TRL & Heritage
PI Launchpad

Presented by

Michael Johnson

Chief Technologist, Engineering and Technology Directorate

Goddard Space Flight Center
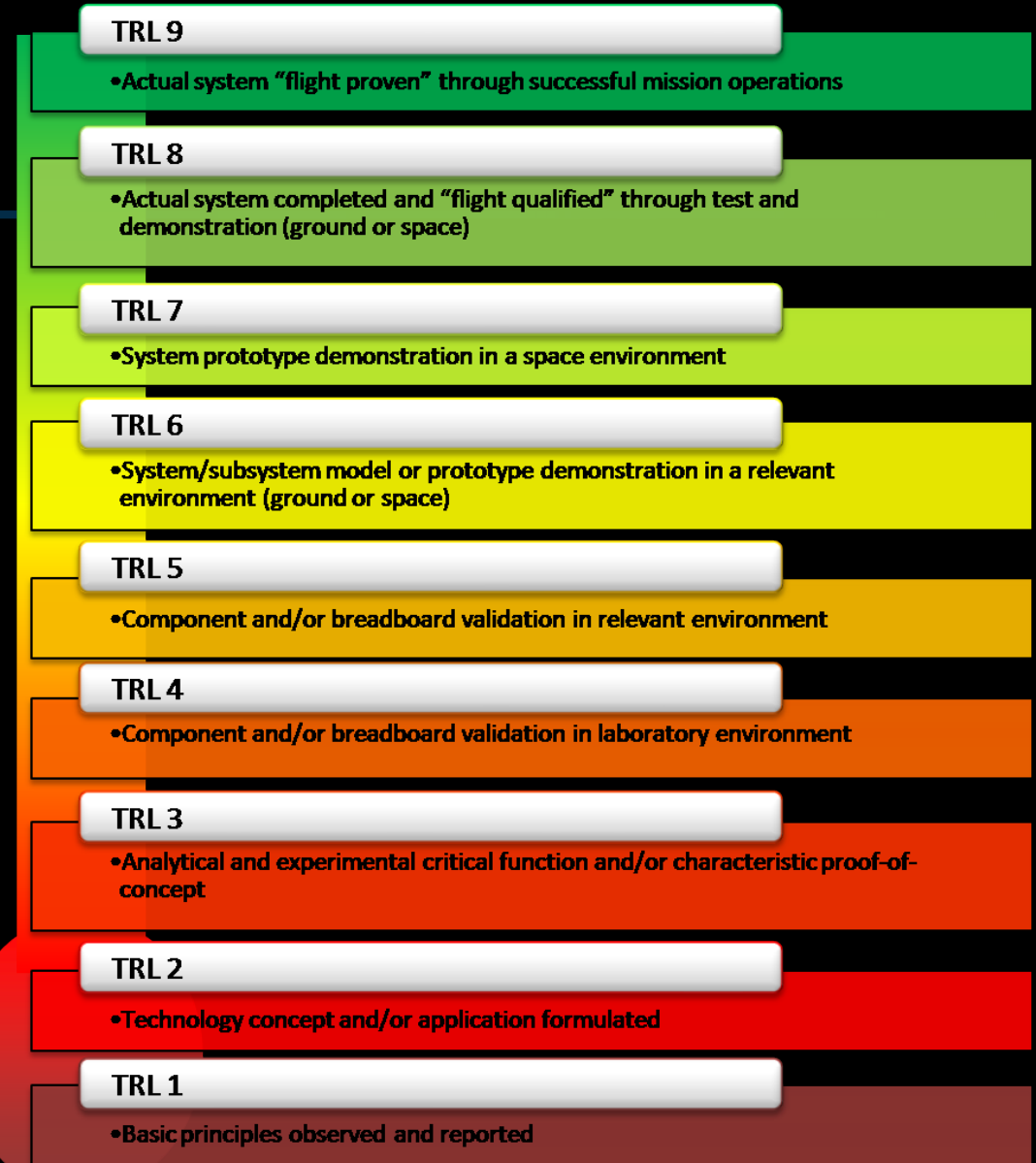
21 June 2021

TRL

What is a TRL?

