AEROJET ROCKETDYNE

Aerospace Technologies: Past, Present, and Future

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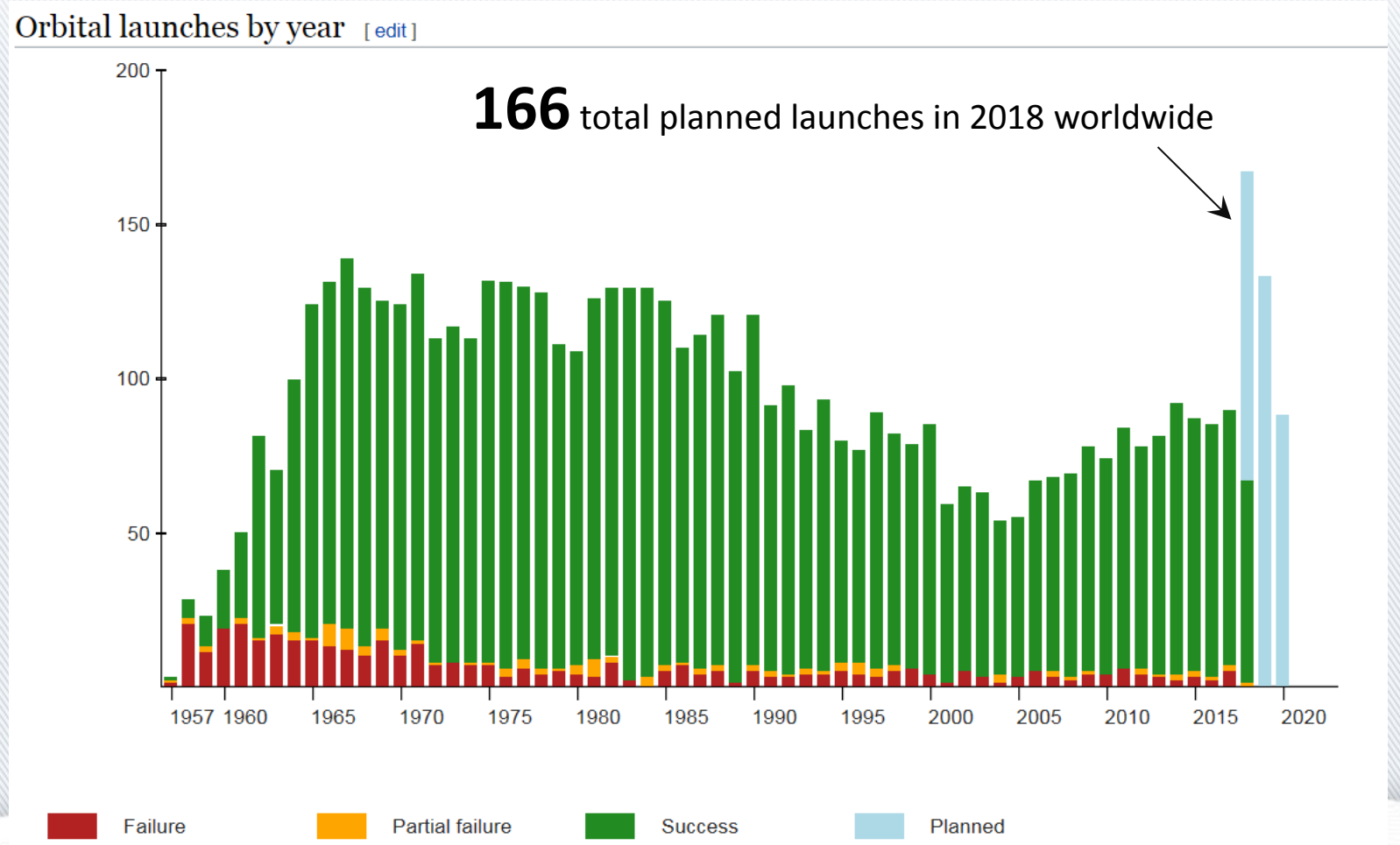
4 October 2018

Approved for Public Release

DID YOU KNOW?

- **How many rockets are launched annually worldwide ?**
- **How many have been launched total?**
- **How many cars have ever been manufactured?**

DID YOU KNOW?



