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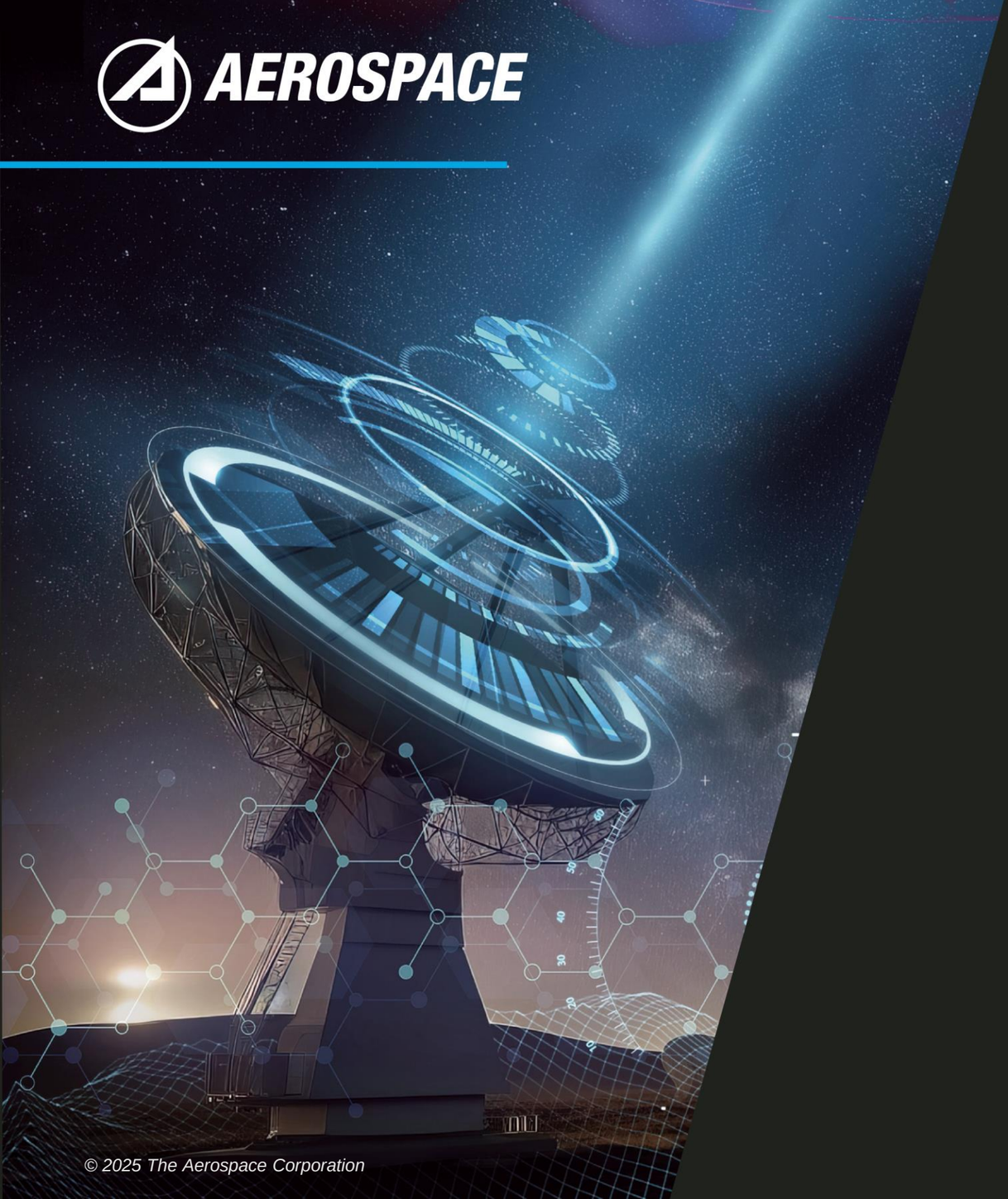
Ground System Architectures Workshop

Amplifying User Effectiveness: Automation, Augmentation, and AI/ML

February 24–27, 2025

Renaissance Los Angeles Airport Hotel

Los Angeles, CA



Working Group A Space Enterprise Integration Working Group: Integrating International Launch Capabilities Using AI

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Space Enterprise Evolution
The Aerospace Corporation

February 27, 2025

Space Enterprise Integration Working Group: Integrating International Launch Capabilities Using AI

