Sub-System and System Testing – The Trend Towards Multi-use “Generic” Aerothermal Test Rigs
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Aero Engine RDT&E* Process

• The aero engine Original Equipment Manufacturers (OEM’s) need to validate:
  – New technologies
  – New uses for proven technologies

• Aerothermal Rigs are used for Sub-system testing and validation

* RDT&E = Research, Development, Test and Evaluation
Aerothermal Rig Examples

Fan Rigs
Compressor Rigs
Combustor Rigs
Turbine Rigs

Other Rigs – Other complex sub-system rigs (bearing, seal, nozzles etc)
Integrated Execution

Integrated capabilities is a key enabler to schedule and cost reduction

Processes Co-located in Newport News, Virginia, USA

Rig installed in Off-Site Facility
Engine Development Program Funding

Design and manufacture aerothermal rigs to validate a specific engine product module

Capital Funding

Invest in multi-purpose rig test facilities
Maintain and upgrade with regular infusions of capital funding
Depreciate these assets over many years

Research & Development Funding

Design and manufacture aerothermal rigs to validate specific technologies

Then…

- Run the aerothermal rigs in the test facilities and gather data
- Remove the rig from the facility, send to stores and “write-off” the value of the product/technology-specific rig
“Generic” Rigs

• **Re-building** aerothermal rigs is nothing new
• Rigs are often designated by their “base” rig marque and their build number, for example “Rig 123 build 4”, but:

Generic Rigs are:
• Multi-use test vehicles that are explicitly designed to accommodate multiple future test campaigns
• Specifically configured to optimize change of test hardware
• Controlled by multiple technical and commercial authorities
• Often funded from multiple sources (Capital, EDP, IR&D, Government R&D funding)
Capital Funding

Invest in multi-purpose rig test facilities
Maintain and upgrade with regular infusions of capital funding
Depreciate these assets over many years

Capital, EDP, IR&D, Government R&D funding

Invest in the design and manufacture of a “base” generic aerothermal rig
Depreciate this asset over many years

Design and manufacture aerothermal rigs to validate specific technologies

The promise of generic rigs:
- Multiple experiments on the same “base” generic rig, maximizing return on investment and minimizing “time-to-data”

Reduced overall cost
Trend Towards more Generic Rigs

• Increasing commercial pressure to maximize R&D return on investment
• Maturation of aero engine architectures
• Multi-national strategic technology development R&D funding, e.g. Horizon 2020
• Multi-divisional engine technology development
• Risk and Revenue Sharing Partners (RRSP’s)
• Compression of engine development program schedules
Opportunities

Technical
• More ambitious testing
• A more comprehensive instrumentation suite
• Higher fidelity data (reduced measurement uncertainty)

Cost/Commercial
• Improved return on investment
• Longer term pricing (for multiple builds)
• Attractive approach for strategic multi-national investment initiatives

Schedule
• Rapid change-out of test hardware (planned)
• Facilitates urgent (un-planned) investigations
Some Generic Rig Challenges

- Multiple funding sources and commercial authorities
- Multiple technical authorities
- Capturing and managing the experimental “wish list”
- Defining the “generic” features
- Multi-build configuration and interface management
- There may be no design solution that meets all future requirements
- Management of multi-build lifing etc
- Technical standards and execution processes changing over time
- Single/Multiple supplier management
- Change Management
The Way Forward

Some rig project execution processes that need to be tailored to the specific challenges of generic rig execution are:

• Pre-program study phase
• Pre-selection of a preferred long term supplier
• Leaning, aligning and standardizing project execution processes
• Long term governance
• Test and test bed change support
• Test result data
Conclusion

• The effectiveness of generic rigs will be measured in the years to come, success will require:
  – Collaboration between all stakeholders including the test facility, OEM, and rig suppliers
  – Desire and persistence to fund these projects over many years

But…the potential benefits are more than worth the effort
Questions?