Lessons learned and risk management of JAXA

Asia-Pacific Conference on Risk Management and Safety

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Japan Space Exploration Agency
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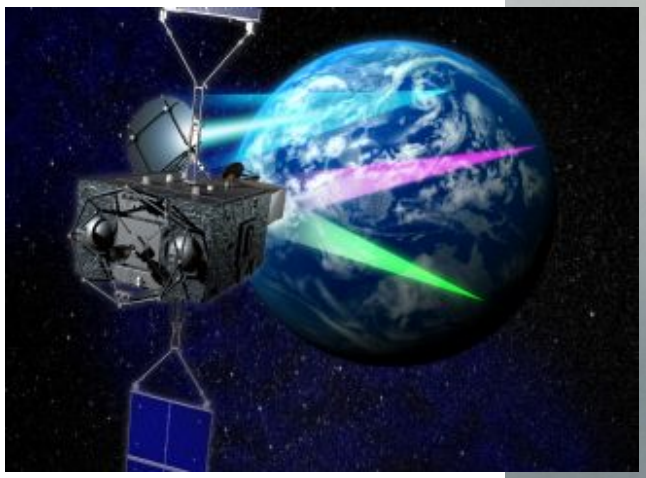
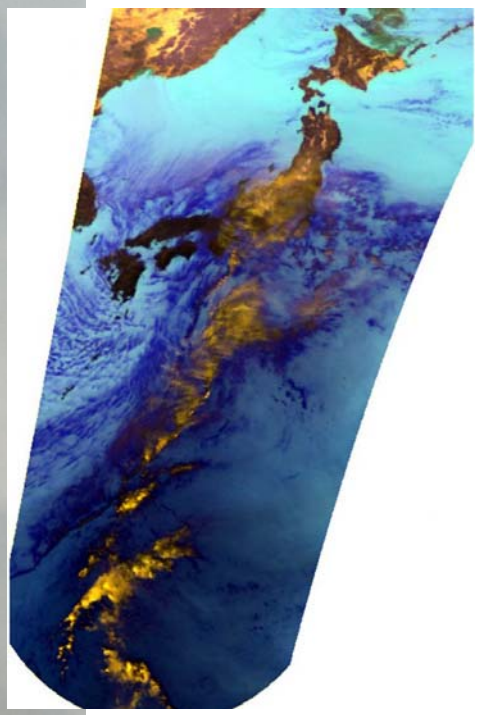
Space Development

Space Activities

Communication



Earth observation



Manned activity

Transportation

Science

Characteristics of space development

Design conditions for **satellites**:
Space environments

- Vacuum
- Zero gravity
- Electromagnetic energy: x-rays, ultraviolet, gamma rays etc.
- Cosmic rays
- Meteoroids
- Temperature

- Total weight: 4 ton
- Mission time: 3-5 years
- Altitude: 900km

ALOS
earth observation
Satellites of JAXA

Characteristics of space development (continued)

Design conditions of
H-IIA launch vehicle

- Total weight: 285 ton
(ref. Toyota Lexus, 1.8 ton)
- Mission time: 50~100min.

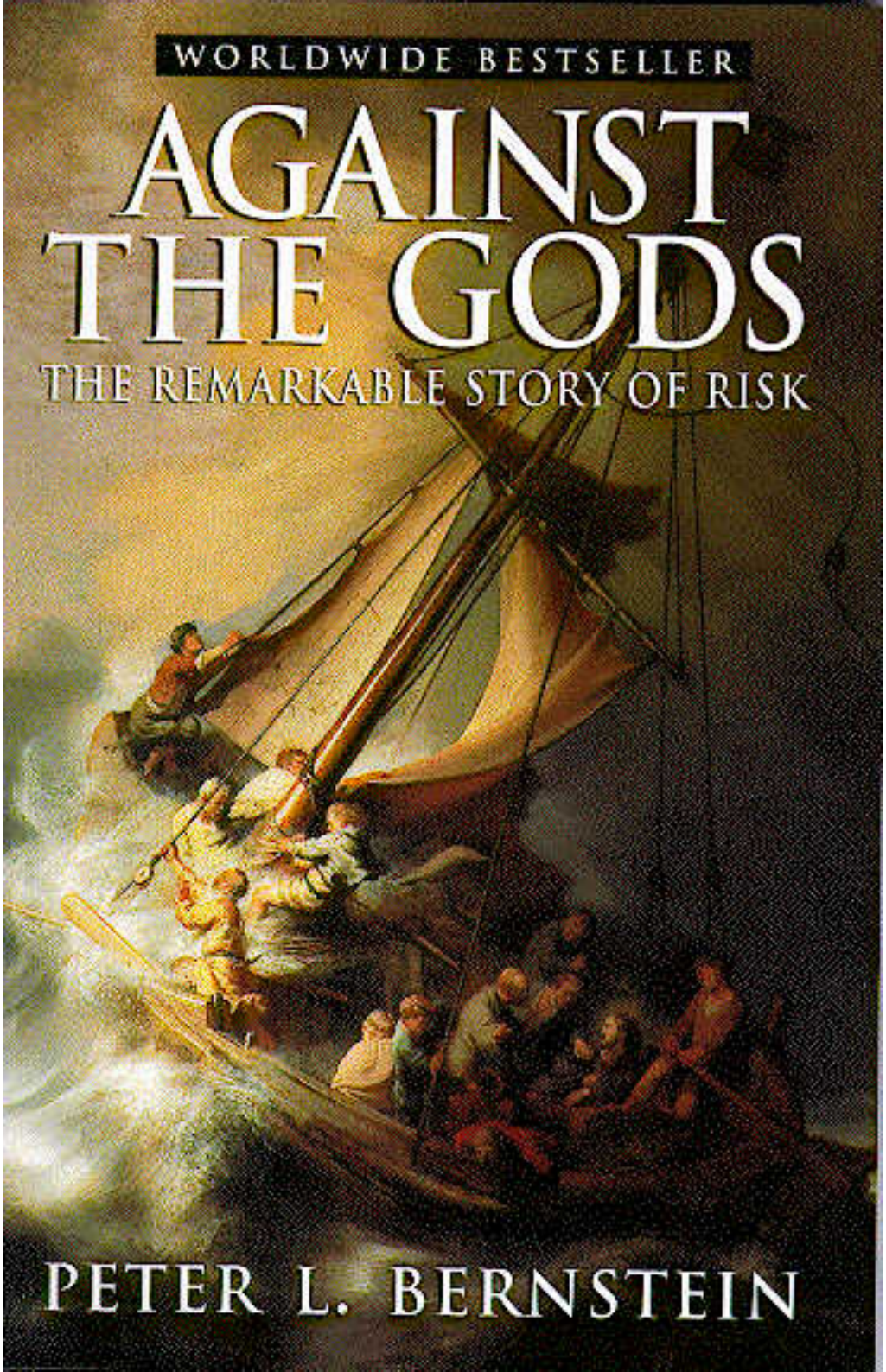
- Engine Power:3MHP
(ref. Toyota Lexus, 206HP)
- Fuel Liquid Oxygen,
and liquid Hydrogen

