The Space Safety Institute

Making commercial human spaceflight safe

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Introduction

- The US CSLAA (Commercial Space Launch Amendments Act) moratorium expires in January 2028 (i.e., FAA becomes fully responsible for the safety of humans on board commercial spaceflight).

- Main area of U.S. commercial human spaceflight business continue to be the provision of commercial services to NASA (i.e., commercial space station). As a consequence, FAA/AST future safety requirements would need to meet/exceed NASA requirements.

- In December 2020 FAA/AST moved away from the rules-based regulatory model of prescriptive requirements and adopted for Launch and Re-entry Licensing a new set of performance requirements (Part 450).

Proposal: Space Safety Institute

The IAASS is promoting the creation of a space safety institute as a government/industry-driven but independent organization performing standardization and conformity assessment of commercial human spaceflight systems **in support** of the regulatory body (i.e., FAA/AST)



Space Safety Institute

The **skills required** for the certification of risk-based designs are above those usually available at regulatory organizations. There is the need for a skilled support organization to:

- Establish safety and technical performance standards
- Independently verifying compliance through multidisciplinary teams
- Monitoring/auditing industry safety programs

A government/industry-driven cooperation, a Space Safety Institute, is better suited, more flexible and cost-effective than upgrading the government regulatory organization.

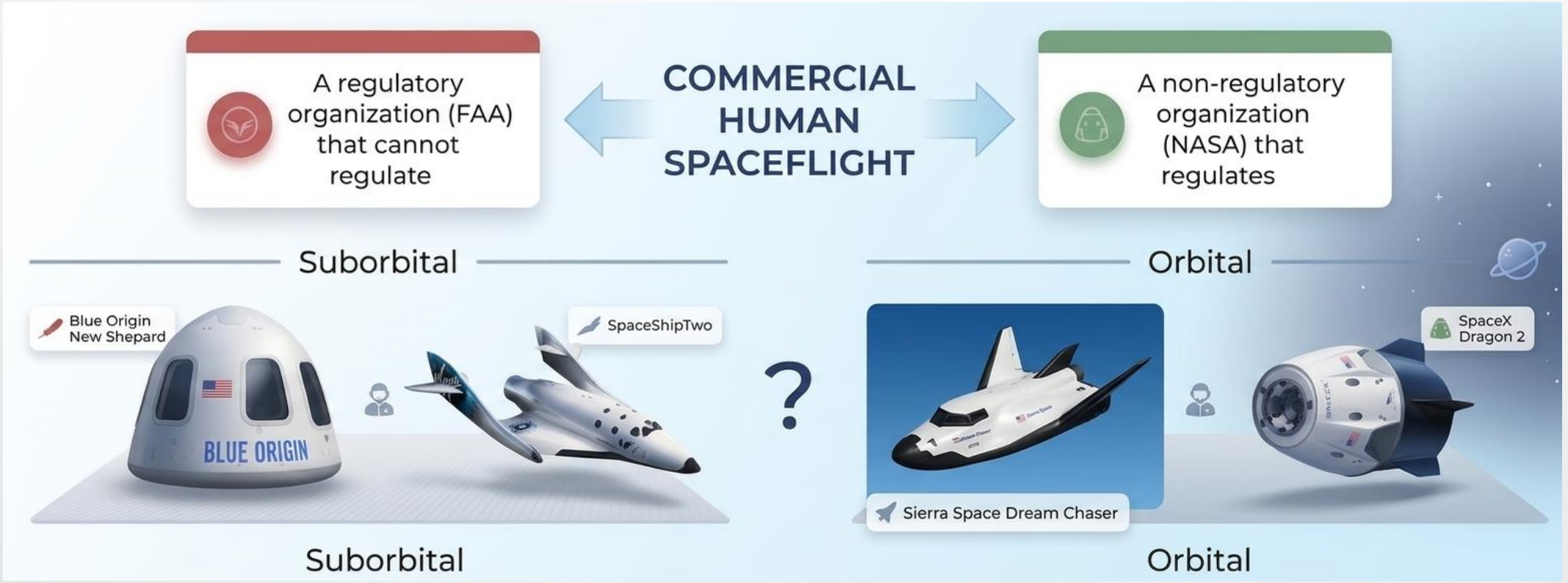
The regulatory body would still play a key-role by establishing:

a) overall safety policies "***how safe is safe enough"*** to be complied with by SSI and industry

b) process for SSI to perform independent safety reviews

c) criteria for operations of SSI (approval, audits)

