JPL

Integration of Missions, Programs and Core Technologies (IMPaCT)

Overview

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Topics

- Purpose of presentation
- IMPaCT Overview
- IMPaCT Architecture
- Relationship to OCT TechPort
- IMPaCT Capabilities
- Application Security and Access Control
- Future Versions
- Summary

Purpose of Presentation

- To provide an overview of IMPaCT, its architecture and capabilities
- To describe the key drivers for the development of IMPaCT
- To outline capabilities that IMPaCT offers to the NASA's Planetary Science Division and planetary mission developers and technologists
- To describe the relationship between IMPaCT and the OCT's Technology Portfolio Management tool, TechPort
- To outline future capabilities that are being developed for IMPaCT including technology assessment and advanced portfolio analysis

IMPaCT Overview

- *Description:* IMPaCT is a web-based database tool designed to support NASA's Planetary Science Division in defining its mission and technology portfolios within resources and operating constraints. Allows portfolios of technologies to be constructed and monitored. The architecture also enables users outside of the PSD to input data and develop portfolios.

- *Scope:* Will *c*ontain comprehensive information on
  - Current planetary missions and possible future missions, including studies
  - Current technology development activities
  - Potential technology development activities related to planetary science
  - Selected State of the Practice technologies

- *Purpose:* To provide the user, particularly PSD, the capability to analyze their portfolios and future needs. It will also provide an assessment of the status of technologies and their infusion paths.
- *Status:* The current version of IMPaCT contains missions, studies and partial technology data sets of interest to PSD. Security and access controls that have now been implemented to allow extending use to other NASA Centers.

Current Drivers for the Development of IMPaCT

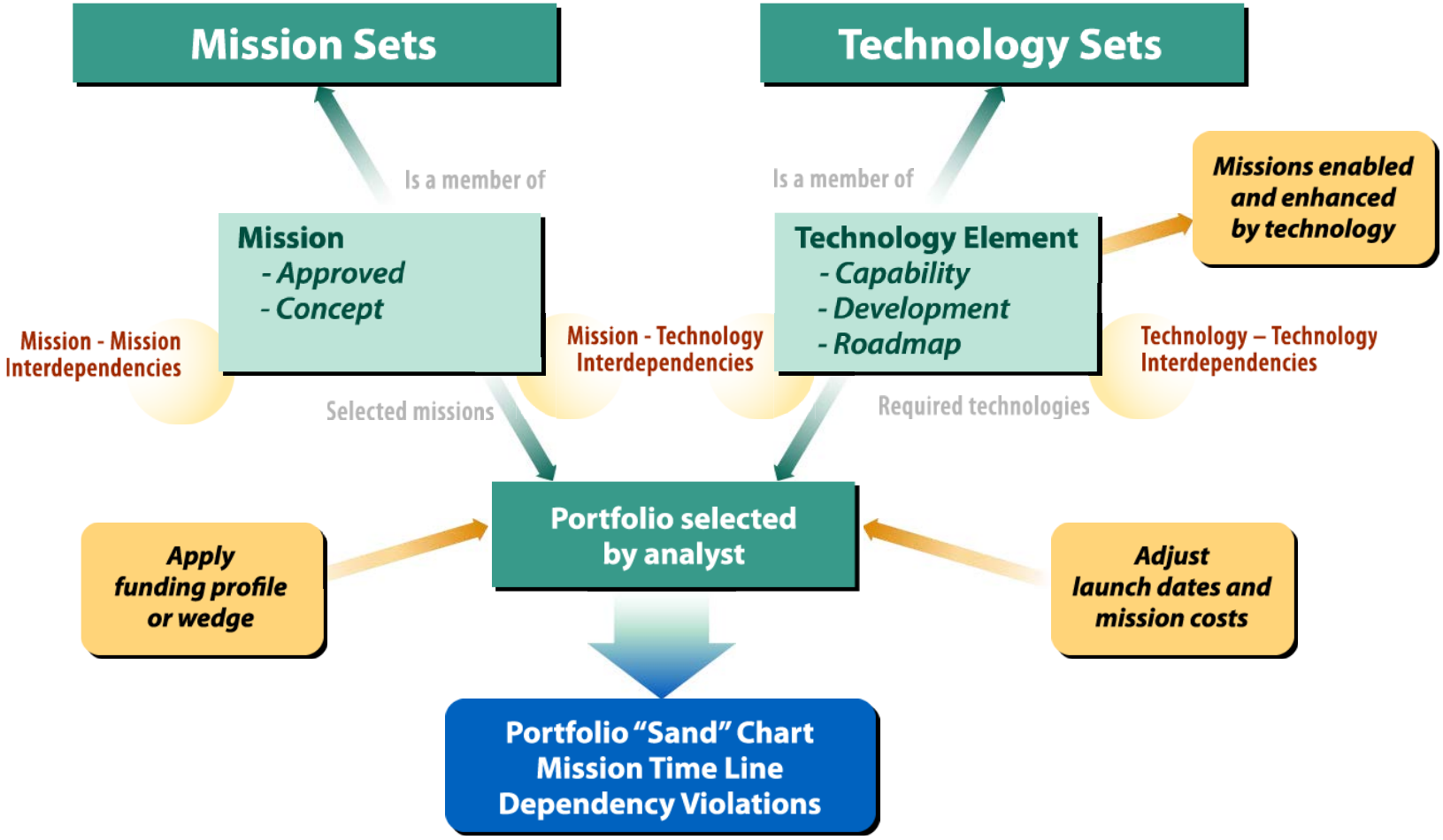
- The Decadal Survey recommended in March 2011 "*the development of a freely available technology database*"
  - customized with the information required by new proposals
  - populated by technologies that have been pre-screened by NASA to ensure that they can be infused with manageable risk.

- The Planetary Science Technology Review Panel recommended in July 2011, the development of a comprehensive technology database that would
  - ensure proper documentation and availability of technology data and development progress.
  - ensure that scientists, technologists, and mission planners have understandable and easily accessible information
  - ensure that technology developments are directly traceable to PSD science goals