Source: https://en.wikipedia.org/wiki/Timeline_of_spaceflight Accessed Aug 31, 2018

DID YOU KNOW?

- How many rockets are launched annually worldwide ?
- How many have been launched total?
- How many cars have ever been manufactured?
- **What exactly are we launching?**

DID YOU KNOW?


1981-2010
SPACE SHUTTLE PROGRAM


CONNECTING RESEARCH AND OPERATIONS
GOES-R
PROVING GROUND


NROL-71 ★ VAFB ★ DELTA IV-H
Serving Those Who Serve


GPS IIF-8

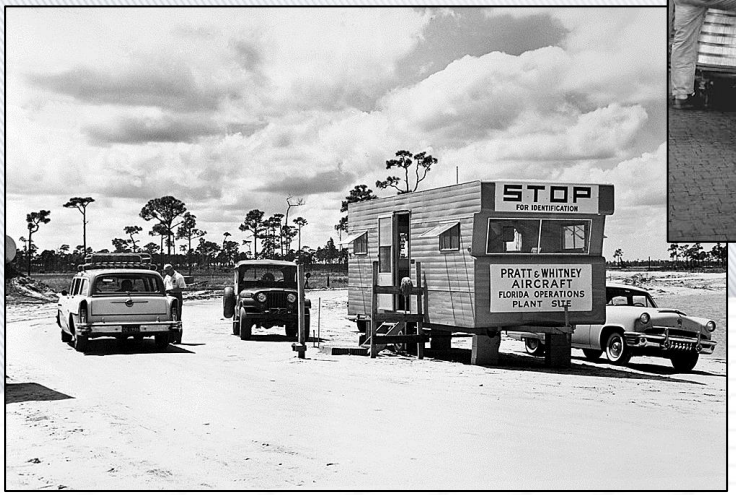

PARKER SOLAR PROBE
A MISSION
TO TOUCH
THE SUN

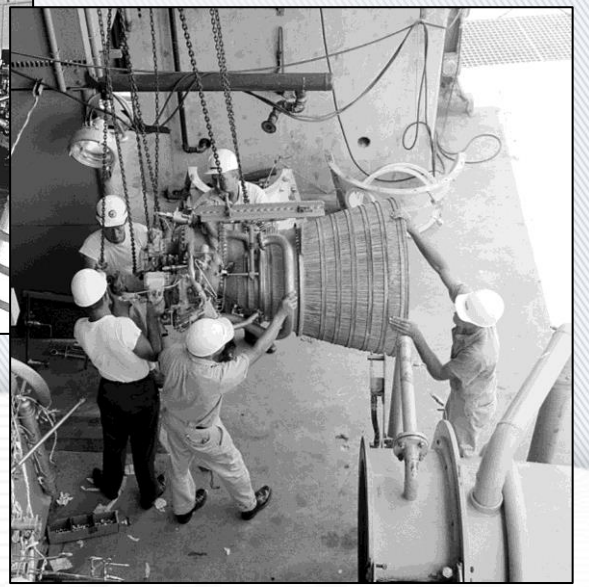
History of WPB /PBC Aerospace Cluster

- Pratt & Whitney Aircraft Florida Research and Development Center opened May 27, 1958
  - ~7,000 acres of swampland → 600,000 sq ft main building

