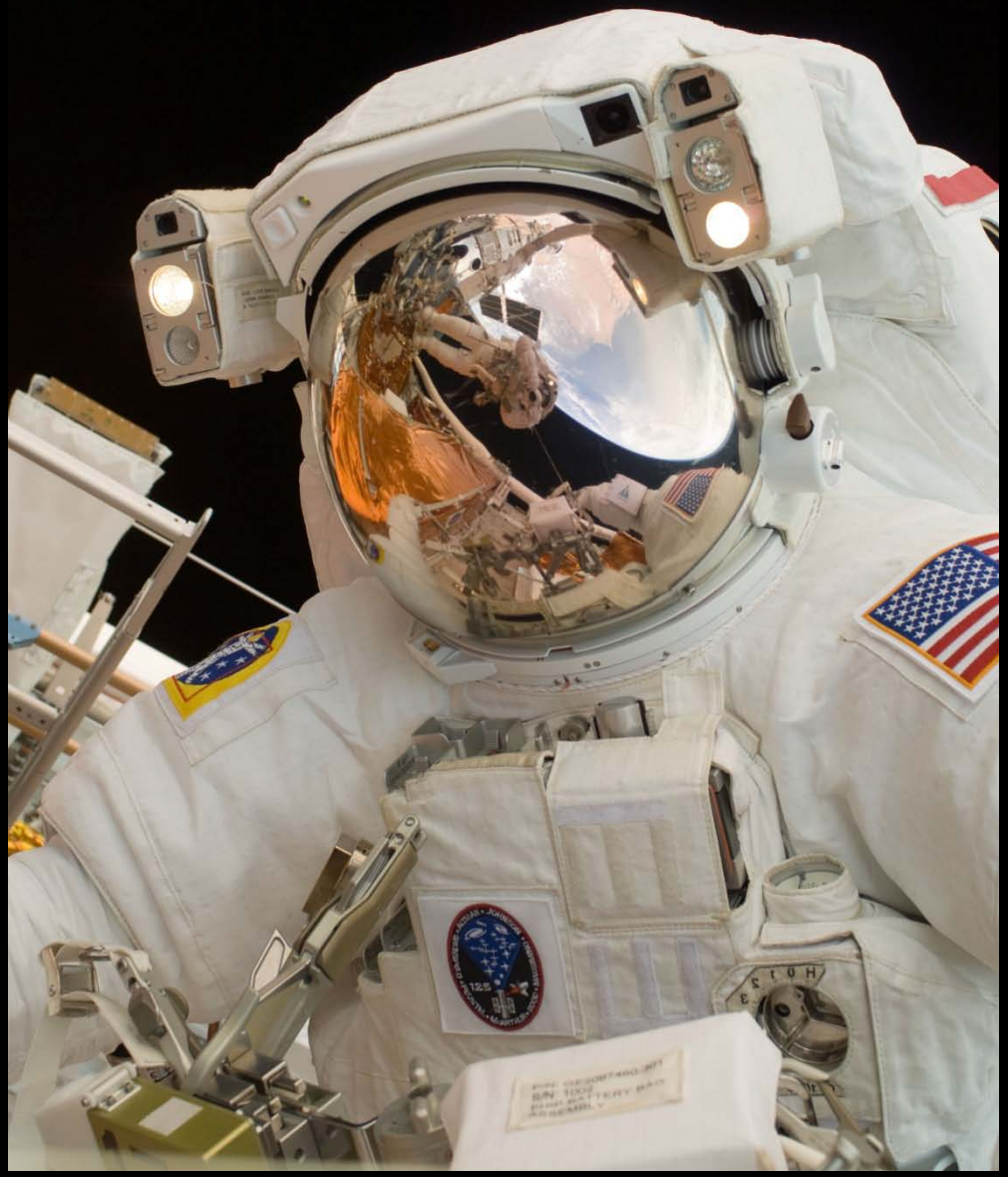


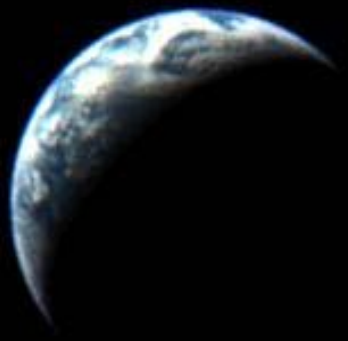
http://spaceflight.nasa.gov/gallery/images/shuttle/sts-125/hires/s125e007493.jpg

