MITCHELL INSTITUTE
for Aerospace Studies

From EMD to Milestone C and Beyond:

Common Issues Affecting Aircraft Programs

Lt Gen Mark D. Shackelford, USAF (Ret.)

Overview of the Study

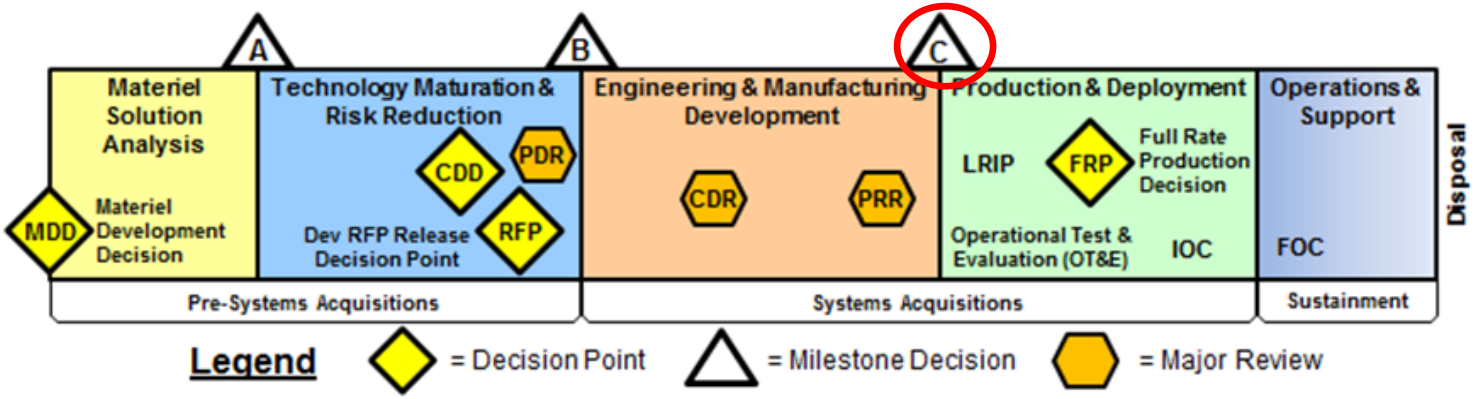
- Why do aircraft programs struggle to move from development to full production?
- Paper developed from series of case studies on aircraft programs
- Study assessed programs at MS-C, when programs transition from development into production

- **Eight Case Studies:**
  - *B-1B Bomber*
  - *C-17 Transport*
  - *A-12 Attack Aircraft*
  - *B-2 Bomber*
  - *F-22 Fighter*
  - *F/A-18 E/F Fighter*
  - *F-35 Joint Strike Fighter*
  - *KC-46 Tanker*
- Common issues plagued every program except F/A-18 E/F
- Issues are usually overcome, but drive cost and schedule growth

What systemic issues contribute to increased costs and delays?

What is Milestone C (MS-C)?

- At MS-C, “a program is reviewed for entrance into the Production & Deployment phase”
- MS-C affirms that design is mature and meets requirements
- Programs often experience major challenges after MS-C
- Significant development work often occurs after MS-C
- Hence, the study examines transition from EMD to MS-C *and Beyond*



MS-C best understood as a process rather than a single event

Common Issues in the Case Studies

Common issues that caused programs to struggle at MS-C and Beyond:

1. *Poor communication and transparency between the government and contractor*
2. *Unstable requirements or unstable funding*
3. *Lack of production-representative assets and insufficient testing*
4. *Poor management decisions that disrupted program stability*

Program	*Poor Communications and Transparency*	*Requirements and Funding Instability*	*Lack of Representative Test Assets and Insufficient Testing*	*Poor Management Decisions*
B-1B (USAF Bomber)		X	X	X
A-12 (USN Carrier Attack)	X		X	X
C-17 (USAF Transport)	X	X	X	X
F-22 (USAF Fighter)	X	X	X	X
B-2 (USAF Bomber)		X	X	X
F-35 (USAF/USN/USMC Fighter)	X	X	X	X
KC-46 (USAF Tanker)	X		X	X
F/A-18 E/F (USN Carrier Fighter)				

Many programs struggled, but only one program (A-12) outright cancelled

Poor Communication and Transparency

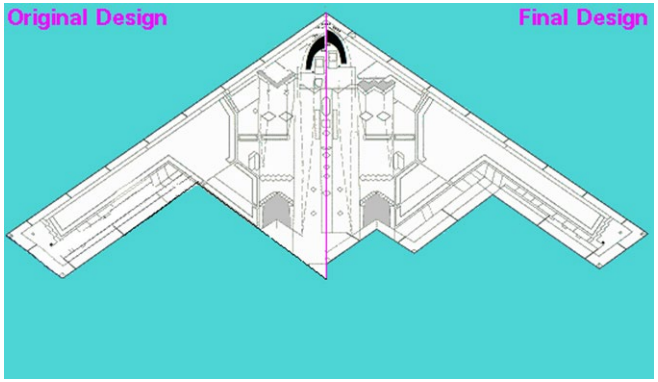
- Developing new aircraft is inherently risky
- Government and industry should be partners in proactive risk management
- Requires accountability *and* trust
- Poor communication and transparency undercuts trust
- An “arms length” relationship does not permit flexible problem-solving
- Also required between primes and subs

Example from the case studies: The C-17 program experienced a breakdown in trust and communication between government and the contractor that was not solved until OSD intervened.

