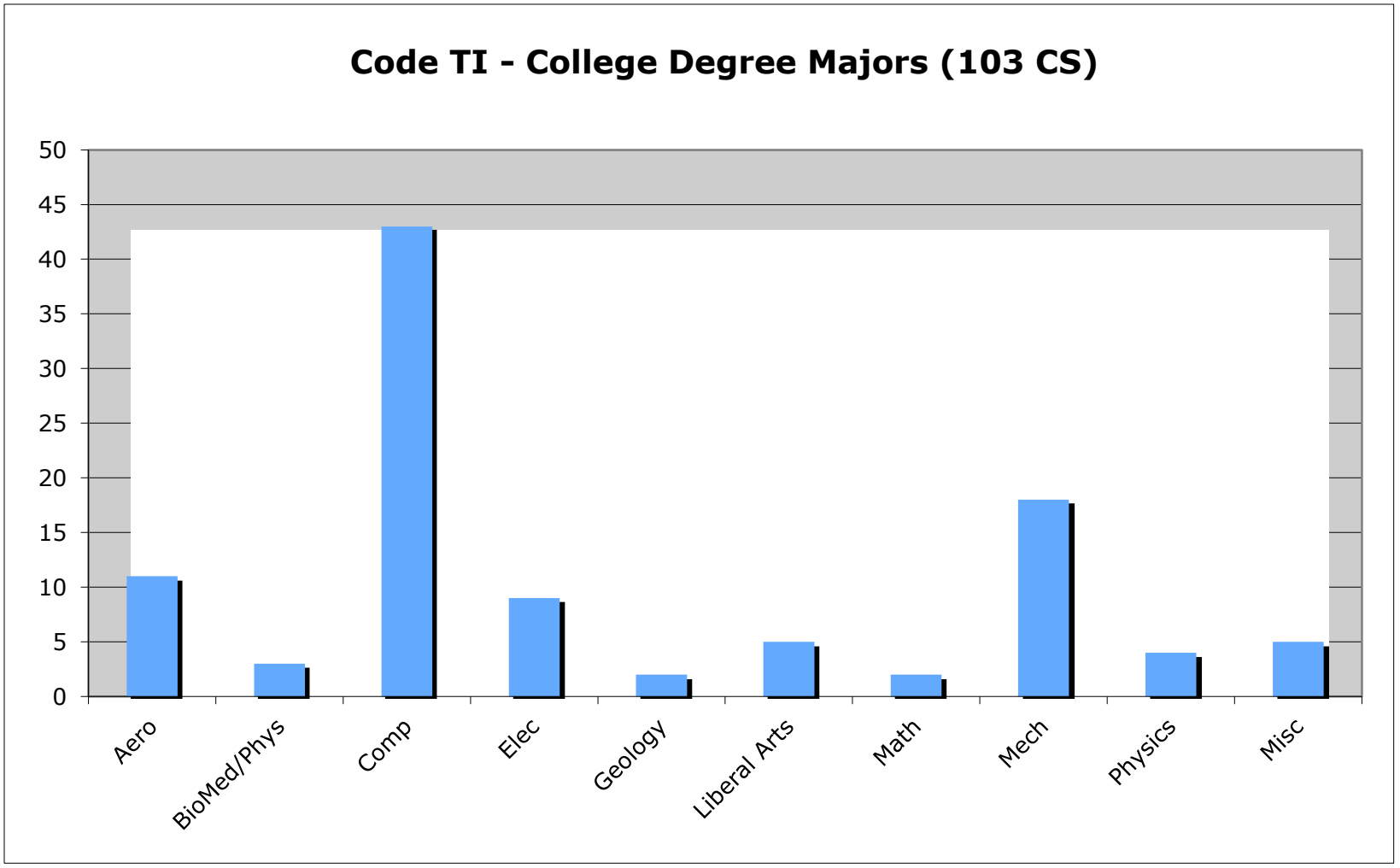


Internal Use Only

Principal Technologies

Software Engineering: static analysis; symbolic execution; model-checking; formal V&V in early design; scalable tools & methods

Automation: components and control systems: planning and scheduling; ISS and science mission operations

Prognostics, Diagnostics & Physics-based Modeling: electro-mechanical actuators; cryogenics; biomass; structures; power generation and distribution; propulsion

Autonomy and Robotics: aircraft emergency landing; autonomous recovery for damaged aircraft; UAVs; rovers; human-robotic teams

Data Sciences: aviation safety & performance; scientific discovery
Information Architecture: analytics; mission operations; enterprise-level systems; securely usable systems

Growth Areas, 2005-2012

Autonomy and automation in civil aviation for airspace management, single-pilot Part 121 operations, and UAVs

Robotics for precursor missions and telerobotics demonstration missions in preparation for next-generation human exploration

Model-based systems engineering, state estimation, prediction of remaining life, anomaly detection and resolution

Data Sciences for all NASA Mission Directorates, FAA, global civil aviation, and other external clients (OGAs)

High-Confidence Software and Systems

Programmatic and Cross-Program Leadership

ARMD System-Wide Safety and Assurance Technology (SSAT Project Manager, Project Scientist)

STMD Autonomous Systems (Project Manager)

STMD Technology Roadmaps

- TA11 “Modeling, Simulation, Information Technology & Processing” (lead)
- TA04 “Robotics, Telerobotics, & Autonomy” (support)
- Avionics Meta-roadmap (support)

Conferences, Workshops, Working Groups

Inter-Agency Software Development Productivity Summit

Conference on Intelligent Data Understanding (annual)

NASA Formal Methods Symposium (annual)

Prognostics & Health Management Society Conference (annual)

SpaceOps (annual)

NASA Spacecraft Fault Management Workshop

NASA Quantum Future Technologies Conference

SAE IVHM Working Group

ISO Working Group on Prognostics

Selected Work for Other Government Agencies

NOAA Geostationary Operational Environmental Satellites-R (GOES-R) - Software Testing

DARPA ADAMS Program – Anomaly Detection at Multiple Scales

DARPA META Program – model-based design of complex cyber-physical systems

DARPA F6 Program – Satellite Technology Package

DIA Multi-modal Psychophysiological Measurement

NSA Quantum Computing – adiabatic model

DOE/Sandia Quantum Computing – adibiatic model

FAA Performance Data Analysis and Reporting System

DOT Toyota Braking Analysis – Software V&V and analysis

Intelligent Systems Division

Technical Area Overviews

Robust Software Engineering Technical Area

Robust Software Engineering (RSE)

RSE is comprised of approximately 20+ individuals, most with advance degrees who produced 57 peer review publications in 2011, 62 in 2010.

RSE staff do not break into groups. The research is often interrelated and organized under three themes:

(1) Advanced verification and validation techniques

(2) Safety assurance technology,

(3) Model-based software engineering and applications.

Technology readiness levels (TRL) for the themes span fundamental to applied, and include opportunities for mission support and technology infusion.

