CHARGE TO MOVE FORWARD

Dr. Michael Gazarik, Vice President, Engineering

Ball Aerospace

Keynote: Ascend x Texas

Wednesday | 29 March

Photo credit: SpaceNews

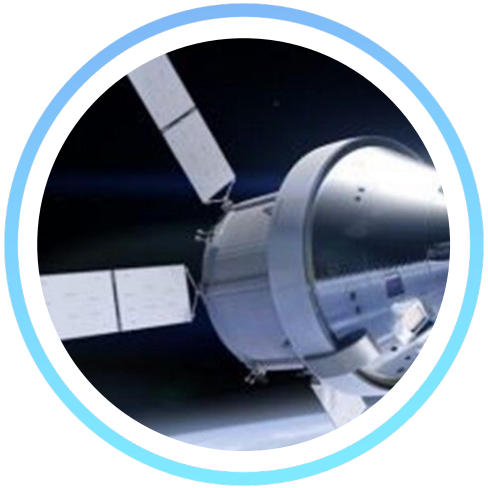
AGENDA

How do we take lessons learned to move toward the future, without inhibiting our potential?

How do we let go of the past that's holding us back?

- Introduction/Background
- Current State of Affairs
- Vision
- Barriers
- Hurdle the Barriers
- Charge to the Community

