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AN INTERNATIONAL STANDARD TO MANAGE SPACE LAUNCH RISK

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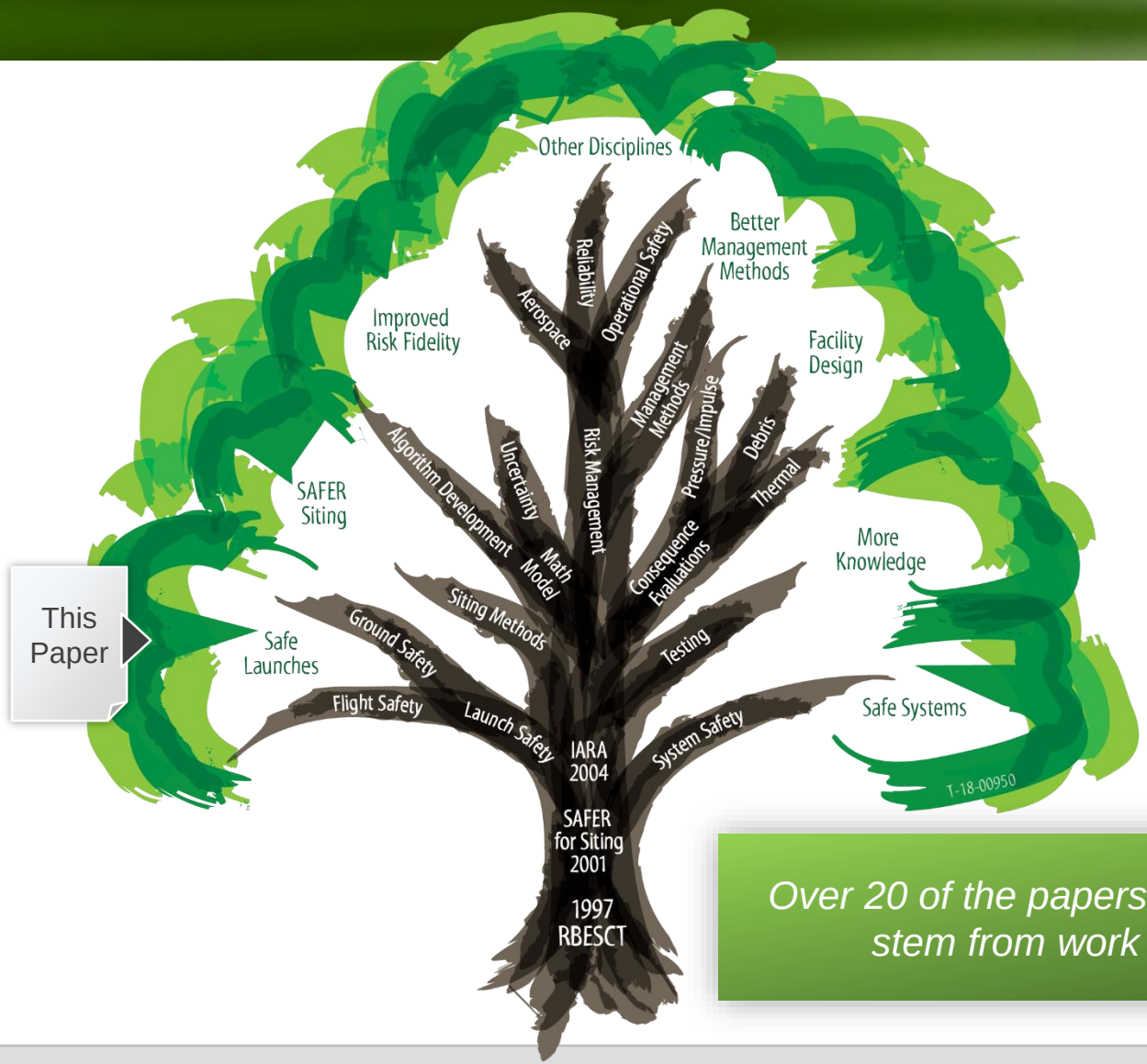
TOPICS

- Background
- Committee approach
- Multiple aspects of managing launch risks
- Essential management elements
  - Identification of risks
  - Assessment of risks
  - Risk reduction measures
  - Acceptance of risks
  - Risk criteria or standard
- Concurrent activities

RESEARCH AND INNOVATION INITIATED BY DDESB



Over 20 of the papers presented at this conference stem from work initiated by the DDESB

BACKGROUND

- Launch & Re-Entry Committee. Formed in 2010. One or two are held each conference cycle.
- At first workshop, reached consensus on many similar approaches used internationally, including analytical approaches and criteria.
- Since IAASS is not a regulating body, this information is in the form of consensus.