Palm Beach County was a pioneer location for aerospace development

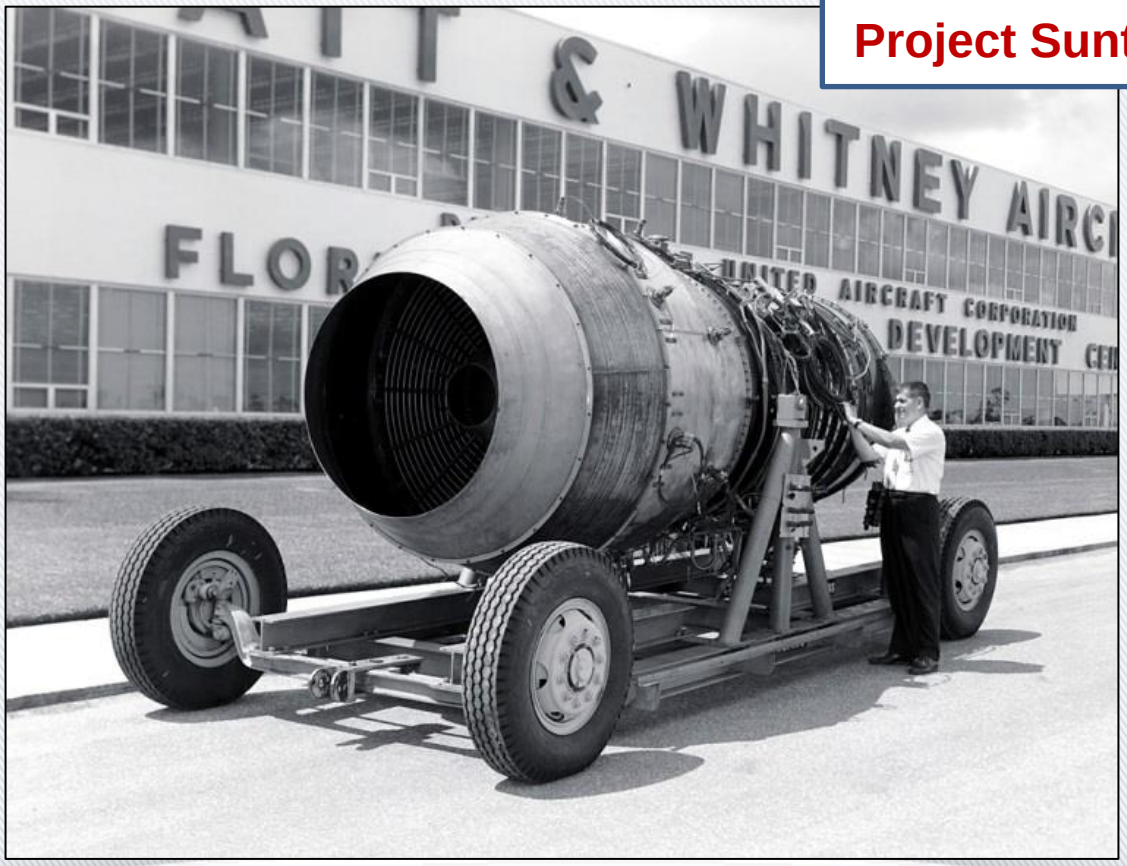
WHAT WAS LIFE LIKE THEN?





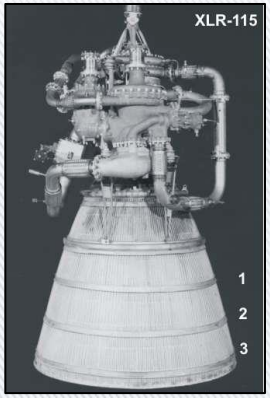
Milestones and Historical Developments

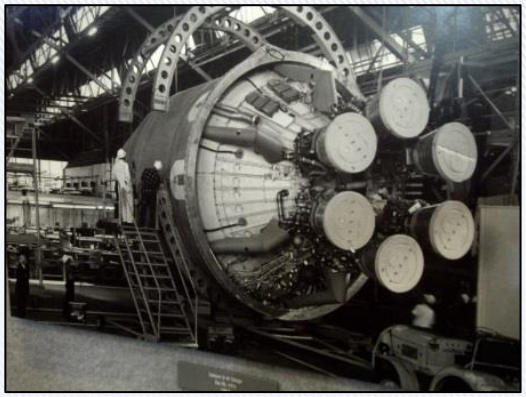
Project Suntan



Technology developed here was the precursor to many later breakthroughs

Milestones and Historical Developments





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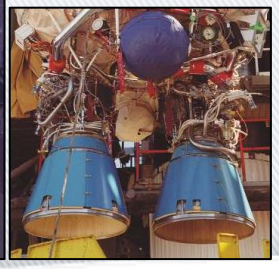


Legacy of technology evolution continues

Milestones and Historical Developments

RS-25
Space Shuttle Main Engines
→ Space Launch System

Technology development is ongoing with new derivatives

GO BEYOND

PRATT & WHITNEY
WEST PALM BEACH

PurePower engines with Geared Turbofan™ technology delivers game-changing reductions in:

- Fuel burn
- Environmental emissions
- Engine noise
- Operating costs

F-135 Powers the F-35 Lightning II

- CTOL/CV (Conventional Take-off and Carrier Variant)
- STOVL (Short Take-off / Vertical Landing)
- The F-35 is an international program being developed to serve the United States, United Kingdom, Italy, the Netherlands, Turkey, Canada, Australia, Denmark, Norway and other allied nations.