CURRENT STATE OF AFFAIRS



Artemis

Photo credit: NASA

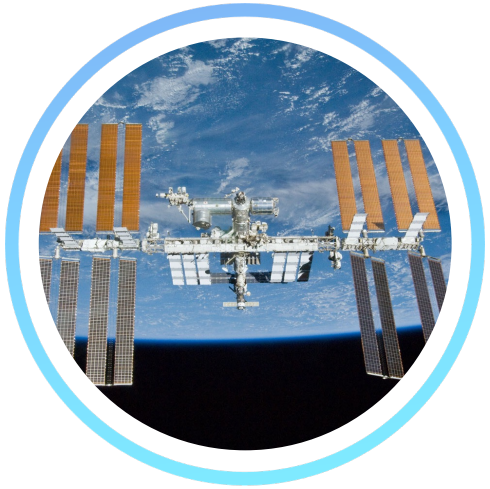
SDA Systems

Proliferated LEO

Gateway Cislunar

Photo credit: Boeing Illustration

Commercial Lunar Program



International Space Station

Commercial Stations

Photo credit: NASA

VISION-CISLUNAR SPACE

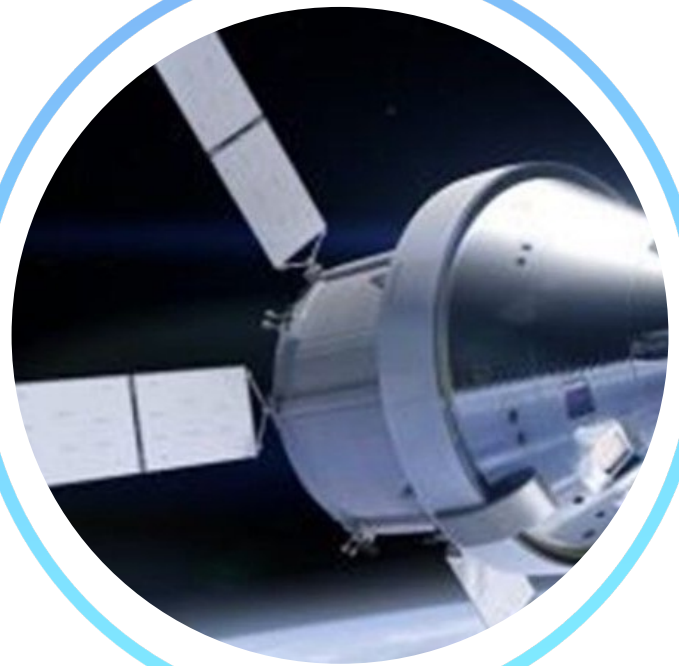


Photo credit: NASA

Artemis & Gateway

Commercial Station & cis-Lunar

Photo credit: NASA

Looking Forward

VISION

Flexibility

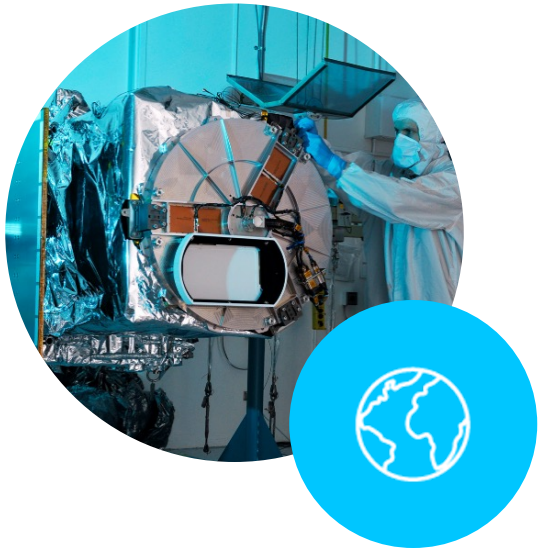
Enabling connectivity across orbits (LEO, GEO, MEO)

Interoperability

Enabling interconnectivity and agile networks for the future

Resilience

Enabling a resilient space infrastructure, with protections against modern cyber threats



Sustainability

Enabling innovative technology for climate risk mitigation and environmental monitoring

CURRENT BARRIERS

- Heritage
- Credible Space
- How to Buy
- Workforce Challenges
- Infrastructure
- Development Practices
- Technology Infusion
- Sustainability Challenges
- Ground System Development
- Cyber Security