- The working group will focus on government leveraging innovative solutions for national missions with emphasis on integrating data/systems/networks with and among owners and operators – all in the national interest. With a focus on Space Enterprise Integration, the discussion will address the use of AI/ML in the applications of:
  - Testing & Quality Assurance
  - Launch Preparation
  - Launch Operations
- Launch leadership panel:
  - David Pierce, Director of NASA Wallops Flight Facility (WFF)
    - *Joe O'Brien, Associate Chief, Wallops Range and Mission Management Office*
  - Matt Archer, Missions and Capabilities Director for Launch, UK Space Agency
  - Lloyd Damp, CEO, Southern Launch
- A town hall discussion follows with broad audience engagement.

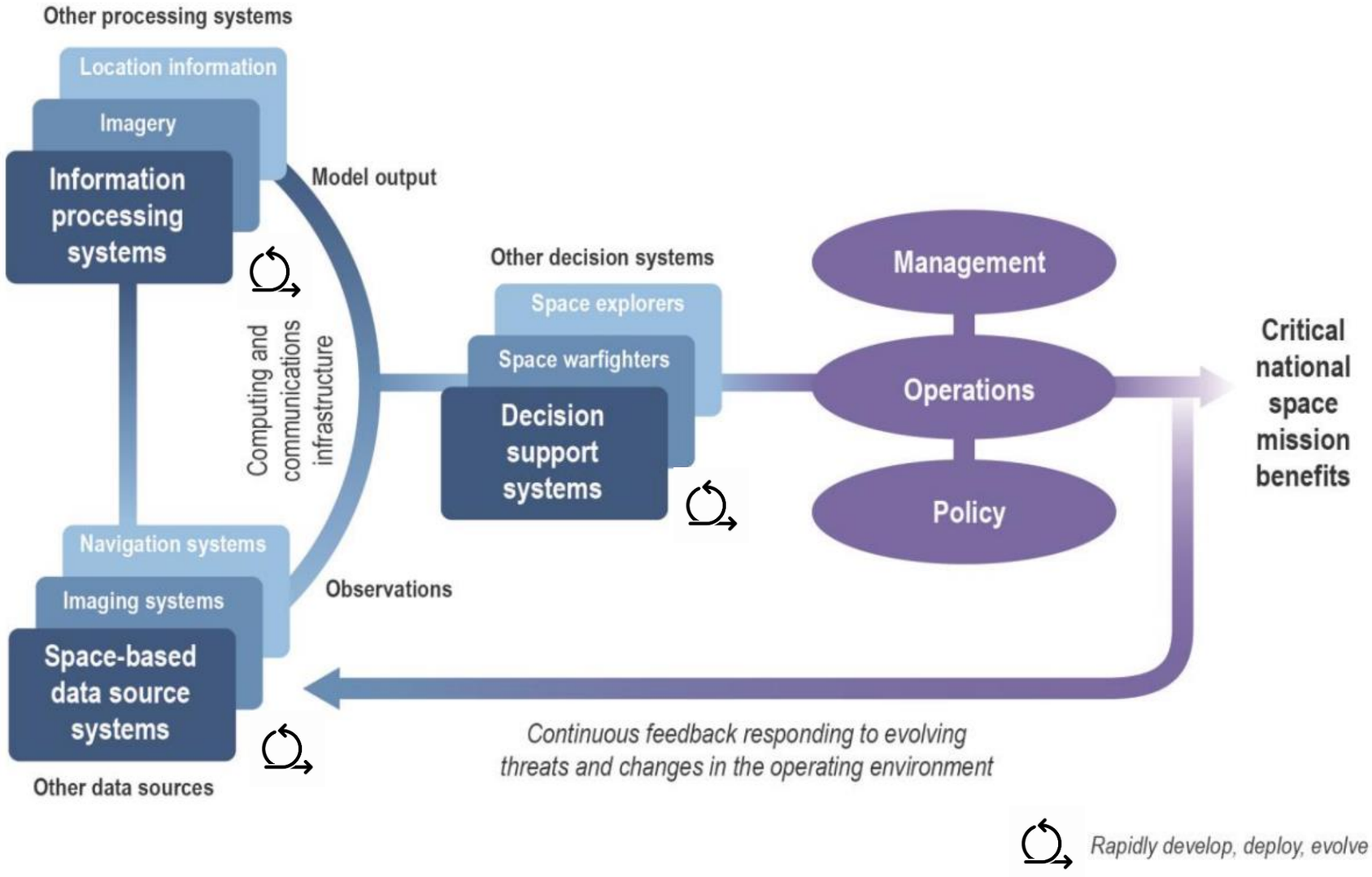
Dave Pierce

Joe O'Brien

Matt Archer

Lloyd Damp

Space Enterprise Integration Working Group: Integrating International Launch Capabilities Using AI