H-IIA
Launch vehicle

Risk management

The words risk derives
from the early
Italian **risicare**,
which means “to dare.”
In this sense, risk is
a choice
rather than a fate.

Peter Bernstein



Space development and Risk management

Space activities have been built on tremendous numbers of failures in the past.

Since space environments are very difficult to simulate on the ground, or space vehicles need very massive power to escape from the earth, space engineers have been solving "Unknown" technical factors derived from many analyses of the causes of failures.

Space developments have confronted enormous "Risks", space communities have been refining their technical and managerial processes in developments to conquer these risks.

Risk management is the essential part of these activities.

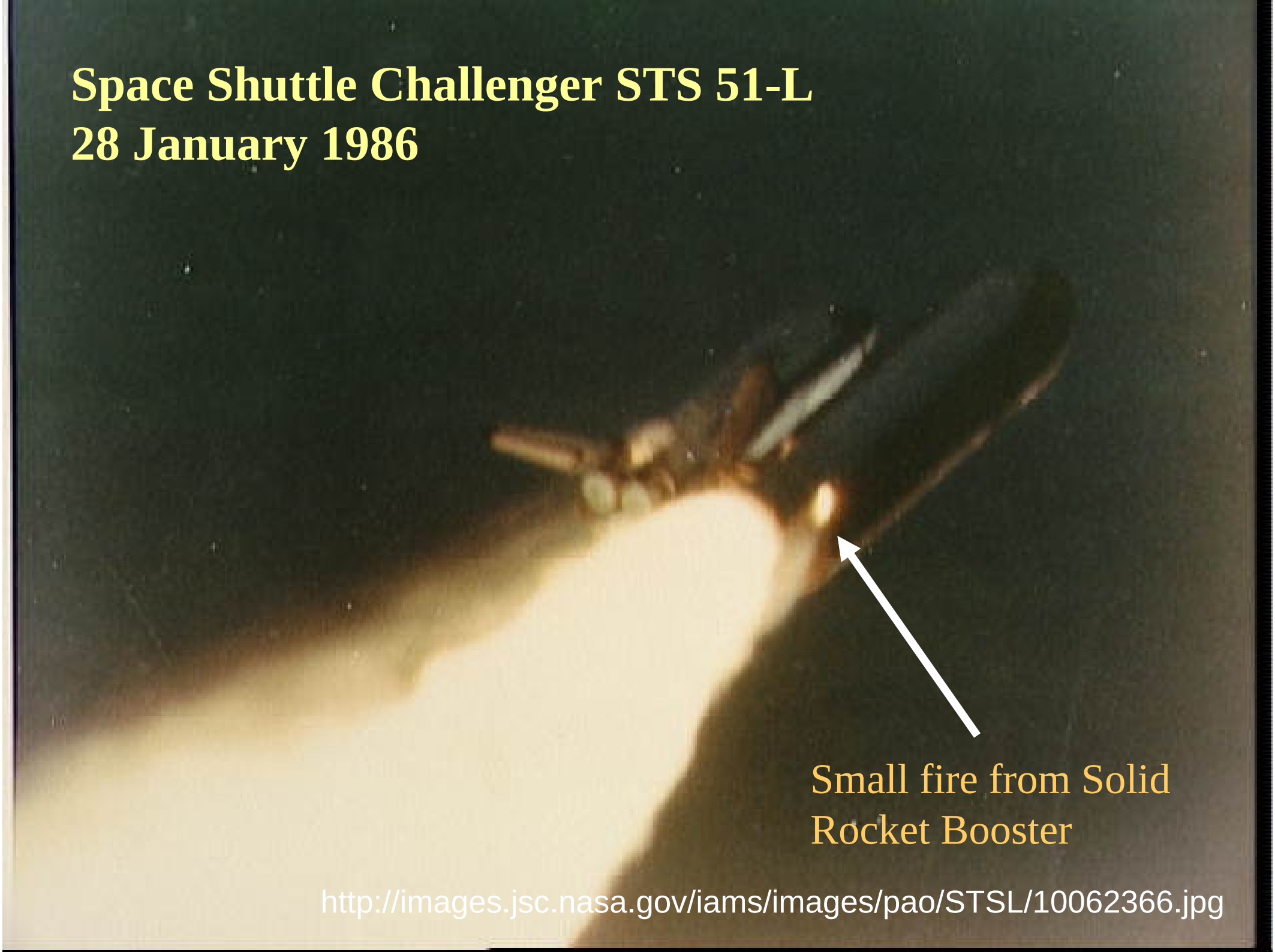
Definition of “Risk and Risk management”

NASA defines **“Risk”.**

The combination of the **probability** that a program or project will experience an undesired event (some examples include a cost overrun, schedule slippage, safety mishap, health problem, malicious activities, environmental impact, failure to achieve a needed scientific or technological breakthrough or mission success criteria) and the **consequences**, impact, or severity of the undesired event, were it to occur. Both the probability and consequences may have associated uncertainties”.