Current Status of Commercial Human Spaceflight rules



Rules-Based Design (Rules not available)

Risk-Based Design (Requirements Available)

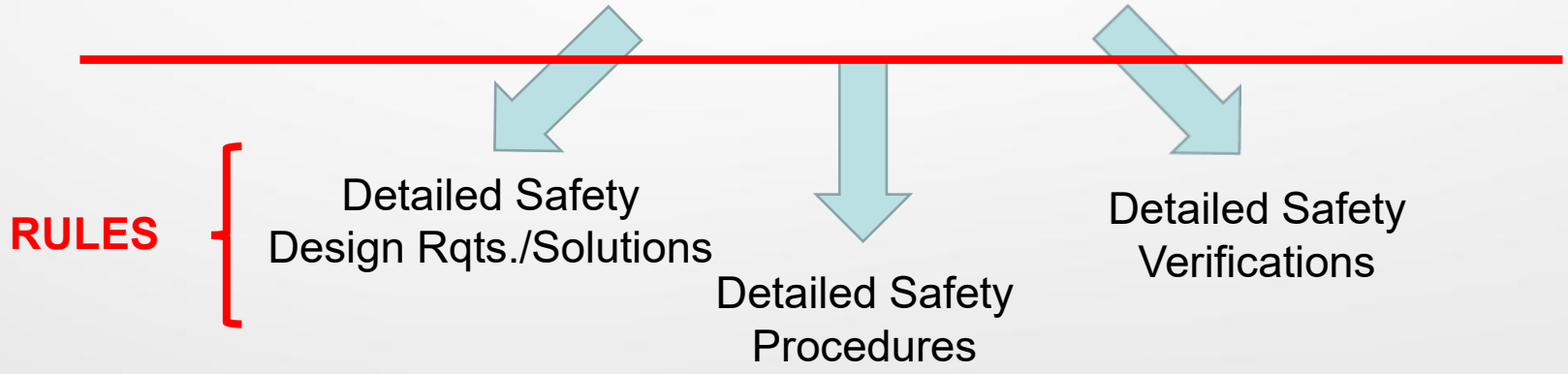
Rules-Based Design vs. Risk-Based Design

Rules-Based Design, traditionally used in aviation, was instead proposed by the commercial suborbital spaceflight industry as the main justification for the “learning period” enshrined in the CSLAA (Commercial Space Launch Amendments Act) of 2004.

Risk-Based Design was started at NASA in the aftermath of the Apollo 1 ground accident that caused the death of 3 astronauts. It was subsequently improved and used on all programs including Shuttle, International Space Station (ISS) and Crew Commercial Program.