Xavier Beurtey, ESA
Paul Wilde, FAA-AST (Houston)
Randy Strom, NASA (Wallops)
Shinichi Wada, JAXA
Rafael C. Molina, ESA
Isabelle Rongier, CNES
John Frost, Moderator
Tom Pfitzer, Chair, Launch Safety Committee
Pat Clemens, APT Research
Darlene Davenport, APT Research
Yoshihara Toru, JAXA
Masami Miki, JAXA
Christian Cazaux, Orbital Systems Directorate
François Cahuzac, Launchers Directorate

COMMITTEE APPROACH

- Multiple factors must be considered in providing safe space launches.
  - System designs
  - Flight path scenarios
  - Sensor and infrastructure of launch organization
  - Range safety system
  - Risk assessments
  - Decision authority
  - Acceptable risk criteria
  - Analytical methods
- While many of these factors would be of interest to establish consensus, they should all be imbedded into the overarching risk management framework. Therefore, the committee begins by establishing a consensus opinion for the minimum requirements for this framework.

ESSENTIAL ELEMENTS

- Identification of risks
- Assessment of risks
- Risk reduction measures
- Acceptance of risks
- A priori risk criteria or standard

For launch safety, five elements are essential for managing launch risks.

IDENTIFICATION OF RISKS

Risk is composed of two essential elements: probability of an undesired event (a hazard) and the resulting consequences. While many spacefaring nations have programs and processes to protect assets and other things of value, the focus of this minimum set is to protect people from death or injury directly resulting from launch. The importance of this element of the risk management framework is to identify situations and scenarios wherein people could be hazarded, including not only the planned or nominal scenario, but also off-nominal, unplanned, and malfunction scenarios.

ASSESSMENT OF RISKS

The identification of potential risks leads directly into a scientific and engineering assessment of the level of seriousness of each identified risk. These assessments combine physical sciences, engineering disciplines, and reliability information with math, statistical, and in some cases, uncertainty calculations to produce an assessment of each risk. Aggregation of the total set of launch risks is recommended. Risk assessments should be objective, scientifically supported with academically acceptable math, and based on data rather than conjecture. Assessments are normally conducted before and after the incorporation of risk reduction measures.

RISK REDUCTION MEASURES

1. Containment
2. Evacuation and sheltering
3. Scenario changes
4. Launch system changes
5. Range flight safety systems

ACCEPTANCE OF RISK BY PROPERLY DESIGNATED AUTHORITY

A risk management framework is not complete without a well-defined and documented approach to accept known risks prior to launch. The legal principle supporting this element requires three parts: a) a properly designated official, b) make a risk informed decision, c) that all of the known risks are within acceptable standards. If each element is adequately met, a degree of liability protection can be afforded.

Requirements:

i. Properly designated authority
ii. Risks are examined with best available information and adequately understood
iii. An established “decision process” used
iv. Results retained to demonstrate process

Avoid:

i. Approval by non-designated officials
ii. Out-of-date information, techniques
iii. Unsupported undocumented decisions
iv. Informal decision processes