Taxonomy, Ontology and Semantics at Johnson Space Center

Agenda

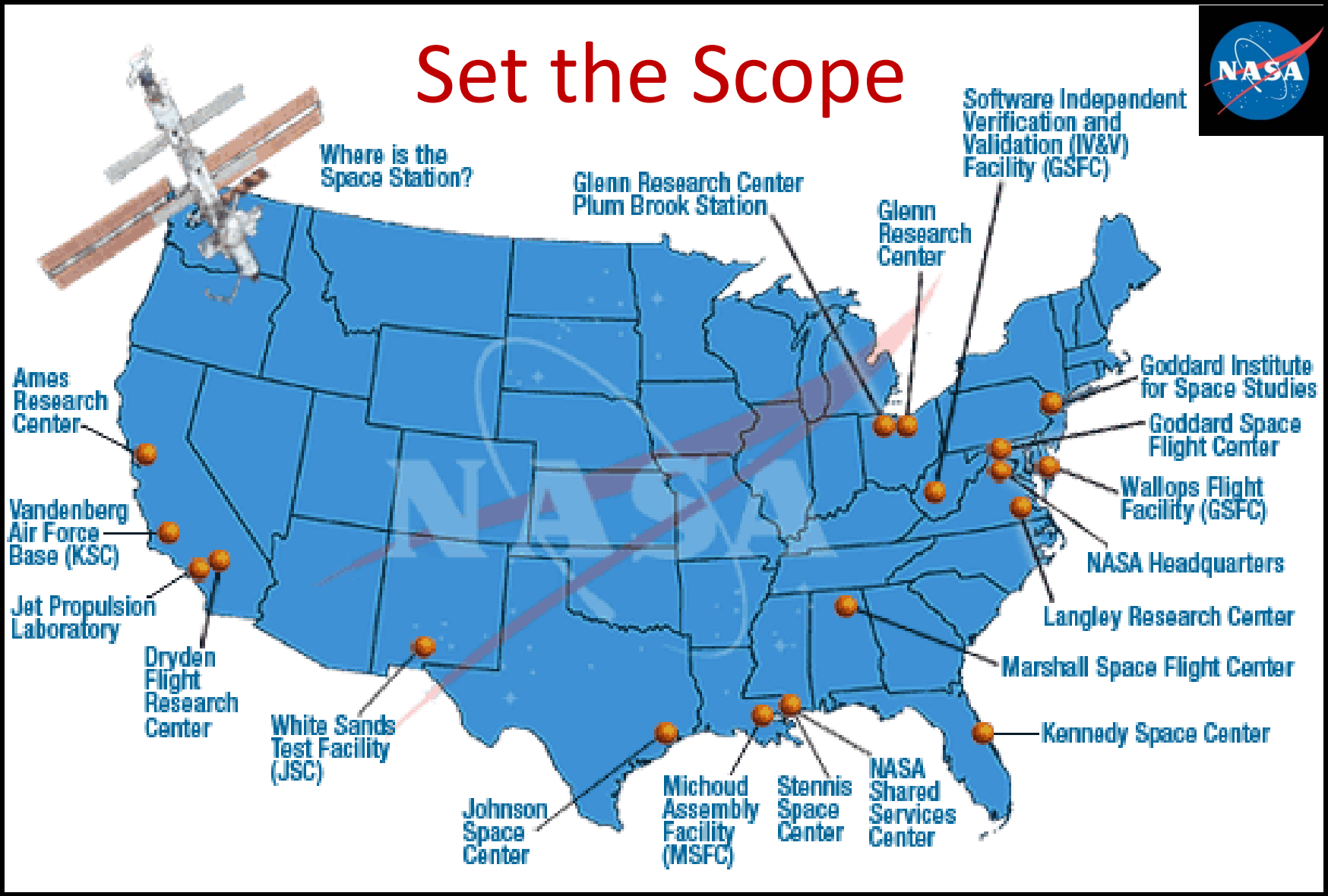
1. Recognizing existing standards
2. Avoiding the Vacuum
3. Setting the Scope, Defining the Vision
4. Informing the Funder
5. Demonstrating ROI
6. Experimenting with Classification
7. Semantics for Multiple Applications= Semantics for the Future