Individuals capable of leading or conducting research and working in a mission culture are highly valued.

RSE research is motivated by NASA's unique problems.

- Research is prioritized against persistent issues across NASA mission directorates: Remote presence; few, unique devices & craft; high assurance; limited resources and etc.
- Problem examples are derived from NASA missions
- RSE technology is typically not export restricted or sensitive.
- RSE leverages the advances from a large community of practice in Comp Sci.
- Staff are expected to develop stature in their respective fields

Best Paper : (Logic in Computer Science 2012); & (SafeComp 2010) **Most Influential Paper** (ICSE 2000); SIGSOFT Impact Paper Award

Keynote Speakers: 6th International Conference on Tests & Proofs 2012, 8th IEEE International Conference on Software Engineering and Formal Methods); Invited Lecture,

SFM-11:CONNECT, 11th International School on Formal Methods for the Design of Computer, Communication and Software Systems: Connectors for Eternal Networked Software Systems, Bertinoro, Italy); (Invited Speaker, Distinguished Lecturer Series "Leon the Mathematician", Aristotle University of Thessaloniki, Greece)

2010:Plenary speaker, 20th International Symposium on Logic-Based Program Synthesis and Transformation);

Google Summer of Code (2012 : 11 Mentors and students; 2011 12 Mentors and students)

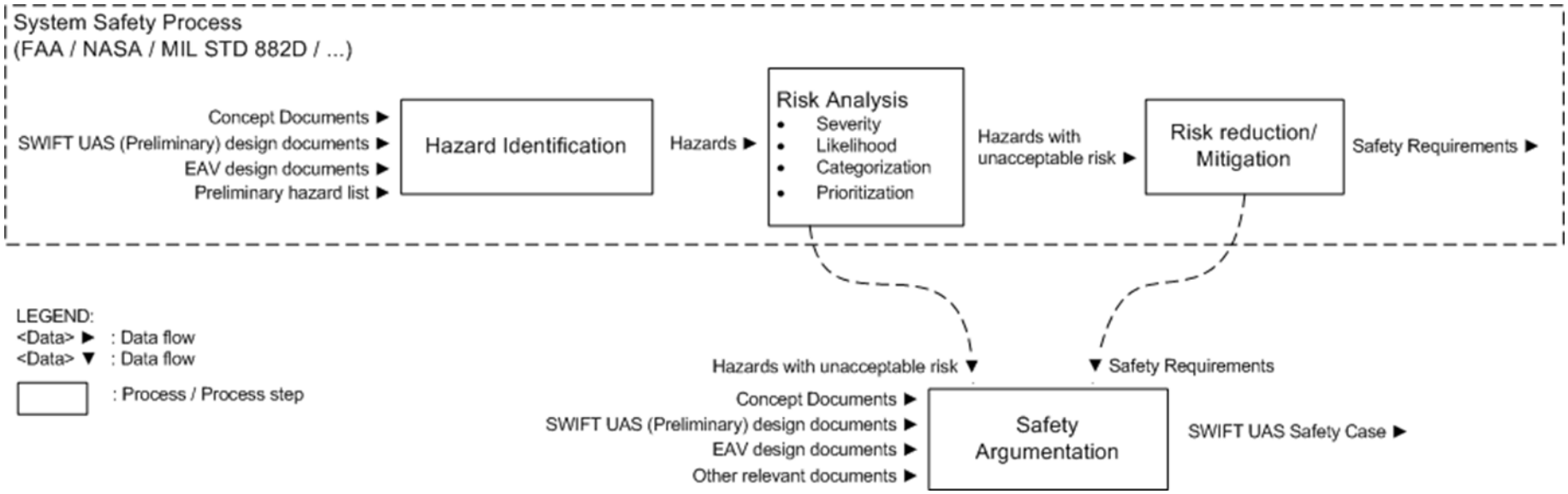
The **advanced verification and validation** theme encompass a wide range of formal and quantitative techniques.

- Frameworks that separate out support services from algorithm development to 1) improve productivity and 2) create useful prototypes for a community of practice and tools for infusion.
  - Low Level Virtual Machine => RSE's MCP & IKOS framework
  - JAVA / Java Virtual Machine => NASA Java Pathfinder, Dalvik / Android verification
  - ECLIPSE => ADVOCATE / Automated Safety Case, AutoCert

  Analysis frameworks need adapting to NASA missions and enhanced performance capabilities (see SoW).
- Novel methods and algorithms and the interplay between various techniques:
  - Model checking and analysis, compositional verification, probabilistic and mathematical approaches to verification, symbolic execution, C/C++ program analysis, program differencing to limit verification and validation (V&V) across different software versions, and smart test case coverage of the verification and validation state space.
- Results are often useful to the two other RSE themes and support the advance capabilities produced by the other three Technical Areas.

The **safety assurance technology** theme includes many methods from past efforts in synthesis projects & applications. It focuses on computer assisted certification using automated program synthesis, verification using annotation inference and theorem provers, and the automated generation of safety cases. This technology has application in the domains of data analysis and state estimation.

AdvoCATE: An Assurance Case Automation Toolset and AutoBayes are examples of work derived from current and past research efforts in automated program synthesis. Techniques from the advance verification and validation theme can be applied to the safety assurance technology theme.



Model-based software engineering and applications theme develops and applies advance tools for software generation in support of NASA missions. The focus is on automation and early in design verification and validation hence this area seeks early in design engineering artifacts such as models of behavior or models used by autocoders that generate code. Support tools provide interfaces and integration with RSE tools such as advance verification and validation techniques, and report logging to feedback results to RSE researchers.

Mission size varies:

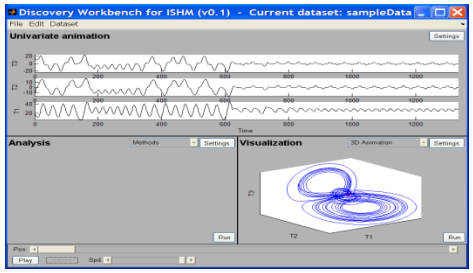
- Large: Adapting RSE methods to work within Orion Contractor's UML tool chain for government oversight. E.g. UML models translated into JavaPathfinder models.
- Mid-sized: Adapt RSE methods and influence NASA owned process on NASA's Lunar Atmosphere and Dust Environment Explorer (LADEE) to use advance static analysis and verification methods without negatively impacting schedule or budget.
- SmallSat: Adapt RSE capabilities on high risk, low budget projects operating with few resources and often reusing legacy, hand generated code.

RSE challenge is to identify opportunities in the development process for conducting early-in-design verification and test.