HERITAGE

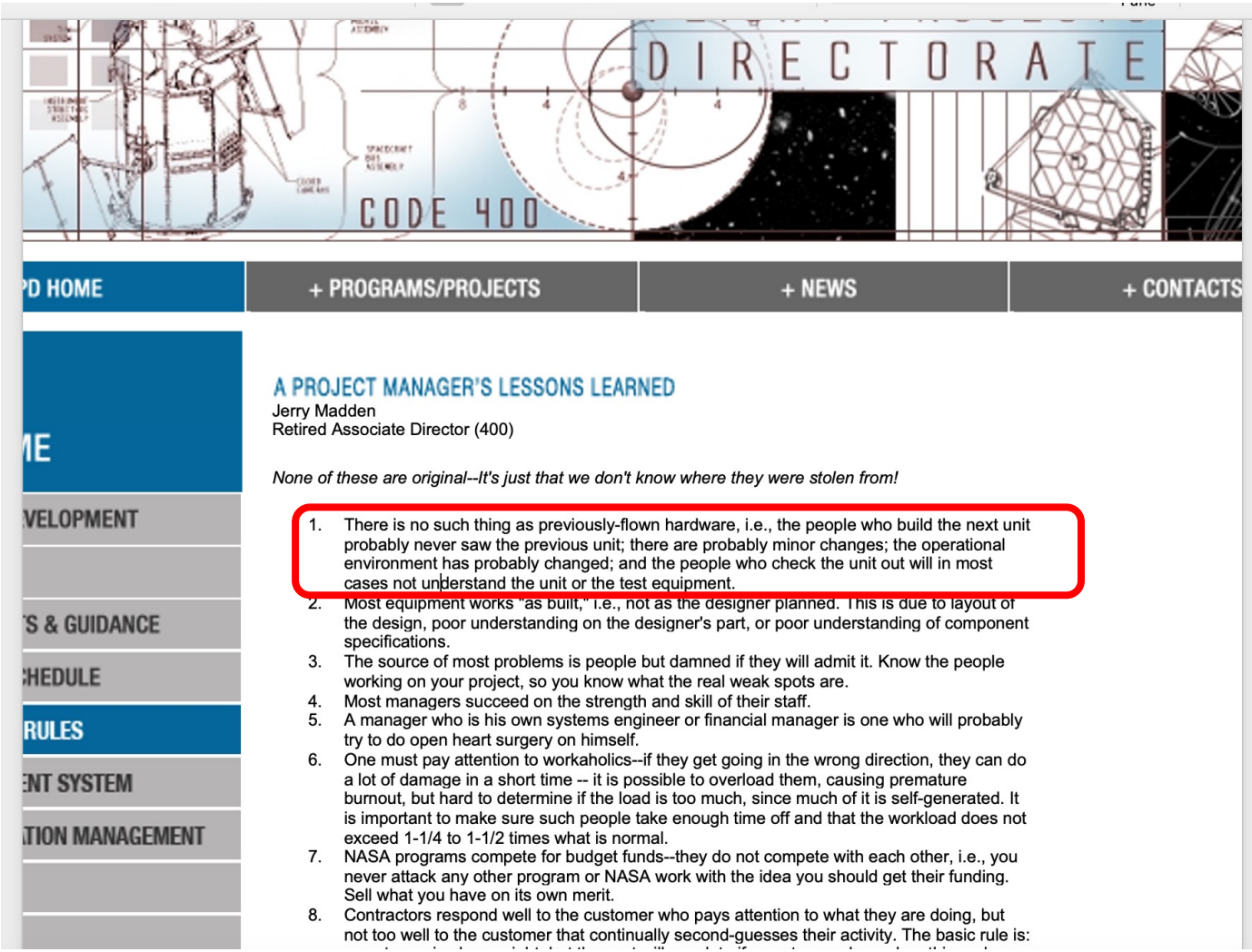
Barrier

- Heritage designs used in different environments can result in challenges and unplanned non-recurring engineering

- Perhaps, also impair infusion of new technology.

How to overcome?

Use smartly and move to modular systems



A PROJECT MANAGER'S LESSONS LEARNED
Jerry Madden
Retired Associate Director (400)

None of these are original--It's just that we don't know where they were stolen from!

1. There is no such thing as previously-flown hardware, i.e., the people who build the next unit probably never saw the previous unit; there are probably minor changes; the operational environment has probably changed; and the people who check the unit out will in most cases not understand the unit or the test equipment.
2. Most equipment works "as built," i.e., not as the designer planned. This is due to layout of the design, poor understanding on the designer's part, or poor understanding of component specifications.
3. The source of most problems is people but damned if they will admit it. Know the people working on your project, so you know what the real weak spots are.
4. Most managers succeed on the strength and skill of their staff.
5. A manager who is his own systems engineer or financial manager is one who will probably try to do open heart surgery on himself.
6. One must pay attention to workaholics--if they get going in the wrong direction, they can do a lot of damage in a short time -- it is possible to overload them, causing premature burnout, but hard to determine if the load is too much, since much of it is self-generated. It is important to make sure such people take enough time off and that the workload does not exceed 1-1/4 to 1-1/2 times what is normal.
7. NASA programs compete for budget funds--they do not compete with each other, i.e., you never attack any other program or NASA work with the idea you should get their funding. Sell what you have on its own merit.
8. Contractors respond well to the customer who pays attention to what they are doing, but not too well to the customer that continually second-guesses their activity. The basic rule is:

Credit: Jerry Madden, NASA

CREDIBLE SPACE

Barrier

- Learn from successes
- Failures can slow us all down
- Watch the oversell

How to overcome?

Build credible systems, build off each other's successes

Left: Air Pollution tester TEMPO Credit: Maxar; Top Right: Ball technician works on The Green Propellant Infusion Mission satellite

HOW TO BUY

Barrier

- Mounting pressure to purchase and deliver on accelerated timelines
- OTA Utilization up 15X (2015-2021, McKinsey & Company)
- Cis-lunar and LEO will be developed via service-based contracts

How to overcome?

- Develop paths through our FAR-based organizations & partner
- Develop trust with buyers co-learning along the way

DEPARTMENT OF THE AIR FORCE
WASHINGTON DC

OFFICE OF THE ASSISTANT SECRETARY

31 October 2022

MEMORANDUM FOR THE DEPARTMENT OF AIR FORCE SPACE ACQUISITION WORKFORCE

SUBJECT: Space Acquisition Tenets

As threats to space systems continue to evolve, and as space becomes even more important in protecting and giving an advantage to our troops, timely delivery of space

Build smaller satellites, smaller ground systems and minimize non-recurring engineering. Use existing technology and designs. Acquire ground and software intensive systems in smaller more manageable pieces that can be delivered faster.

Get the acquisition strategy correct, including contract type and contract incentives for both speed and performance. Have clear, specific, unambiguous statements of work, minimize and avoid government furnished equipment and avoid putting the government in the middle of multiple contracts as the integrator. Do not be afraid to use fixed price contracts.

Enable teamwork between contracting officers and program managers, and they preferably should be collocated.

Award contracts with realistic cost and schedule targets to avoid low bids and buy-ins. Ensure companies have the correct skills to successfully execute the contract. Understand what companies are capable of doing or not doing.

Maintain stability in programs. Push back on year-to-year budget changes that drive rebaselining and slow down acquisitions. Avoid accepting new requirements after going on contract.