Avoid Creating a Taxonomy in a Vaccum



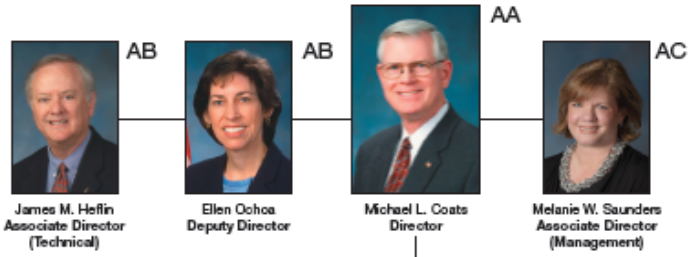
http://apod.nasa.gov/apod/ap980904.html

Set the Scope



http://nasajobs.nasa.gov/work/where.htm

National Aeronautics and Space Administration



James M. Heflin
Associate Director
(Technical)

Ellen Ochoa
Deputy Director

Michael L. Coats
Director

Melanie W. Saunders
Associate Director
(Management)

Lyndon B. Johnson Space Center
November 8, 2010

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Opportunity and Diversity

Jean E. Engle
Chief
Knowledge Officer

Bernard J. Roan
Chief Counsel

Debra L. Johnson
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Flight Crew Operations

Paul S. Hill
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Mission Operations

Stephen J. Altemus
Director,
Engineering

Larry N. Sweet
Director,
Information Resources
and Chief Information Officer

Dorothy E. Swanson
Chief Financial Officer

Joel B. Walker
Director,
Center Operations

Eileen K. Stansbery
Director,
Astromaterials Research
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Terrence W. Wilcutt
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Frank J. Benz
Manager,
White Sands Test Facility

Jeffrey R. Davis
Director,
Space Life Sciences

Glenn C. Lutz
Manager,
EVA Office

John P. Shannon
Manager,
Space Shuttle Program

Michael T. Suffredini
Manager,
International Space
Station Program

Lawrence D. Thomas
Manager,
Constellation Program

Alan J. Lindenmoyer
Manager, Commercial
Crew & Cargo Program

http://www.nasa.gov/centers/johnson/pdf/145649main_Directorate_Level_Organization_chart.pdf

