

Technology Needs: Aeronautics

T. Edwards

1. List other **strategic opportunities** for Ames to consider.
2. List other **technical capabilities** resident at Ames.
3. What other **capabilities** do we need **to address new opportunities**?
4. What **studies, collaborations, resources** are needed to position Ames to successfully address these opportunities?

Technology Needs: Exploration

E. Tu

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Technology Needs: Science

M. Bicay

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2. List other **technical capabilities** resident at Ames.
3. What other **capabilities** do we need **to address new opportunities**?
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Technology Needs: OCT

J. Hines

1. List other OCT technology **gaps and/or overlaps**.
2. How do the **OCT roadmaps** relate to the **Ames Technology Expertise Areas**?
3. How do you see the **Ames supporting the roadmaps**?
4. How do you see the **roadmaps supporting Ames**?
5. What is the correct balance between **push vs pull** technologies?

ARCTek 2012

Strategic Technology Vision for Ames



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As you listen to each presentation, please consider how you would answer each of the questions below. During the interactive portion of ARCTek, you will have an opportunity to discuss your answers with colleagues.

Technology Needs: The Nation and Agency

P. Worden

1. **What R&D (or technologies) should Ames invest in**, that we currently are not, to achieve NASA's priorities and maintain our technological edge?
2. What **partnerships** should we cultivate to create new opportunities for Ames?
3. In what ways can we **do more with less** to revolutionize access to space?
4. How else can we **position Ames assets and its workforce** to achieve new ways of doing business, or more efficiently perform/manage the work we have?

Technology at Ames Research Center

S. Zornetzer

1. What core **technical competencies** and/or capabilities should we **emphasize/de-emphasize**?
2. How can Ames be more **effective and efficient** at responding to opportunities?
3. What Ames organizations should investigate **teaming arrangements** to prepare for new work?
4. How can mission support organizations better **enable technology developments** and innovation?

Technology Expertise Areas



1. SPACECRAFT SYSTEMS AND TECHNOLOGIES

»Spacecraft Systems and Architectures

- Mission Architectures
 - Clusters
 - Motherships/Hubs
 - Constellations
 - Formations
 - Swarms
- Platforms
 - Pico Satellites
 - Nano Satellites
 - Micro Satellites
 - Small Satellites

»Subsystems and Components

- Avionics
- Propulsion
- ADCS
- Structures and Materials
 - Materials
 - Structures
 - Mechanical Systems
 - Manufacturing
- Thermal Control and Management
- Communications
- Power
- Software

»Systems Engineering

- Subsystems Trades
- V & V
- Requirements Analysis

»Payloads and Instruments

- Life Science
- Space Weather
- Earth Observation
- Planetary Atmospheres
- Planetary Probes
- Heliophysics
- Assembly, Integration, Test
- Accommodations

»Sample Return and Reentry Technologies

- EDL
- Sample Acquisition
- Sample Recovery
- Preparation and Handling
- Containment
- Environmental Monitoring and Control

»Free Flyer Space Biotechnology

- Flight Systems Integration, Test and Operations
- Habitat Design and Development
- Experimental Sensors and Measurement Tools

»Mission Operations, Range Support, and Ground Systems Technologies

- Mission Operations Technologies
- Ground Systems and Technologies
 - Mission Planning Systems
 - ISHM
- Range Support Technologies

»Software Systems, Enabling Tools, and Associated Technologies

- End-to-End Mission Design and Simulation
 - Orbital Trajectory
 - More
 - Concept
 - Science Traceability
 - Instrument Definition
 - Ground Systems

- Software Systems
 - Mission Assurance Systems
 - Hardware-in-the-Loop Testing
 - Mission Design Technologies
- Enabling Tools

»Additional Areas to be Worked

- Power Systems
- Thermal
- Miniaturization
- Advanced Materials
- Radiation Hardening
- Plug and Play Capability
- Sustainability
- Intelligent Systems
- Autonomous Subsystems

2. SUSTAINABLE AND SUSTAINING TECHNOLOGIES

»Clean Energy

- Biofuels
 - Cellulosic
 - Algal
 - Algal Genetic Differences
 - Systems Engineering
 - ♦ Integrate Component Processes
 - ♦ Assess Potential Sustainability and Ecosystem Impacts
- Solar
 - Sun Photometry
 - Photovoltaic
 - Thermal
- Piezo
- Wind
- Climate Change/Future Environment
 - NASA Earth Exchange

