

# Space Safety Institute

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SRI 3rd World Congress Webinar Series "Space Safety"  
December 13, 2020

## Introduction

- The US CSLAA (Commercial Space Launch Amendments Act) moratorium expires in 2023 (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 as part of international programs (i.e. ISS, future Moon2Mars). As a consequence, FAA/AST future safety requirements need to meet/exceed NASA requirements.
- Since October 2020 FAA/AST is moving away from the aviation rules-based regulatory model of prescriptive requirements and adopted for Launch and Reentry Licensing a new set of performance requirements.

## Proposal: Space Safety Institute

It is recommended 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)

	COMPANY	SAFETY INSTITUTE	REGULATORY BODY	INT. ORG
<b>POLICIES</b>	-	<i>advise</i>	<i>develop</i>	<i>coordinate</i>
<b>STANDARDS</b>	<i>implement</i>	<i>develop</i>	<i>validate</i>	-
<b>CERTIFICATION</b>	<i>data</i>	<i>perform</i>	<i>oversight</i>	-
<b>PROCESSES</b>	<i>establish/execute</i>	<i>establish/execute</i>	<i>establish/execute</i>	-
<b>AUDITS</b>	-	<i>Company</i>	<i>Safety Institute</i>	-
<i>COMPETENCE</i>				
<i>INDEPENDENCE</i>				
<i>AUTHORITY</i>				

## 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** 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)

## Proposal: Space Safety Institute (cont'd)

The limitations of the aviation regulatory model (i.e. FAA human resources limited & inspection-oriented) in coping with advanced systems have been tragically demonstrated by the recent crashes of the Boeing B-737 Max.

### **Flawed analysis, failed oversight: How Boeing, FAA certified the suspect 737 MAX flight control system**

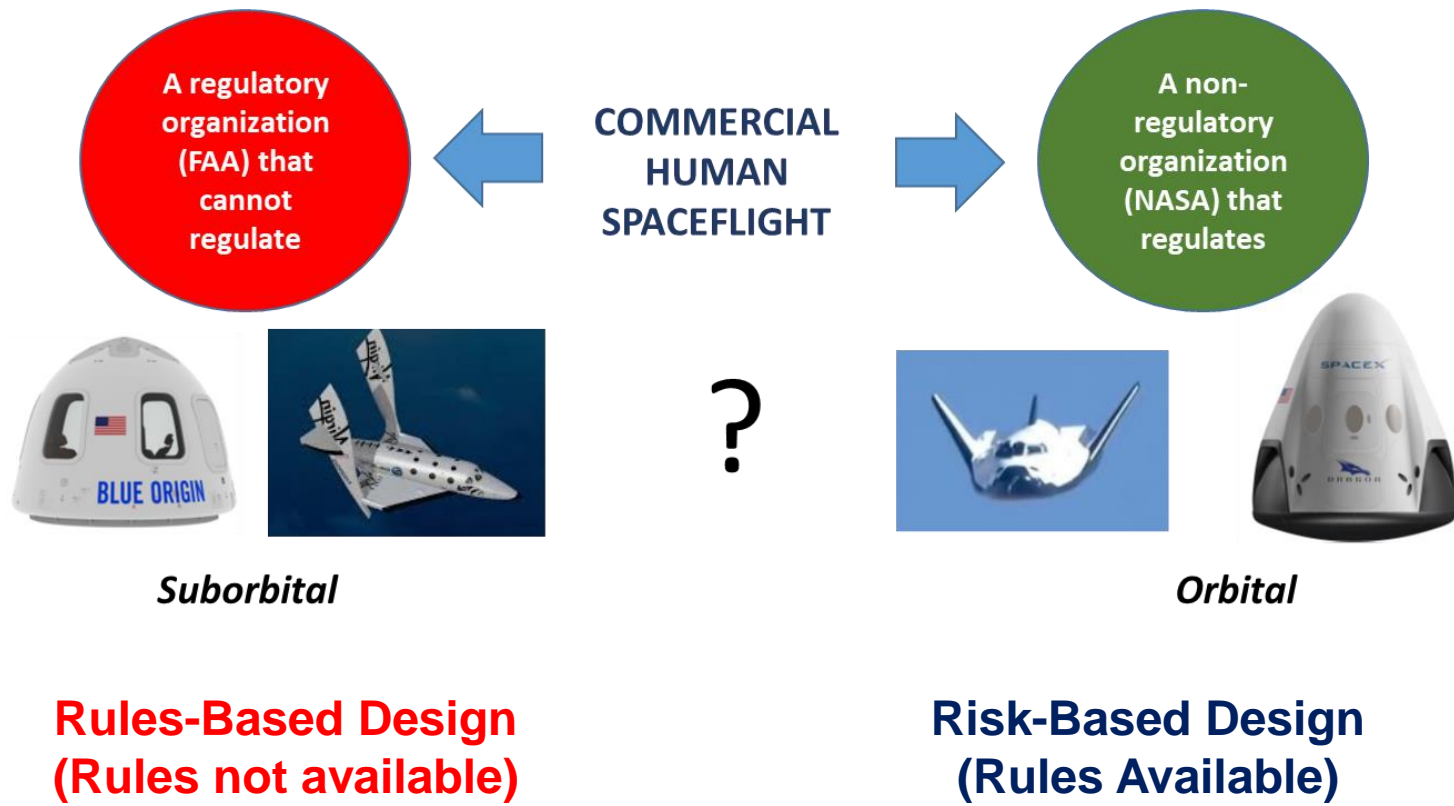
March 17, 2019 at 6:00 am | Updated March 21, 2019 at 9:46 am