Avoid over-classifying. Putting programs in the "special access program" category hinders the integration of space capabilities across other domains and can hinder getting ideas from a broader pool of industry. Avoid classifying systems as "no foreign" to enable future sharing with allies.

Deliver ground before launch. Ensure ground systems are completed and ready for operations before launch of a new capability.

SPACENEWS

New guidance from Space Force acquisition boss: 'The traditional ways must be reformed'

by Sandra Erwin — November 1, 2022

Frank Calvelli, assistant secretary of the Air Force for space acquisitions and integration, visits the Space Development Agency, Sept. 30, 2022. Credit: SDA

In an Oct. 31 memo, Calvelli laid out nine "space acquisition tenets" intended to drive change in the procurement of space systems

- **Reinvention of NASA:**
  - The traditional model (from 1960s to 1990s)
  - The transitional model (from 1993 – 2006)
  - The network model (from 2006 to present)

The Reinvention of NASA
- by Loizos Heracleous,
- Douglas Terrier,
- and Steven Gonzalez

April 23, 2018

Change Management

The Reinvention of NASA

by Loizos Heracleous, Douglas Terrier, and Steven Gonzalez

April 23, 2018

Credit: NASA 2018, Air Force, 2022, Space News, 2022

WORKFORCE CHALLENGES

Barrier

- Aerospace workforce shortage
- Need to broaden reach to attract tomorrow's talent

How to overcome?

- Double down on *Diversity and Inclusion* efforts and strategy
- Form regional hubs

SPACENEWS

Space industry CEOs pledge to create more inclusive workforce

by Sandra Erwin — April 5, 2022

Industry networking event at the 37th Space Symposium in Colorado Springs. Credit: Tom Kimmell Photography

Companies said they will 'significantly increase the number of women and employees from underrepresented groups'

COLORADO SPRINGS – Top executives from the space industry on April 5 signed a pledge to advance diversity across the workforce.

THE WHITE HOUSE

SEPTEMBER 09, 2022

FACT SHEET: Vice President Harris Announces Commitments to Inspire, Prepare, and Employ the Space Workforce

FIGURE 8 | The Deloitte diversity and inclusion maturity model

Mandate → Transition point → Movement

	Level 1	Level 2	Level 3	Level 4
	COMPLIANCE	PROGRAMMATIC	LEADER-LED	INTEGRATED
Focus	Compliance with equal opportunity/ affirmative action goals	Increasing the representation of specific demographic groups (e.g., women)	Leveling the playing field for all employees by addressing systemic cultural barriers	Leveraging difference to create business value
Center of gravity	Legal/HR/D&I team	HR/D&I team	Business leaders	Whole organization
Illustrative characteristics	• Largely homogeneous workforce • Diversity seen as a problem to be managed • Legacy clubs/ cliques and other passive exclusions exist • Actions are largely reactive; any additional focus is on the recruitment of diverse talent	• Business case is articulated • Diversity seen in terms of demographic numbers and targets in place • Ad-hoc and/or stand-alone initiatives such as mentoring, unconscious bias training, employee resource groups and events • Resistance from the majority is nascent • Minority employees adapt or leave	• More sophisticated understanding of D&I and link to business strategy • D&I a personal priority for the CEO and executive team • Systemic cultural barriers surfaced • Strategy for culture change created and growing resistance managed • Leaders/managers are committed, role model inclusion, and are held accountable for actions/outcomes • Talent systems reset • Progress monitored relentlessly	• Workforce is demographically and cognitively diverse • Shared sense of purpose (i.e., diversity of thinking) and meaning • Integration into all aspects of the organization—e.g., behaviors, structures, and systems • Flexibility mainstreamed • Focus on high-performing, diverse-thinking teams • External brand matches internal one

Deloitte Insights | deloitte.com/insights

Credit: Triangle DEI Blog, 2020, White House, 2022, SpaceNews 2022, EY 2022

INFRASTRUCTURE

Barrier

- Space assets expected to grow, need infrastructure to keep pace
- Lack of standard interfaces & protocols

How to overcome?