Rules-Based Design

EXPERIENCE



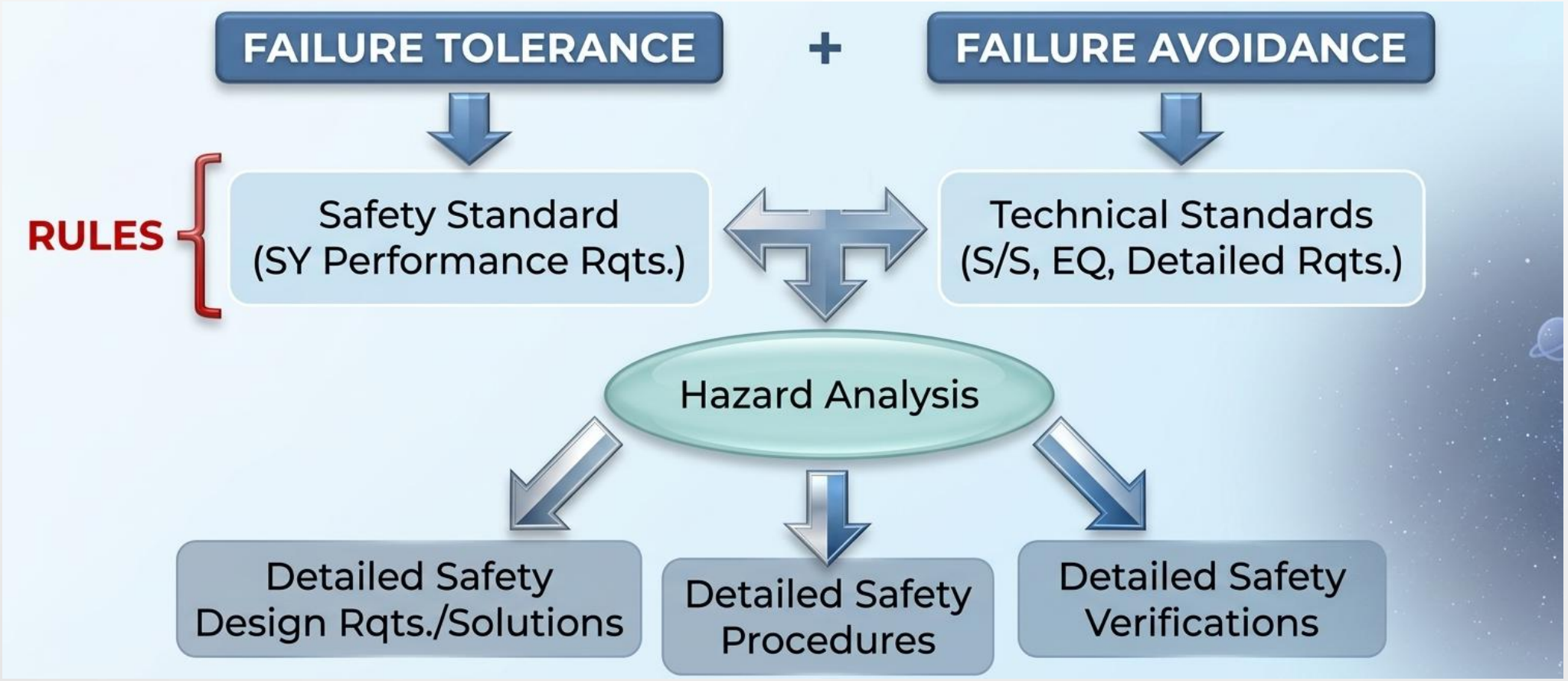
Rules-Based Design

Rules-Based Design consists in implement prescribed design reqts/solutions, operational procedures, and verifications.