GO BEYOND

System Engineering – Validation

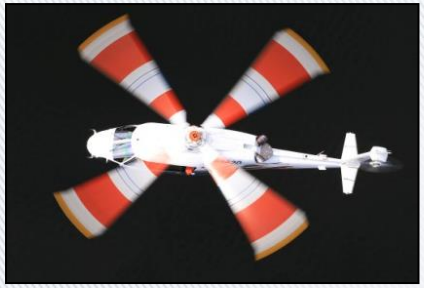
Assembly, Instrumentation & Test

- Development assembly and disassembly validation engines for commercial and military engines and Auxiliary Power Units (APU)
- Interim Depot for F135 engine
- Sensor Application Lab
- State-of-the-art Instrumentation Lab
- Automated Clean Line
- World Class Test Facilities

SIKORSKY
A LOCKHEED MARTIN COMPANY

DEVELOPMENT TEST CENTER
CORE ACTIVITIES

New Product Development

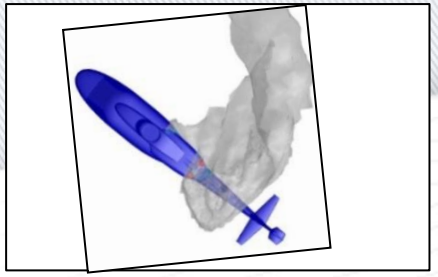



Product Upgrades


New Missions/Enhanced Capability


Technology Demonstrations


Design Validation




Prototyping / Modifications


DEVELOPMENT TEST CENTER
FAST FACTS

Typically 20 – 25 Aircraft in flow
~1,500 Flight hours per year
~2,000 Sorties per year

Site presence established 1977

~80 Safety-of-flight reviews per year

3 Fixed base telemetry stations
1 Mobile telemetry platform
~1,500 Measurements per aircraft
~40 GB of data per sortie

CURRENT ROCKET PROGRAMS
WEST PALM BEACH

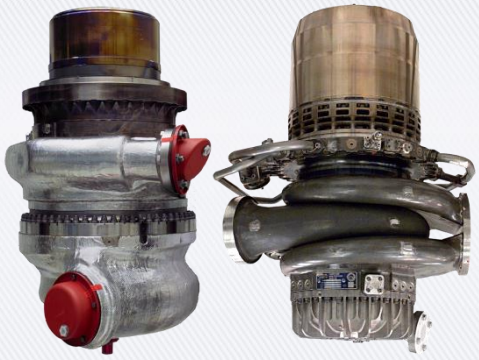
Turbopump Assembly Center of Excellence

RL10A

RL10B

RL10C

RS-25



RS-68

Atlas V

Delta IV

SLS

Hypersonic Systems

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KEY CHALLENGE IS COMPLEXITY

Designing & manufacturing high quality complex systems requires strong systems integration and quality analysis processes

Constant Focus on Quality and Continuous Improvement

Process Improvement and Waste Elimination

- 6S and Visual Workplace
- Value Stream Management
- Standard Work
- Production Preparation Process
- Total Productive Maintenance
- Set-up Reduction

Problem Solving

- Process Variation Management
- Market Feedback Analysis
- Turnback Process
- Root Cause Analysis
- Mistake Proofing