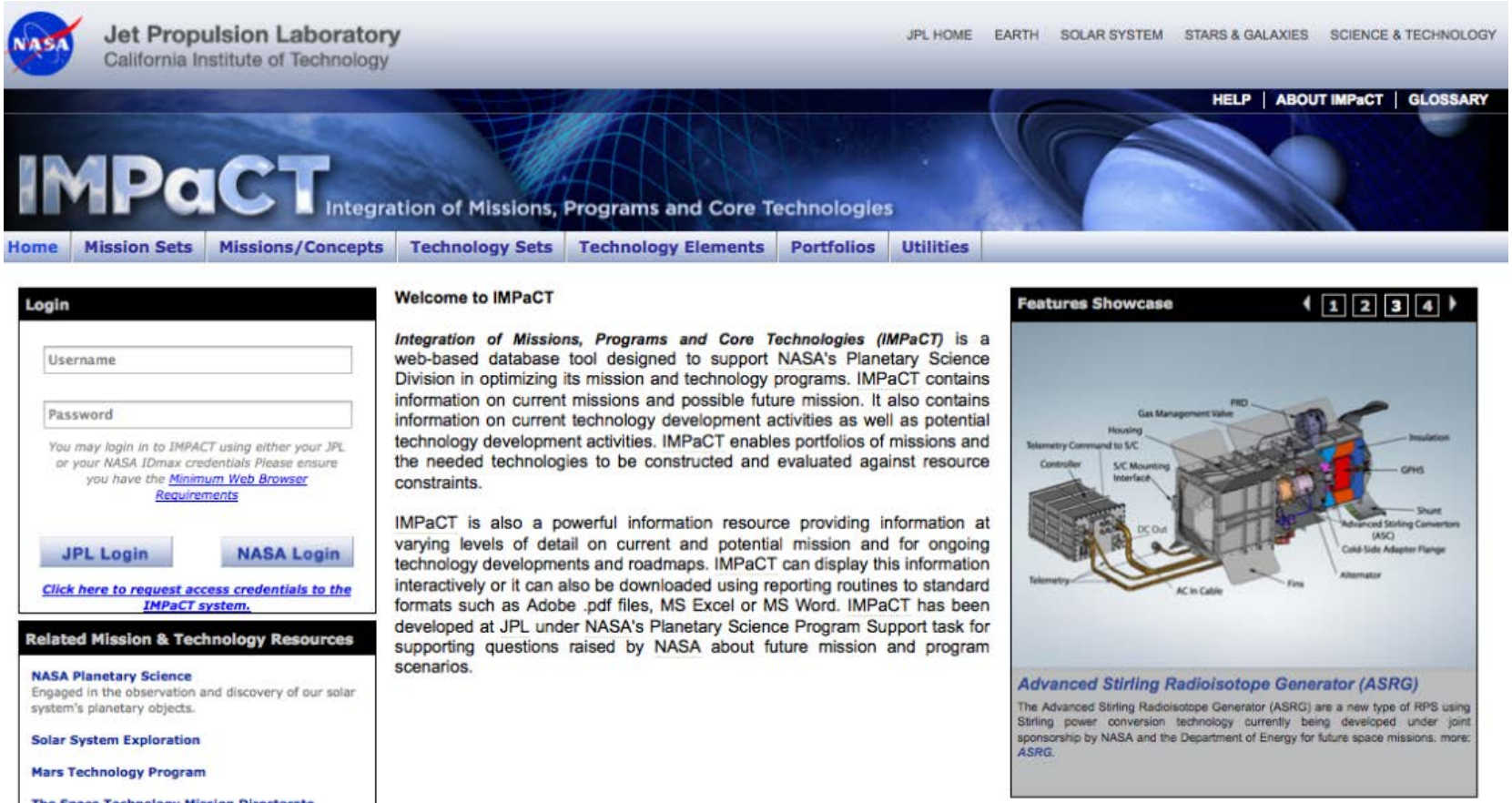
Related Activities

- NASA's Office of the Chief Technologist is developing a Technology Portfolio Management system called TechPort
  - TechPort is an online system that provides high level information about NASA funded technology projects
- The IMPaCT team worked on the TechPort development effort through FY12, when the initial TechPort version was released within NASA.
- The IMPaCT team continues to support the TechPort development by participating in the NASA Center Rep working group.
- IMPaCT leverages the data collected in TechPort by
  - Adding data important to PSD mission and technology programs
  - Providing analysis capabilities not available in TechPort
  - Showing the linkages between technologies and missions

IMPaCT Architecture



IMPaCT Home Page and Login



Missions/Concepts – Screen Shots Highlights

- Mission Sets
- Mission/Concept – Listing
- Mission/Concept – Overview
- Mission/Concept – Technical Description
- Mission/Concept – Cost
- Mission/Concept – Dependencies

Mission Sets

Home | Mission Sets | Missions/Concepts | Technology Sets | Technology Elements | Portfolios | Utilities

Mission Sets

Add New Mission Set

Showing 1 to 15 of 15 sets (filtered from 19 total sets)

Filter: planetary

Mission Set	Description	Agency	Directorate	Division	
Decadal Survey Mission and Technology Studies 2010 (DS)	Mission and Technology Studies performed in support of the 2010 Planetary Science Decadal Survey	NASA	Science Missions	Planetary Science	Edit
Discovery (Disc)	The Discovery Program goal is to achieve outstanding results by launching many smaller missions using fewer resources and shorter development times. The main objective is to enhance our understanding of the solar system by exploring the planets, their moons, and small bodies such as comets and asteroids. The program also seeks to improve performance through the use of new technology and broaden university and industry participation in NASA missions.	NASA	Science Missions	Planetary Science	Edit
Discovery Missions of Opportunity	NASA Missions of Opportunity give the U.S. scientific community the chance to participate in non-NASA missions by providing funding for a science instrument or hardware components of an instrument. They also offer the possibility to use an existing NASA spacecraft for a new science investigation. Five Discovery Program Missions of Opportunity have been selected.	NASA	Science Mission Directorate	Planetary Science	Edit
Europa Study 2012	Missions directed toward the study of one of Jupiter's moons, Europa, which may hold the potential for life in deep underground oceans.	NASA	Science Missions	Planetary Science	Edit
In-Space Propulsion Technology (ISPT)	The In-Space Propulsion Program work being performed at the Glenn Research Center develops primary propulsion technologies that can benefit near and mid-term science missions by reducing cost, mass and/or travel times. The In-Space Program is working to develop next generation electric propulsion technologies, including Ion and Hall thrusters. Solar Sails, which are a form of propellantless propulsion, are also being developed. Solar Sails rely on the naturally occurring sunlight for the propulsion energy. Other propulsion technologies being developed include advanced chemical propulsion and aerocapture.	NASA	Science Missions	Planetary Science	Edit
Mars Exploration Program	The Mars Exploration Program is a science-driven program that seeks to understand whether Mars was, is, or can be, a habitable world. To find out, we need to understand how geologic, climatic, and other processes have worked to shape Mars and its environment over time, as well as how they interact today. Includes past, current and possible future Mars Exploration missions. Does not include Discovery missions or Mars Scouts (which are now part of the Discovery Program).	NASA	Science Missions	Planetary Science	Edit

Missions/Concepts - Listing

Home | Mission Sets | Missions/Concepts | Technology Sets | Technology Elements | Portfolios | Utilities