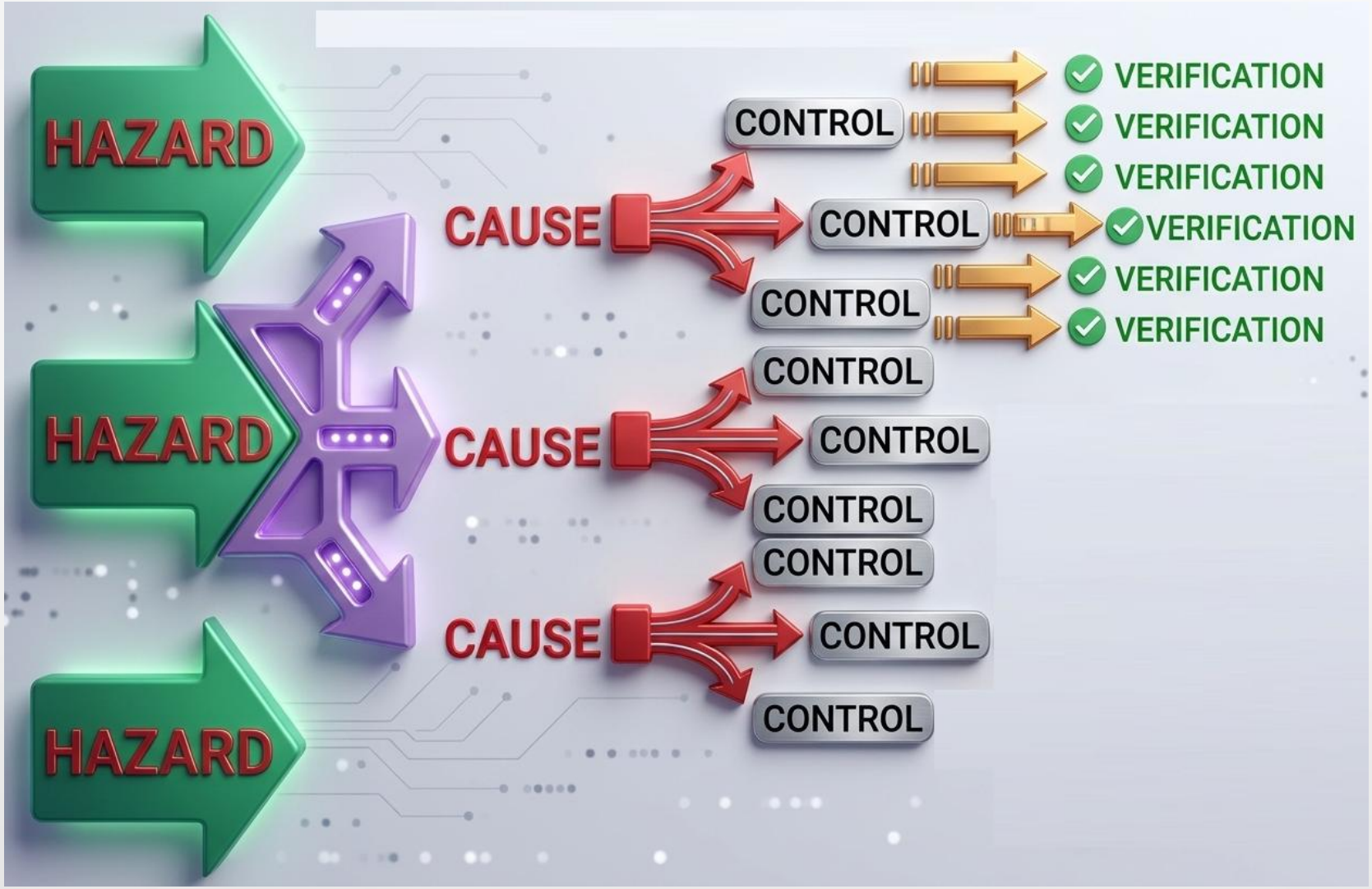
Advantages:
- Easier for developers and operators to implement
- **Easy to check compliance with for the safety authority.**
- Schedule efficient: just read and transpose into design
- No need (for industry) to think “is this good enough”.

Disadvantages:
- **Are reactive (established/changed post mishap).**
- May be effective in some cases but not in other cases.
- May prove to be more costly than other equally effective solutions.
- Can inhibit innovation or become obsolete.
- May lead to over/under-engineering
- Nurture a compliance mindset rather than a safety mindset

Risk-Based Design



Risk-based design: hazard analysis



SMS & Independent Reviews

Two key elements for **risk-based design** effective implementation:

SAFETY MANAGEMENT SYSTEM (SMS):

The developer/operator has to establish a system to ensure that

- the safety policy is clearly stated and communicated
- design processes are documented and followed

-qualified /trained human resources are available

-hazards data are maintained and tracked

INDEPENDENT REVIEWS

Safety design rqts/solutions, operational procedures and verifications must be validated by an independent team of experts

Risk-Based Design Advantages and Limits

- Performance standards give to designer flexibility and make it possible to find the lowest-cost means to achieve compliance with safety goals.
- Performance standards can accommodate technological changes and the emergence of new hazards in ways that prescriptive standards cannot.
- Performance standards can be imprecise when the requirements are too loosely specified or can be questionable when performance has to be assessed by quantitative predictions. Sometimes uncertainty may be injected just because of the need to keep goals generic.

Way ahead

- The Aerospace Corporation one of the largest and most prestigious FFRDC (Federally Funded Research and Development Center) in US is developing the Space Safety institute to cover:
  - Human spaceflight safety
  - **Launch and reentry safety**
  - **Space Debris**
  - **Cybersecurity**