Discovery and Systems Health Technical Area

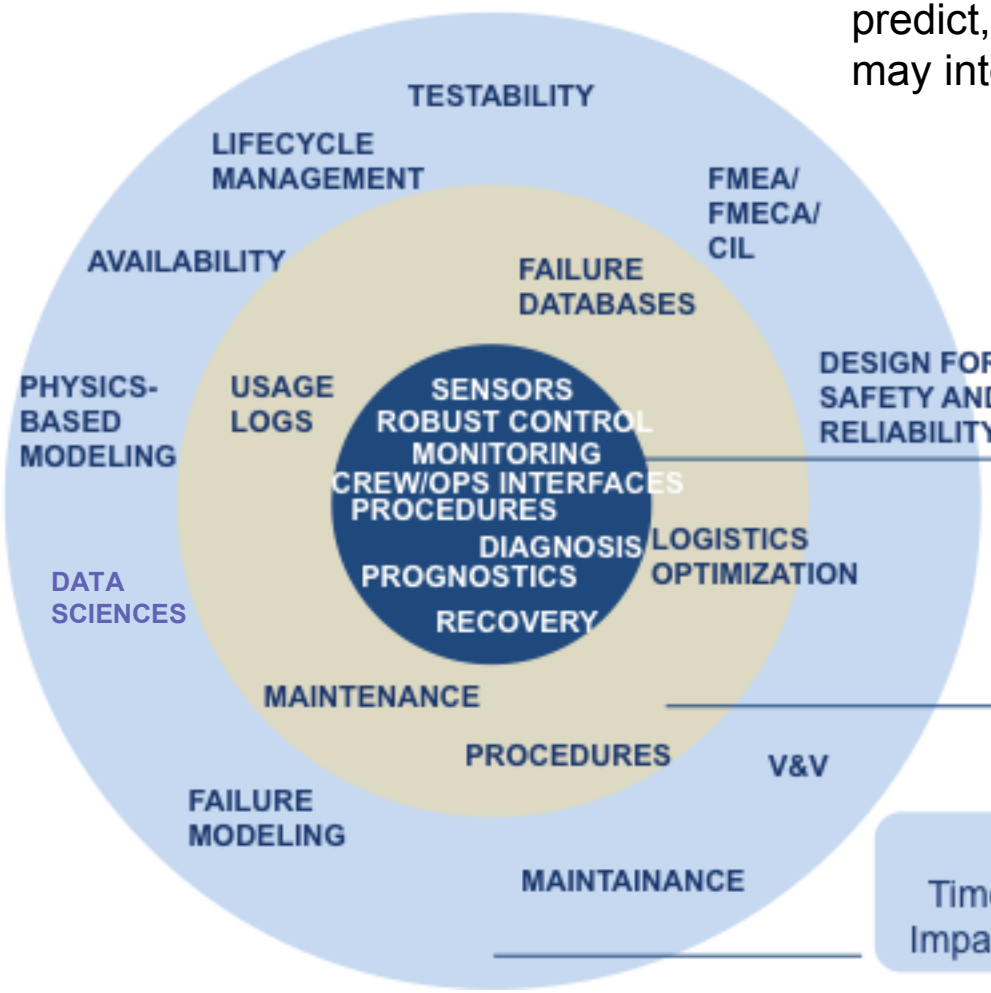
Discovery and Systems Health (DaSH)

- Approximately 60 people in four groups
- Lead ISHM organization within NASA
- Broad range of customers across NASA
- Low-to-mid TRL (1-7) technology development, maturation, and infusion
- Providing state assessment of systems
  - System inception through operation
  - Technology elements
    - Data Mining
    - Failure Prediction
    - Fault Diagnosis
    - Decision Making
    - Physics-Based Modeling
    - Quantum Computing
- Enabling resilience of systems
  - Mitigation of off-nominal conditions



Systems Health Management

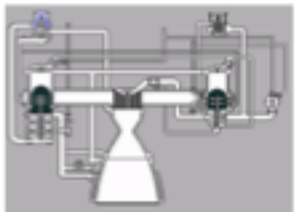
Capability to contain, prevent, detect, diagnose, predict, respond to, and recover from conditions that may interfere with nominal system operations.



OPERATIONAL CYCLE
Time constant: msecs-hours
Impact: Vehicle/system level

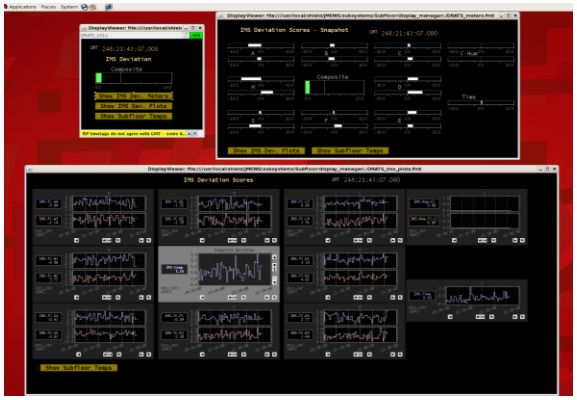
LOGISTICS CYCLE
Time constant: days - weeks
Impact: Fleet level

DESIGN CYCLE
Time constant: years-decades
Impact: System-of-systems level



Applications: ACAWS-Advanced Caution and Warning System

- Fault Management Solution that combines
  - dynamic and interactive graphical representations of
    - systems
    - systems modeling
  - automated diagnostic analysis and root cause identification
  - impact assessment
  - procedure identification
  - FR identification
- Benefits
  - Increased situational awareness
  - A clear representation of system health status
  - Faster and more accurate fault diagnosis and root cause ID
  - Automated mission and system impact assessment
  - Automated procedure and Flight Rule identification
- Approach
  - Architecture integrates distinct technology elements, e.g.,
    - TEAMS
    - IMS
- Results
  - Application to HDU
    - Anomaly detection system for HDU subfloor area
    - Fault diagnosis of HDU power system subset
      - Provided guided troubleshooting by recommending additional manual observations
      - Malfunction and recovery procedures automatically recommended and executed.
      - Level of automation for each instruction user-selectable (automated, consent to proceed, human execution)



Applications: Prognostics for Energy Storage for Electric UAV Propulsion

Problem/State of the Art:

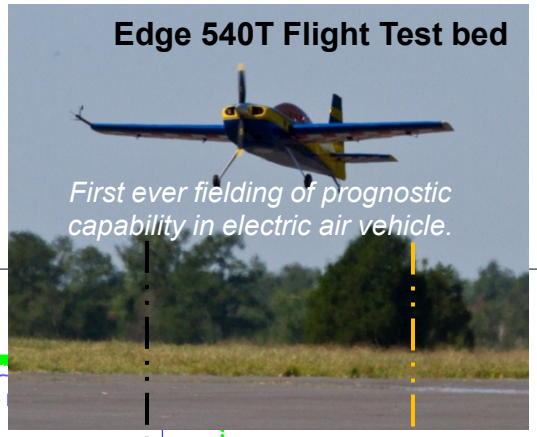
- Current health capability provides alerting when component is at threshold. Conservative flight planning leading to wasted potential flight time.

