

Risk Based Technology Portfolio Management

***How NASA is Prioritizing Technology
Developments to Return to the Moon to Stay***

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Introduction

- **Return to the Moon?
Been There, Done that
- *38 years ago!***
- **This Time it's Different**
 - **No Cold War**
 - **We are Going To Stay**
 - **Use the Moon as Preparation for Going to Mars**
- **The Technologies Needed will be Mostly
New, Just like Before**

The Constellation Program

- **A Program of Projects**
 - **Orion – Crew Vehicle**
 - **Ares – Launch Vehicle, Earth Departure Stage**
 - **Lunar Lander – Recently Established**
 - **Lunar Surface Systems – Being Established**
 - **Ground Operations, Mission Operations, Communications Projects**
- **Schedule**
 - **ISS Missions – 2017**
 - **Lunar Sortie Missions – 2019**
 - **Lunar Outpost Construction Start– 2020**
 - **Mars Missions – 2035**

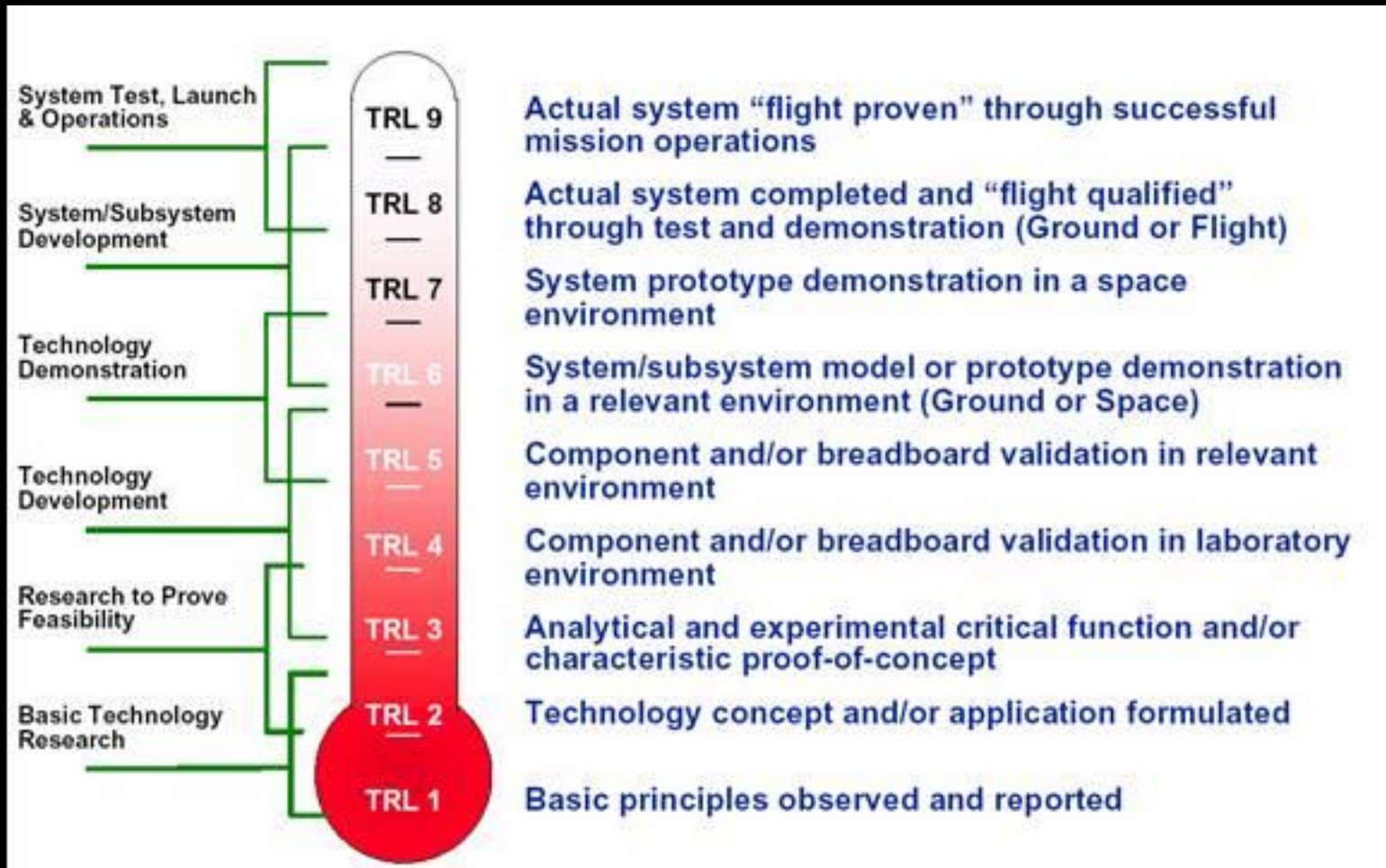
The Systems Engineering Connection

- **Technology Insertion Programs**
 - **Traditional SE Function**
 - **Requirements Based**
 - **Run in Parallel With PM and SE Activities to Assure Needed Technologies are There When Needed**
- **Unique Challenges Posed by Constellation**
 - **Use of Technological Advances since 1968**
 - **Many New Technologies Needed**
 - **Many New Challenges in Integration**
 - **Success Highly Dependent on Technology Development**

The Approach and the Difficulties

- **Approach Must be Risk Based**
 - **Risks of Needed Technologies Not Mature when Needed**
 - **TRL Level 6 Needed by Project PDR**
 - **TRL Level 8 Needed by Project System Integration and Operational Test**
 - **Risks of Technology Gaps**
 - **Risks of Technology Duplication**
 - **Risks of NASA Technology Competencies Not Mature to Manage Technology Projects**
 - **Cost Risks**

An Aside: Technology Readiness Levels



JSC Engineering Directorate Technology Initiative

- **Establish Advanced Development Working Group**
 - **Technology Integration**
 - **Liaison to Programs and Projects for Technology**
 - **Liaison to all 10 NASA Centers**
 - **Honest Brokerage**
 - **Arbitration**
- **Assure Technology Needs Met for Constellation**
 - **Risk Based Approach**
 - **Assurance of Technology Gap Filling**