- Standards and sharing
- Develop with space and infrastructure in-mind
- Build off each other's capabilities
- Work with partners to build future groundwork

Credit: Aerospace Defense Forum, 2015

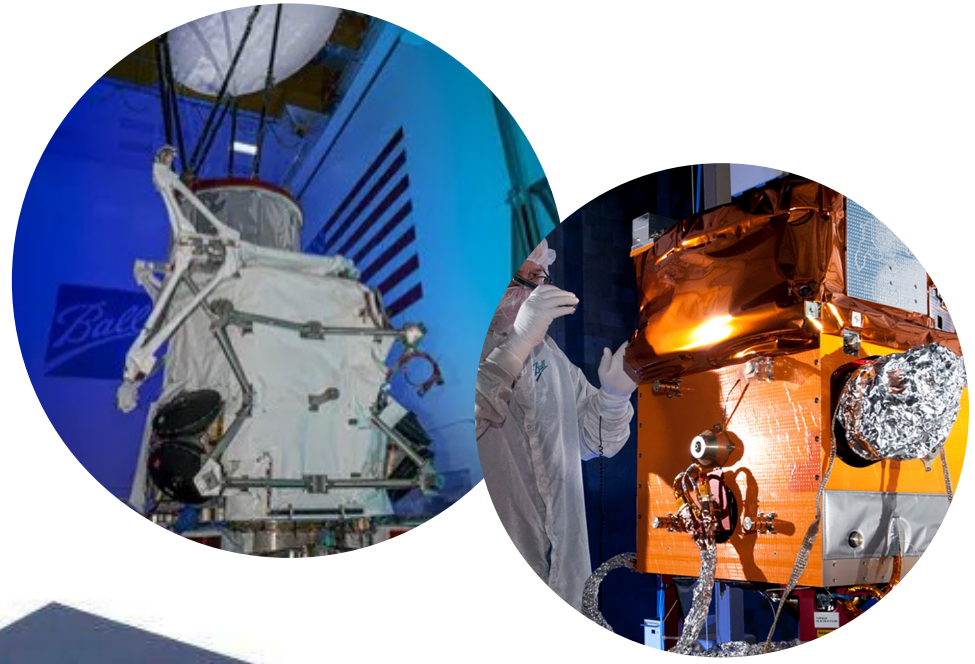
DEVELOPMENT PRACTICES

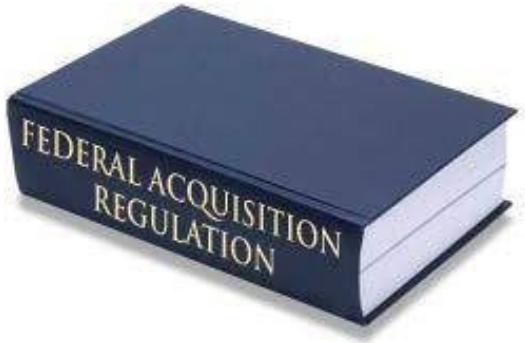
Barrier

- How to execute non-FAR in a FAR based organization?
- Where to take risks?
- Flight rules serves us well until now

How to overcome?

- Tailoring doesn't work
- Embrace new flight rules for development practices





Left: WSF-M Microwave Imager (MWSI) Integration and Test; Top Right: Ball Aerospace developed an ESPA-class standard interface vehicle for the U.S. Air Force Space Test Program

Credit: NASA 2021

TECHNOLOGY INFUSION

Barrier

- Can be challenging to address issues & risks from mission owners and gain their buy-in
- Embrace new technology from partners

How to overcome?

- Demonstrate and infuse technology development – fly early and often
- Include mission stakeholders

Left: Technology Infusion Credit: Via Satellite archives Top Right: Ball Aerospace's Rideshare launching on a SpaceX Falcon 9 Credit: Kinesis