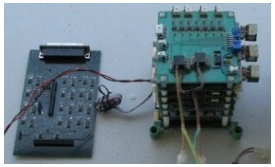
Approach

- Particle filter algorithm to monitor battery usage and project when low limit will be reached.
- Flight test of Health Management and Prognostics to predict Remaining Useful Life (RUL) during flight.
- Benefits
  - Prevents dead stick condition from overestimating battery power.
  - Provides condition based run time updates of available aloft time.
  - Enables flight plan battery estimation and monitoring for on-board contingency algorithms in autonomous system.

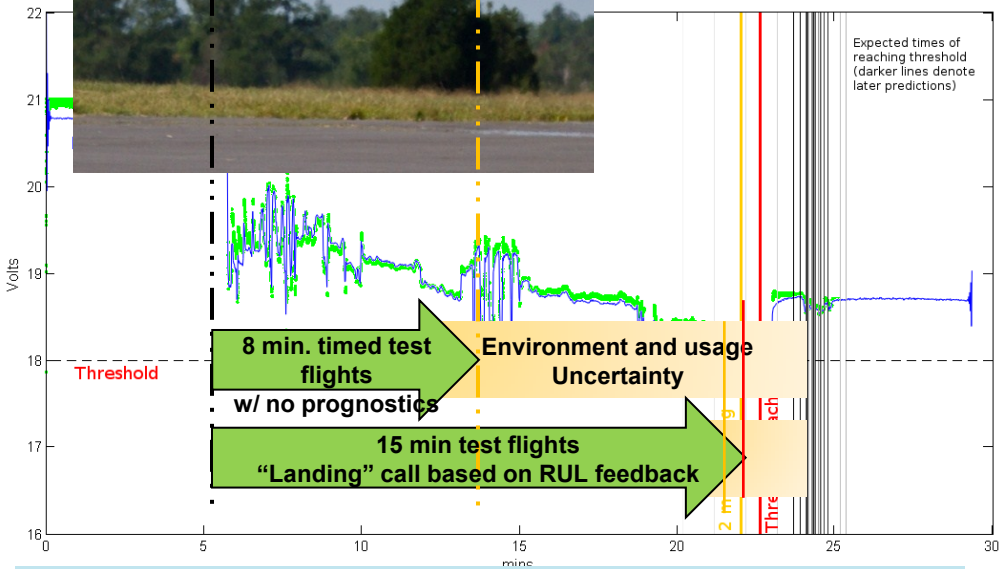
Results

- Early and consistent RUL estimates; amber and read alert warning
- Has resulted in near doubling of flight time due to trust in health management system





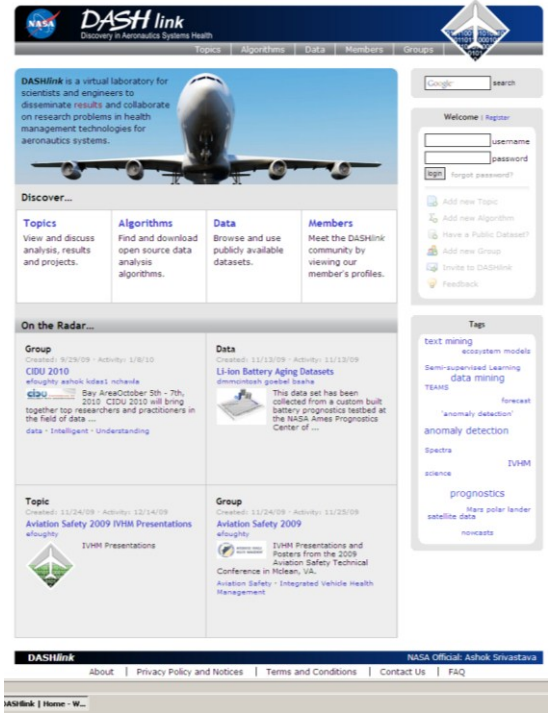
BHM hardware & Real time CPU



"Battery health prognostic feedback adds valuable Safety benefits to mission operations…"
"We are now allowing longer flights because we have Battery Health Management"
Dave Hare,
LaRC Subscale Test Vehicle Flight Operations Director

Applications: Data Mining: Identifying and Tracking Approach and Landing Issues at Southwest Airlines

- Open-sourced data mining software for analyzing flight data recorder output
  - Disseminated via DASHlink, a collaborative IVHM website with over 400 members worldwide.
    - sequenceMiner
      - A discrete sequence analysis program for anomaly detection
    - ORCA
      - A program for mining outliers in large multi-variate data sets using distance-based metrics
- Southwest Airlines employed sequenceMiner and Orca
  - Uncovered operationally significant exceedances of limits specified in SWA's Flight Operations Manual that were not identified by SWA's existing analysis methods:
    - parameter spikes driven by data errors
    - high roll and pitch events near final approach
    - hard nose over prior to landing
  - Events flagged by these software tools will be added to SWA's daily exceedance review.
  - Southwest plans to incorporate these software tools into daily operations – 1600 flights/305 planes.



SOUTHWEST
FLIGHT OPS SAFETY
Flight Data Analysis Program

Applications: LADEE: Fault Management Systems Engineering

Objectives

- Assess the operational capability of single string LADEE to
  - Contain
  - Prevent
  - Detect
  - Isolate, and
  - Respond to conditions that may interfere with nominal mission operations.
- Manage faults and continue operations under various scenarios.
  - Weave “safety nets” by identifying strategies that leverage functional redundancies
- Mitigate the risk of a single string architecture
  - Engaging in Fault Management early in the project phase.

Applications: Ares I-X Ground Diagnostic Prototype

- Ares I-X: the first uninhabited test flight of the Ares I on 10/28/2009
- NASA ARC, KSC, MSFC, and JPL worked together to build a prototype ground diagnostic system
- Was deployed to Hangar AE at KSC, where it monitored live data from the vehicle and the ground support equipment while Ares I-X was in the VAB and while it was on the launch pad
- Combined three data-driven and model-based IVHM algorithms: TEAMS-RT, IMS (aka AMISS), and SHINE
- Focused on diagnosing the first-stage thrust vector control and the ground hydraulics
- Ensured a path to certification
- Kept up with live data from 280 MSIDs using only a PC
- Funded by Ares I, by ETDP, and by KSC Ground Ops

Autonomous Systems and Robotics Technical Area

Autonomy Research and Development for Human-Machine Endeavors

Autonomous Systems & Robotics

Lead : Kalmanje KrishnaKumar

Deputy : Kevin Wheeler

AAS
Applied Avionics Software Group

GL: Greg Dorais

ACES
Advanced Control And Evolvable Systems

GL: Nhan Nguyen

DGL: John Kaneshige

DAT
Deployable Automation Technologies

GL: Brian Glass

IRG
Intelligent Robotics Group

GL: Terry Fong

DGL: Maria Bualat

PSG
Planning and Scheduling Group

GL: Jeremy Frank

Staff Strength:

~100 Engineers and Scientists
~32 Civil Servants
~68 Contractors

Group Descriptions

Applied Avionics Software (AAS)

AAS group performs applied research, development, and testing of avionics ITAR NASA Class B software for flight missions. AAS is a part of the TI CMMI L2 organization and practices model-based software engineering. The main focus is on raising the TRL of autonomy technologies and integrating autonomy systems into flight software. The group has experience in developing and deploying avionics software for a wide variety of missions.