## Current Status of Commercial Human Spaceflight rules

- The Commercial Space Launch Amendments Act of 2004 (CSLAA) established a moratorium (also called 'learning period) for safety regulations of flight participants (crew and passengers) of 8 years, later extended until 2023, **based on the old-fashioned principle that standards do not anticipate progress but follow it**
- An exception is the NASA procurement of commercial crew transportation services to the International Space Station (ISS), because the ISS Inter-Governmental Agreement (IGA) requires that NASA is the safety certification authority for those vehicles in accordance with agreed safety technical and risk management processes.

## Current Status of Commercial Human Spaceflight rules (cont'd)



## Rules-Based Design vs. Risk-Based Design

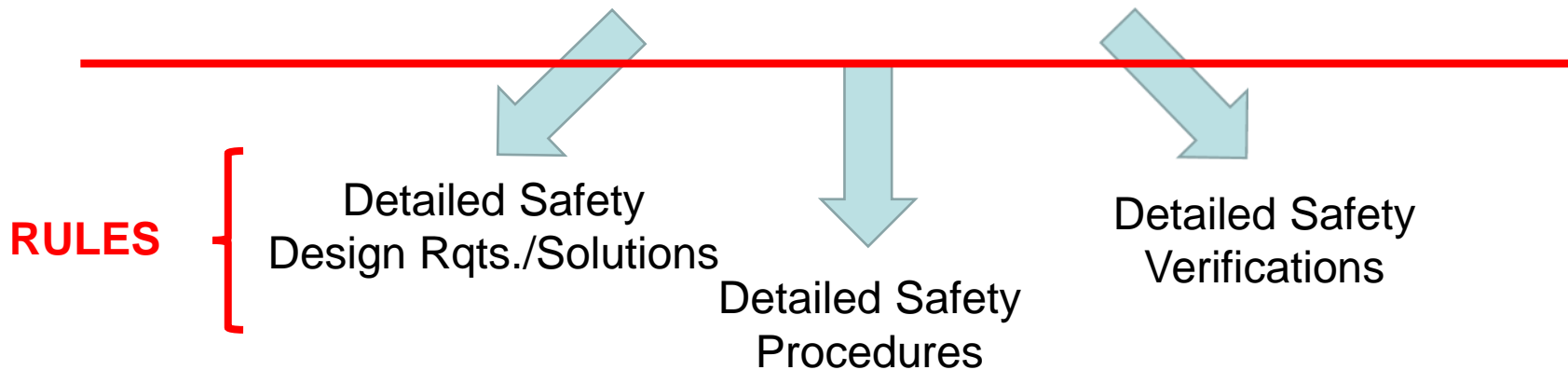
***Rules-Based Design***, traditionally used in aviation, was instead proposed by the commercial suborbital spaceflight industry as the main justification for the “learning period” enshrined in the CSLAA (Commercial Space Launch Amendments Act) of 2004.