Decision Making

- Benchmarking
- Passport Process

**Process-Oriented, Data-Driven, Customer-Focused,
Improved Business Results by Driving to Stretch Goals**

Reliance on Data-Driven Decision-Making

Design & Dev | Supply Chain | Mfg, Assembly, and Test | Launch Support

Engineering Analysis and Systems Integration

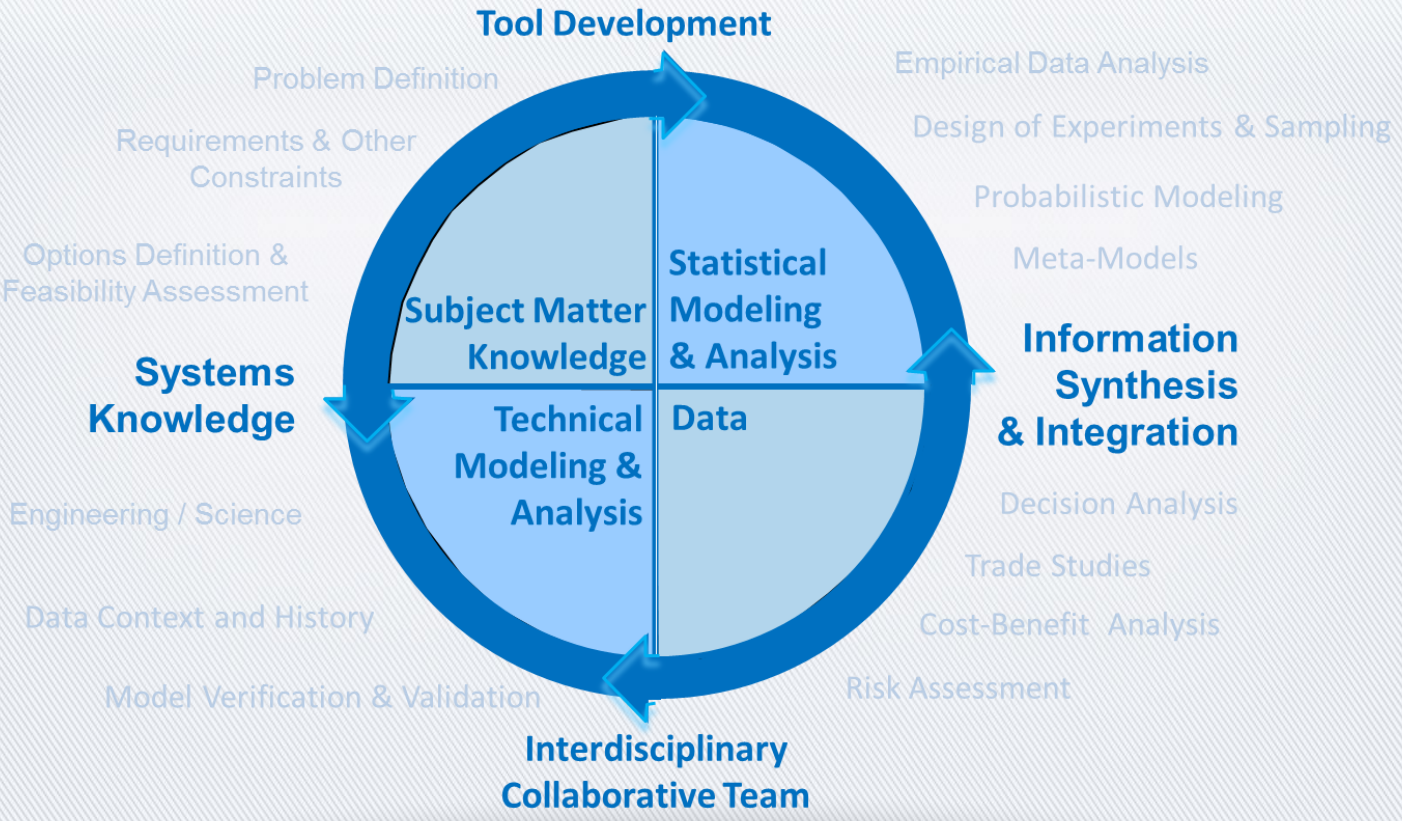
Quality and Mission Assurance

Business & Program Management

Affordability & Continuous Improvement

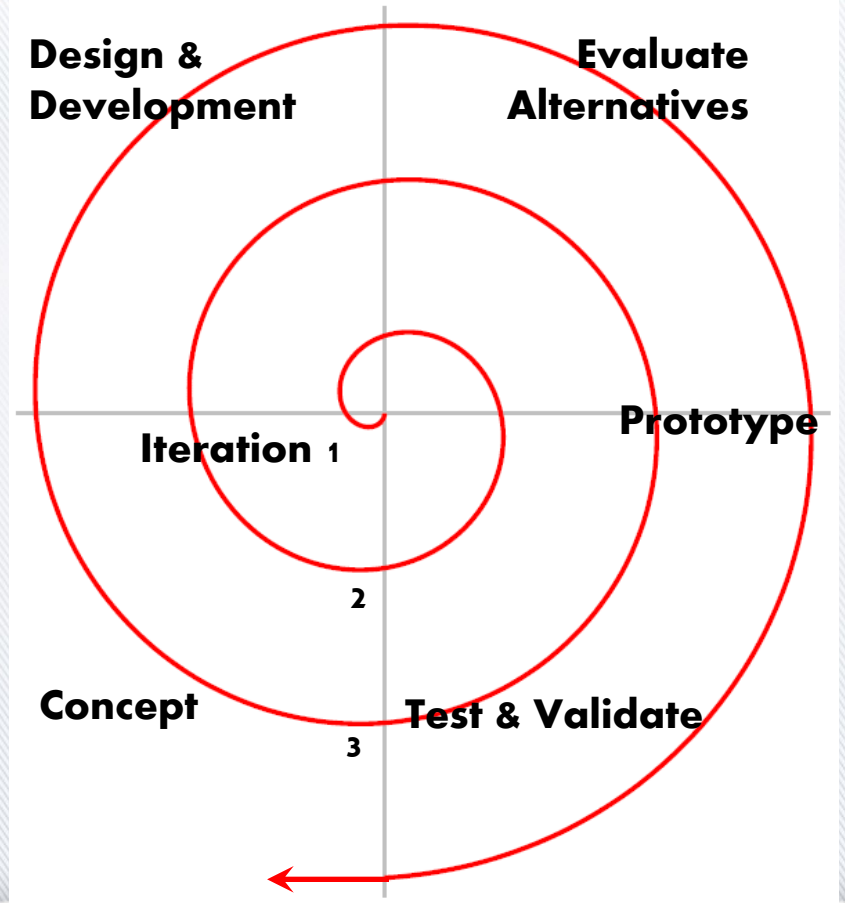
Implementation of quality processes based on statistical methods across the full value stream