Also they define “**Risk Management.**

An organized, systematic **decision making process** that efficiently identifies, analyzes, plans, tracks, controls, communicates, and documents risk to increase the likelihood of achieving program/project goals”


Space Shuttle Challenger STS 51-L
28 January 1986
Small fire from Solid
Rocket Booster
http://images.jsc.nasa.gov/iams/images/pao/STSL/10062366.jpg

17 years later tragedy occurred again on STS-107 Columbia.

Risk management for space shuttle might have some fault

STS-114 had to wait 2.5 years to launch

Risk based approach

Current approach :
Do at first, if it fails then think how to treat these failures.
Program/Project may stop for a while.

If you wish never to fail a program/project,
your approach have to differ from usual.

Risk based approach :
Think at first, expecting some failures may happen and preparing for next steps to deal these failures, then do.
Program/Project may not stop

But many time unexpected failures will occur by the "Unknown" causes. How to conquer "Unknowns" is big issue in space development

Failures of launch vehicles

February 1998
H-2 F5 GTO

Cause:
Hot gas leaked from combustion chamber burned wire of fuel valve at 2nd stage engine

November 1999
H-2 F8 GTO

Cause:
Turbo pump was broken by cavitations at 1st stage engine

November 2003
H-2A F6 LEO

Cause:
Under investigation

NASDA **JAXA**

Failures of Satellites

August 1994
ETS-6
Geostationary Orbit

Cause:
Stick in propulsion valve of Apogee engine

June 1997
ADEOS
Low Earth Orbit

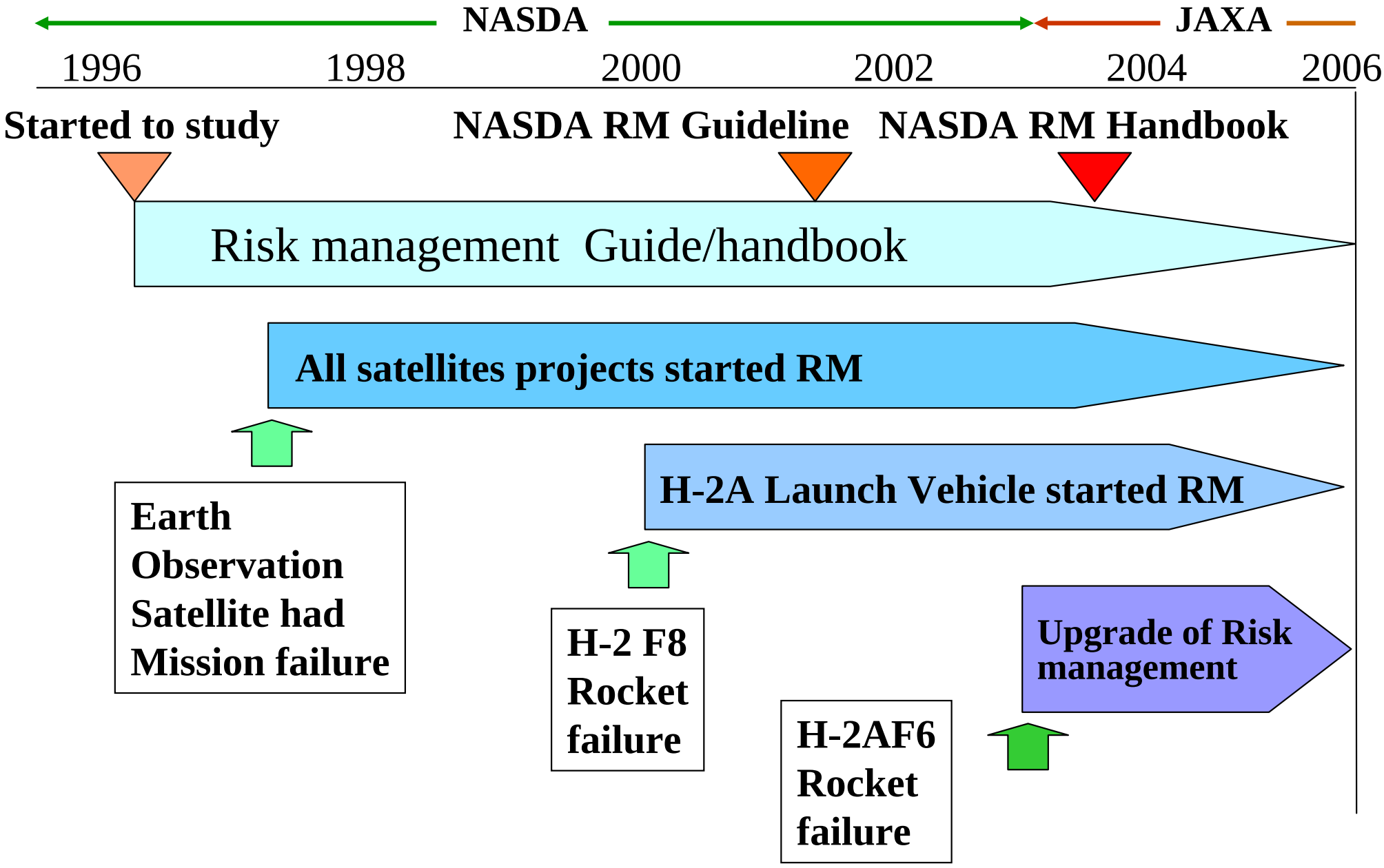
Cause:
Under estimation of thermal expansivity of laminate film at low temperature of solar paddle cause fatigue at Tension control