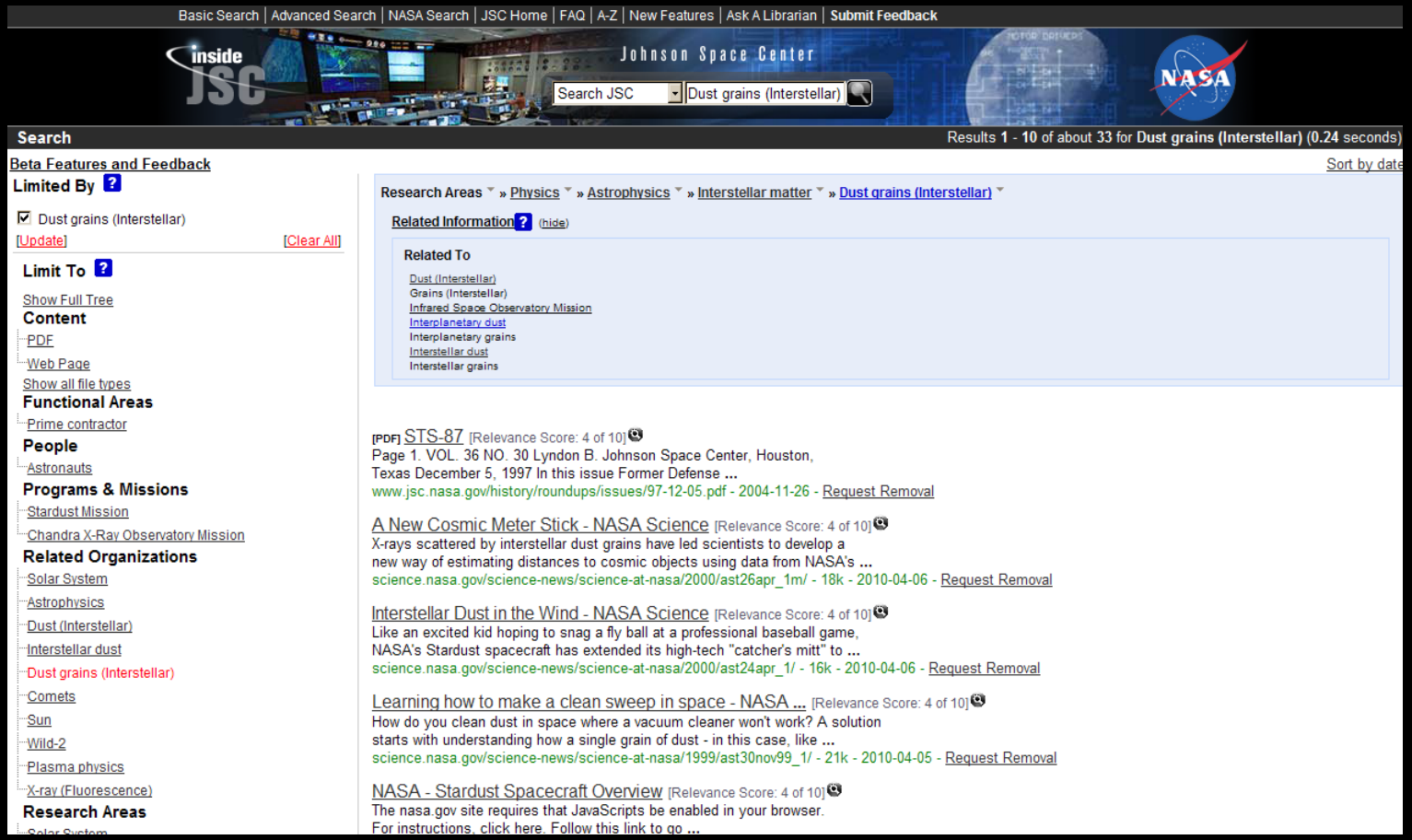
Demonstrating the Value of Ethereal Assets

1. Fundamental value
2. Common language
3. Tangible benefits
4. Successful application means…

http://apod.nasa.gov/apod/ap051107.html

Search Interface, Classification Example: Expedition 19

Search Interface, Classification Example: Interstellar Dust Grains

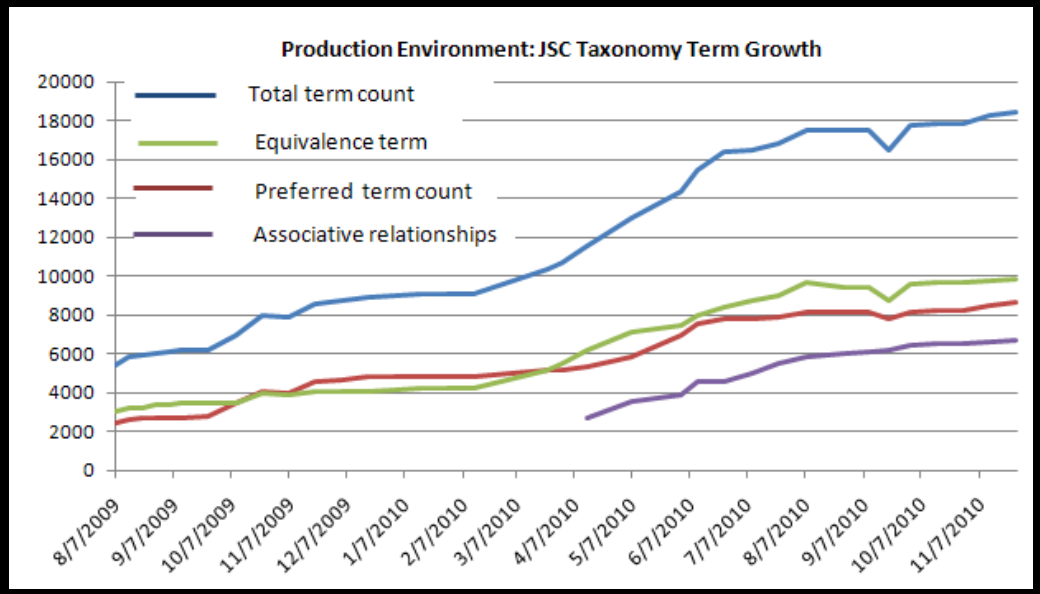


ROI

- ✓ Solidify the value of ethereal assets
  - In a cost benefits analysis[1], JSC information workers search habits were found to be slightly higher than industry levels; 10.5 hours per week compared to 8.8[2]. Monetizing this data with survey respondents salary ranges, and applying it to a conservative 20% improvement in findability for existing SharePoint users, yields a savings of over 12 million dollars per year.