Advanced Control and Evolvable Systems (ACES)

The main focus of ACES group is to conduct research and development of advanced flight control architectures and real-time flight simulation capabilities. The core competencies of ACES group include intelligent guidance, navigation, control, modeling and simulation technologies. ACES conducts foundational and applied research in adaptive, robust, and optimal control; trajectory guidance and planning; advanced concept aircraft design; and evolvable systems for automated design.

Deployable Automation Technologies (DAT)

DAT group conducts applied research and development in automated planetary and small-body sample acquisition and handling systems, and instrument automation and health monitoring. Lightspeed communication delays require that space sample acquisition systems, such as drills, must be autonomous and able to self-recover from faults. The focus of the group is in instrument and sampling automation technologies for realizing this need.

Intelligent Robotics Group (IRG)

IRG is dedicated to exploring extreme environments, remote locations, and uncharted worlds. IRG conducts applied research in a range of areas including computer vision, digital mapmaking, geospatial data, ground data systems, human-robot interaction, interactive 3D user interfaces, robot navigation, and robot software architecture.

Planning and Scheduling Group (PSG)

PSG builds automated planning and scheduling systems and discrete control system for NASA missions. These planning and scheduling systems are essential components for the operation and automation of manned spacecraft, deep space probes, planetary rovers, instruments such as drills, autonomous vehicles, fixed wing aircraft, and rotorcraft

Sample ASR Projects

AAS

LADEE Avionics, SMD

Edison Demonstration of Smallsat Networks (EDSN) Avionics, (

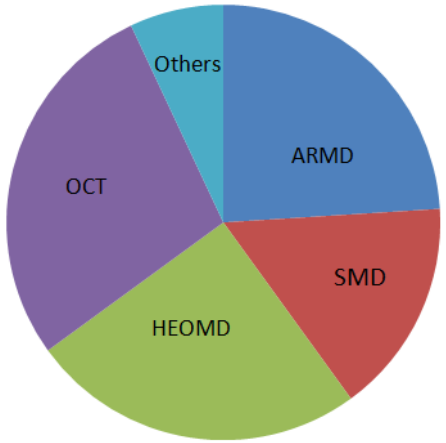
SWORDS/ CNAT Avionics, OCT

ACES

Elastically Shaped Aircraft, ARMD

Loss of Control Prediction, ARMD

Tactical Flight Management, ARMD



IRG

HET (SPHERES, surface telerobots, RAPID), OCT

Disaster Response (GeoCam)

Ground Systems: xGDS & VERVE (AES Analogs, HRS-HSI, LASER-Matt)

Mapmakers (LMMP, LASER-Ara)

PSG

Solar Array Constraint Engine, HEOMD

Autonomous Mission Operations , HEOMD, OCT

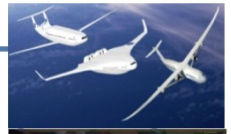
Emergency Landing Planner for Damaged Aircraft, ARMD

DAT

Icebreaker Project, SMD

Autonomy Research and Development for Human-Machine Endeavors

- Intelligent Control
  - Adaptive & predictive control
  - Flight planning
- Computer Vision
  - Planetary rovers & free flyers
  - UAV autonomy
- Intelligent Robotics
  - High fidelity dynamics models
  - Digital terrain models
  - NASA vision workbench
- Flight Management Systems
  - Elastically shaped A/C
  - Uncertainty quantification & inference
- Automated Planning & Scheduling
  - Giga Pan
  - Tensegrity robots
- Machine Learning
  - Cubesat designs
  - Drilling automation
  - Evolvable designs
- Avionics Software
  - Model Based Flight Software Development
  - Research labs


Nextgen Aircraft GN&C

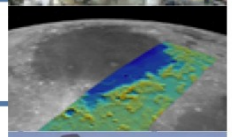

Autonomous Mission Operations


Small S/C Avionics


Automated Drilling


Autonomous Rovers

Telerobotics – Free-flyers


Planetary Mapping

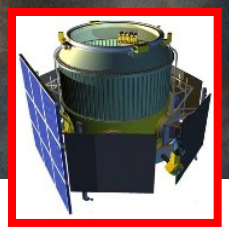

Electric Aircraft Autonomy

http://ti.arc.nasa.gov/tech/asr

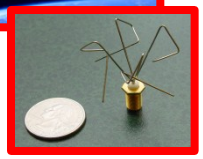
ASR Technologies – A History of Success

National Aeronautics and Space Administration

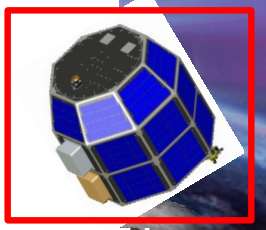
1999-present



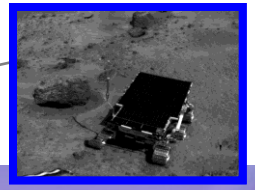
PHERES



Science
Lab



E Lunar
biter



Visualization Tools

Collaborative and Assistant Systems Technical Area

Collaborative Assistant Systems (CAS)

Develops information technologies and collaboration tools that facilitate the specialized work of distributed teams in NASA mission settings.

Mission Statement: The goal of the collaborative and assistant systems research is to design new information technologies and collaboration tools that facilitate the process by which NASA engineers, scientists, and mission personnel collaborate in their unique work settings. The research activities in this area focus on applying information management, artificial intelligence, and computer-supported cooperative systems that are more usable, augment human cognition, and facilitate the specialized work of distributed teams in NASA mission settings.