October 2003
ADEOS-2
Low Earth Orbit

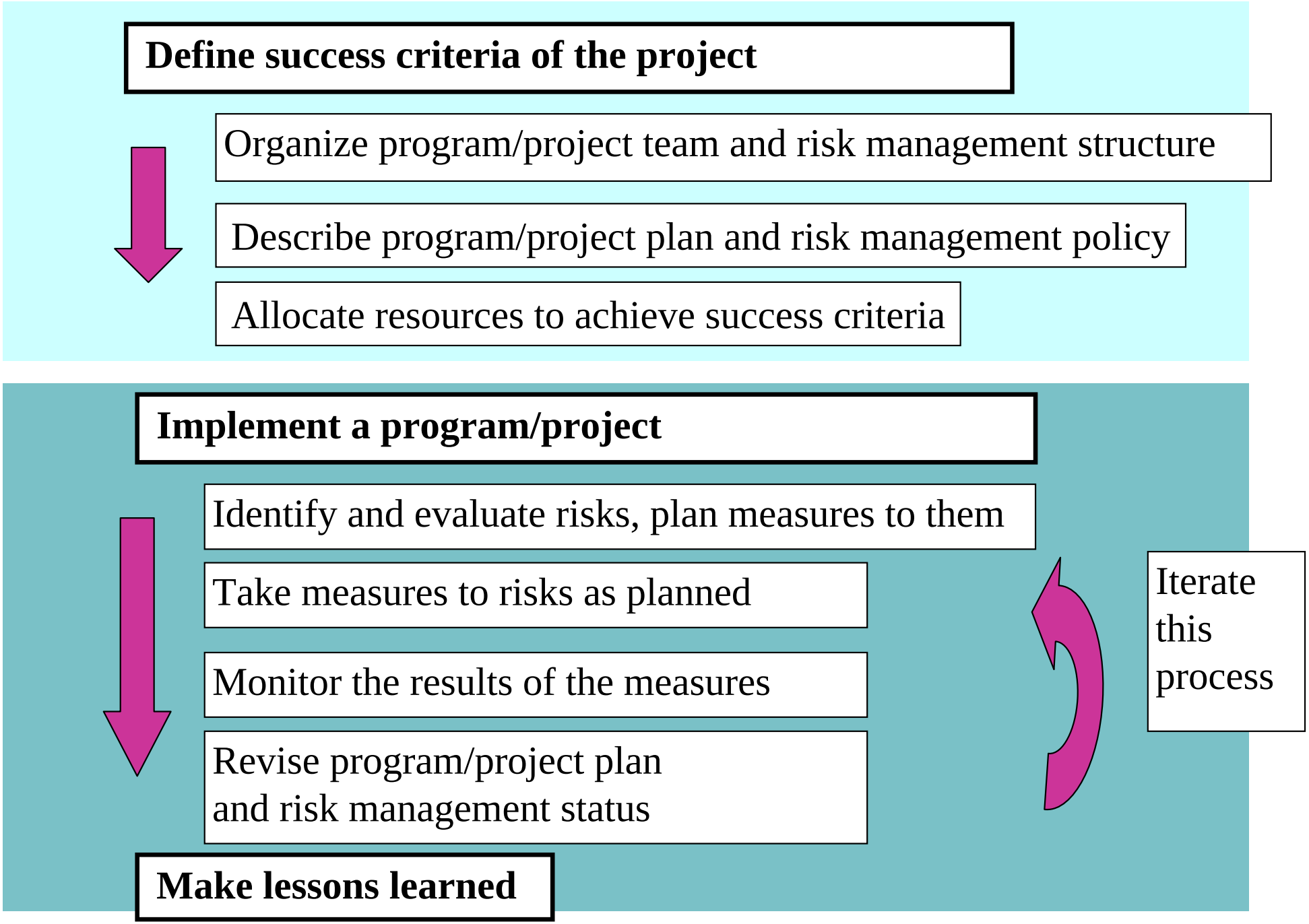
Cause:
Under investigation

NASDA **JAXA**

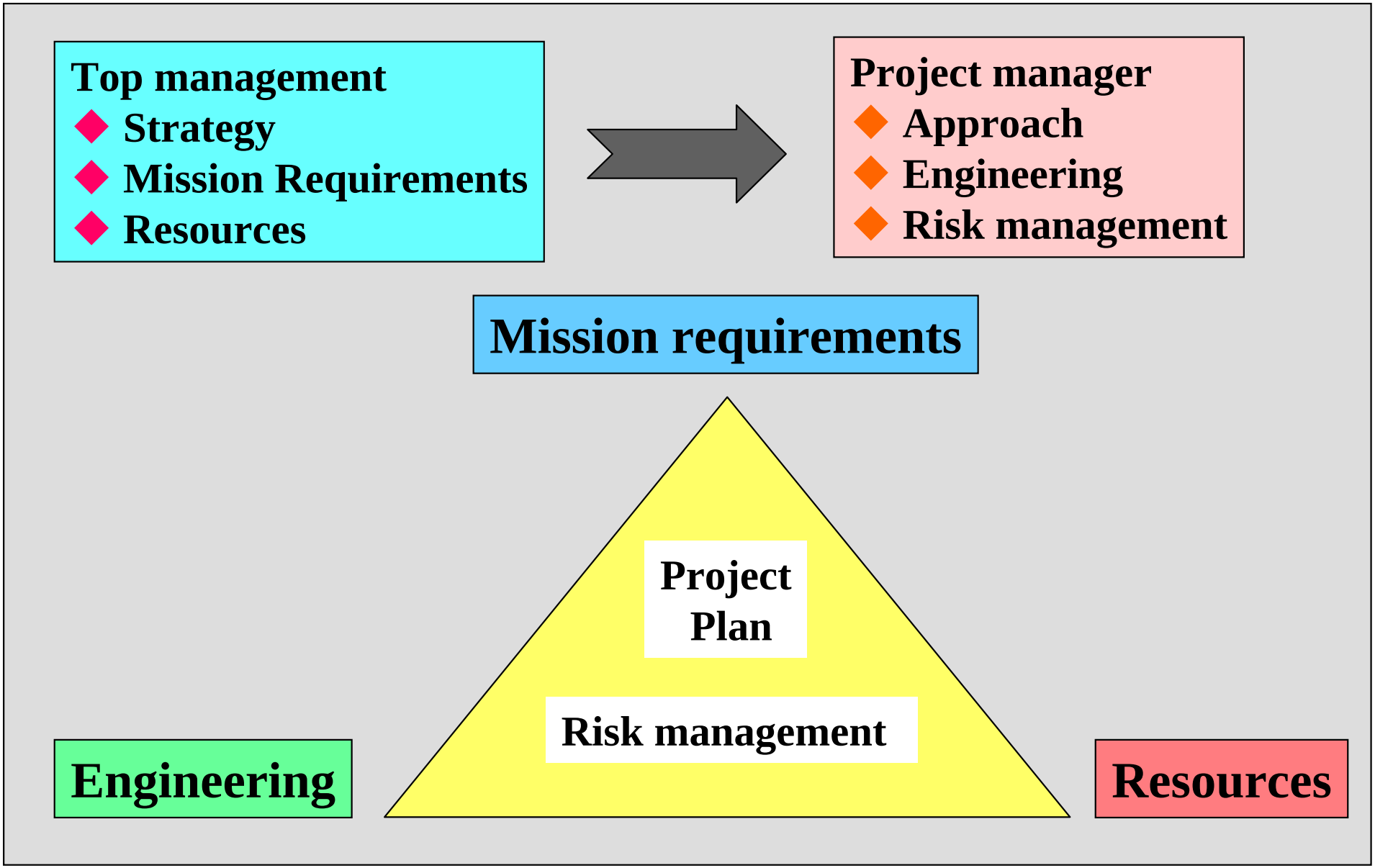
History of Risk Management in NASDA/JAXA