Missions/Concepts

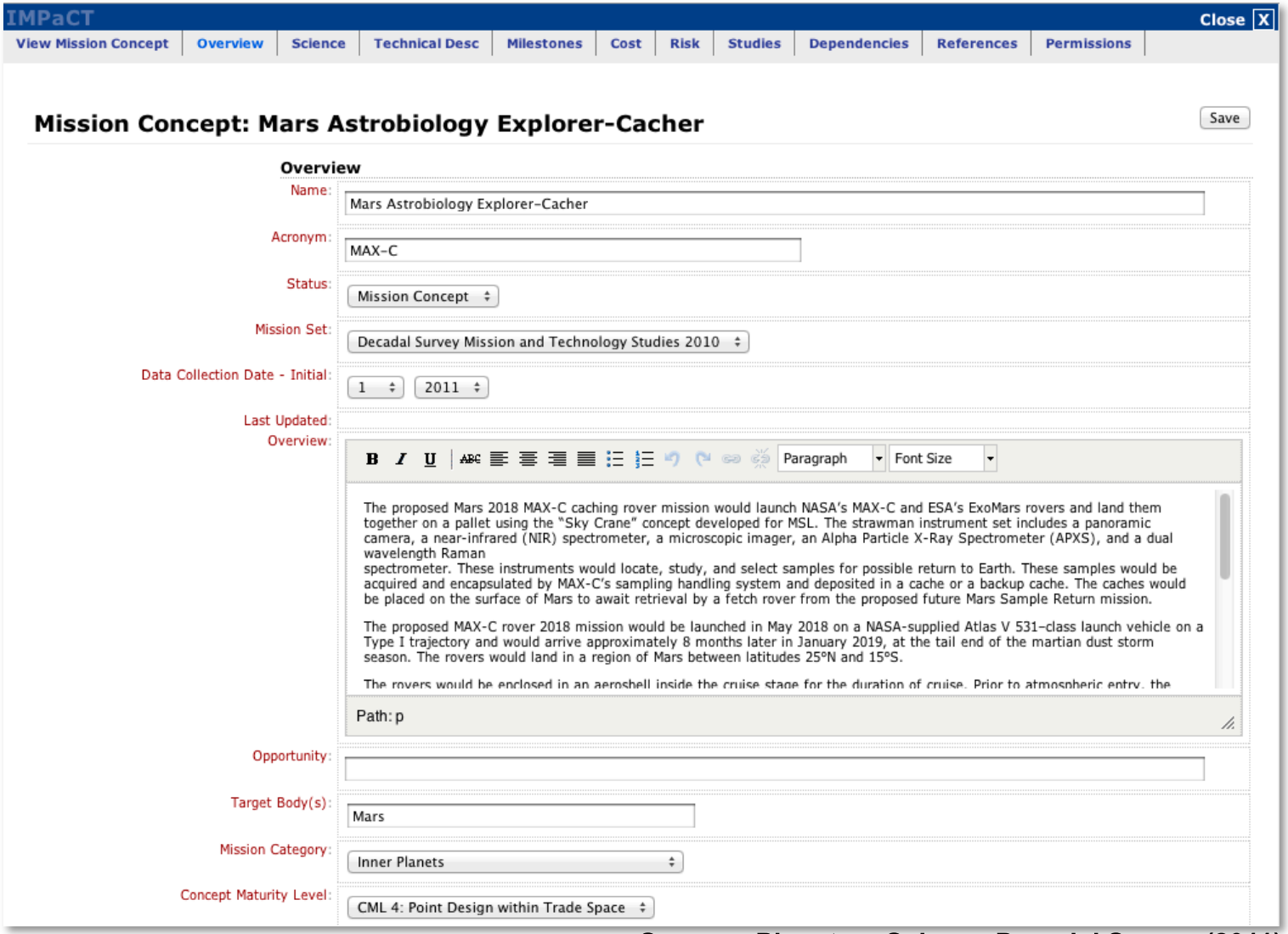
Add New Mission/Concept

Showing 1 to 20 of 20 records (filtered from 138 total records)

Filter: discovery

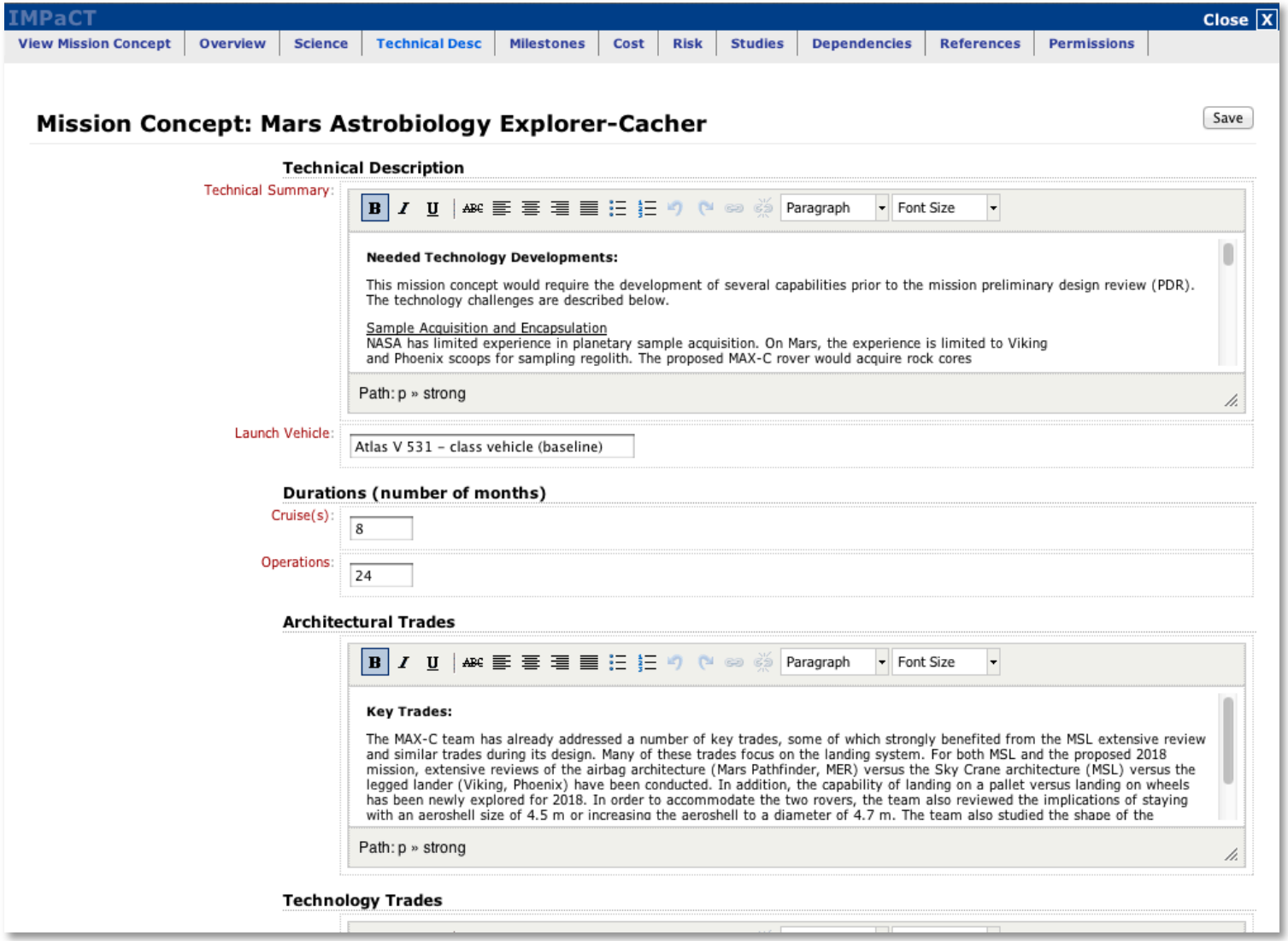
Mission Set	Opportunity	Mission/Concept	Target Body	Nominal Launch	Latest Study	CML
Decadal Survey Mission and Technology Studies 2010						
Decadal Survey Mission and Technology Studies 2010	Discovery or New Frontiers	Mars Polar Climate Mission	Mars		2010	CML 2
Discovery						
Discovery	Discovery 6	Comet Nucleus Tour (CONTOUR)	Mission to fly by three comet nuclei			CML 9
Discovery	Discovery 9	Dawn	Asteroids - Vesta and Ceres	2007	2006	CML 9
Discovery	Discovery 8	Deep Impact	Comet Temple 1			CML 9
Discovery	Discovery 5	Genesis		2001		CML 9
Discovery	Discovery 11	Gravity Recovery and Interior Laboratory (GRAIL)	Moon	2011		CML 9
Discovery	Discovery 12	InSight	Mars			
Discovery	Discovery 10	Kepler	Extra-Solar Earth-Like Planets	2009		CML 9
Discovery	Discovery 3	Lunar Prospector	Earth's Moon			CML 9
Discovery	Mars Scout 2	Mars Atmosphere and Volatile EvolutioN	Mars	2013		CML 9
Discovery	Discovery 2	Mars Pathfinder	Mars			CML 9
Discovery	Discovery 7	MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER)	Mercury			CML 9
Discovery	Discovery 1	Near Earth Asteroid Rendezvous	Asteroid 433 Eros			CML 9
Discovery	Mars Scout 1	Phoenix Lander	Mars			CML 9
Discovery	Discovery 4	Stardust	Comet Wild 2	1999		CML 9
Discovery Missions of Opportunity						
Discovery Missions of Opportunity	Missions of Opportunity	ASPERA-3 (Analyzer of Space Plasma and Energetic Atoms)	Mars			CML 9
Discovery Missions of Opportunity	Missions of Opportunity	EPOXI	Hartley 2			CML 9
Discovery Missions of Opportunity	Missions of Opportunity	Moon Mineralogy Mapper	Moon	2008		CML 9
Discovery Missions of Opportunity	Missions of Opportunity	Stardust-NExT	Tempel 1			CML 9
Discovery Missions of Opportunity	Missions of Opportunity	Strofio	Mercury			