Realistic expectations should include planning for:

- Implementation
- Growth /Governance
- Maintenance
- Application



1. Doane, Mike. Connecting the JSC Taxonomy to Sharepoint, August 2010.
2. International Data Corporation. Hidden Costs of Information Work: A Progress Report, May 2009. Doc #217936

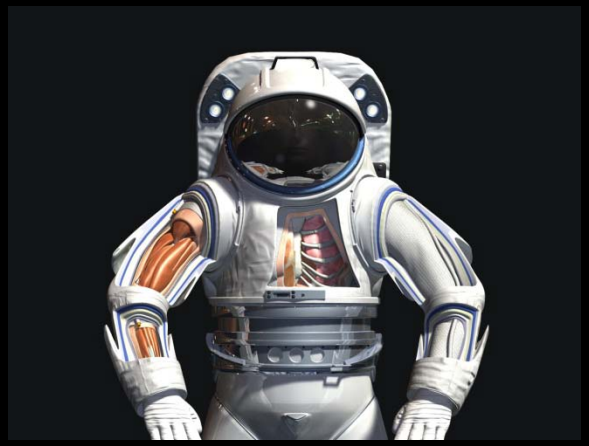
Semantics for a New Path: Space Technology Roadmaps

Propulsion Technology

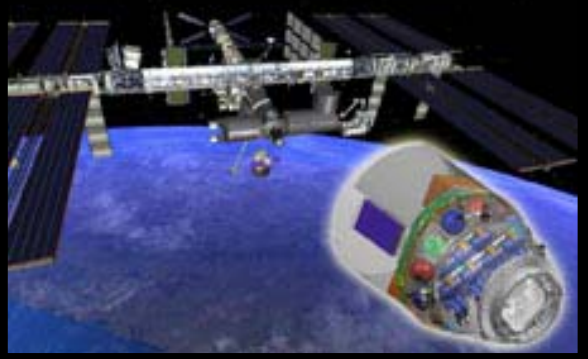
Communication & Navigation

Tele-Robotics & Autonomous Systems

Exploration and Robotic Missions



Human Research

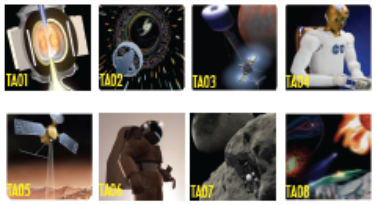


Commercial Crew

http://spaceflight1.nasa.gov/gallery/

Technology Area Structure: Draft

National Aeronautics and Space Administration



TA01 • LAUNCH PROPULSION SYSTEMS

Solid Rocket Propulsion Systems
- Propellants
- Case Materials
- Nozzle Systems
- Hybrid Rocket Propulsion Systems
- Fundamental Solid Propulsion Technologies

Liquid Rocket Propulsion Systems
- LH_2/LOX Based
- RP/LOX Based
- CH_4/LOX Based
- Detonation Wave Engines (Closed Cycle)
- Propellants
- Fundamental Liquid Propulsion Technologies

Air Breathing Propulsion Systems
- TBCC
- RBCC
- Detonation Wave Engines (Open Cycle)
- Turbine Based Jet Engines (Hyback Boosters)
- Ramjet/Scramjet Engines (Accelerators)
- Deeply-cooled Air Cycles
- Air Collection & Enrichment System
- Fundamental Air Breathing Propulsion Technologies

Ancillary Propulsion Systems
- Auxiliary Control Systems
- Main Propulsion Systems (Excluding Engines)
- Launch Abort Systems
- Thrust Vector Control Systems
- Health Management & Sensors
- Pyro & Separation Systems
- Fundamental Ancillary Propulsion Technologies

Unconventional / Other Propulsion Systems
- Ground Launch Assist
- Air Launch / Drop Systems
- Space Tether Assist
- Beamed Energy / Energy Addition
- Nuclear
- High Energy Density Materials/Propellants