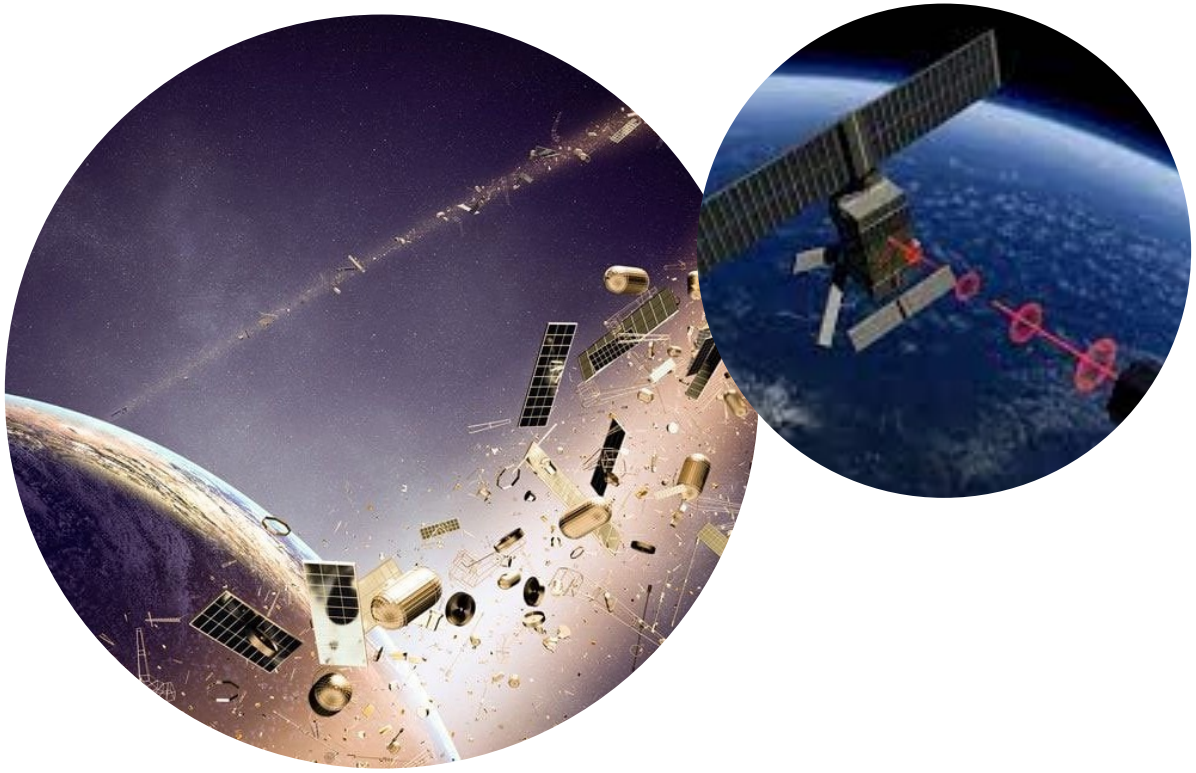
SUSTAINABILITY

Barrier

- Infrastructure challenges currently exist
- Standards still needed to address orbital debris
- What is the paradigm to service and clean?

How to overcome?

- Technology not the barrier anymore. Regulatory & ownership
- Build products with re-use and infrastructure in-mind



Left: Orbital debris Credit: Smithsonian Magazine; Top Right: ESA active debris removal Credit: European Space Agency

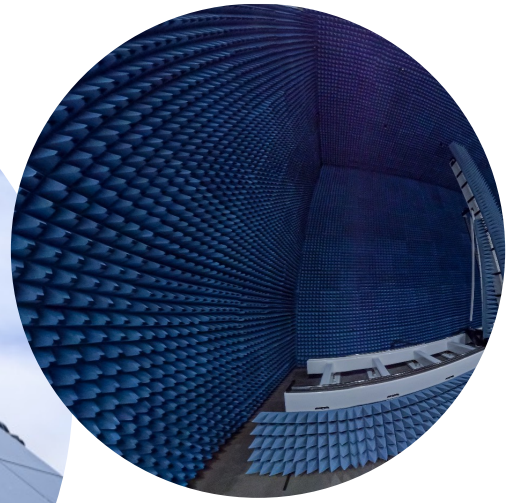
GROUND SYSTEM DEVELOPMENT

Barrier

- Space assets expected to grow, ground system architecture needs to scale and integrate
- Ground systems still often remain a challenge post-launch

How to overcome?

- Modern software architectures and practices
- Double-down on workforce & training



Left: Ball Aerospace ground systems;
Top Right: Near Field Range

CYBER SECURITY

Barrier

- Cyber security is a rising challenge, will need trust in the supply chain

How to overcome?

- Double down on knowledge transfer and standards
- Workforce development & human resource considerations

POLICY

Here's the Pentagon's New Plan to Woo and Retain Cyber Workers

The 2023-27 strategy aims to improve identification, recruitment, development, and retention of civilians in IT and related jobs.

OCTOBER 11, 2022

FACT SHEET: Biden-Harris Administration Delivers on Strengthening America's Cybersecurity

Credit: Defense News, 2023, White House, 2022

Rewrite today's rules to move forward to tomorrow

Images: WSF-M, Roman Filter Wheel, Integrated Cockpit Sensing Technology