***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.

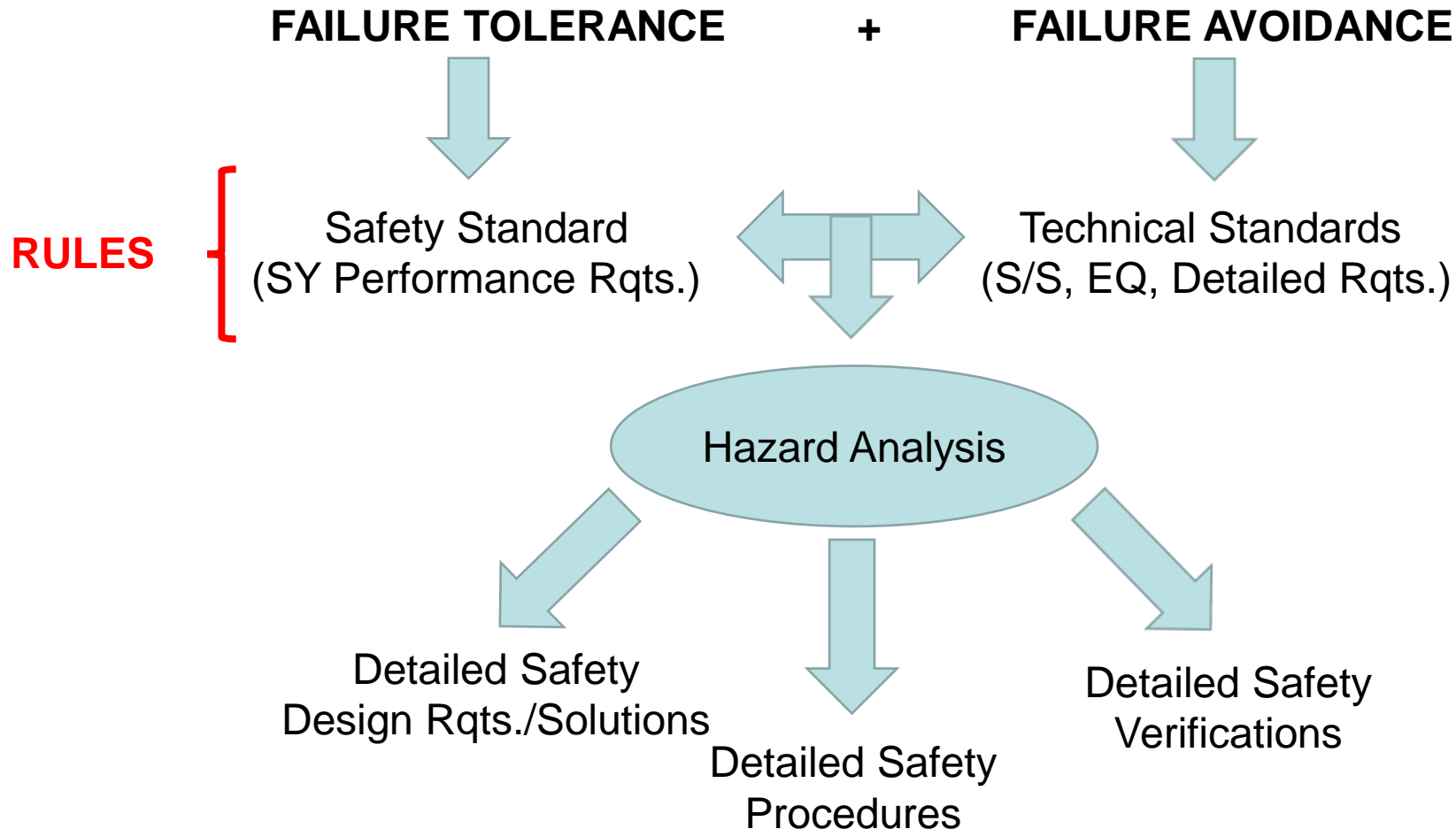
### ***Advantages:***

- 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”.

