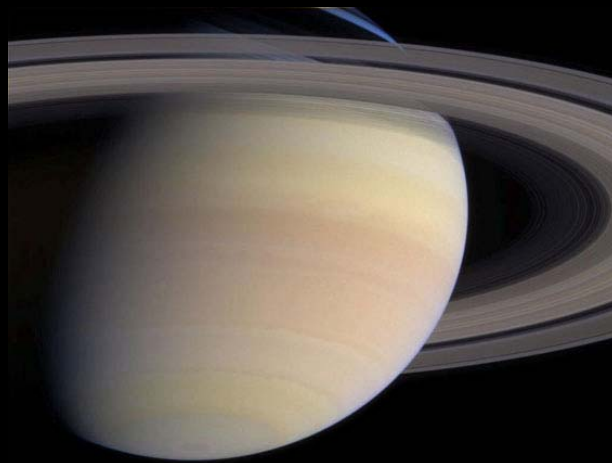


International Project Management: The Cassini-Huygens Mission

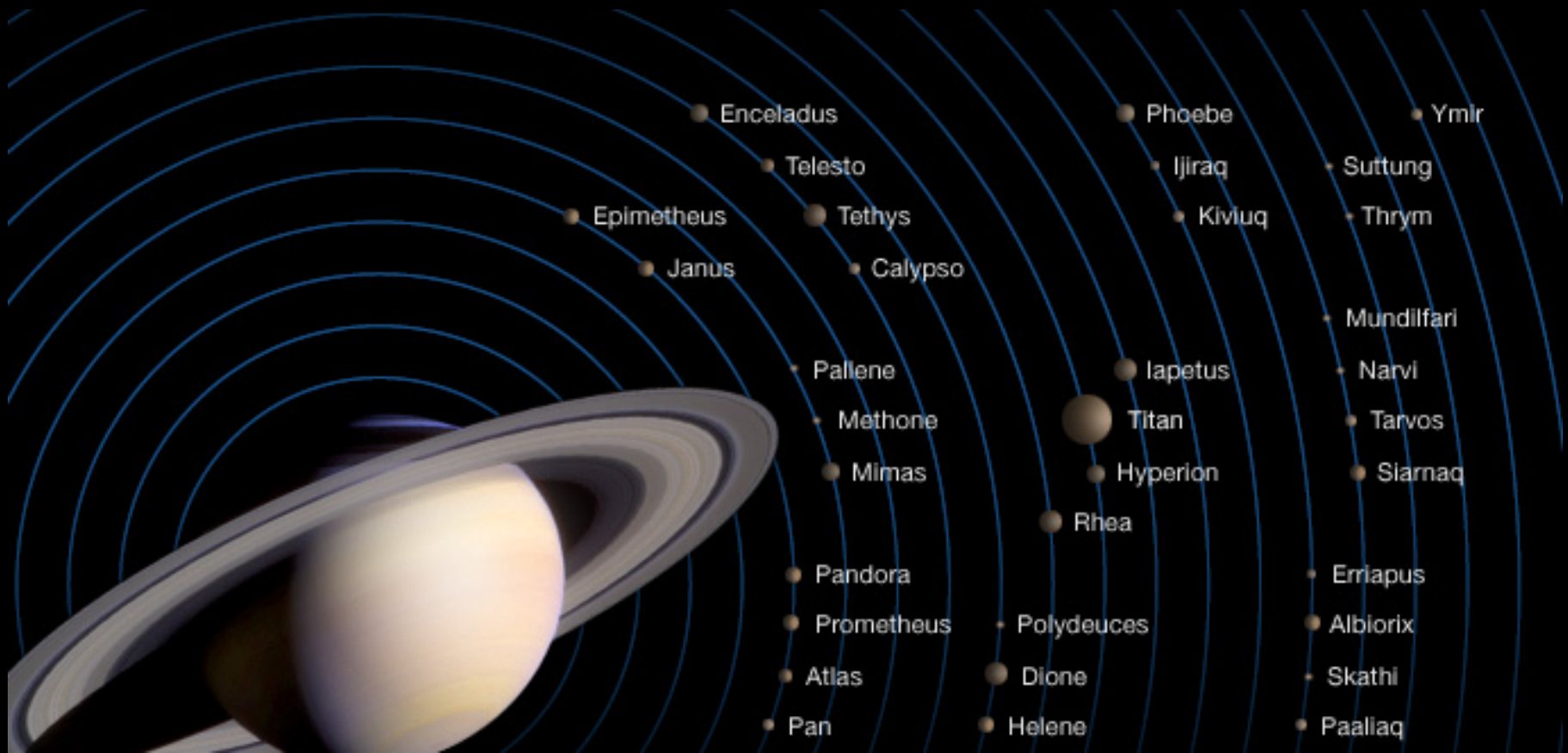
NASA Case Study



NASA Academy of Program/Project & Engineering Leadership

<http://appel.nasa.gov>

How would you explore the moons of Saturn?

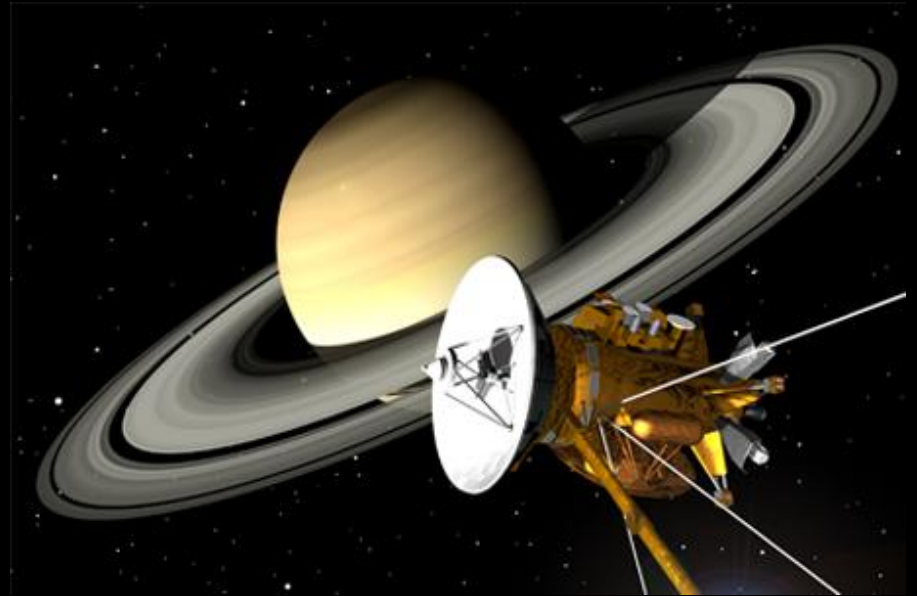


(watch a video: <http://saturn.jpl.nasa.gov/video/videodetails/?videoID=19>)

<http://appel.nasa.gov>

Cassini-Huygens

- U.S. - European mission to explore Saturn
 - NASA and Italian Space Agency: Cassini spacecraft
 - European Space Agency: Huygens probe
- Launched October 1997
- 6.7 year voyage to Saturn