Mission/Concept - Overview



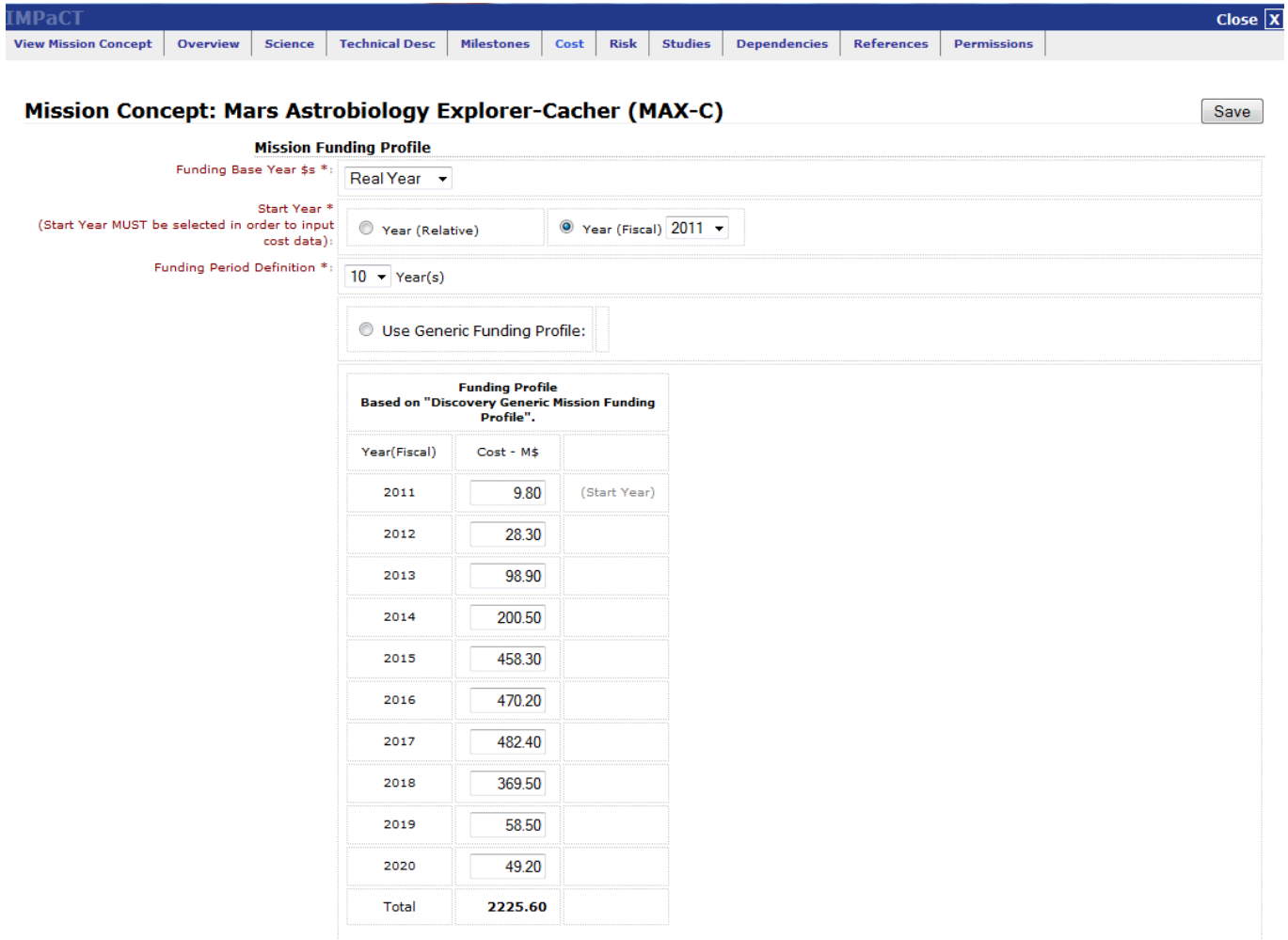
Source: Planetary Science Decadal Survey (2011)

Mission Concept – Technical Description



Source: Planetary Science Decadal Survey (2011)

Mission Concept - Cost



Source: Planetary Science Decadal Survey (2011)

Mission Concept - Dependencies

IMPaCT Close

Edit | Delete

Mission Concept

Overview | Science | Technical Desc | Milestones | Cost | Risk | Studies | Dependencies | References

Mars Astrobiology Explorer-Cacher

Technology Dependencies

1 to 2 of 2 dependencies

Dependent			Would Depend Upon			Priority	Comment
Type	Name	Milestone	Type	Name	Milestone		
Mission Concept							
Mission Concept	Mars Astrobiology Explorer-Cacher	Phase B Start	Capability	Max-C Specific Technologies	TRL 6	1	
Mission Concept	Mars Astrobiology Explorer-Cacher	Phase B Start	Development	Instrument Technology Funding Total	TRL 6	3	Both the Raman and NIR spectrometers are being developed under the NASA Planetary Instrument Definition and Development Program.

Mission Dependencies

1 to 1 of 1 dependencies

Dependent			Would Depend Upon			Priority	Comment
Type	Name	Milestone	Type	Name	Milestone		
Mission Concept							
Mission Concept	Mars Astrobiology Explorer-Cacher	Phase CD Start	Mission Concept	Mars 2018 Sky Crane	Phase E Start	1	

Dependents

1 to 2 of 2 Dependents

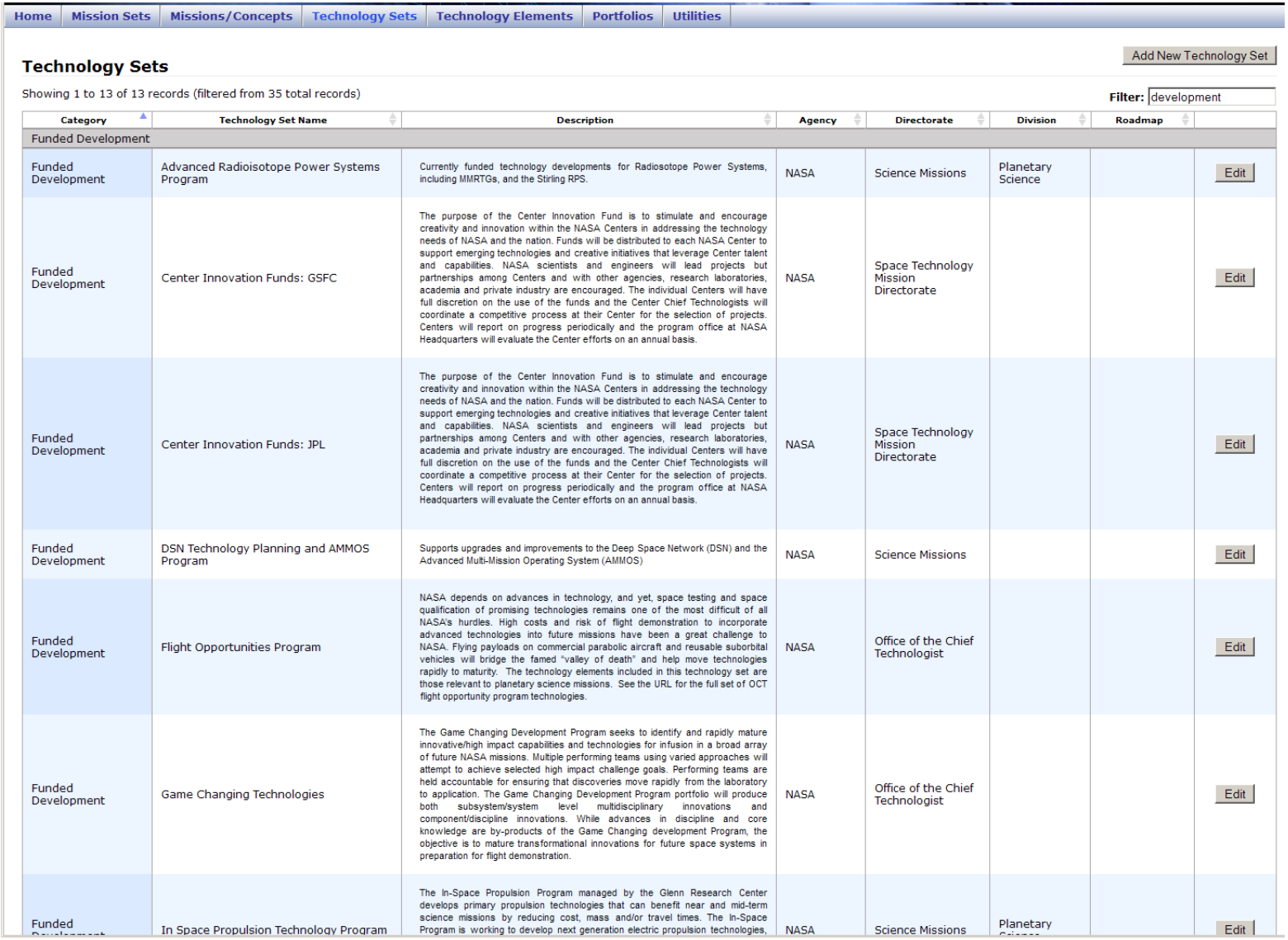
Dependent			Would Depend Upon			Priority	Comment
Type	Name	Milestone	Type	Name	Milestone		
Mission Concept							
Mission Concept	Mars Sample Return Orbiter	Phase B Start	Mission Concept	Mars Astrobiology Explorer-Cacher	Phase E Complete	1	
Mission Concept	Mars Sample Return Lander	Phase A Start	Mission Concept	Mars Astrobiology Explorer-Cacher	Phase E Complete	1	The Mars Astrobiology Explorer Cacher must successfully cache a core sample before the Mars Sample Return Lander mission is initiated