Def: Technology Readiness Levels (TRLs) are a type of measurement system used to assess the maturity level of a particular technology.
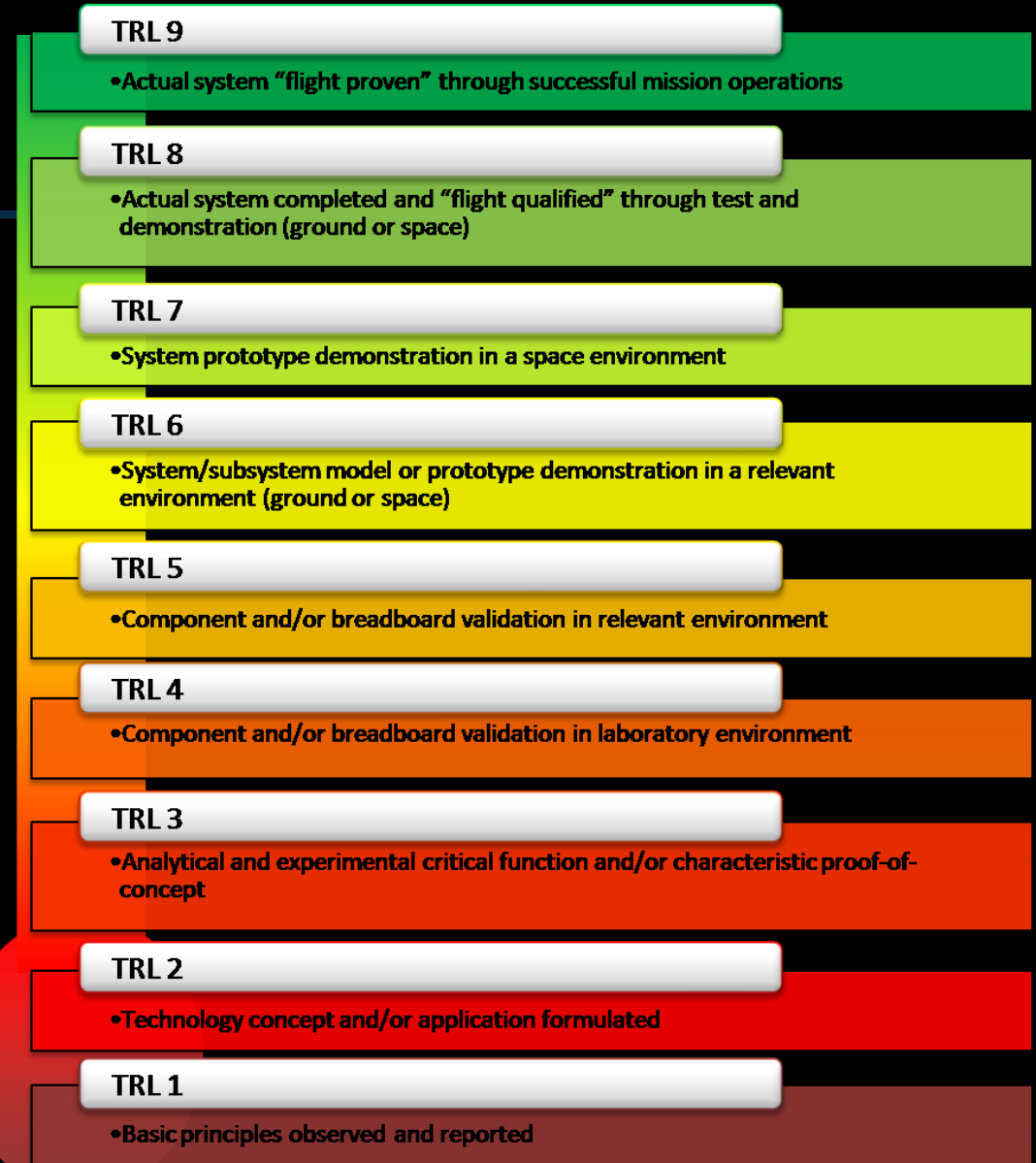
A common language.