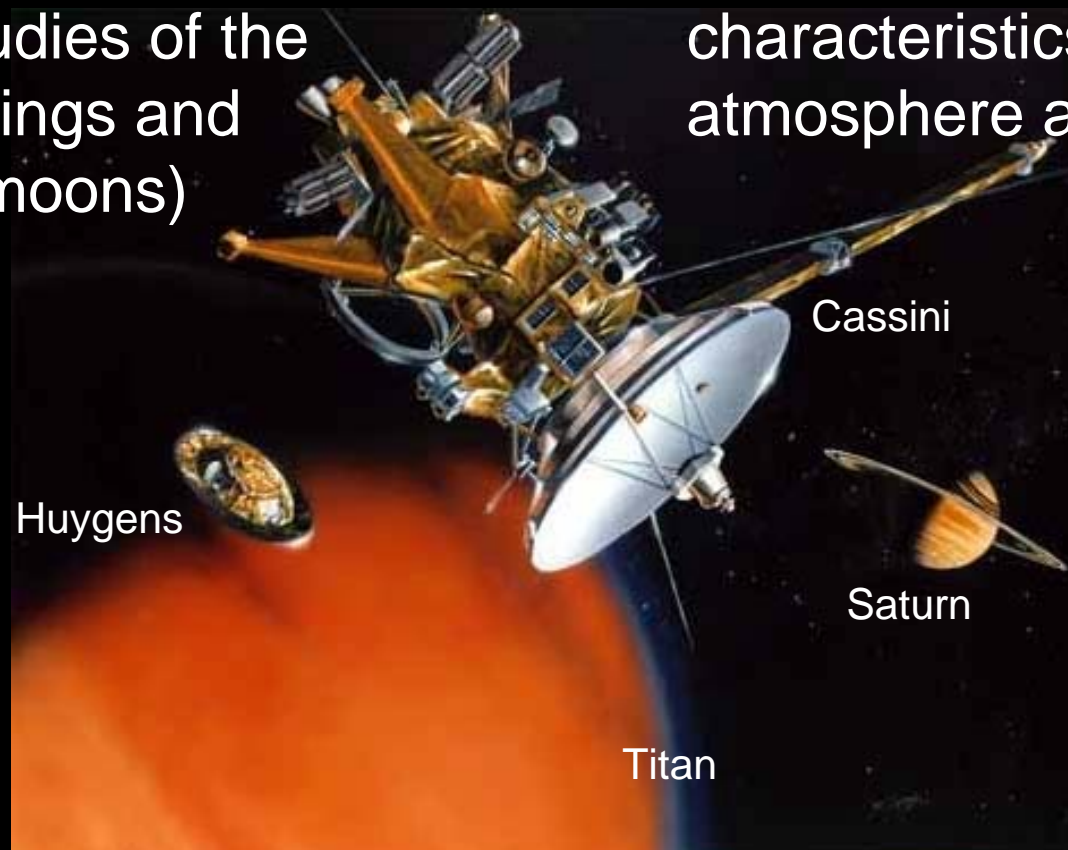


Cassini

- Delivered Huygens probe to Titan
- Remained in orbit around Saturn for detailed studies of the planet, its rings and satellites (moons)

Huygens

- Released by Cassini to land on surface of Saturn's moon Titan
- Investigated characteristics of Titan's atmosphere and surface



Cassini-Huygens: the Complex Project Environment

	<i>Complex Project-Based Organization</i>	<i>Functional Organization</i>
Problems	Novel	Routine
Technology	New/invented	Improved/more efficient
Team	Global, multidisciplinary	Local, homogeneous
Cost	Life cycle	Unit
Schedule	Project completion	Productivity rate
Customer	Involved at inception	Involved at point of sale
Survival skill	Adaptation	Control/stability

Discussion point: does this model describe Cassini-Huygens?

Defining Project Complexity at NASA

PROGRAMMATIC

Budget

- Congressional appropriations
- Changing agency constraints and priorities

Contractual

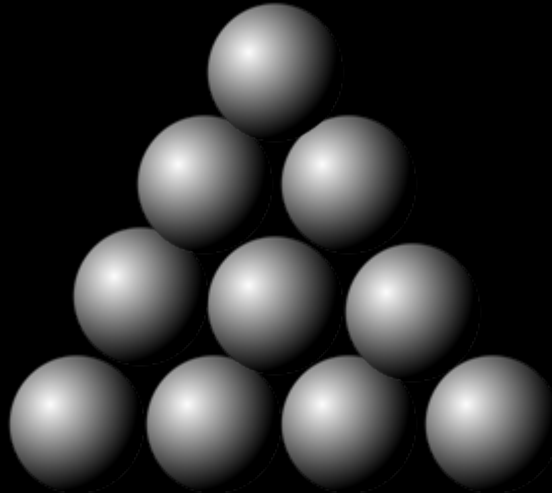
federal regulations

Schedule

- Launch windows
- Science/operational requirements

Sustained commitment

- Administration
- Congress
- Public
- Partners - academia, international, industry