TA02 • IN-SPACE PROPULSION TECHNOLOGIES

Chemical Propulsion
- Liquid Storable
- Liquid Cryogenic
- Gels
- Solid
- Hybrid
- Cold Gas/Warm Gas
- Micro-propulsion

Non-Chemical Propulsion
- Electric Propulsion
- Solar Sail Propulsion
- Thermal Propulsion
- Tether Propulsion

Advanced (TRL <3) Propulsion Technologies
- Beamed Energy Propulsion
- Electric Sail Propulsion
- Fusion Propulsion
- High Energy Density Materials
- Antimatter Propulsion
- Advanced Fission
- Breakthrough Propulsion

Supporting Technologies
- Engine Health Monitoring & Safety
- Propellant Storage & Transfer
- Materials & Manufacturing Technologies
- Heat Rejection
- Power

TA03 • SPACE POWER & ENERGY STORAGE

Power Generation
- Energy Harvesting
- Chemical (Fuel Cells, Heat Engines)
- Solar (Photo-Voltaic & Thermal)
- Radioisotope
- Fission
- Fusion

Energy Storage
- Batteries
- Flywheels
- Regenerative Fuel Cells

Power Management & Distribution
- FDIR
- Management & Control
- Distribution & Transmission
- Wireless Power Transmission
- Conversion & Regulation

Cross Cutting Technology
- Analytical Tools
- Green Energy Impact
- Multi-functional Structures
- Alternative Fuels

TA04 • ROBOTICS, TELE-ROBOTICS & AUTONOMOUS SYSTEMS

Sensing & Perception
- Stereo Vision
- LIDAR
- Proximity Sensing
- Sensing Non-Geometric Terrain Properties
- Estimating Terrain Mechanical Properties
- Tactile Sensing Arrays
- Gravity Sensors & Celestial Nav.
- Terrain Relative Navigation
- Real-time Self-calibrating of Hand-eye Systems

Mobility
- Simultaneous Localiz. & Mapping
- Hazard Detection Algorithms
- Active Illumination
- 3-D Path Planning w/ Uncertainty
- Long-life Extr. Environ. Mechanisms
- Robotic Jet Backpacks
- Smart Tethers
- Robot Swarms
- Walking in Micro-g

Manipulation
- Motion Planning Alg., High DOF
- Sensing & Control
- Robot Arms (light, high strength)
- Dexterous Manipul., Robot Hands
- Sensor Fusion for Grasping
- Grasp Planning Algorithms
- Robotic Drilling Mechanisms
- Multi-arm / Finger Manipulation
- Planning with Uncertainty

Human-Systems Integration
- Crew Decision Support Systems
- Immersive Visualization
- Distributed Collaboration
- Multi Agent Coordination
- Haptic Displays
- Displaying Range Data to Humans

Autonomy
- Spacecraft Control Systems
- Vehicle Health, Prog/Diag Systems
- Human Life Support Systems
- Planning/Scheduling Resources
- Operations
- Integrated Systems Health Management
- FDIR & Diagnosis
- System Monitoring & Prognosis
- V&V of Complex Adaptive Sys's
- Automated Software Generation
- Software Reliability
- Semi Automatic Systems

Auton. Rendezvous & Docking
- Rendezvous and Capture
- Low Impact & Androgenous Docking Systems & Interfaces
- Relative Navigation Sensors
- Robust AR&D GN&C Algorithms & FSW
- Onboard Mission Manager
- AR&D Integration & Standardization

RTA Systems Engineering
- Human safety
- Refueling Interfaces & Assoc. Tools
- Modular / Serviceable Interfaces
- High Perf., Low Power Onboard Computers
- Environment Tolerance
- Thermal Control
- Robot-to-Suit Interfaces
- Common Human-Robot Interfaces
- Crew Self Sufficiency

TA05 • COMMUNICATION & NAVIGATION

Optical Comm. & Navigation
- Detector Development
- Large Apertures
- Lasers
- Acquisition & Tracking
- Atmospheric Mitigation

Radio Frequency Communications
- Spectrum Efficient Technologies
- Power Efficient Technologies
- Propagation
- Flight & Ground Systems
- Earth Launch & Reentry Comm.
- Antennas