Integrating Statistical and Engineering Models



Teamwork and communication across functions is key

INTEGRATED DEVELOPMENT PROCESS

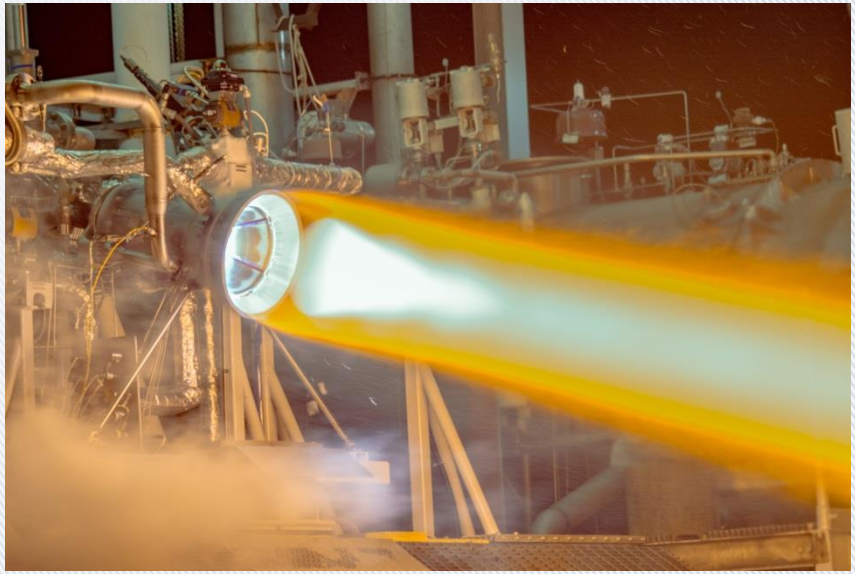


Modeling and Analyses Shorten the Product Development life cycle

Future Directions: Hypersonics

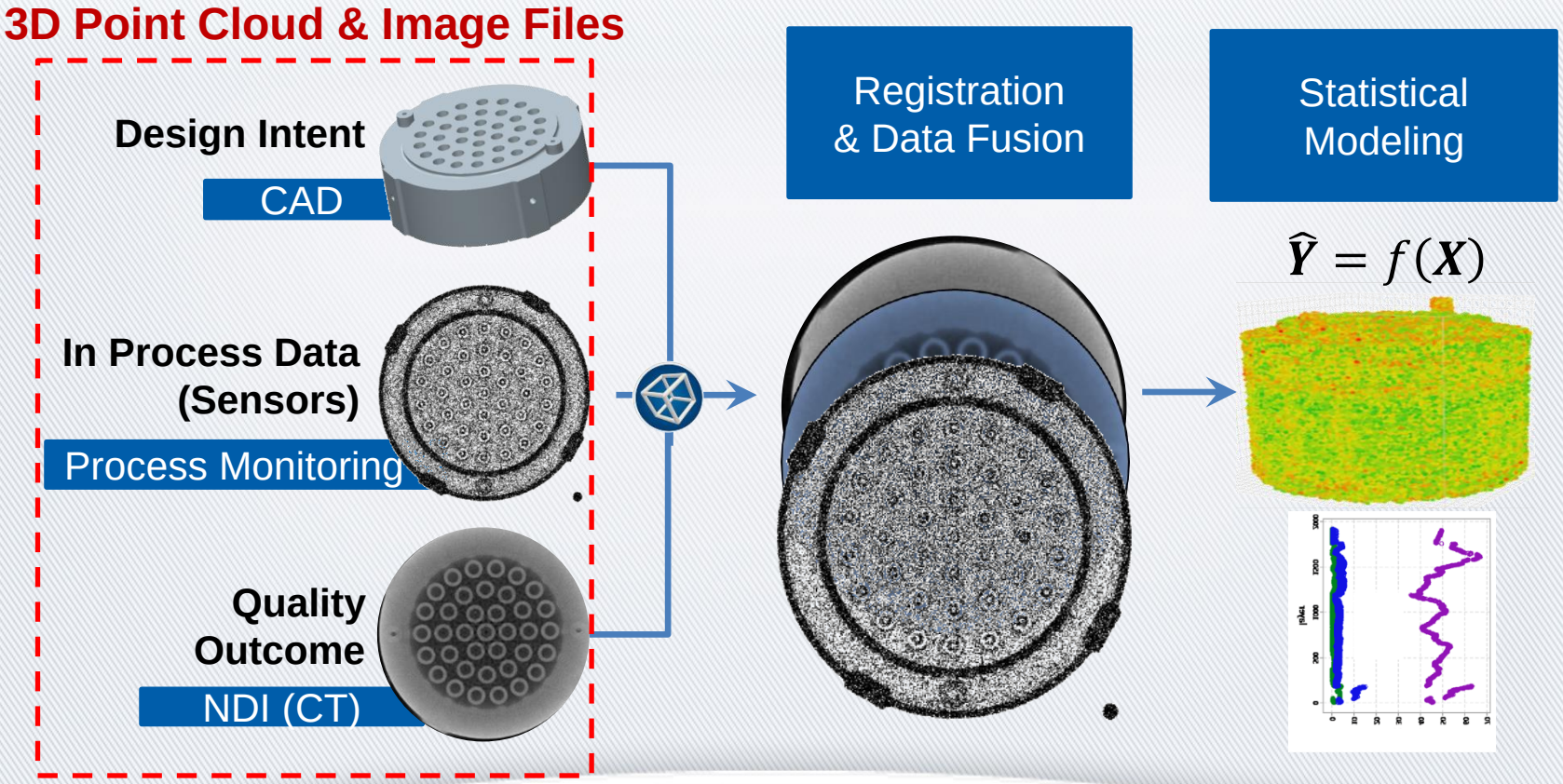
Hypersonic systems are game-changing propulsion technology with both commercial and military applications

Future Directions: Additive Manufacturing (AM)



Process control and understanding are keys to achieving potential benefits of AM while maintaining same quality levels

Future Directions: Leveraging Big Data in AM



Opportunity to use data to reduce development cost and cycle time

KEYS TO FUTURE SUCCESS

Better integration leads to improved velocity and performance

Thank you!