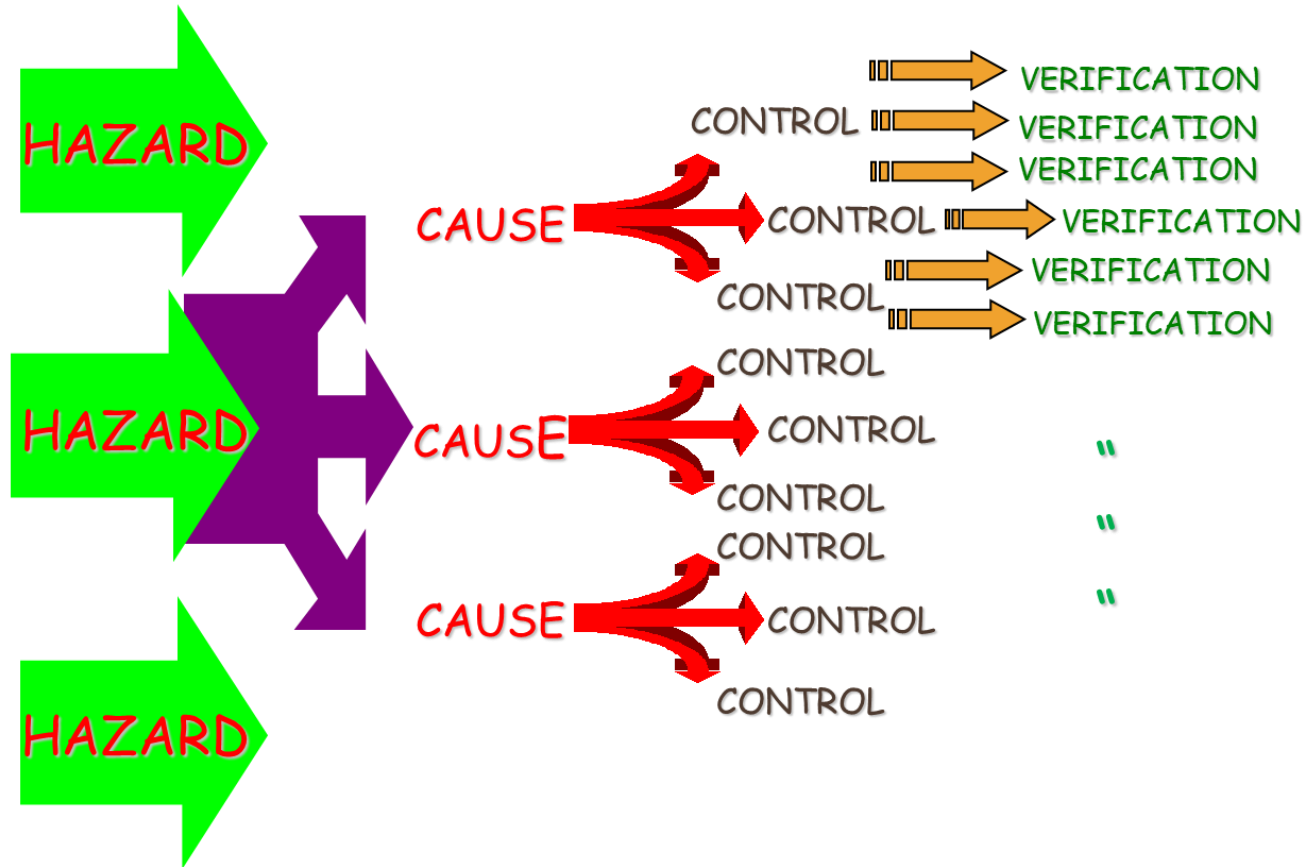
### ***Disadvantages:***

- **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 reqts/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 studying the concept in view of further developing the Space Safety institute to cover:
  - Human spaceflight safety
  - Launch and reentry safety
  - Space Debris
  - Cybersecurity