Source: Planetary Science Decadal Survey (2011)

Technology – Screen Shots Highlights

- Technology Sets
- Technology Element – Overview
- Technology Element – Performance
- Technology Element – Milestones

Technology Sets



Home | Mission Sets | Missions/Concepts | Technology Sets | Technology Elements | Portfolios | Utilities

Technology Sets

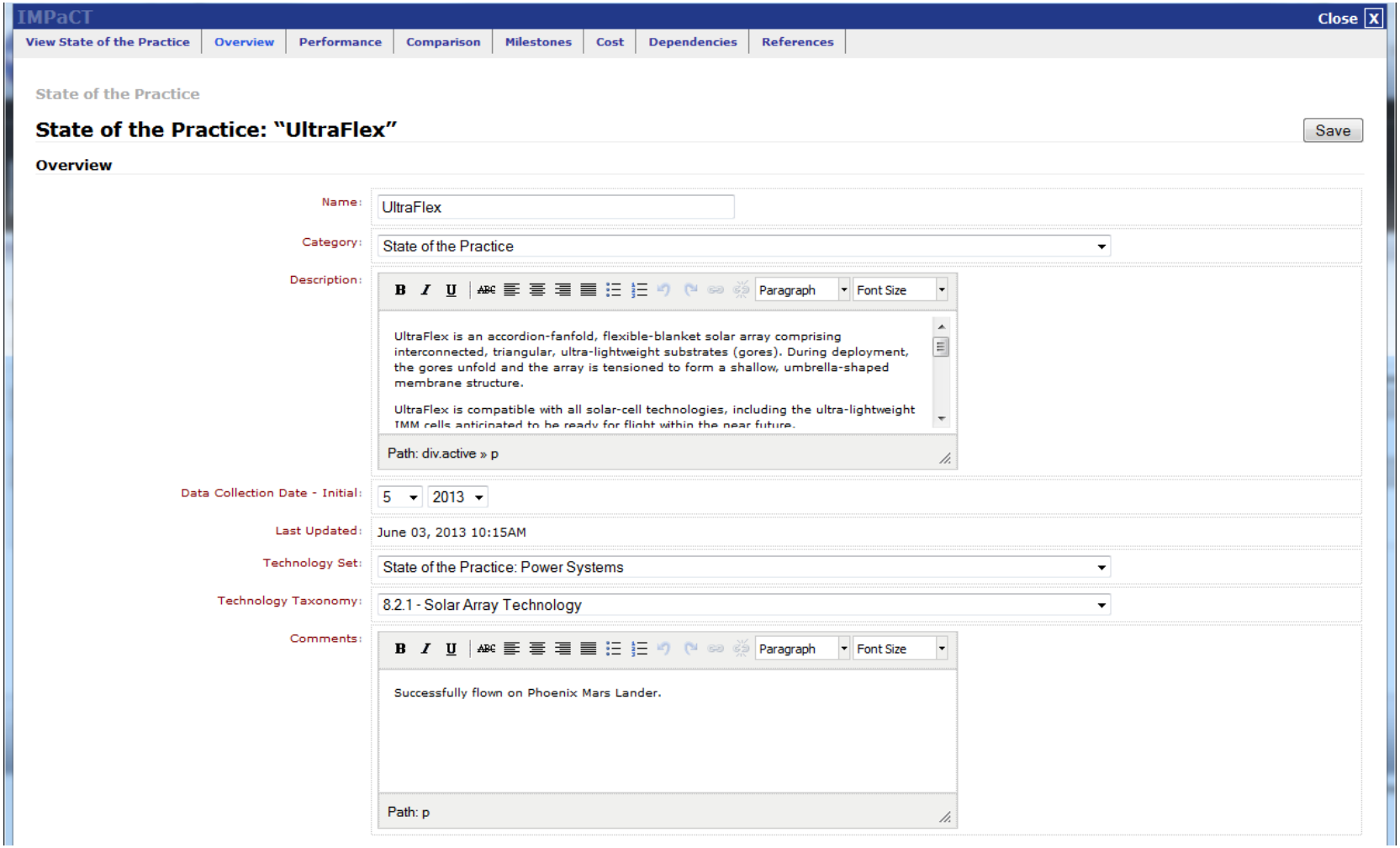
Add New Technology Set

Showing 1 to 13 of 13 records (filtered from 35 total records)