Conceptual risk management flow of JAXA



Project activity is a commitment of Project manager to the top management



The Risk Exposure Calculator

This calculator evaluates "pressure" to project manager

Growth	**Pressure for performance**	+	**Rate of expansion**	+	**Inexperience of key employees**	= _____	**Score**
Culture	**Rewards for entrepreneurial risk-taking**	+	**Executive resistance to bad news**	+	**Level of internal competition**	= _____	**Score**
Information management	**Transaction complexity and velocity performance**	+	**Gaps in diagnostic performance measure**	+	**Degree of decentralized decision making**	= _____	**Score**

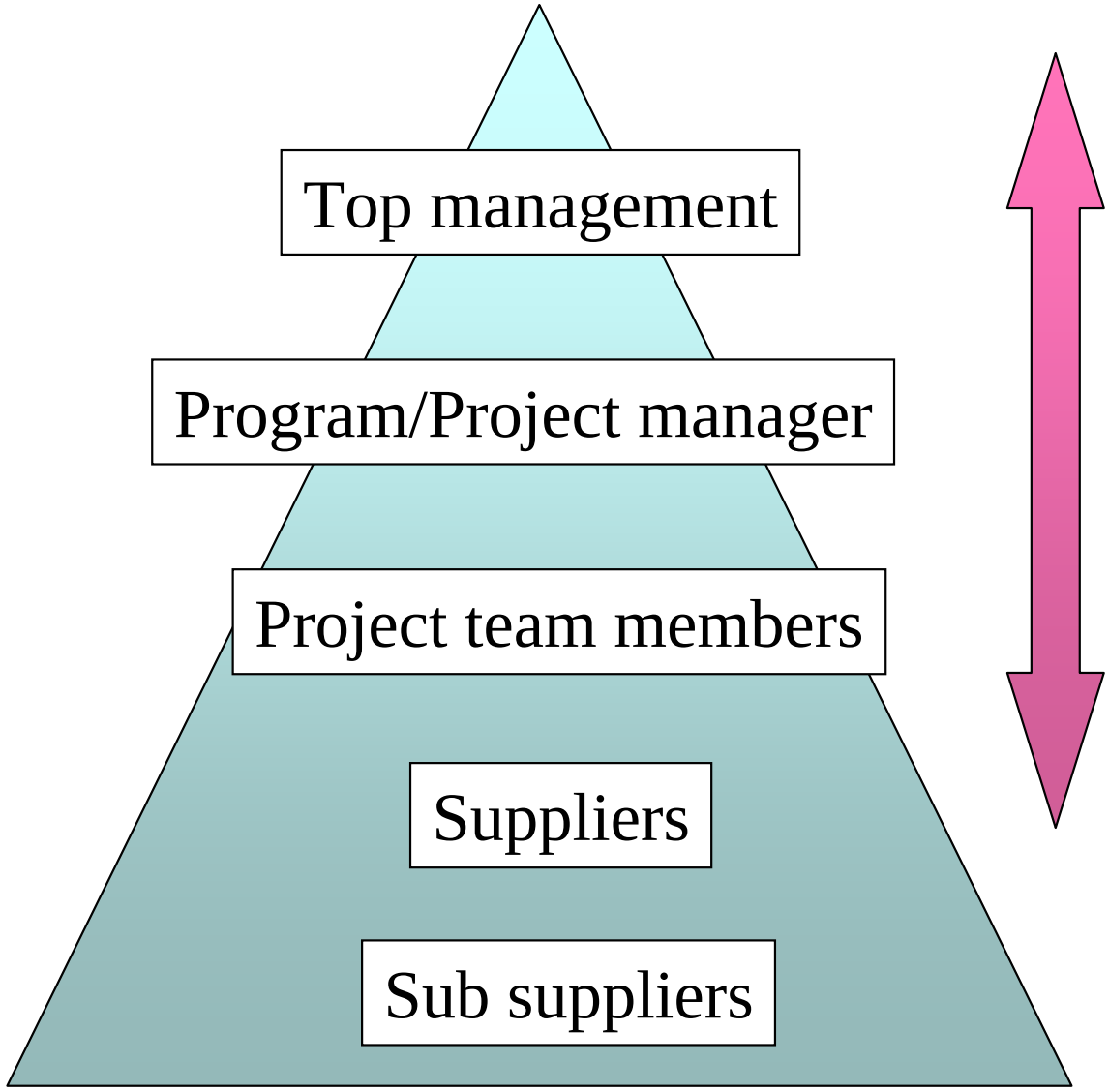
Score 5 if high, 1 if low

Total Score = _____

Safe	**Cautious**	**Urgent**
9-20 point	**21-34 point**	**35-45 point**

Robert. L. Simons, "Performance measurement & control systems for implementing strategy", Prentice Hall, 1999

Risk management hierarchy



Risk management is a tool for a person who will announce success or fail to mass media.