 - **Assurance of No Technology Duplications**

The Approach to Meeting the Needs

- **Identify Core Competencies**
 - Center Basis
 - Categories – Core, Support, Gaps
- **Develop Technology Portfolio**
 - Existing Competencies in Development
 - Existing Technology Developments
 - Identify Gaps in Both
- **Prioritize Technology Competencies and Technologies based on Risk**
 - START Tool
 - TRL Calculator
 - AD² Tool
- **Pipeline both Needed Competencies and Technology Developments Based on Requirements**

The START Tool

- **ST**rategic **A**ssessment of **R**isk and **T**echnology
 - Developed by JPL
 - Used in Unmanned Interplanetary Mission Projects
- **Capabilities**
 - Quantifies the features of each technology
 - Assesses Risk
 - Calculates ROI
 - Compare Candidate Technologies for Development
- **Contact:**
 - <http://start1.jpl.nasa.gov/index.cfm>
 - Charles.R.Weisbin@jpl.nasa.gov

The TRL Calculator

- Tool for applying NASA's Technology Readiness Levels (TRLs) to technology development programs
- Microsoft Excel spreadsheet application
 - Standard set of questions about the program
 - Graphically displays TRL achieved
- Provides repeatable system for measuring a technology's maturity
 - "Snap shot" of program maturity at a given time
 - Historical picture of what's been done so far
- Contact:
<https://acc.dau.mil/CommunityBrowser.aspx?id=25811>

The Advanced Degree of Difficulty (AD²) Tool

- **AD² deals what is required to move a technology from one TRL to another.**
 - **Design Readiness Level**
 - **Manufacturing Readiness Level (MRL)**
 - **Integration Readiness Level (IRL)**
 - **Software Readiness Level (SRL)**
 - **Operational Readiness Level**
 - **Human Readiness Levels (HRL) (skills)**
 - **Capability Readiness Levels (CRL) (people and tools)**
 - **Organizational aspects (ability of an organization to reproduce existing technology)**
- **Contact:**
 - **http://pmchallenge.gsfc.nasa.gov/docs/2007Presentations/Presentations/Bilbro_James.pdf**
 - **James.W.Bilbro@nasa.gov**

1) Assess and Prioritize Technology Needs

Technology Needs Assessments for Exploration

Architectural Level (Level I)

- ESAS Technology Assessment;
- LAT 1 Technology Assessment;
- LAT2 Technology Assessment;
- MAT (?)