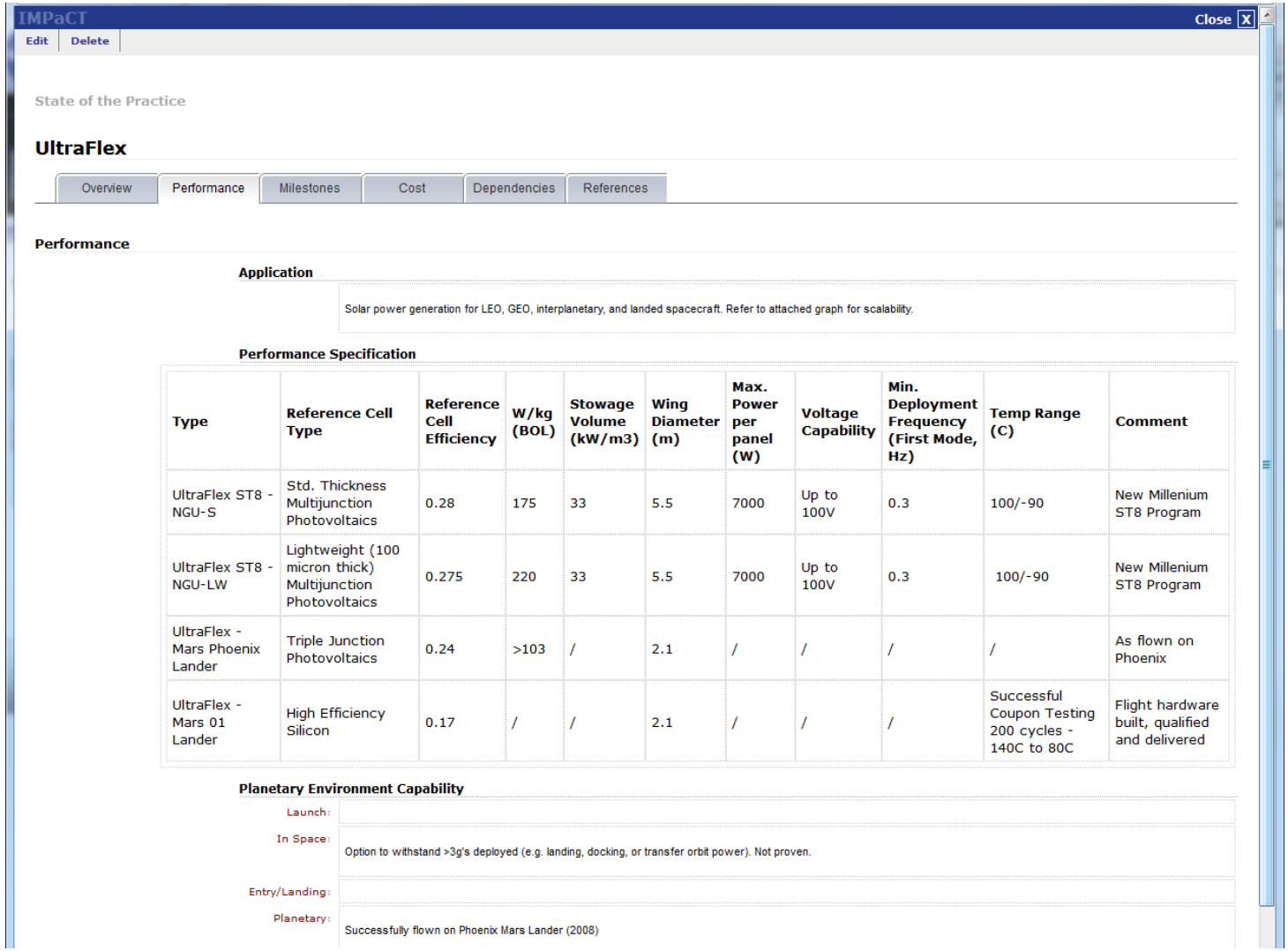
Filter: development

Category	Technology Set Name	Description	Agency	Directorate	Division	Roadmap	
Funded Development							
Funded Development	Advanced Radioisotope Power Systems Program	Currently funded technology developments for Radiosotope Power Systems, including MMRTGs, and the Stirling RPS.	NASA	Science Missions	Planetary Science		Edit
Funded Development	Center Innovation Funds: GSFC	The purpose of the Center Innovation Fund is to stimulate and encourage creativity and innovation within the NASA Centers in addressing the technology needs of NASA and the nation. Funds will be distributed to each NASA Center to support emerging technologies and creative initiatives that leverage Center talent and capabilities. NASA scientists and engineers will lead projects but partnerships among Centers and with other agencies, research laboratories, academia and private industry are encouraged. The individual Centers will have full discretion on the use of the funds and the Center Chief Technologists will coordinate a competitive process at their Center for the selection of projects. Centers will report on progress periodically and the program office at NASA Headquarters will evaluate the Center efforts on an annual basis.	NASA	Space Technology Mission Directorate			Edit
Funded Development	Center Innovation Funds: JPL	The purpose of the Center Innovation Fund is to stimulate and encourage creativity and innovation within the NASA Centers in addressing the technology needs of NASA and the nation. Funds will be distributed to each NASA Center to support emerging technologies and creative initiatives that leverage Center talent and capabilities. NASA scientists and engineers will lead projects but partnerships among Centers and with other agencies, research laboratories, academia and private industry are encouraged. The individual Centers will have full discretion on the use of the funds and the Center Chief Technologists will coordinate a competitive process at their Center for the selection of projects. Centers will report on progress periodically and the program office at NASA Headquarters will evaluate the Center efforts on an annual basis.	NASA	Space Technology Mission Directorate			Edit
Funded Development	DSN Technology Planning and AMMOS Program	Supports upgrades and improvements to the Deep Space Network (DSN) and the Advanced Multi-Mission Operating System (AMMOS)	NASA	Science Missions			Edit
Funded Development	Flight Opportunities Program	NASA depends on advances in technology, and yet, space testing and space qualification of promising technologies remains one of the most difficult of all NASA's hurdles. High costs and risk of flight demonstration to incorporate advanced technologies into future missions have been a great challenge to NASA. Flying payloads on commercial parabolic aircraft and reusable suborbital vehicles will bridge the famed "valley of death" and help move technologies rapidly to maturity. The technology elements included in this technology set are those relevant to planetary science missions. See the URL for the full set of OCT flight opportunity program technologies.	NASA	Office of the Chief Technologist			Edit
Funded Development	Game Changing Technologies	The Game Changing Development Program seeks to identify and rapidly mature innovative/high impact capabilities and technologies for infusion in a broad array of future NASA missions. Multiple performing teams using varied approaches will attempt to achieve selected high impact challenge goals. Performing teams are held accountable for ensuring that discoveries move rapidly from the laboratory to application. The Game Changing Development Program portfolio will produce both subsystem/system level multidisciplinary innovations and component/discipline innovations. While advances in discipline and core knowledge are by-products of the Game Changing development Program, the objective is to mature transformational innovations for future space systems in preparation for flight demonstration.	NASA	Office of the Chief Technologist			Edit
Funded Development	In Space Propulsion Technology Program	The In-Space Propulsion Program managed by the Glenn Research Center develops primary propulsion technologies that can benefit near and mid-term science missions by reducing cost, mass and/or travel times. The In-Space Program is working to develop next generation electric propulsion technologies,	NASA	Science Missions	Planetary Science		Edit

Technology Element – Overview: UltraFlex SOP



Technology Elements – Performance: UltraFlex SOP



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State of the Practice

UltraFlex

Overview | Performance | Milestones | Cost | Dependencies | References

Performance

Application

Solar power generation for LEO, GEO, interplanetary, and landed spacecraft. Refer to attached graph for scalability.

Performance Specification

Type	Reference Cell Type	Reference Cell Efficiency	W/kg (BOL)	Stowage Volume (kW/m3)	Wing Diameter (m)	Max. Power per panel (W)	Voltage Capability	Min. Deployment Frequency (First Mode, Hz)	Temp Range (C)	Comment
UltraFlex ST8 - NGU-S	Std. Thickness Multijunction Photovoltaics	0.28	175	33	5.5	7000	Up to 100V	0.3	100/-90	New Millenium ST8 Program
UltraFlex ST8 - NGU-LW	Lightweight (100 micron thick) Multijunction Photovoltaics	0.275	220	33	5.5	7000	Up to 100V	0.3	100/-90	New Millenium ST8 Program
UltraFlex - Mars Phoenix Lander	Triple Junction Photovoltaics	0.24	>103	/	2.1	/	/	/	/	As flown on Phoenix
UltraFlex - Mars 01 Lander	High Efficiency Silicon	0.17	/	/	2.1	/	/	/	Successful Coupon Testing 200 cycles - 140C to 80C	Flight hardware built, qualified and delivered

Planetary Environment Capability

Launch:

In Space: Option to withstand >3g's deployed (e.g. landing, docking, or transfer orbit power). Not proven.

Entry/Landing:

Planetary: Successfully flown on Phoenix Mars Lander (2008)

Technology Elements – Performance: UltraFlex SOP (cont'd)

Maturity & Availability

Current TRL: TRL 9 Actual system "flight proven" through successful mission operations

Availability: 2.1m arrays proven on planetary landers. Scaled-up versions under development for Orion MPCV and future planetary mission concepts.