Each level have to implement risk management and communicate with their risks

Conditions of successful program/project activities

- Provide refined scenario to win, and understandable strategy
- Sufficient environments to support program/project activity
- Adequate resources such as budget, schedule, staff, facility etc.
- Team of an experienced leader and well motivated staffs
- All employee share the mind not to fail mission

Approach to deal “Technical risks”

- Robustness will be achieved by using technologies which have enough maturity
- Keep to use same model and improve them -KAIZEN-
- Keep the way of “Test as fly and Fly as test”
- Sharpen the sensibility to perceive “Risks” and re-evaluate the verification process and data

Requirements for Risk Management

The concept of risk management flow is very simple, however, it is very difficult to embody this concept into the concrete activities.

Organizations have to digest this concept and re-integrate everyday works into a systematic framework from the view points of risk management.

So many organizations might not reach to this point.

To construct an effective risk management requires,

- **Strong intention of the top management to prevent failures**
- **Independent assessment to report objective news directly to the top management**
- **Providing verified tools to perceive risks beforehand**
- **Training of all employees to communicate their risks in the organization**

Lessons learned

NASA defines “**Lessons learned**;
the significant knowledge or understanding gained through past or current programs and projects that is documented and collected to benefit current and future programs and projects”.

Tohara propose,
“Lessons Learned” are substantial knowledge that are extracted from well planned successes or past bitter experiences.
Lessons learned are typical examples that show us, what were bad points at planning or decision making.
It is instructive to know how failures occurred and how countermeasures to the troubles were taken effectively. In most cases, causes of failures were not simple, many factors were tangling. It is very important to analyze the causes from both managerial and technical aspects.

H-II Flight 8 Launch from Tanegashima Space Center on 15th Nov. 1999

Salvaged the 1st stage engine of H-II F8 from the pacific ocean

Communication between senior and young people

20 years ago

Senior people preferred to communicate with young generation by drinking after office hour. There was discussion between them.

Nowadays

Space system and management became very complex, and every person are very busy, so they have no time to practice old way.

Also young generation are smarter than 20 years ago, they prefer to communicate with senior people not by drinking, but lecture style or on the web information.

But essential problem is common to today and 20 years ago.

Senior people have to transfer their experience about past significant failures that shook the organization by their voice.

It is their duty!

Category of lessons learned

a. Lessons learned from personal experiences

Every person have some experience to transfer to young generation or new comers.

b. Lessons learned from significant failures reports

Every mission failures or slightly succeeded mission have many thing to be analyzed into knowledge.

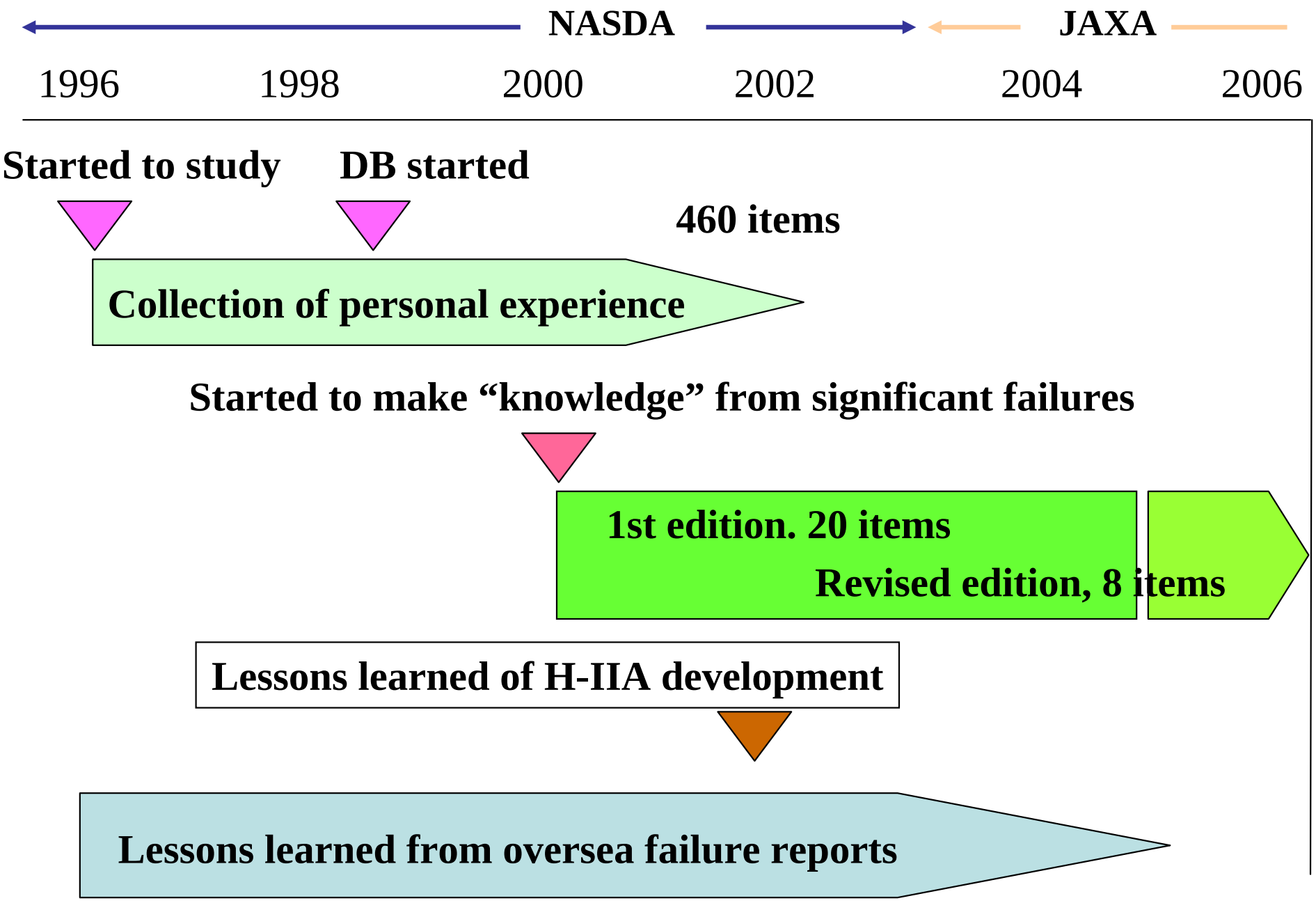
c. Lessons learned from projects

Every project manager has to make Lessons learned to transfer their knowledge to followers.

d. Lessons learned from oversea information

Failure report from oversea will teach us unexpected failure mode.