RISK CRITERIA OR STANDARD

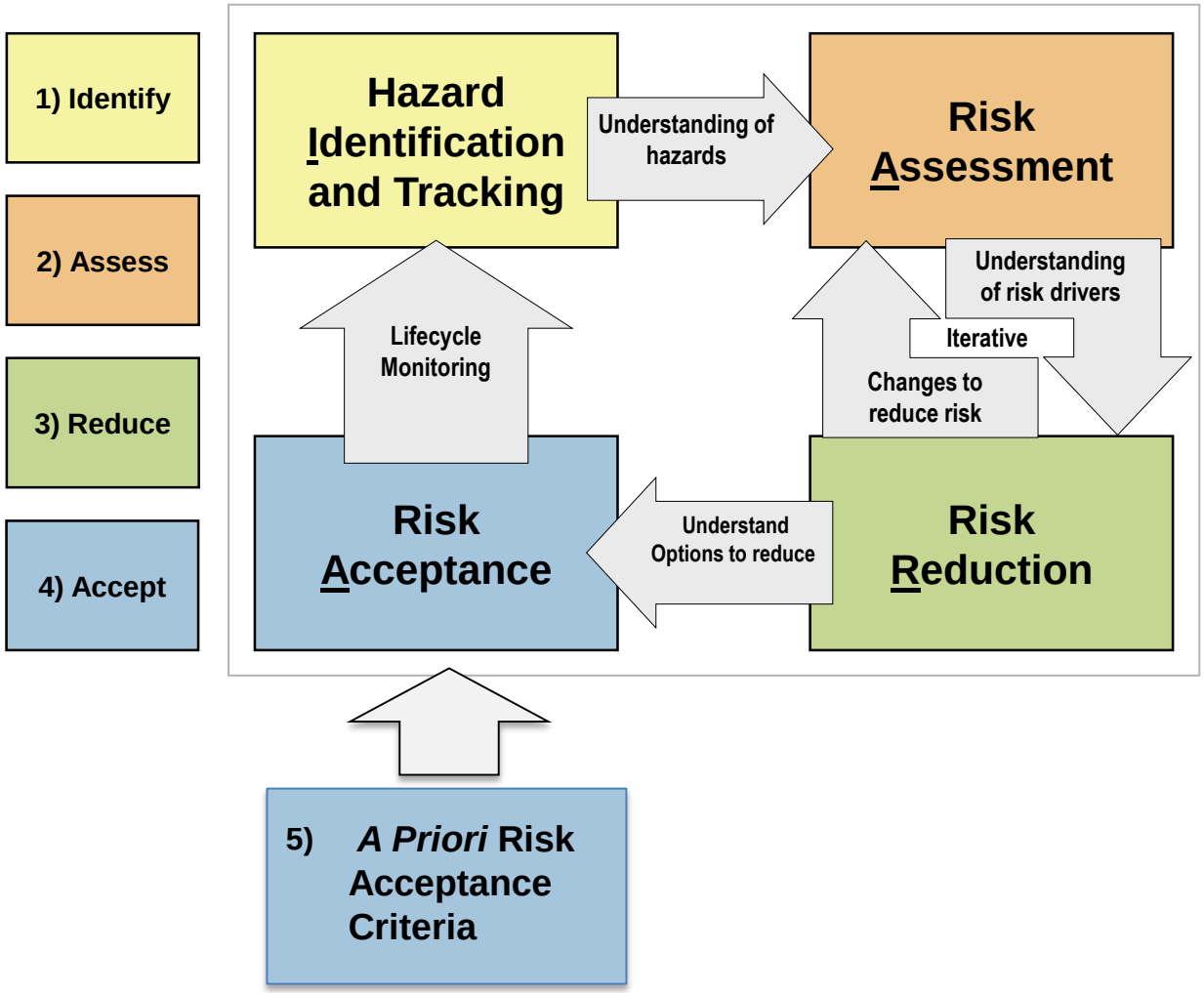
To support risk acceptance decisions, a set of criteria/standards should be developed and used. Most spacefaring nations use at least two levels of protection based on voluntary or involuntary risk acceptance per launch. Workers associated with the launch by virtue of their job are exposed to more risks than the surrounding population.[1] A typical protection standard may be set at the risk level associated with other heavy industry with an acceptable risk level of $1x10^{-4}$ or one fatality in 10,000 years.[2] The general population with no vested interest in the launch may have a protection level at the $1x10^{-6}$ level, or one fatality in a million years. This level is widely viewed as equivalent to the legal *de minimis* concept.[3]

[1] Some nations use a three-tier set of standards with a middle standard for personnel associated with the launch but not directly hazarded.

[2] Some nations are willing to accept a higher risk level than the *de minimis* for personnel in their country.

[3] While there is no international standard for risk to populations, most nations use numerical standards close to these numbers.

SUMMARY


1) Identify
2) Assess
3) Reduce
4) Accept
Hazard Identification and Tracking
Understanding of hazards
Risk Assessment
Understanding of risk drivers
Iterative
Changes to reduce risk
Lifecycle Monitoring
Risk Acceptance
Understand Options to reduce
Risk Reduction
5) A Priori Risk Acceptance Criteria

CONCURRENT ACTIVITIES

- The IAASS compiled this minimum standard in 2017 and published it in the *Journal of Space Safety Engineering* in March 2018. This is designed for new space-faring nations.
- This standard is scheduled to be reviewed by the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) in February 2019.
- Risk management training on this approach to launch and re-entry risk is available via the APT Safety Engineering and Analysis Center (SEAC). The SEAC's Risk Management for Safety Professionals training course has adapted the IARA to eight discrete safety disciplines, including launch and re-entry safety.

SAFETY ENGINEERING
SEAC
& ANALYSIS CENTER