UltraFlex Development Programs	Wing Dia. (m)	Maturity Achieved
Qualification UltraFlex solar array wing	3.1	Successfully completed full wing level qualification tests
Wake Shield 04	3.2	Completed PDR & 90% of design
Ball/ABLE INSIDE Jupiter Qual-Board	4.5	Deep Space Coupon qualification
Mars 01-Lander	2.1	Flight hardware delivered
Mars Phoenix Lander	2.1	100% Flight success
NASA-New Millenium ST8	5.5	Completed CDR; TRL6
NASA Crew Exploration Vehicle-Orion	6.0	PDR 8/2009 (ongoing)

Development Plan - if applicable

Start Year: N/A

Initial TRL:

Final TRL:

Development time - Years:

Technology Hurdles to get to TRL 6

Technology Hurdles to get to TRL 6:

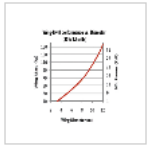


Fig. performance 1 UltraFlex Performance Scaled Performance of Derived UltraFlex Arrays

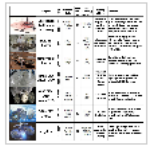


Fig. performance 2 UltraFlex Development Milestones

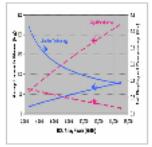
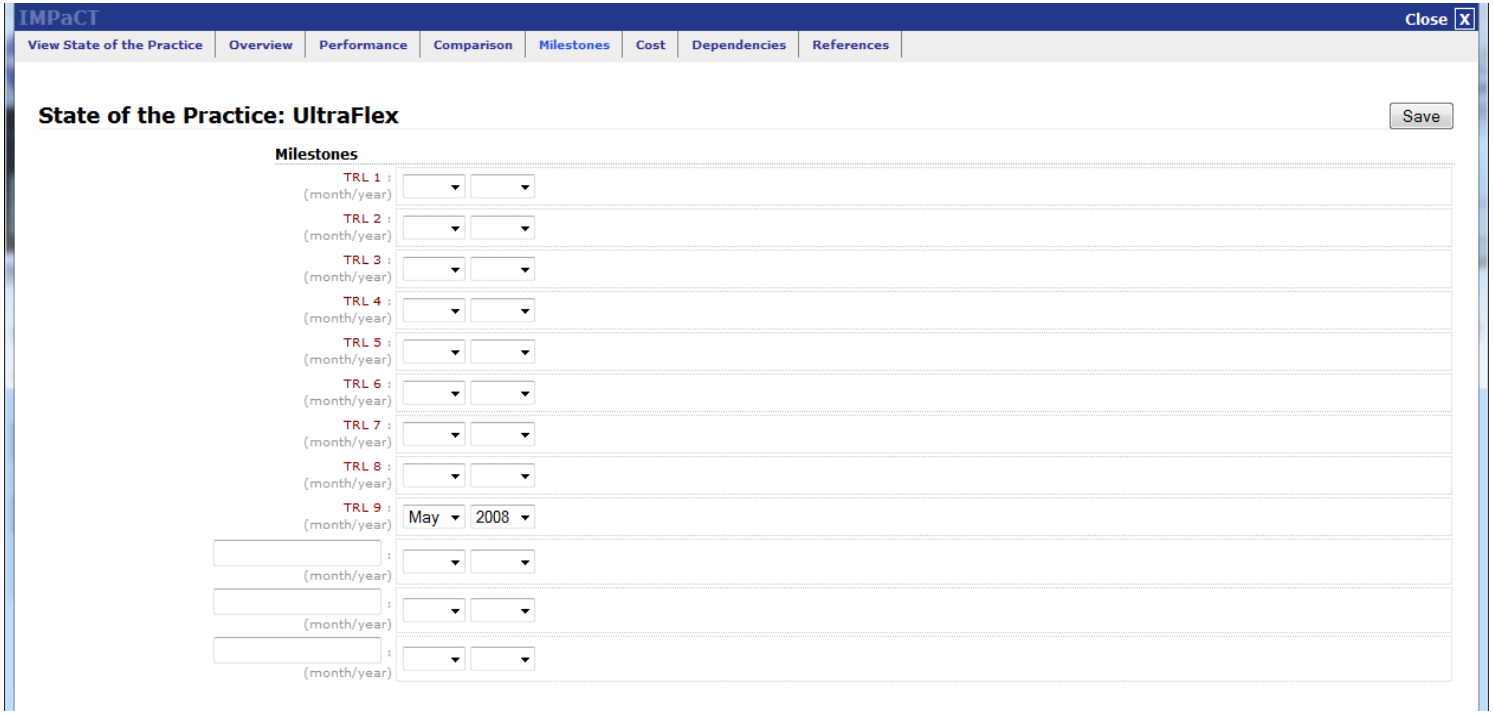


Fig. performance 3 UltraFlex Mass/Structural Benefits From White et al.

Technology Element – Milestones: UltraFlex SOP



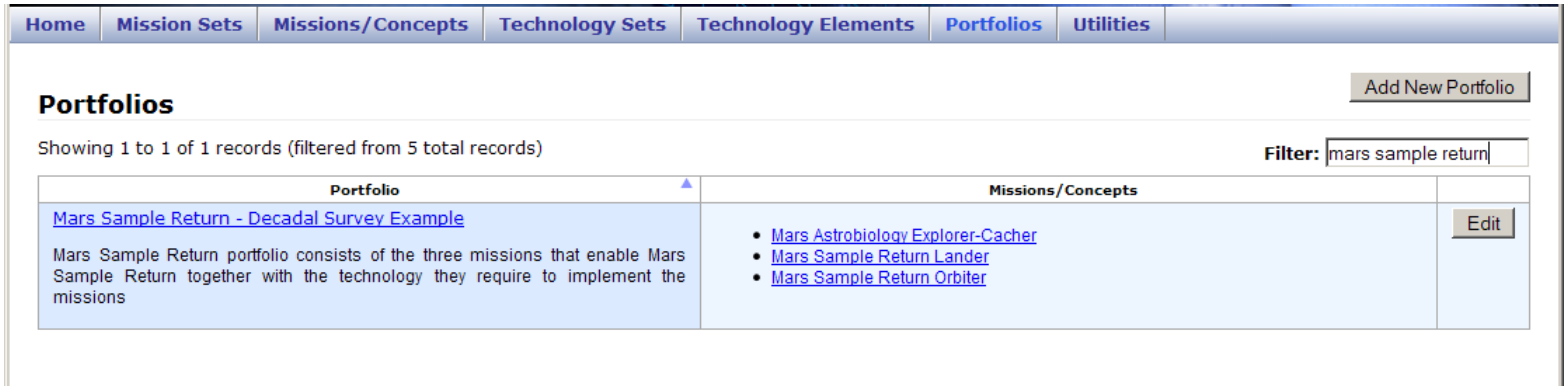
Technology – State of Practice

- State of the Practice technologies are being incorporated into IMPaCT with participation from JPL Team X subsystem chairs
- Approach is to:
  - Identify key figures of merit (FOMs) for each subsystem (e.g. W/kg for solar arrays)
  - Map the current technology capability into the FOMs
  - Experiment with describing this information graphically for ease of understanding
  - Define interdependencies between different FOMs and different subsystems.
- The PSPS study team is working with the JPL A-team to apply information in the IMPaCT database to mission concept development studies