History of Lessons Learned in NASDA/JAXA



Lessons learned from projects

Recommended contents to project lessons learned

1. What project / subsystem manager planned to their project.

2. What kind of risk management they planned and implemented

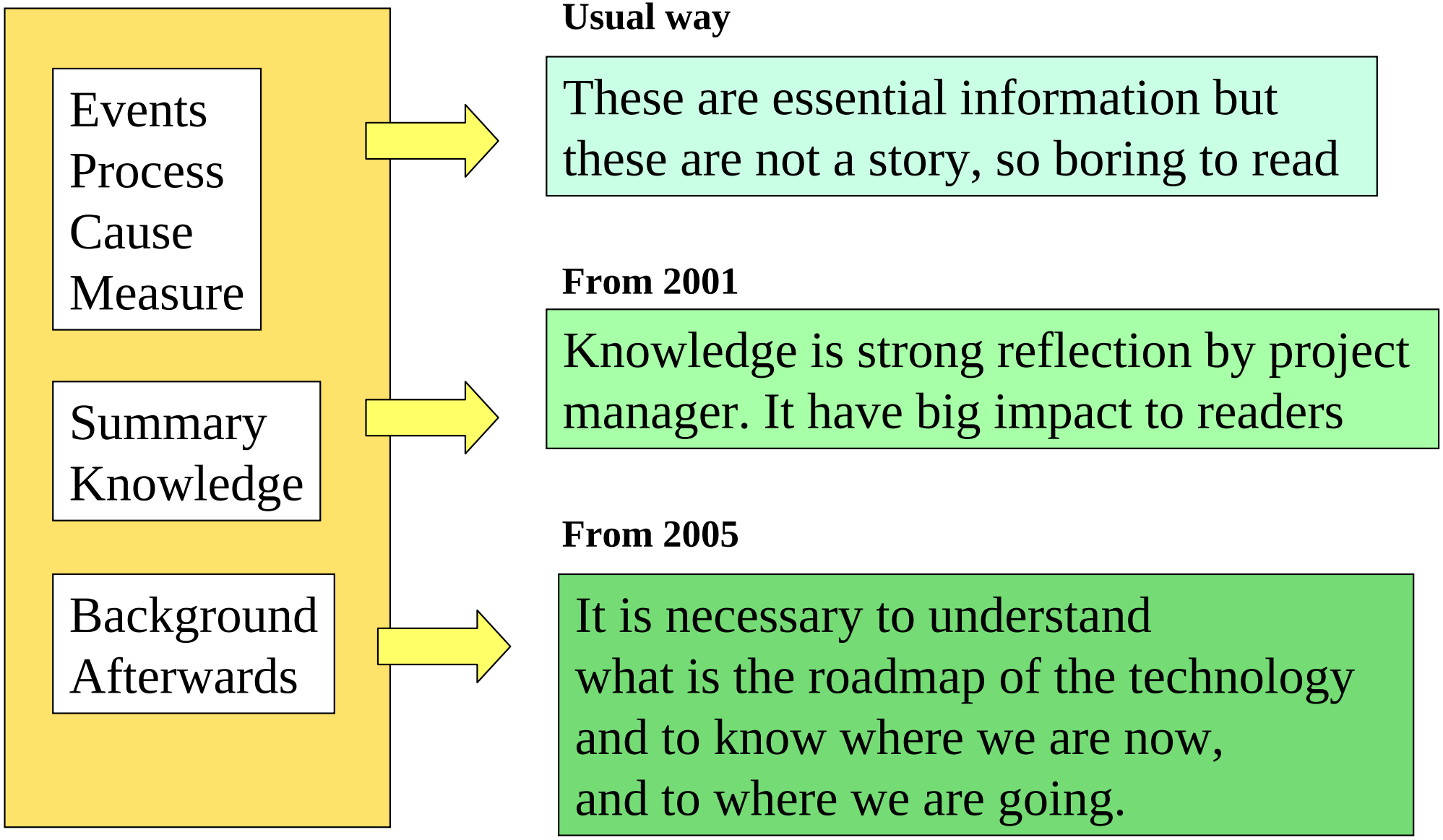
3. What had happened in their project

4. How they overcame

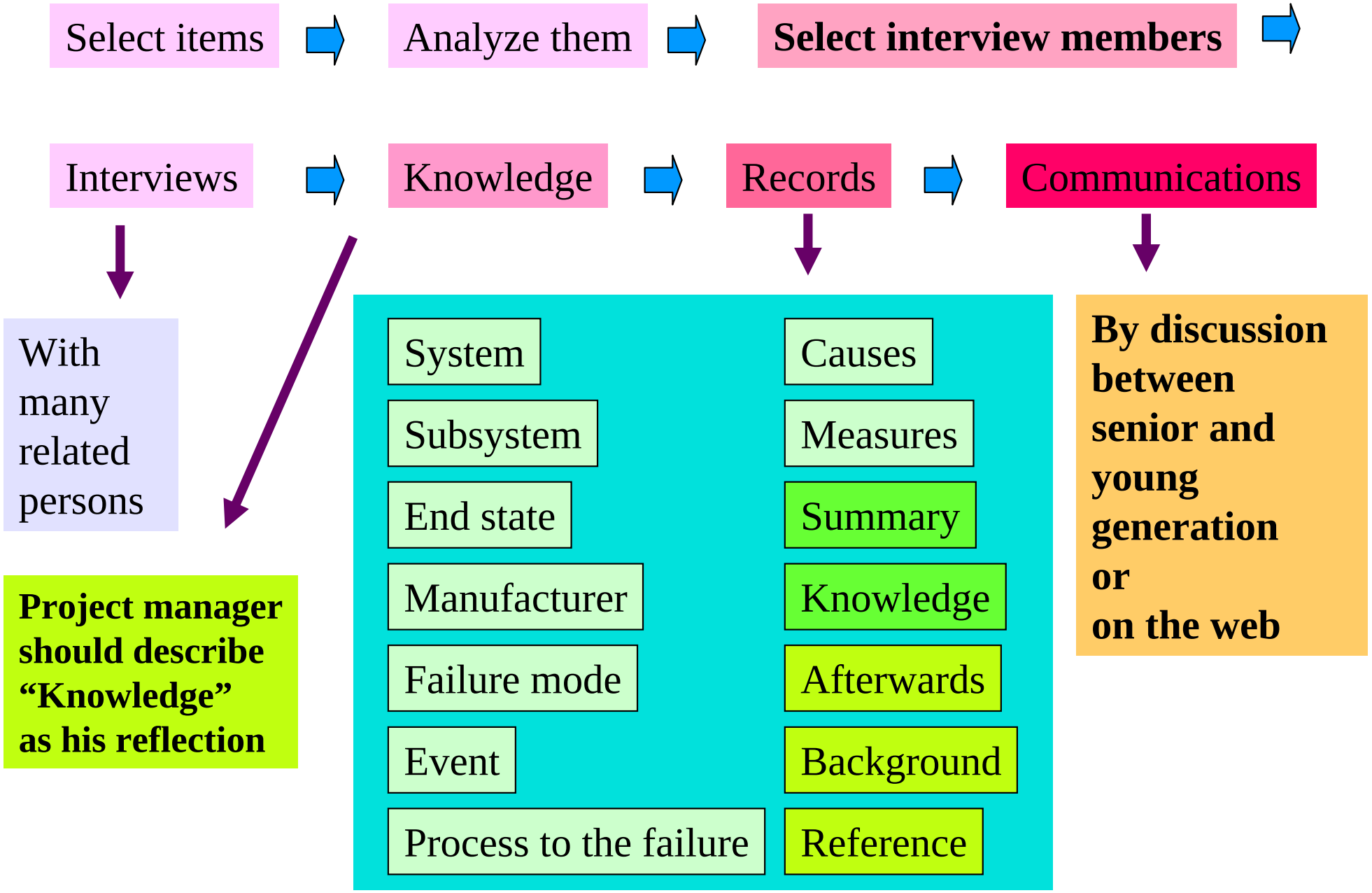
5. Finally how much they could achieved their mission success criteria

6. What is their recommendation to following projects managers

Contents of significant failures reports



Work flow of significant failures records



Lessons learned from oversea failure reports

It is very interesting that, when JAXA have some failure, same failures had already happened or may happen in U.S. or Europe.

NASDA/JAXA had started to make summary of failure reports of oversea since 1996.

It is very instructive to analyze these failure modes.

Rule to collect and deploy Lessons learned