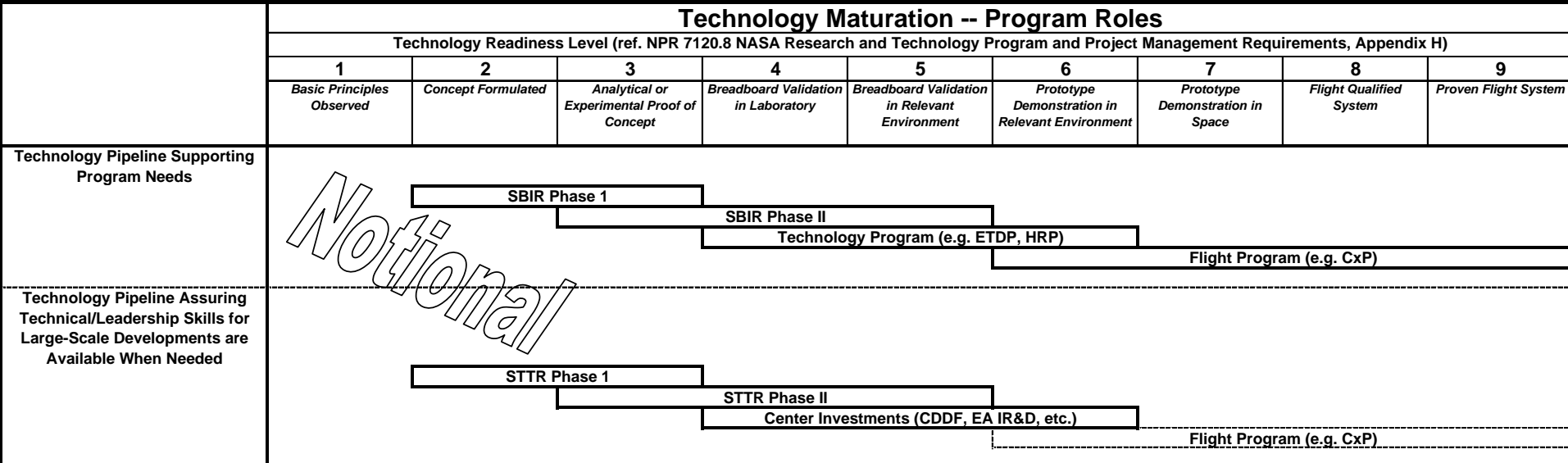
Program Level (Level II)

- CxP Technology Prioritization Panel

Project Level (Level III)

- CEV GFE Mgr;
- EVA Systems Technology Dev't Mgr;
- Lunar Lander Tech Integration Lead

2) Pipeline Technology Developments for each Technical Area



3) Sustain the Technology Pipeline with Partnerships and Documented Expectations/Endorsements



Technology Requirements Sources

- **Vision for Space Exploration – 2004**
- **Exploration Systems Architecture Study – 2005**
- **Lunar Assessment Team 1 Report –2006**
- **Constellation Architecture Requirements Document – Baselined at SRR 2006**
- **Lunar Assessment Team 2 Report – 2007**
- **Mars Assessment Team Report – Preliminary 2007**

The Initial Technology Portfolio



Just the Beginning

- **Advanced Development Working Group Achievements**
 - **Prioritized Most FY2008 IR&D Projects at JSC**
 - **Established Liaisons with Existing Projects**
 - **Developed Contacts with Upcoming Projects**
 - **Developed Liaisons with Other Centers**
 - **Providing Approach to NASA HQ for Adoption**
- **Work is Proceeding and is Exciting**

Summary and Conclusions

- **NASA JSC Engineering Directorate
Stepping Up to the Complex Challenge of
Technology for Constellation**
- **Risk Based Approach to a Fundamental
SE Function**
- **Will Assure Technology Gaps Filled**
- **Will Assure No Technology Duplications**
- ***Now, Where we are Really Going!***

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