PEOPLE

TECHNICAL

Interfaces/systems engineering

Technological readiness

One-of-a-kind systems

Harsh environment

Software

Long operational lifetimes

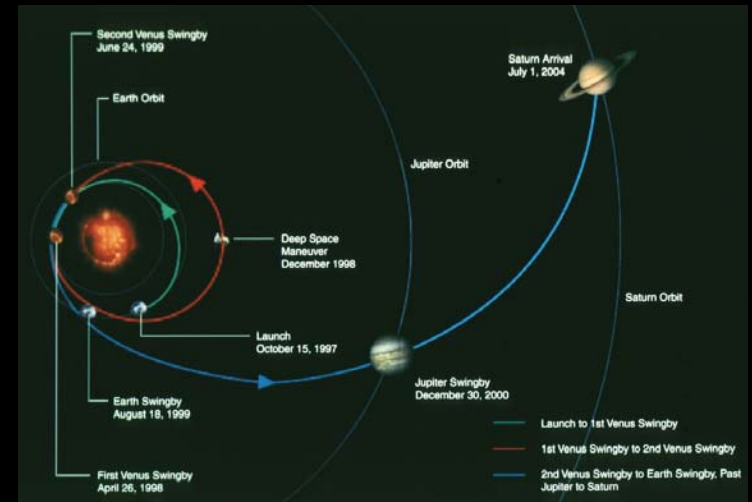
Unique test facilities & eqpt.

High performance requirements

It has to work the first time

Technical Complexity: Zero Room for Error

- Journey to Saturn included “gravity assists” (slingshot acceleration effects) from Venus, Earth and Jupiter - incredibly precise timing
- Cassini orbiter would “insert” Huygens probe in orbit of Titan (one of Saturn’s moons)
- Complex communications among Cassini, Huygens, Deep Space Network, and ground system



Cassini trajectory to Saturn



Huygens descent to surface of Titan

Organizational Complexity

Italian Space Agency



Cassini high-gain antenna; radio subsystem equipment

NASA



Cassini orbiter; launch vehicle and associated integration & test

ESA



Huygens probe and associated communications equipment on Cassini orbiter

Case Study: International Collaboration

1998: New project manager 8 months after launch

Challenge #1

- Adding scientific activities during multi-year “cruise” to Saturn
 - ✓ Pressure from scientists - planetary fly-bys posed unique opportunity
 - ✓ Project could “exercise” systems before Saturn
 - ✓ Existing agreements: no additional budget or schedule
 - ✓ Multi-party negotiations with international science team

Solution: Science was added at no cost to the mission

Case Study: International Collaboration

Challenge #2

- Adding full test of data communications system between Cassini and Huygens
 - Some key stakeholders considered test unnecessary
- Test result: **failure in telemetry system**
 - Significant data from Huygens about Saturn's moon Titan would be lost

Solution: Required changing Cassini's trajectory as it entered orbit around Titan