Lessons learned is “Inheritance of knowledge”.

Technology is based on knowledge of predecessor,
but young people never learn senior people’s lessons,
and tend to repeat same failures.

Nowadays, failures should be prevented because failure
may affect life of organization .
So lessons learned is vital reference for young generation
to avoid fatal failures.

Organization has to provide a rule to collect and deploy
“lessons learned” inside or outside of it.

TOYOTA motors way

After 7 months they launched new model into the market,

they have “Big Reflection conference”

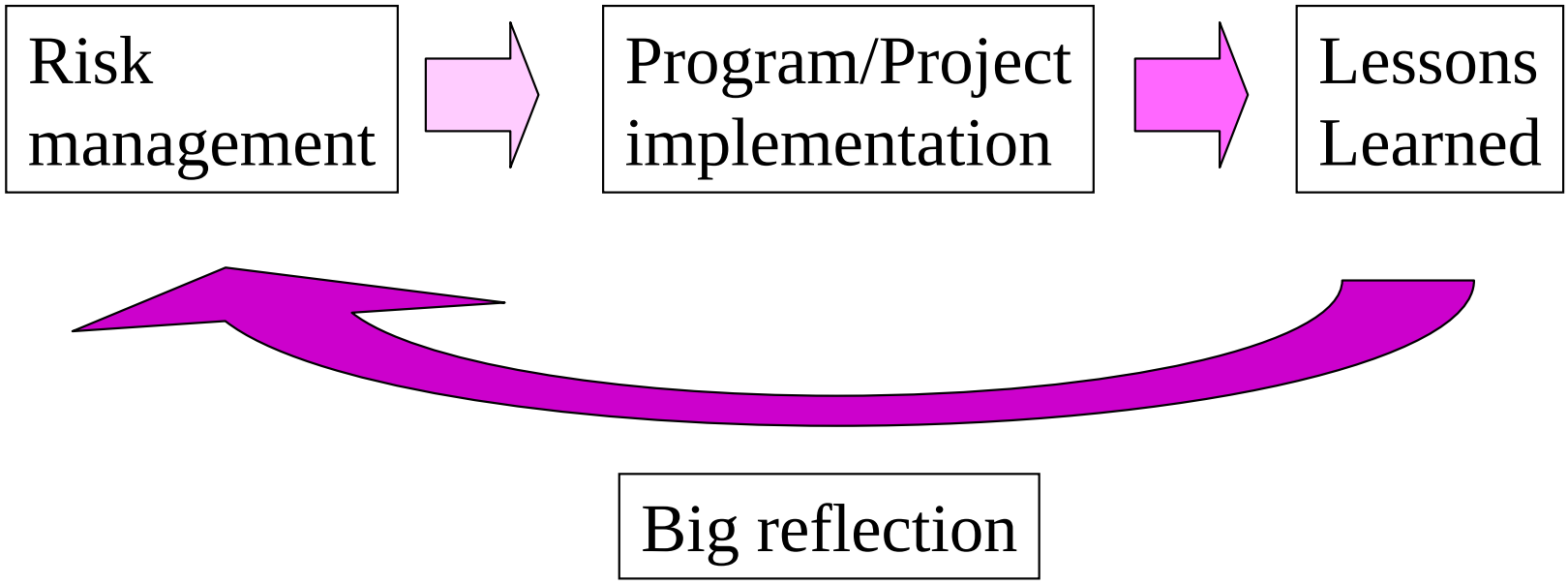
All section managers related to the new model gather to

this conference and discuss what were their reflection in

this project and think how to upgrade their management way

Conclusion

Lessons Learned will teach us the weak points of current risk management. Risk management should be upgraded by lessons learned.




Thank you for your attention