Internetworking
- Disruptive Tolerant Networking
- Adaptive Network Topology
- Information Assurance
- Integrated Network Management

Position, Navigation, and Timing
- Timekeeping
- Time Distribution
- Onboard Auto Navigation & Maneuver
- Sensors & Vision Processing Systems
- Relative & Proximity Navigation
- Auto Precision Formation Flying
- Auto Approach & Landing

Integrated Technologies
- Radio Systems
- Ultra Wideband
- Cognitive Networks
- Science from the Comm. System
- Hybrid Optical Comm. & Nav. Sensors
- RF/Optical Hybrid Technology

Revolutionary Concepts
- X-Ray Navigation
- X-Ray Communications
- Neutrino-Based Navigation & Tracking
- Quantum Key Distribution
- Quantum Communications
- SQIF Microwave Amplifier
- Reconfigurable Large Apertures

TA06 • HUMAN HEALTH, LIFE SUPPORT & HABITATION SYSTEMS

Environmental Control & Life Support Systems & Habitation Sys.
- Air Revitalization
- Water Recovery & Management
- Waste Management
- Habitation

Extravehicular Activity Systems
- Pressure Garment
- Portable Life Support System
- Power, Avionics and Software

Human Health & Performance
- Medical Diagnosis / Prognosis
- Long-Duration Health
- Behavioral Health & Performance
- Human Factors & Performance

Environmental Monitoring, Safety & Emergency Response
- Sensors: Air, Water, Microbial, etc.
- Fire Detection, Suppression
- Protective Clothing / Breathing
- Remediation

Radiation
- Risk Assessment Modeling
- Radiation Mitigation
- Protection Systems
- Space Weather Prediction
- Monitoring Technology

TA07 • HUMAN EXPLORATION DESTINATION SYSTEMS

In-Situ Resource Utilization
- Destination Reconnaissance, Prospecting, & Mapping
- Resource Acquisition
- Consumables Production
- Manufacturing & Infrastructure Emplacement

Sustainability & Supportability
- Logistics Systems
- Maintenance Systems
- Repair Systems

"Advanced" Human Mobility Systems
- EVA Mobility
- Surface Mobility
- Off-Surface Mobility

"Advanced" Habitat Systems
- Integrated Habitat Systems
- Habitat Evolution

Mission Operations & Safety
- Crew Training
- Environmental Protection
- Remote Mission Operations
- Planetary Safety

Cross-Cutting Systems
- Modeling, Simulations & Destination Characterization
- Construction & Assembly
- Dust Prevention & Mitigation

TA08 • SCIENCE INSTRUMENTS, OBSERVATORIES & SENSOR SYSTEMS

Remote Sensing Instruments / Sensors
- Detectors & Focal Planes
- Electronics
- Optical Components
- Microwave / Radio
- Lasers
- Cryogenic / Thermal

Observatories
- Mirror Systems
- Structures & Antennas
- Distributed Aperture

In-Situ Instruments / Sensor
- Particles: Charged & Neutral
- Fields & Waves
- In-Situ

TA09 • ENTRY, DESCENT & LANDING SYSTEMS

Aeroassist & Atmospheric Entry
- Rigid Thermal Protection Systems
- Flexible Thermal Protection Systems
- Rigid Hypersonic Decelerators
- Deployable Hypersonic Decelerators
- Instrumentation & Health Monitoring
- Entry Modeling & Simulation

Descent
- Attached Deployable Decelerators
- Trailing Deployable Decelerators
- Supersonic Retropropulsion
- GN&C Sensors
- Descent Modeling & Simulation

Landing
- Touchdown Systems
- Egress & Deployment Systems
- Propulsion Systems
- Large Body GN&C
- Small Body Systems
- Landing Modeling & Simulation

Vehicle Systems Technology
- Architecture Analyses
- Separation Systems
- System Integration & Analyses
- Atmosphere & Surface Characterization

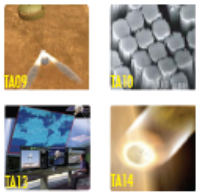
TA10 • NANOTECHNOLOGY

Engineered Materials & Structures
- Lightweight Structures
- Damage Tolerant Systems
- Coatings
- Adhesives
- Thermal Protection & Control