Collaborative Assistant Systems Technical Area

50+ Civil servants and contractors

Area Lead
Mr. Richard Papasin

Deputy Area Lead
open

Chief Scientist
(Info Management Technologies)
Dr. Richard Keller

Chief Scientist
(Human-Centered Computing)
Dr. William Clancey

Mission Themes:

Multi Mission Operations & Tools
Mr. Jay Trimble

Aeronautics Assistant Systems
Dr. Deepak Kulkarni

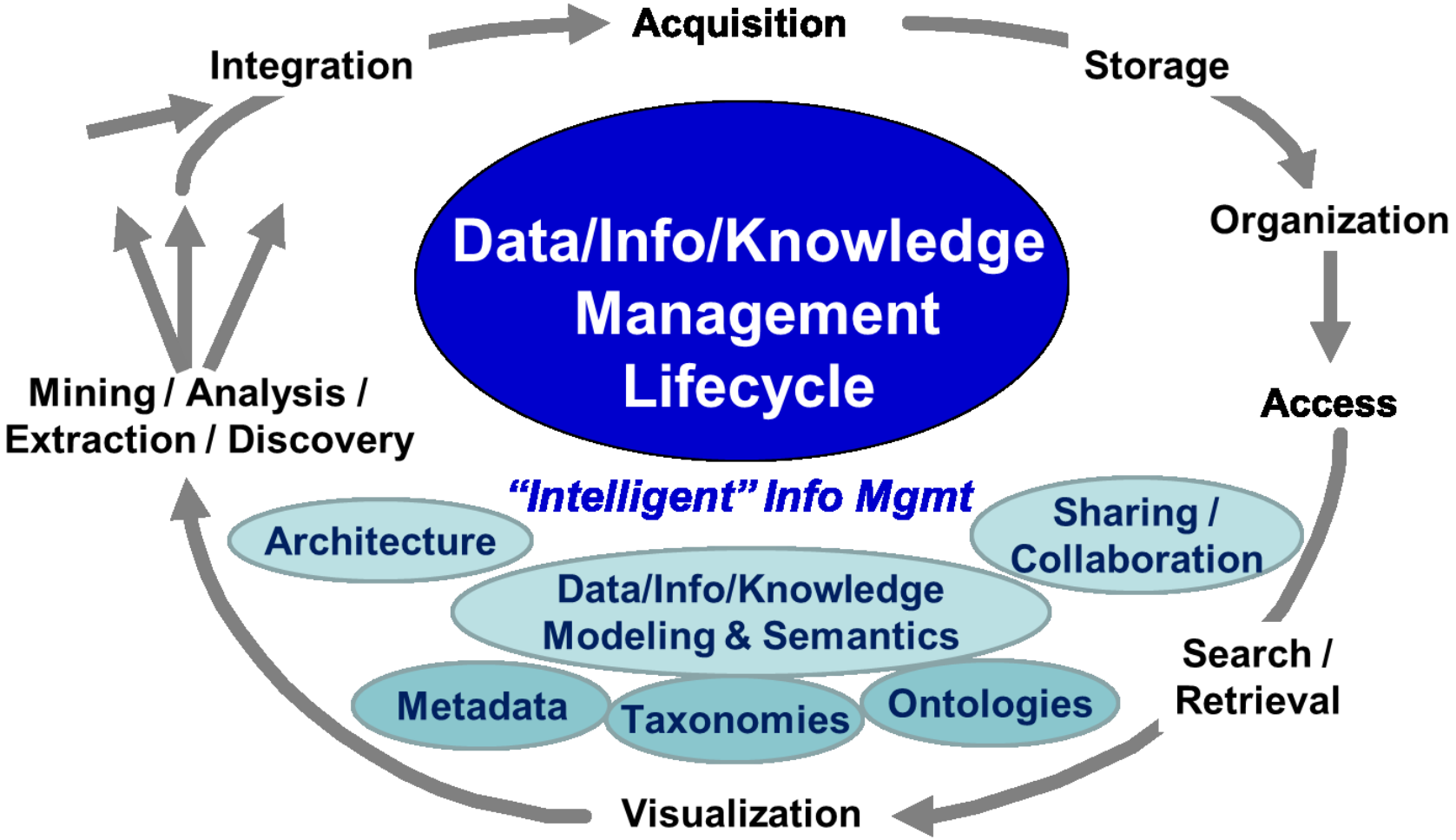
Human Spaceflight and Research Systems
Mr. Ernest Smith

Collaborative Exploration Systems Development
Ms. May Windrem

Science Mission Support
Dr. Aaron Duley

Agency Information Technologies
Mr. Ian Sturken

CAS Technology Focus 1:
Information Management Technologies

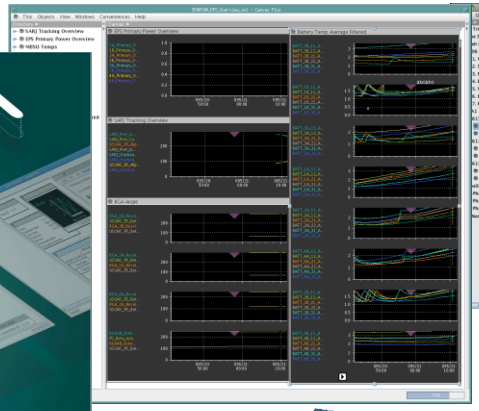


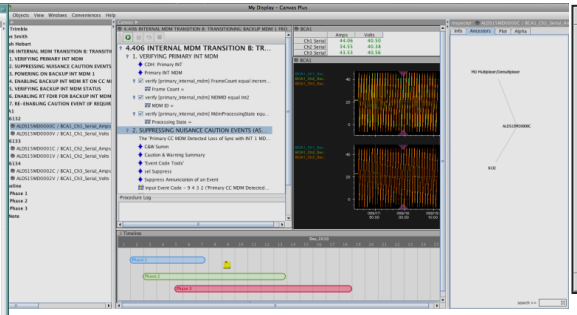
CAS Technology Focus 2:
Human Centered Computing

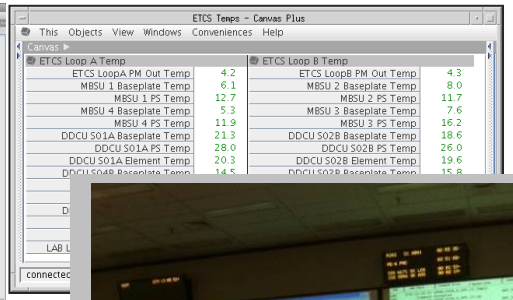
- **Participatory Design (Project Partnership)**
- **Ethnography**
  - Participant Observation
  - Photography & Time-Lapse Video
  - Field Notes
  - Interviews (oral histories) & Surveys
- **Video Interaction Analysis**
- **Empirical Requirements Analysis**
  - Field experiments with prototypes doing authentic work
- **Work Practice Simulation**
- **Simulation-To-Implementation System Development**
- **Invent Technologies to Enhance Human Capabilities**
  - Perceptual-Motor: Monitoring, VR, Teleoperation
  - Cognitive: Agent-Based Workflow Systems
  - Social: Networking Sites, Customized News, Translators

MCT: Mission Critical Technologies

MCT brings information from many sources through one consistent, intuitive interface. This capability replaces stove-piped tools, each of which has its own data set, data format, and user interface. MCT provides a framework and toolset for user tools in multiple environments. Applying MCT as a standard user interface tool across multiple facilities reduces costs associated with maintaining unique facilities and training personnel to use those facilities. MCT is being developed for capabilities across tech areas and directorates at Ames, JPL, and JSC.