Ref: https://www.nasa.gov/directorates/heo/scan/engineering/technology/technology_readiness_level
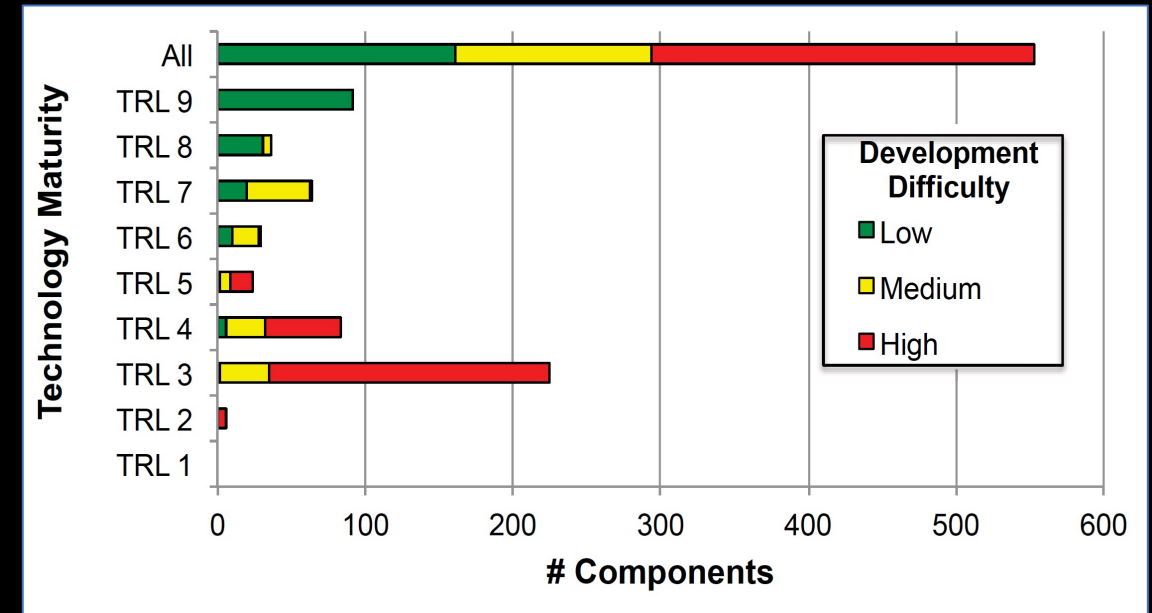
TRL 9
•Actual system "flight proven" through successful mission operations

TRL 8
•Actual system completed and "flight qualified" through test and demonstration (ground or space)

TRL 7
•System prototype demonstration in a space environment

TRL 6
•System/subsystem model or prototype demonstration in a relevant environment (ground or space)

TRL 5
•Component and/or breadboard validation in relevant environment

TRL 4
•Component and/or breadboard validation in laboratory environment

TRL 3
•Analytical and experimental critical function and/or characteristic proof-of-concept

TRL 2
•Technology concept and/or application formulated

TRL 1
•Basic principles observed and reported

TRL

There is no "good" or "bad" TRL ...

except when there is…

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TRL

… because technical maturity typically scales inversely with technical risk.