Energy Generation & Storage
- Energy Storage
- Energy Generation

Propulsion
- Propellants
- Propulsion Components
- In-Space Propulsion

Sensors, Electronics & Devices
- Sensors & Actuators
- Nanoelectronics
- Miniature Instruments



TA11 • MODELING, SIMULATION, INFORMATION TECHNOLOGY & PROCESSING

Computing
- Flight Computing
- Ground Computing

Modeling
- Software Modeling & Model-Checking
- Integrated Hardware & Software Modeling
- Human-System Performance Modeling
- Science & Engineering Modeling
- Frameworks, Languages, Tools & Standards

Simulation
- Distributed Simulation
- Integrated System Lifecycle Simulation
- Simulation-Based Systems Engineering
- Simulation-Based Training & Decision Support Systems

Information Processing
- Science, Engineering & Mission Data Lifecycle
- Intelligent Data Understanding
- Semantic Technologies
- Collaborative Science & Engineering
- Advanced Mission Systems

TA12 • MATERIALS, STRUCTURES, MECHANICAL SYSTEMS & MANUFACTURING

Materials
- Lightweight Structure
- Computational Design
- Flexible Material Systems
- Environment
- Special Materials

Structures
- Lightweight Concepts
- Design & Certification Methods
- Reliability & Sustainment
- Test Tools & Methods
- Innovative, Multifunctional Concepts

Mechanical Systems
- Deployables, Docking and Interfaces
- Mechanism Life Extension Systems
- Electro-mechanical, Mechanical & Micromechanisms
- Design & Analysis Tools and Methods
- Reliability / Life Assessment / Health Monitoring
- Certification Methods

Manufacturing
- Manufacturing Processes
- Intelligent Integrated Manufacturing and Cyber Physical Systems
- Electronics & Optics Manufacturing Process
- Sustainable Manufacturing

Cross-Cutting
- Nondestructive Evaluation & Sensors
- Model-Based Certification & Sustainment Methods
- Loads and Environments

TA13 • GROUND & LAUNCH SYSTEMS PROCESSING

Technologies to Optimize the Operational Life-Cycle
- Storage, Distribution & Conservation of Fluids
- Automated Alignment, Coupling, & Assembly Systems
- Autonomous Command & Control for Ground and Integrated Vehicle/Ground Systems

Environmental and Green Technologies
- Corrosion Prevention, Detection, & Mitigation
- Environmental Remediation & Site Restoration
- Preservation of Natural Ecosystems
- Alternate Energy Prototypes

Technologies to Increase Reliability and Mission Availability
- Advanced Launch Technologies
- Environment-Hardened Materials and Structures
- Inspection, Anomaly Detection & Identification
- Fault Isolation and Diagnostics
- Prognostics Technologies
- Repair, Mitigation, and Recovery Technologies
- Communications, Networking, Timing & Telemetry

Technologies to Improve Mission Safety/Mission Risk
- Range Tracking, Surveillance & Flight Safety Technologies
- Landing & Recovery Systems & Components
- Weather Prediction and Mitigation
- Robotics / Telerobotics
- Safety Systems

TA14 • THERMAL MANAGEMENT SYSTEMS

Cryogenic Systems
- Passive Thermal Control
- Active Thermal Control
- Integration & Modeling

Thermal Control Systems
- Heat Acquisition
- Heat Transfer
- Heat Rejection & Energy Storage

Thermal Protection Systems
- Entry / Ascent TPS
- Plume Shielding (Convective & Radiative)
- Sensor Systems & Measurement Technologies

Space Technology Roadmaps **STR • TABS**

TECHNOLOGY AREA BREAKDOWN STRUCTURE

http://www.nasa.gov/pdf/501627main_TASR-TABS_Foldouts-A.pdf

Conclusions

At NASA Johnson Space Center (JSC), the Chief Knowledge Officer has been developing the JSC Taxonomy to capitalize on the accomplishments of yesterday while maintaining the flexibility needed for the evolving information environment of today.

A clear vision and scope for the semantic system is integral to its success. The vision for the JSC Taxonomy is to connect information stovepipes to present a unified view for information and knowledge across the Center, across organizations, and across decades.

Semantic search at JSC means seemless integration of disparate information sets into a single interface. Ever increasing use, interest, and organizational participation mark successful integration and provide the framework for future application .