Framework provides core services and manages components

Database Loader
Legacy File Converter
Developer Toolkit
Relational Database

Utilities that support MCT component development and data management

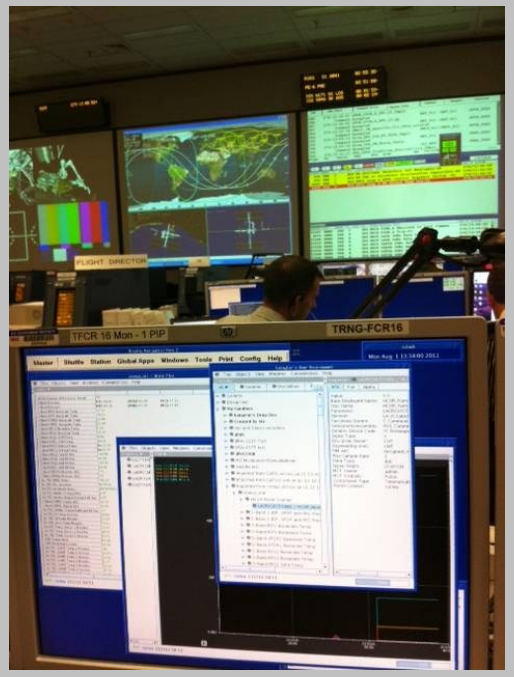
Database to store MCT content and share objects among users

Components provide user functions

Adapters provide interface to external data sources

Java

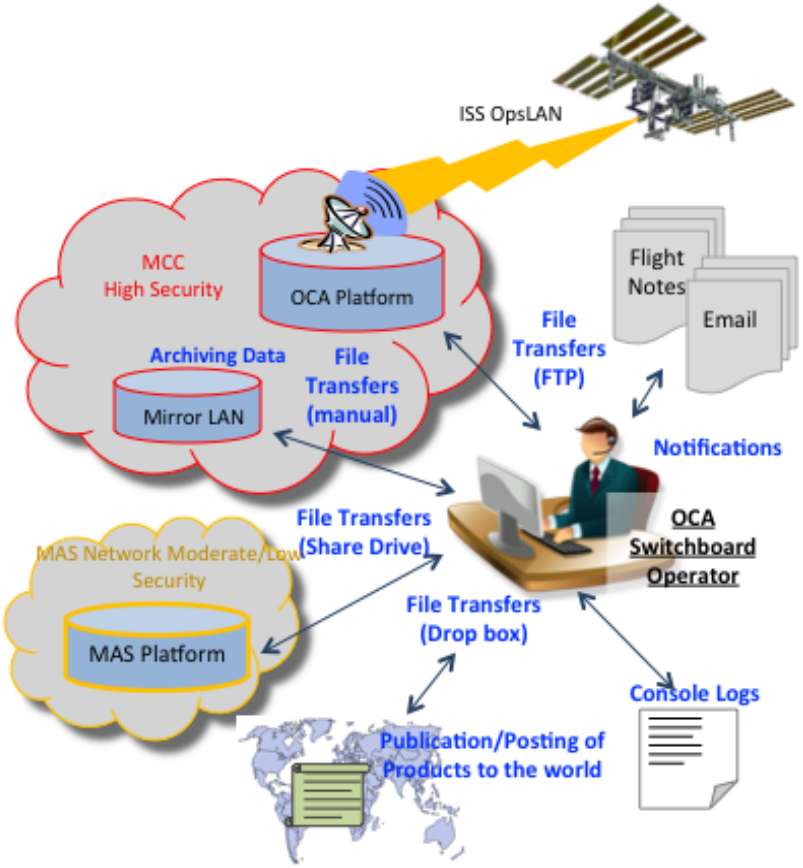
OSGi Alliance



MCT in JSC's Mission Control Center

OCAMS: Orbital Communication Adapter Management System
Agent-Based Application Augmenting Flight Control

OCAMS automates and facilitates two-way communication and coordination between the Space Station crew and the operations staff on Earth by routing instructions, photos, e-mail, data, and documents, and by performing notification and alerting functions. OCAMS utilizes a multi-agent Brahms framework to manage the OCA workflow. Agents interoperate seamlessly with existing Mission Control software to perform OCA tasks.



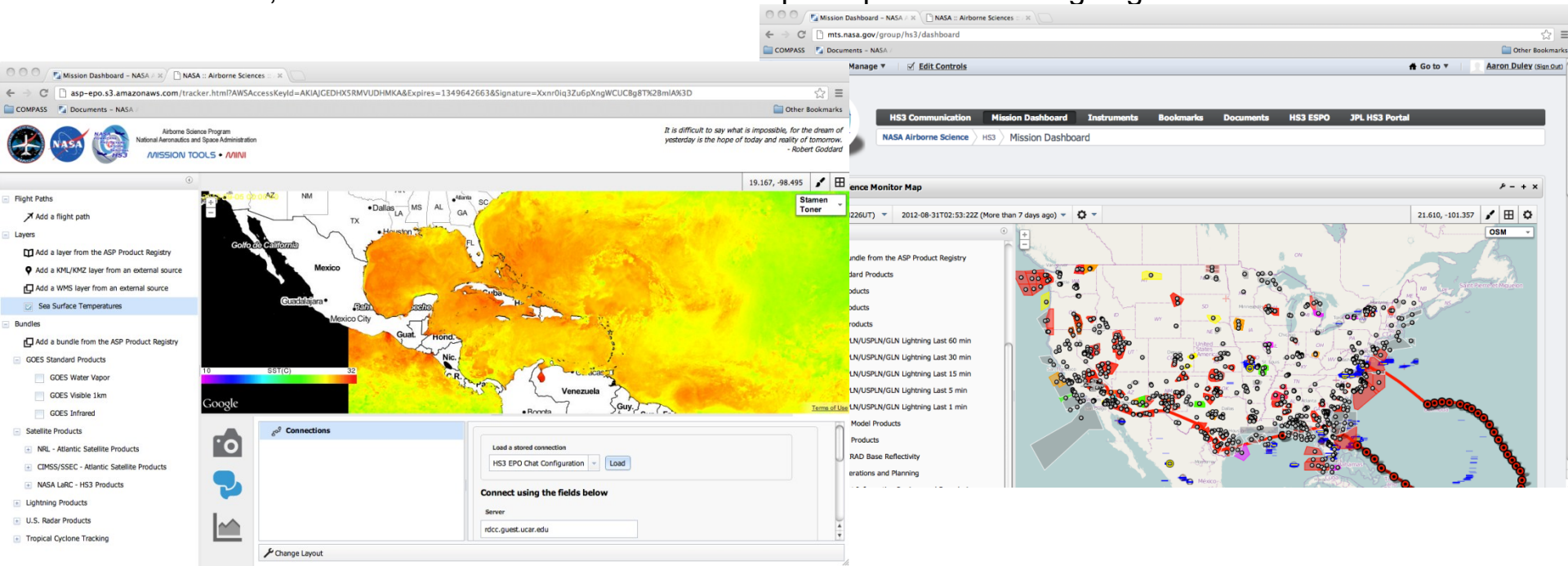
National Aeronautics and Space Administration