Portfolio Analysis

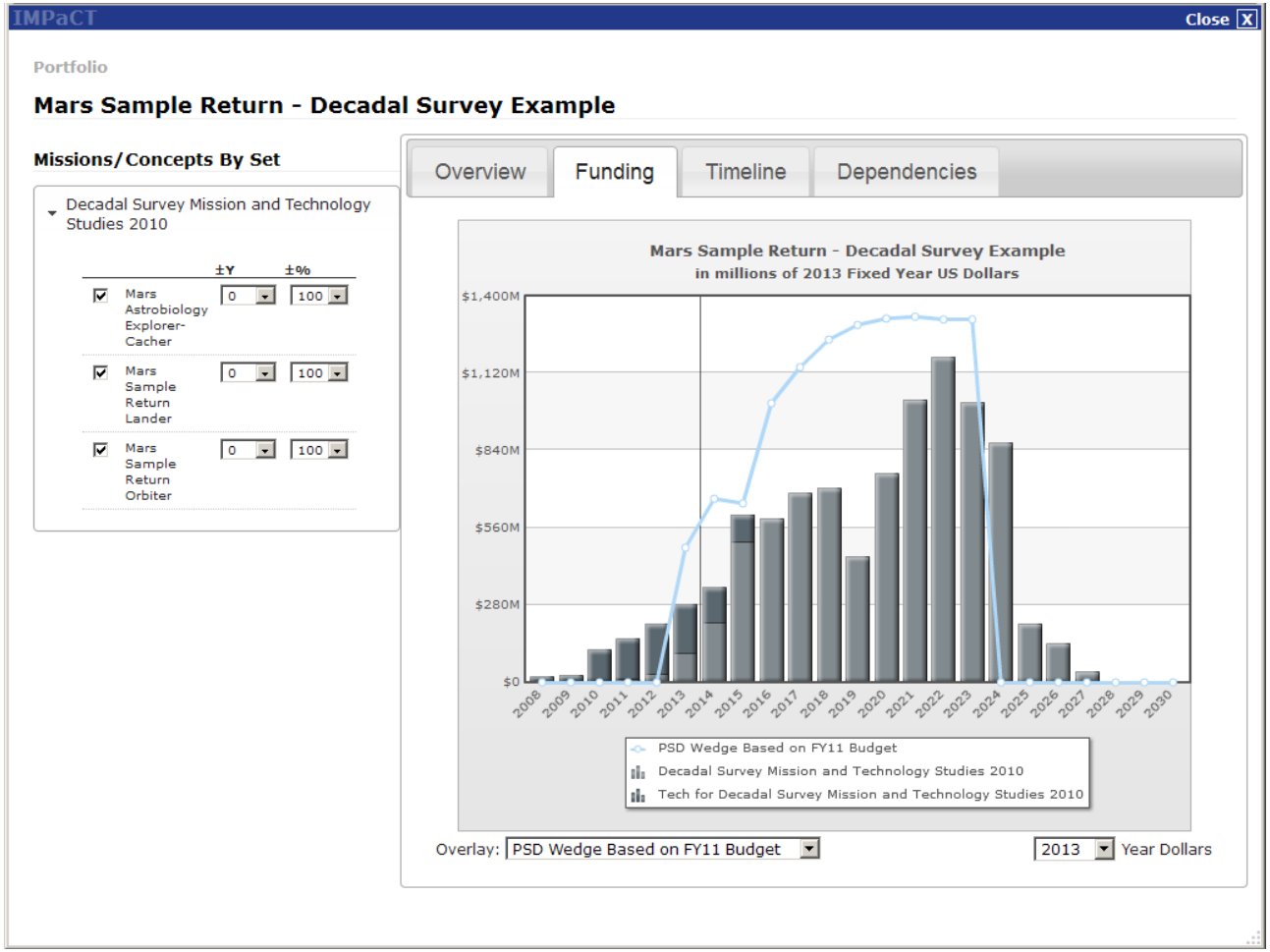
- IMPaCT portfolio analyses are used to develop an integrated plan for missions and technologies.
  - Useful for 'what if' scenarios.
- Portfolios provide analysis options for:
  - Accommodating funding constraints
    - Delaying the start of mission or technology elements
    - Reducing the cost of mission or technology elements
  - Determining impact of dependencies
    - Does starting a mission earlier impact technology readiness?
    - Does a mission delay impact other missions?

Portfolios - Listing



Source: Planetary Science Decadal Survey (2011)

Portfolio Analysis Capabilities: Hypothetical Example Funding – Wedge based on FY11 Budget



Source: Planetary Science Decadal Survey (2011)

Application Security and Access Control

- The basic IMPaCT security application requirements are covered by a general JPL IT Security Plan that describes the controls in place to meet essential security requirements for Scientific, Engineering, and Research Information
- The specific application security and access control requirements are defined in an security implementation plan that ensures protection of IMPaCT information assets for:
  - Confidentiality – Applying restrictions on information access and disclosure, including means for protecting proprietary and ITAR information
  - Integrity - Guarding against improper information modification or destruction, and includes ensuring information authenticity
  - Availability - Ensuring timely and reliable access to and use of information

Application Security and Access Control

- The IMPaCT application resides outside the JPL firewall to allow access by non-JPL users
  - Access to application data is restricted to approved JPL & NASA personnel via secured login – JPL LDAP & NASA IdMAX
  - User roles and associated functions for data access and management have been defined
- The application security plan was completed January 15 and the current version of IMPaCT includes implementation of Phase I of the security plan
  - IMPaCT users are assigned User Role(s) to enable specific view and edit privileges
  - Access to data items and data functions are managed by User Roles
  - Each data item is owned by a user who can choose to keep data private (in a private work area) or make it available on a selective or general basis
  - Data configuration control is enhanced as only authorized users can make changes

Improvements Planned for Future Versions

- Technology assessment capability, including technology relevance, readiness (TRL) and infusion
- Explicit definition of environmental requirements for the technology
- Instrument developments and target mission applications
- Alternative methods of inputting data – keyboard, Excel, PDF. Goal is to make this user friendly.
- Data export capability. Goal is to provide IMPaCT data to other analysis and reporting tools.
- Printer friendly reporting

Examples of Technology Applications

- Types of assessments which the 4X Planetary Science Program Support task has been asked to conduct include:
  - Technology relevance – e.g., to PSD, Mars Program, Outer Planets Program. Changes in relevance to be tracked as the portfolio is updated
  - Technology readiness – technology readiness levels and progress in advancing readiness
  - Technology infusion – status of plans for application in ground and flight systems and monitoring progress in advancing readiness
- Technology efforts that we expect to include in the next 6 months include: STMD Game Changing Technologies, STMD Technology Demonstration Missions, ISPT, Early Stage Innovation, Center Innovation Funds and PIDDP (PICASSO/MATTISE)
- New capabilities are being added to IMPaCT as needed to augment our existing analysis tools including adding new fields and summary reports.

Examples of Technology Applications

- Very strong, broad interest in technology assessment from NASA sponsors and other communities.
  - PSD managers want to know what STMD is doing and if it will be useful for planetary science
  - STMD managers are seeking feedback on the relevance of their technologies to future missions
  - AGs, PIs, technologists, mission concept developers seek a clear understanding of what technologies are upcoming and how they might be applied to their area of interest

Summary

- IMPaCT provides a powerful methodology to assess and develop an integrated plan for missions and technologies.
  - The functional capabilities are now in place and the mission and technology databases are being expanded
- IMPaCT provides access to broad sets of spacecraft technology data (and instruments, in the near future) for use in formulation phase studies
- IMPaCT is becoming a resource for the routine technology assessments performed for NASA's PSD.
- Feed back is requested from users to improve the capabilities to meet needs.

References

- IMPaCT has been reported as new software in the JPL New Technology Reporting System
  - NTR #48197, July 2011
- IMPaCT featured in the January 2013 NASA TechBriefs
  - http://www.techbriefs.com/component/content/article/15485
- An OpenSource version of the IMPaCT S/W is available on SourceForge since May 2012
  - http://sourceforge.net/projects/impactportfolio/
- IMPaCT Points of Contact
  - Programmatic: Pat Beauchamp Patricia.M.Beauchamp@jpl.nasa.gov
    Chet Borden Chester.S.Borden@jpl.nasa.gov
  - Development & Application: Susan Jones Susan.K.Jones@jpl.nasa.gov