- ✓ Major technical challenge
- ✓ Used much of Cassini's fuel reserve

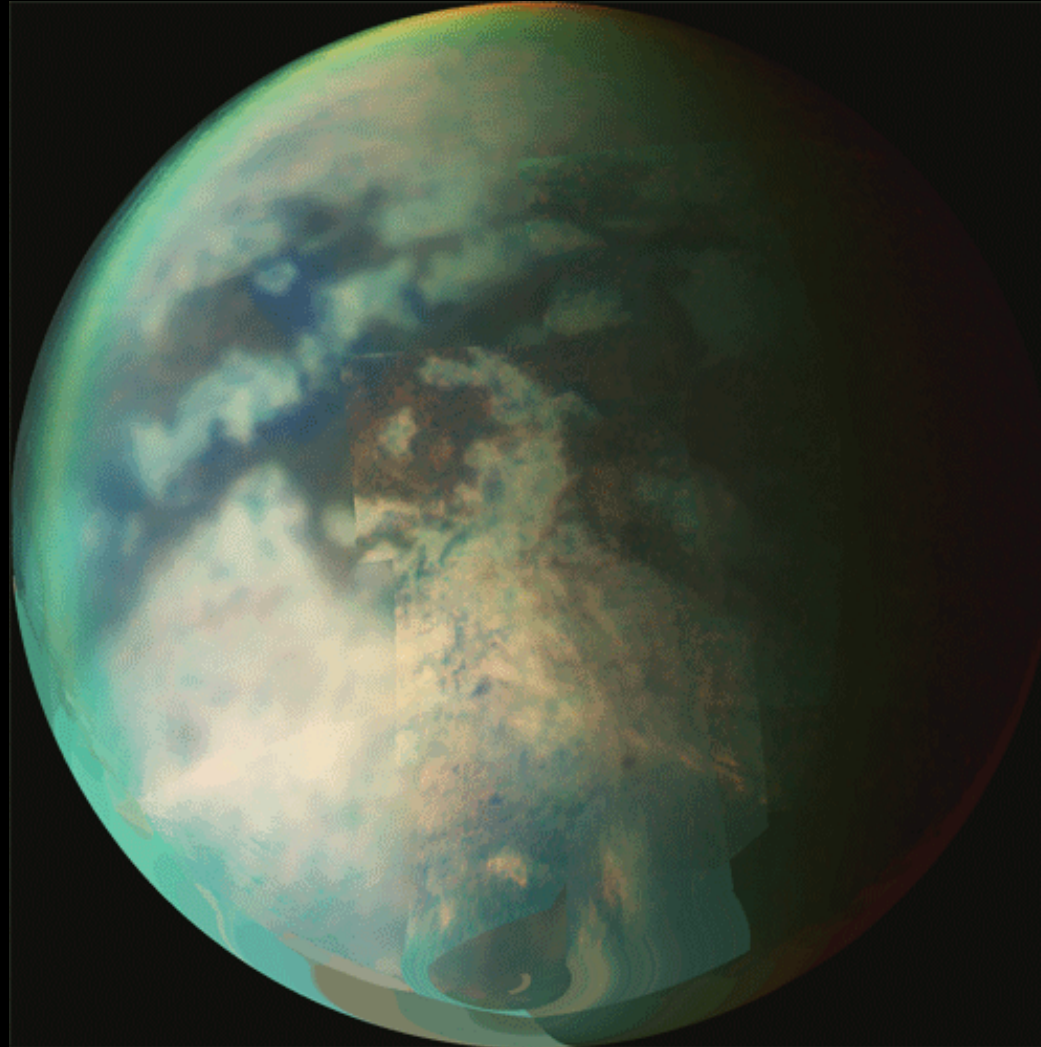
Case Study: International Collaboration

Challenge #2a: Regulations prohibited exchange of funds between NASA and ESA to solve the data communications problem

Solution: Instead of funds, ESA sent engineers to the Jet Propulsion Lab to work with the NASA team there

- ESA engineers encounter Cassini team of 200+, more complex and time-consuming processes
- Language barriers with ESA's non-English native speakers
- ITAR and post-9/11 security environment in U.S.

Outcome: Mission Success



A close encounter with Titan

<http://appel.nasa.gov>

"It is difficult to say what is impossible,
for the dream of yesterday
is the hope of today
and the reality of tomorrow."

- Robert Goddard

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