Ames

Discovery Innovations Solutions

MTS: Airborne Science Mission Tool Suite

The NASA Airborne Science Mission Tools Suite (MTS) is a collection of web-based software tools, accessible in a single integrated environment, that can assist in the planning, monitoring and execution of Airborne Science Missions. At its most basic, MTS enables *(a) tracking the near real-time position of aircraft, (b) the visualization of geo-referened model and scientific data products, (c) the remote monitoring of instrument measurements and status, and (d) the facilitation of distributed team communication and collaboration.* These capabilities are largely enabled by the NASA SensorNet project, which is developing the airborne networking infrastructure to enable SATCOM of aircraft parameter data, and instrument data during flight missions. MTS represents the companion ground segment to the SenorNet project, both of which contribute to the Airborne Science Program's multi-center and cross-cutting infrastructure team. MTS also supports education and public outreach versions, such that teachers and students can participate with an ongoing mission.



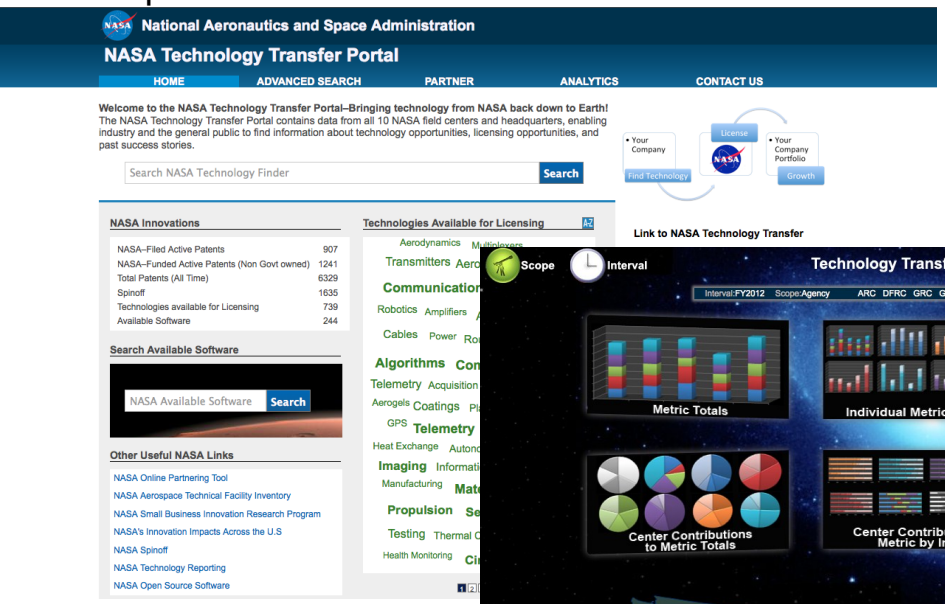
National Aeronautics and Space Administration

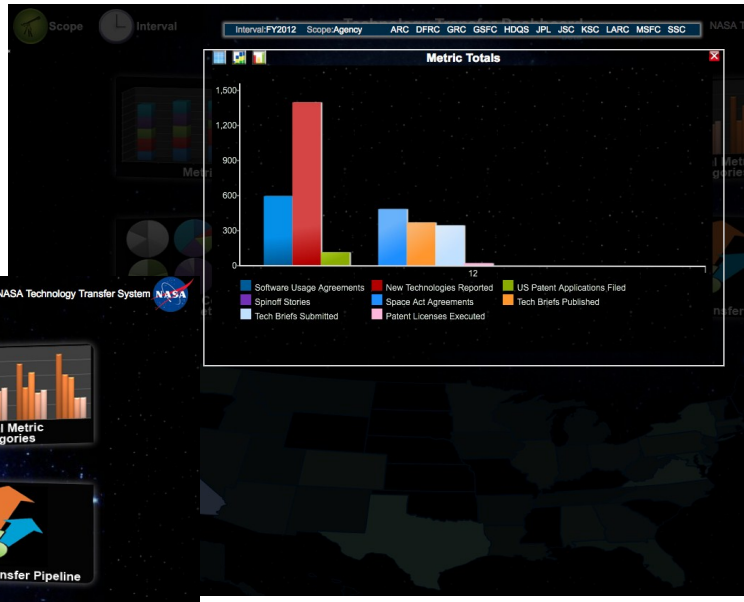
Ames

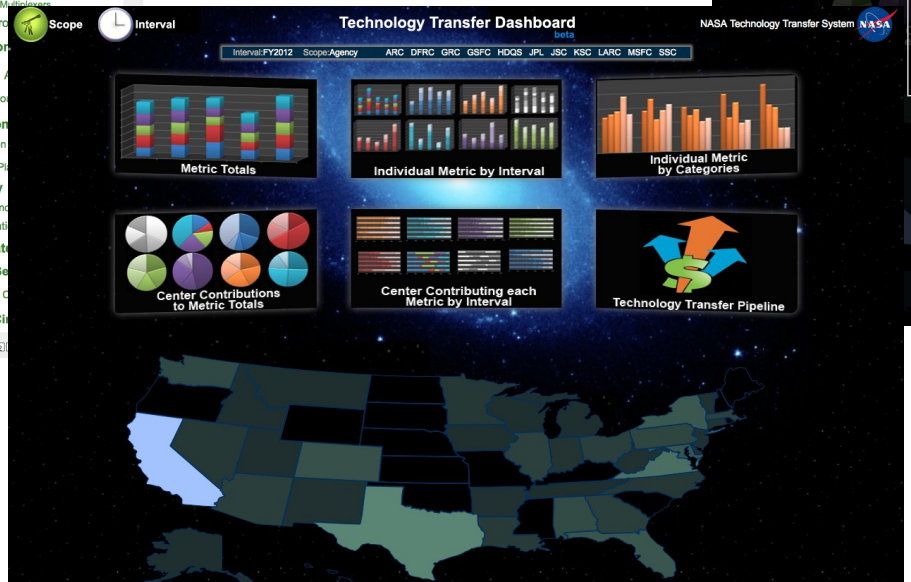
Discovery Innovations Solutions

NTTS: NASA Technology Transfer System

NTTS is a web-based database application that supports the Agency's entire technology transfer process. NTTS is the Agency's sole system for all of its technological data assets, including New Technology Reports (NTRs), technology transfers, patents, contract grants, partnerships, software releases, tech briefs, success stories, waivers, New Technology Summary Reports (NTSRs), awards, leads, licenses, and Technology Opportunity Sheets (TOPS). NTTS leverages a schema-less XML database that integrates data and provides benefits, such as flexibility of data storage, easy integration with outside systems, and rapid application development.







Closing Comments