Launch Lifecycle Use Cases for AI

Pre-Project Phase	Design & Engineering	Manufacturing & Assembly	Testing & Quality Assurance	Launch Preparation & Mission Readiness	Launch & Post-Launch Operations	Project Closure & Lessons Learned
Conceptualization and Feasibility Analysis Involves conceptualizing the rocket design, conducting feasibility studies, assessing technical and financial viability of the project. **AI Use Case:** • **Insurer optimization / indemnification of risk** • **Dynamic business model perspective / testing (cost/benefit)**	***Preliminary Design*** Involves developing a high-level design concept, including overall dimensions, propulsion system selection, and basic structural layout. **AI Use Case:** • **Design core components, structures, engineering approaches** • **Requirements tracking** • **Optimization of weight and thrust** • **Material selection – driving efficiency** • **Sled/launch/balloon**	***Component Manufacturing*** Involves manufacturing of rocket components: airframe, engines, avionics, payload compartments. Specialized manufacturing: machining, welding, additive manufacture **AI Use Case:** • **Identifies hardware issues that point back to requirements** • **Improve/reduce human intervention**	***Component Testing*** Each component undergoes rigorous testing to verify its functionality and durability. This includes stress tests, vibration tests, thermal tests, and electrical tests. **AI Use Case:** • **Testing for legacy system failure** • **Testing for newer design failures** • **Identification of failure points** • **AI as a pre-mortem**	***Launch Site Preparation*** Preparing launch site, ensuring safety protocols, conducting pre-flight checks. Ground support equipment tested, launch infrastructure inspected and verified. **AI Use Case:** • **Mission optimization** • **Maximize use of payload** • **Administrative pre-work** • **Ingest customer requirements** • **Identify discrepancies from prior lessons learned**	***Launch Operations*** Rocket launched per schedule. Mission control monitors launch and provides real-time support. Post-launch trajectory analysis and data collection begin. **AI Use Case:** • **Anomaly detection from high volumes of data – drawing from sufficient data using the same systems (except weather, RF data)**	Project closed and comprehensive project review conducted. Documenting lessons learned, identifying areas of improvement, archiving project documentation for reference. **AI Use Case:** • **Streamline data delivery**
Funding and Resource Allocation Includes budget planning, resource allocation, and establishing partnerships with suppliers and contractors. **AI Use Case:** • **Fuel use, fuel waste, optimization** • **Managing availability of consumables (methane, etc.) WRT availability, price points based on time of year**	***Detailed Design*** Engineering designs created, spec'd to each component and subsystem. CAD tools and simulation techniques used to optimize design and ensure performance, safety. **AI Use Case:** • **Data on anomalies identify COA for new design** • **Iterate on design to identify a quick, stable solution** • **Run Monte Carlos / simulation** • **Gamification, predictable patterns** • **Simulation // Training development/protocols**	***Subsystem Integration*** Components integrated into subsystems (propulsion, guidance and control, communication systems). Testing/verification ensure compatibility, functionality. **AI Use Case:** • **Procedures development** • **SWaP optimization** • **Training on examples for lessons learned** • **Supply chain knowledge for performance and quantity** • **AUKUS supply chains**	***System-Level Testing*** After assembly, to evaluate overall performance, including propulsion, navigation, comms systems. Includes ground-based tests and simulated launch scenarios. **AI Use Case** • **LLM for documentation writing (need explainable AI and Trusted AI for open and closed systems as well as policies/ procedures and for proprietary data** • **Check out and verification that network is configured to appropriate standard**	***Integration and Checkouts*** Rocket is integrated with launch vehicle; final checkouts are performed to ensure proper connectivity and functionality. Includes testing electrical connections, fueling systems, telemetry systems. **AI Use Case:** • **LLM for documentation writing** • **Health and safety testing**	***Post-Launch Data Analysis and Evaluation*** After launch, data is analyzed to evaluate the performance of the rocket and its subsystems. Lessons learned are documented and improvements for future projects identified. • **AI Use Case: LLM for documentation writing**	• **AI interface into a digital engineering model in the interface itself – map to regulatory regime and testing results to support regulatory review** • **AI provide first cut at mission design**