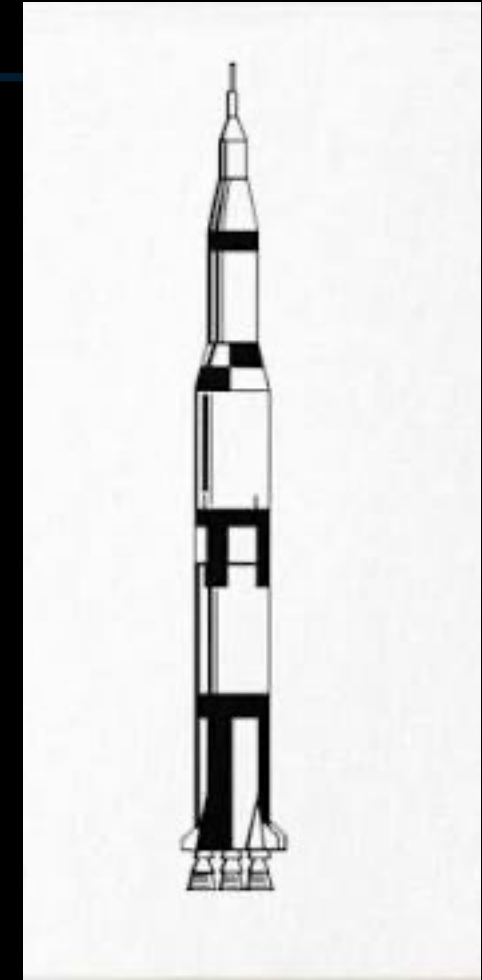A summary of component TRL information for a complex project.

Heritage

What is heritage?
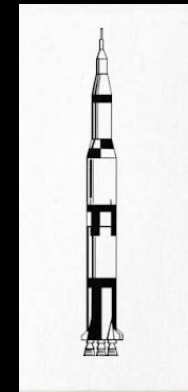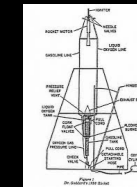
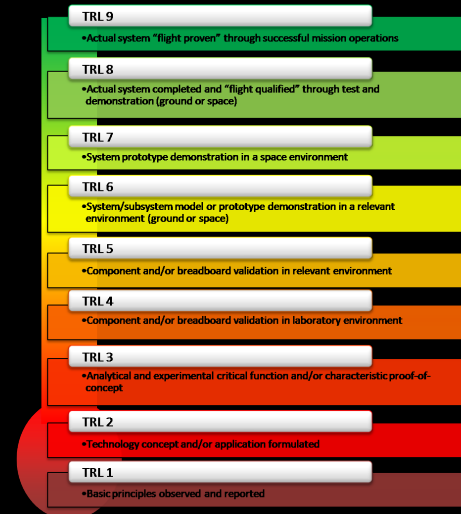**Def:** Something transmitted by or acquired from a predecessor.
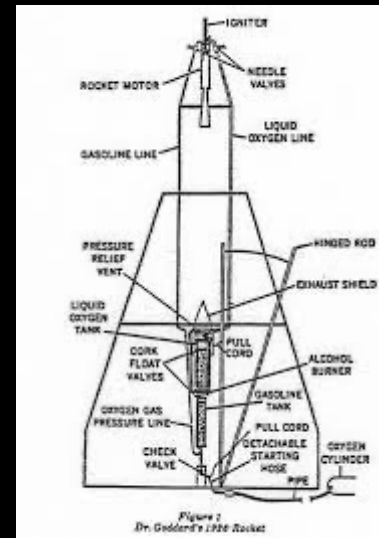
Dr. Robert Goddard's 1926 rocket

Saturn V

TRL & Heritage

Use of **heritage systems** raises TRL (lowers cost and technical risk)…

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TRL & Heritage

Use of **heritage systems** raises TRL (lowers cost and technical risk)…

except when it doesn't.
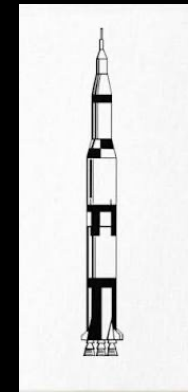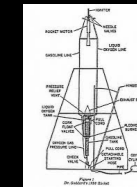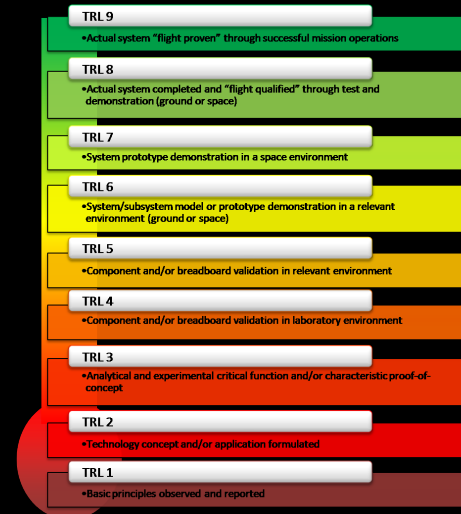
September 8, 2004