»Building Management

- Prognostics
- Intelligent Control
- Water Recovery
- Data Mining/Analytics

»Modeling

- Predictive Modeling
- High End Computing
- Computational Throughput
- Predictive Modeling
- Visualization
 - Hyperwall

»Sustainable Systems

- ISRU
 - Bio ISRU
 - Water Recycling
 - Air Revitalization
 - Solid Waste Management
 - Systems Analyses/Trade Studies
- Bioremediation
- Green Aviation
 - Electric Aircraft
 - Airships
 - Air Traffic Management
 - Rotorcraft
 - Fixed-Wing

»Prognostics for Sustainable Systems

- Energy Storage
- Algal
- Electronics
- Mechanical
- Wind Turbines
- Microgrid Health

3. NANO AND MICRO TECHNOLOGIES AND SYSTEMS

- Energy Conversion and Control
 - Nano Wire-Based Solar Cell
 - Substrate Sculpting for Enhanced Solar Energy Capture and Conversion
 - Graphene and CNT Based Super Capacitors
 - Materials and Device Energy Conversion
 - Nanostructured Materials for Energy Harvesting and Saving
- Nano Medicine
 - Drug Delivery
 - Wound Healing
- Engineered Materials and Structures
 - Computational Modeling
 - Carbon-Based Nano Structures
 - Wafer Scale Graphene
 - Single and Multi-Walled CNT
 - Nano Scale Additives for Oxidation resistance and Toughening
 - Radiation Hardening Materials
 - Lightweight Materials for TPS
 - Materials for Biomedical Applications
 - Multifunctional Hybrid Laminate Structures with Aligned CNT for Structural NDE
 - Hierarchically Organized Materials – Nano Wires
 - Adhesive Materials
- Propulsion
 - Sensors, Electronics, and Devices
 - Chem Sensors
 - Radiation Sensors
 - Biosensors
 - Radiation Resistant Non-Volatile Memory
 - X-Ray Tubes for Instrumentation
 - Flexible Substrate Electronic Devices
 - Nano Antenna and Metamaterials-Based Optoelectronics and Plasmonics
 - Waveguide Device Fabrication for High Sensitivity Optical Detections and Enhanced Energy
 - Biophotonics and Chemical Imaging Using Multi Mode Optical Fibers and Microfluidics
 - Electro-Optical Materials for Optical Switch and RF and IR Detectors
 - Fiber Electronics for E-Textiles

4. SENSORS, INSTRUMENTS, DEVICES, MATERIALS, PHOTONICS, AND OPTICAL IMAGING

- Sensors
- Instruments
- Devices
- Materials
- Photonics, Optics

»Aeronautics Test

- Wind Tunnel Experimental Technology
 - Photogrammetry
 - Schlieren
 - ♦ RBOS
 - PIV
 - Pressure Sensitive Paint

5. AERONAUTICS

- Global Prediction, Monitoring and Response
 - Predicting and Modeling Global Changes
 - Biospherics
 - Atmospheric
 - Monitoring and Assessing the Risks
 - Responding to Catastrophic Events
- Integrated Systems
 - Environmentally Responsible Aviation (ERA)
 - Unmanned Aerial Systems (UAS)
- Fundamental Aeronautics
 - Experimental Fluid Dynamics
 - Hypersonic
 - Supersonic
 - Subsonic
 - Rotary Wing
 - Fixed Wing
 - Aerothermodynamics
 - Aeromechanics
 - Guidance Navigation and Control
 - Systems Analysis
 - Multi-Disciplinary Design, Analysis and Optimization
 - Aeroelasticity
 - Aero-Servo-Elasticity
 - Aero-Propulsive-Servo-Elasticity
 - Aerodynamics
- Airspace Systems
 - Simulation Facilities
 - Modeling and Simulation
 - Human-in-the-Loop Simulation
 - Collaborative Traffic Flow Management
 - Uncertainty Characterization
 - Data Fusion
 - Traffic Management Optimization
 - Guidance Navigation and Control
- Aviation Safety
 - Prognostics
 - Data Mining
 - Human-Automation Integration
 - Computer Science
 - V&V of Flight Critical Systems