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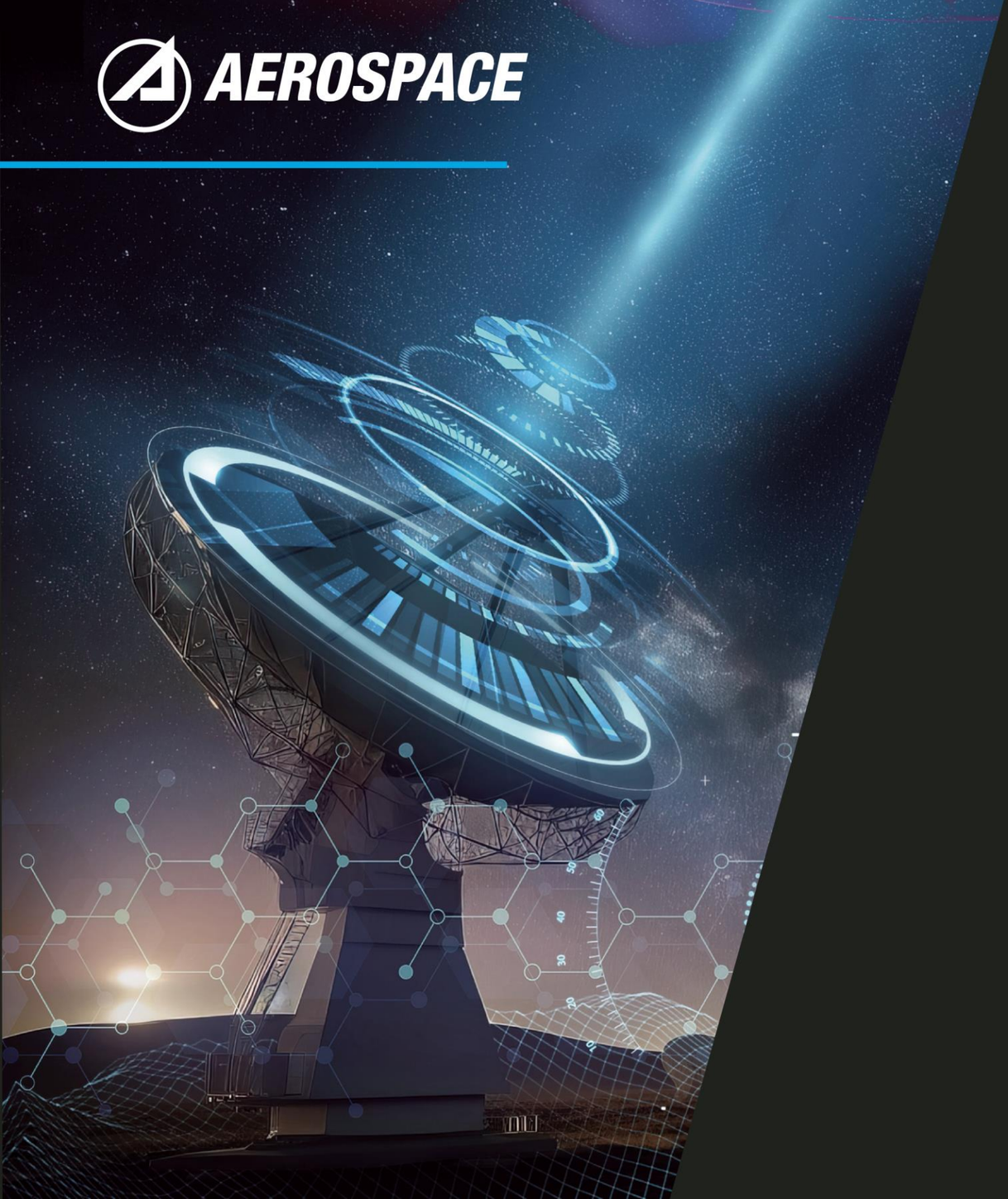
AI
MISSION PLANNING
ROCKET TESIGNG
ROCKET DESIGN
ORBIT INSERSTION



Thank you