Failure to establish trust <u>early</u> increases risks to program execution

Requirements & Funding Stability

- Requirement definition and cost estimates *should* (but don't always) establish a stable programmatic baseline
- Added requirements can force expensive, lengthy redesigns
- Funding can be underestimated, redirected by Service, or cut by Congress
- Unstable requirements and funding often increase costs and cause delays
- Instability leads to lower procurement quantities and higher unit costs



Example from the case studies: New requirements demanded a fundamental redesign of the B-2 bomber that added considerable delay and drove up costs.

Unstable requirements and unpredictable funding can increase program costs and delays

Production-Representative Test Assets

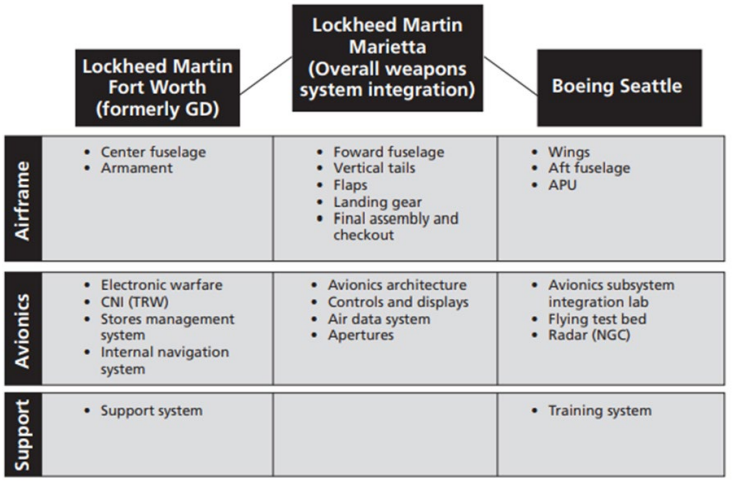
- MS-C coincides with initial operational testing
- This testing often uncovers problems
- Lack of representative test aircraft can delay realistic testing
- Common issues:
  - *Insufficient time allocated for testing*
  - *Production contract awarded before testing reveals issues*
  - *Production aircraft require costly retrofits*

Example from the case studies: B-1B production began prior to major testing. After testing revealed problems, production aircraft needed expensive retrofitting.

Insufficient margin for realistic testing can lead to schedule/cost growth

Shortfalls in Program Management

- Management choices can make or break a program
- Both prime and government have management responsibilities
- Examples of poor management:
  - Changing facility locations during EMD
  - Poor oversight of major subcontractors
  - Underinvesting in engineering discipline
  - Cutting corners on quality control processes
- Most common government management failure is lack of effective oversight



SOURCE: Lockheed Martin F/A-22 website.

RAND *MG276-2.1*

Example from the Case Studies: The development of the F-22 was split between several sites/companies, creating an inefficient division of labor and delaying deliveries of test aircraft.

Complex programs falter without strong, experienced managers

Active Contract Management Can Help

- Active Contract Management is a framework for program management
- Government must be able to understand and assess program data
- Government should change its contract or program approach as needed
- Communication should be open and frequent
- Goal is partnership and accountability
- Trust enables everyone to focus on delivering capability within cost and schedule goals

Active Contract Management is a set of strategies developed by the Harvard Government Lab for improving contract outcomes through data and purposeful management of contractors

KC-46: an example of an inflexible approach to risk management

Active Contract Management is an adaptive approach to managing risk

How did F/A-18 E/F Avoid These Issues?

- Good relationship between government and contractor
- Integrated Product Team
- Management was data-informed
- Requirements strictly controlled
- Stable funding
- Seven test asset aircraft, ample time to test
- Logical workshare arrangement
- Sufficient management reserve

F/A-18 E/F avoided issues through partnership and strong management

Conclusions

Considerations for Future Programs:

1. Establish government-contractor trust and good communications early
2. Maintain stable requirements and predictable funding
3. Ensure sufficient production-representative test assets are available and sufficient time to conduct testing
4. Government and contractor need strong, experienced management
5. Active Contract Management can foster a collaborative and data-informed management culture

Future acquisition programs can use these principles to achieve a balance between speed, capability, and affordability

Delivering programs on time and budget requires flexible & disciplined approaches to program and contract risk management

www.mitchellaerospacepower.org