6. HYPERSONICS AND ENTRY, DESCENT, AND LANDING (EDL) TECHNOLOGIES

- Aerothermodynamics
 - Computational Fluid Dynamics (CFD) Development and Application
 - Fluid Dynamics
 - High Temperature Shock Tube Testing
 - Electric Arc-Driven Shock Tube
 - High Temperature Gas Physics
 - Ballistic Range
 - Shock Layer Radiation Modeling
 - Supersonic Aerodynamics
 - Ballistic Range
- TPS Materials
 - Material Characterization
 - Material Modeling
 - High Temperature Material Processing
 - Material Science
 - Material Engineering
 - TPS Design and Development
 - TPS Evaluation and Certification
 - Arc Jet Complex
 - TPS Sizing
- Entry System Development
 - Engineer Design and Analysis
 - Airborne Entry Observation
 - Free Flight Testing
 - Flight and Ground Hardware Development
 - Concept Development
 - Ballistic Range
 - TPS Margin and Reliability Process Development
 - TPS Instrumentation Development
 - Entry System Engineering
- High Enthalpy Testing
 - TPS Instrumentation Development
 - Facility Characterization
- Multi-Physics Modeling and Simulation

7. INFORMATION TECHNOLOGIES

- Software
 - Avionics and Controls
 - Flight Avionics
 - Spacecraft Flight Software
 - Software Engineering Technologies
 - Tools
 - Verification and Validation
 - Mission Operations
 - Human Spaceflight
 - Science Spacecraft
 - Unmanned Aerial Systems (UAS)
 - Community Open Source Development
 - Policy
 - Practice
 - Agile Software Development
- Web Applications
 - Development
 - Hosting
 - Operations
- Information Processing
 - Decision Support Systems
 - Collaborative Design
 - Work Systems Design
 - Data Mining
 - Integrated Information Systems
- High Performance Computing
 - Modeling and Simulation
 - Visualization
- Intelligent Systems
 - Integrated Systems Health Management
 - Physics-Based Modeling
 - Diagnostics and Prognostics
 - Functional Fault Analysis
 - Machine Learning
- Mixed-Initiative Systems
- Autonomous Systems
 - Autonomy
 - Controls
- Robotics
 - Autonomy, Planning, Scheduling, Execution
 - Unmanned Aerial Systems (UAS)
 - Image Processing
 - Robotic Systems
 - Drilling
- Human-Systems Engineering
 - Human-in-the-Loop Simulation
 - Controls
 - Simulation
 - Human Factors
 - Roles and Responsibilities
 - Function Allocation
 - Operations Definition
 - Design Requirements
 - Lifecycle Maintenance and Repair
 - Displays and Controls
 - Human-Computer Interaction
 - Needs, Task, and Workload Analysis
 - Process Engineering
 - Decision Support Systems
 - Data Management Systems
 - Collaboration Support Systems
 - Human-Computer Interaction
- Cloud Computing
 - Infrastructure as a Service
 - Platform as a Service
- Information Security
 - Security Penetration Testing
 - Security Planning
 - Agency Security Operations Center
 - Security Services Engineering
 - Incident Management
- Networking
 - High Performance Networking
 - Advanced Network Peering
 - LAN/WAN Engineering
 - LAN/WAN Operations

8. EXPLORATION TECHNOLOGIES

- Human Performance
 - Modeling and Simulation
 - Cognitive Modeling
 - Measures and Metrics
 - Vision Research
 - Visiomotor
 - Countermeasures and Mitigation
 - Performance Enhancing Technologies
 - Advanced Displays
 - Acoustics
 - Haptics
 - Manual Control
 - Virtual Environments
- Multi-Agent Operations
 - Human Collaboration and Teamwork
 - Human-Automation Integration
 - Human-Robotic Integration
 - Crew-Vehicle Systems Integration
- Training
 - Protocol/Curriculum Development
 - Skill Assessment and Maintenance
 - Customization for Individuals
 - Just-in-Time/Onboard Systems
- Robotics
 - Human Robotic Systems
 - Sensing and Perception
 - Mobility
 - Manipulation
 - Autonomous Rendezvous and Docking
- Human Exploration Technologies
 - Medical Monitoring and Care Technologies
 - Telemedicine
 - In Space Monitoring
 - Environmental Control and Life Support
 - Atmosphere Revitalization
 - Water Processing
 - Waste Management
 - Systems Engineering
 - Human Health and Performance
 - Exercise Countermeasures
 - Artificial Gravity
 - Bio Sentinels
 - Psychophysiology
 - Radiation
 - Biological Countermeasures
 - Physical Countermeasures
 - Dosimetry
 - Human-Centered Planning Systems
 - Integrated Information Systems
- Autonomy and Avionics
 - Automated Planning Technology
 - Discrete Control Technology
 - Software Verification Algorithms
 - Avionics and Processing Systems
 - Instrumentation and Sensors
 - Technology Integration