Ref. NBC News

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The Cause

The likely cause of the "unquantified science degradation" was a design error that involved the orientation of gravity-switches on a **heritage** sample return capsule avionics unit (SRC-AU).

Discussion of Recommendation 1:

The Genesis mishap occurred mainly because of failures in NASA's Systems Engineering process.

TRL 6
• System/subsystem model or prototype demonstration in a relevant environment (ground or space)

TRL 5
• Component and/or breadboard validation in relevant environment

System- or sub-system-level demonstration of the SRC-AU (TRL-6 validation) would likely have led to mission success.

So…

Proceed wisely.

Used appropriately, the TRL process and appropriately applied "heritage" can avoid "negative chutes" and "unquantified science degradations."

Important Tidbits

- The TRL process defines a common language…
  - But there are multiple dialects.
  - A description of the system state is just as (or more) important than the number

- Defining a system by its TRL can be deceptive and misleading.
  - E.g., the step from TRL(n) to TRL(n+1) could be 1 day and $ 20…
  - Or it could be 5 years and >$100M
  - And is it the "technology" development" really an "engineering" development?

- Use "heritage" carefully.
  - E.g., will the "heritage" system be used in the same environment?
  - Are the interfaces the to the system identical? (Are you sure?)
  - Is the use of the heritage system consistent with its intended use?
  - Is the mission duration the same?
  - ...

Valuable Resources

Program and Project Management

The NASA Office of the Chief Engineer (OCE) establishes Agency-level program and project management policies and requirements, and provides guidance to assist the programs and projects in the implementation and tailoring of the policy requirements.

It is NASA policy to apply program and project management procedural requirements, to plan, track progress, accomplish mission objectives, and follow the requirements and life-cycle reviews unique to their investment area as defined in the NASA procedural requirements for space flight, research and technology, information technology (IT) and institutional infrastructure. The procedural requirements establish the framework and process by which NASA formulates and implements programs and projects consistent with the governance model NPD 1000.0, NASA Governance and Strategic Management Handbook, and establish a standard of uniformity in the management of programs and projects.

The OCE is responsible for the overarching Agency program/project management policy:

- NPD 7120.4 — Program/Project Management

The following organizations are responsible for the program and project management procedural requirements related to each of the four investment areas indicated below:

- Office of the Chief Engineer (OCE): Space Flight, and Research and Technology:
  - NPR 7120.5 — NASA Space Flight Program and Project Management Requirements
  - NPR 7120.8 — NASA Research and Technology Program and Project Management Requirements
- Office of the Chief Information Officer (OCIO): Information Technology
  - NPR 7120.7 - NASA Information Technology Program and Project Management Requirements
- Office of Strategic Infrastructure (OSI): Institutional Infrastructure (includes Facilities Projects and Environmental Programs):
  - NPR 8820.2 - Facility Project Requirements (FPR)
  - NPR 8590.1 - Environmental Compliance and Restoration Program

Additional information on Program and Project Management (PM) may be found on the PM NEN Community of Practice site at https://nen.nasa.gov/web/pm , and the OCE Tab in NODIS at http://nodis3.gsfc.nasa.gov/OCE_rep/OCE_list.cfm.

Ref:https://www.nasa.gov/offices/oce/functions/prog_proj_mgmt.html

Ref: https://www.nasa.gov/connect/ebooks/nasa-systems-engineering-handbook

Thank you.

Michael.A.Johnson@nasa.gov

Ref: https://www.nasa.gov/directorates/heo/scan/engineering/technology/technology_readiness_level