9. SPACE AND EARTH SCIENCE TECHNOLOGIES AND APPLICATIONS

- Space Science Technologies and Applications
 - Instruments, Observatories and Sensor Systems
 - Remote Sensing Instruments / Sensors
 - ♦ Detectors and Focal Planes
 - Optical
 - Infrared (Near and Far)
 - Radiation Testing
 - Electronics
 - Detector Control and Readout
 - Optical Components
 - ♦ Spectrometer
 - Echelle
 - Grism
 - ♦ Polarimeter

10. BIOLOGICAL TECHNOLOGIES AND APPLICATIONS

- Cryogenic / Thermal
 - LN2 and LHe Cryostat Design
 - RET Developments
 - Temperature Control Systems for Optical Systems
- In-Situ and Analog Instruments / Sensors
 - Sample Capture / Return
 - Sample Detection, Isolation, Tagging, Identification, Transport
 - Sample Acquisition, Handling and Delivery
 - Robotic Planetary Access, Subsurface Drills, Rovers, ISRU (In Situ Resource Utilization)
 - Sterilization / Cleaning Technology
 - Tools and Analog Testbed Integration
 - Instrument Development
 - ♦ Science Requirement Definition
 - ♦ Design
 - ♦ Integration and Test
 - Observatories
 - ♦ Mirror Systems
 - ♦ Active Optics
 - ♦ High Contrast Optics
 - Lab Simulations
- Modeling, Simulation, Information Technology and Processing
 - Modeling
 - Geophysical, Planetary and Astrophysical Science Modeling
 - ♦ Computational Chemistry
 - Global Atmospheric Modeling
 - ♦ Planetary Atmospheres
 - ♦ Earth Atmosphere
 - ♦ Extrasolar Planetary Atmospheres
 - Observation Simulations
 - ♦ Science Data Lifecycle Development
 - ♦ Science Processing Pipeline Development
 - ♦ Science Data Processing Algorithm Development
 - ♦ Time Series Data Analysis
 - ♦ Spectrometry
 - ♦ Polarimetry
 - ♦ Intelligent Data Understanding
 - Collaborative Science
 - ♦ Archive Product Design
 - ♦ Design of Web Tools to Enable Collaborative Science
 - Earth Science Technologies and Applications
 - UAV Based Technologies
 - Platforms
 - Science and Applications Instruments
 - Communications and Control
 - Systems Integration
 - Mission Ops
 - In-Situ Sensors
 - ♦ Trace Gas Instruments
 - CO₂
 - CO
 - CH₄
 - O₃
 - N₂O
 - ♦ Spectroscopy
 - Aerosols
 - ♦ Composition
 - ♦ Size Distribution
 - ♦ Extinction
 - Airborne
 - ♦ Trace Gas Instruments
 - ♦ CO₂
 - ♦ CO
 - ♦ CH₄
 - ♦ O₃
 - ♦ N₂O
 - ♦ Meteorological Measurement System
 - ♦ High Precision Temperature, Pressure and Wind
- Bio-Payload Technologies
 - Cell, Tissue, and Animal Habitat Systems
 - Flight Systems Integration, Test and Operations
 - Commercial and Translational Bioscience Technology
- Space Synthetic Biology
 - Bioinformatics, Biocomputation Technologies
 - Genetic Engineering Technologies
 - Biological ISRU
 - Advanced Materials
 - Bioplastics
 - Biological Molecular Fabrication
 - Biosensors
 - Bio Mining
 - Human Health
 - ♦ Tissue Regeneration/Repair
 - ♦ Biological Delivery Systems
 - ♦ Synthesis of Pharmaceuticals
 - Fuel Production
 - Life Support
 - ♦ Food Production
 - ♦ Water Production
 - ♦ Oxygen Production
 - ♦ Waste Resource Recovery
 - Astrobiology Missions
- In-Situ Bioanalytical and Sample Management Technologies
 - Medical Monitoring Technologies
 - Radiation Health and Biocounter-Measures
 - Automated Bio Processing
- Biomimetics, Biologically-Inspired Technologies