Contracting Quality Early in the Lifecycle Using AS9145 Data Deliverables

A recommended practice developed by the Aerospace Industries Association's (AIA) Joint Strategic Quality Council (JSQC)

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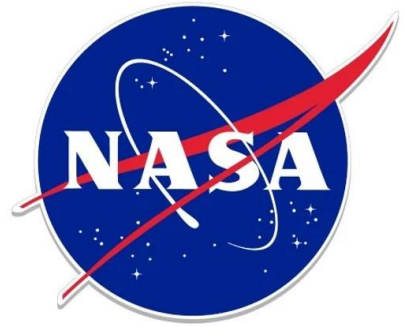


Joint Strategic Quality Council (JSQC) – The Joint Strategic Quality Council is a collaborative, non-competitive partnership, improving performance through mutually beneficial quality assurance initiatives.

*Major Defense Acquisition Program Contractors

Source: JSQC/Mras

Joint Strategic Quality Council Journey

Purpose: JSQC Collective Strategic Plan / Provide better value to the Warfighter

- ✓ IAQG and DCMA initiated partnership (2012)
- ✓ Initial discussions on potential opportunities
- ✓ OCT 2017 Introduction to AIA (Mr. Shields brief)
- ✓ NOV 2017 first AIA white paper published (OASIS)
- ✓ EQC Initiated
- ✓ 1st project White Paper/CONOPS complete (OASIS)
- ✓ JSQC Standard tempo
- ✓ NASA engagement
- ✓ NAS 412 Revision (R2)
- ✓ March 2019 F2F Kennedy Space Center
- ✓ AAQG/IAQG engagement
- ✓ JSQC partnership and tempo remains strong through COVID
- ✓ AIA V/R Standard
- ✓ DCMA publishes article on JSQC
- DCMA Launch Joint Strategic Quality Council
- ✓ DCMA Man. 2301-06 Revision
- ✓ AAQG Customer Major Noncompliance Standard
- ✓ NAS 3306 Released
- ✓ NAS 413 Released
- ✓ AAQG/ AS9018 – OASIS Standard Released
- ✓ AIA/JSQC presentation to CQSDI
- ✓ AIA meeting with LTG Bassett – JSQC support
- ✓ NAS 412 Revision (R3)
- ✓ DCMA Inst. 8210.1 Rev. D
- ✓ DCMA Man. 2303-01 Revision
- ✓ NAS 413 Revision (R1)

CY	3-4Q 2015	2016	2017	2018	2019	2020	2021	2022	2023	2024

All parties have been collaborating for over a decade

Source: JSQC/Mras

Contracting Quality Early/Handbook

Project Objective:

Ensuring quality early in a program results in fewer defects, less schedule risk, and ultimately lower total cost of execution. Establish and publish industry best practice. Obtain DoD/NASA concurrence to implement on future programs.

Lead
Brian Tenney, Lockheed Martin

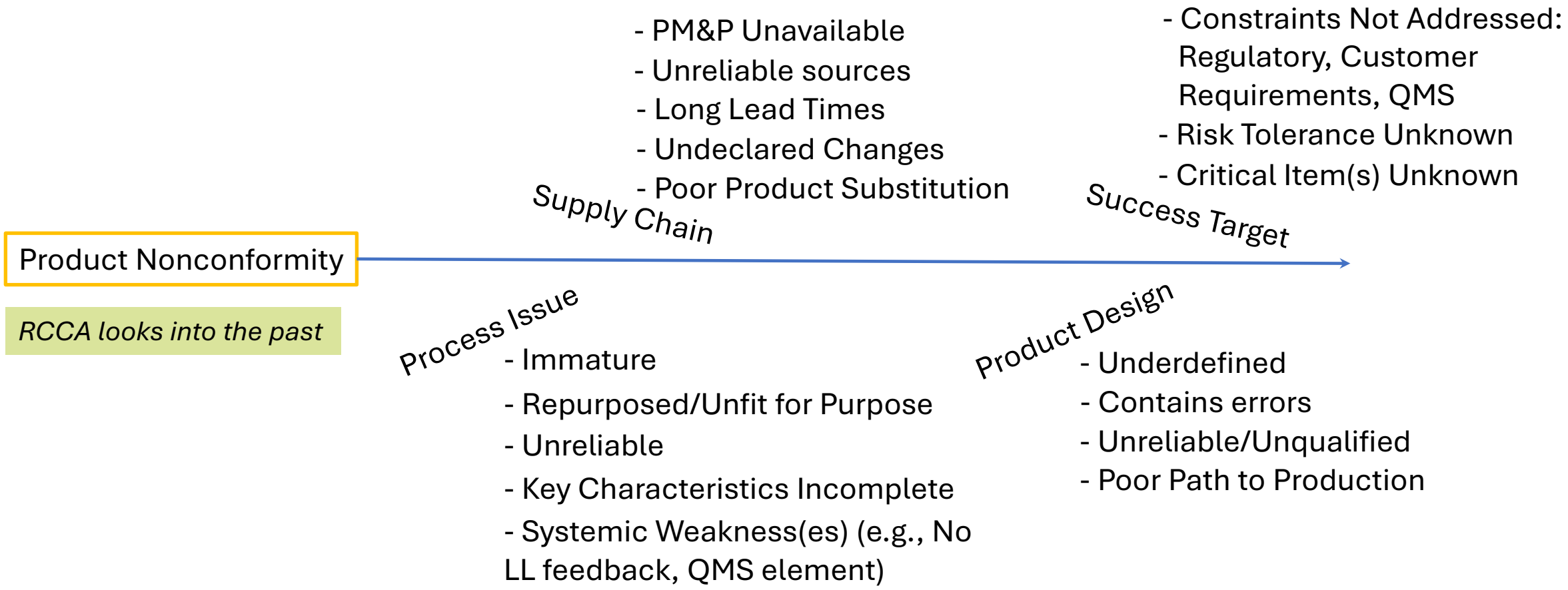
Team Members:
Government
- Craig Bennett, DCMA
- Jeannette Plante NASA
- Antonio Petito DoD
- Albert Ismailov DoD
- David Karr AFMC

Industry
- Lockheed Martin (Jose Lafon/ Heather Rennerfeldt/ Barry Benczowski)
- RTX (Don Desfosse)
- Rolls Royce (Kyle Hummel)

Project Goals and Deliverables

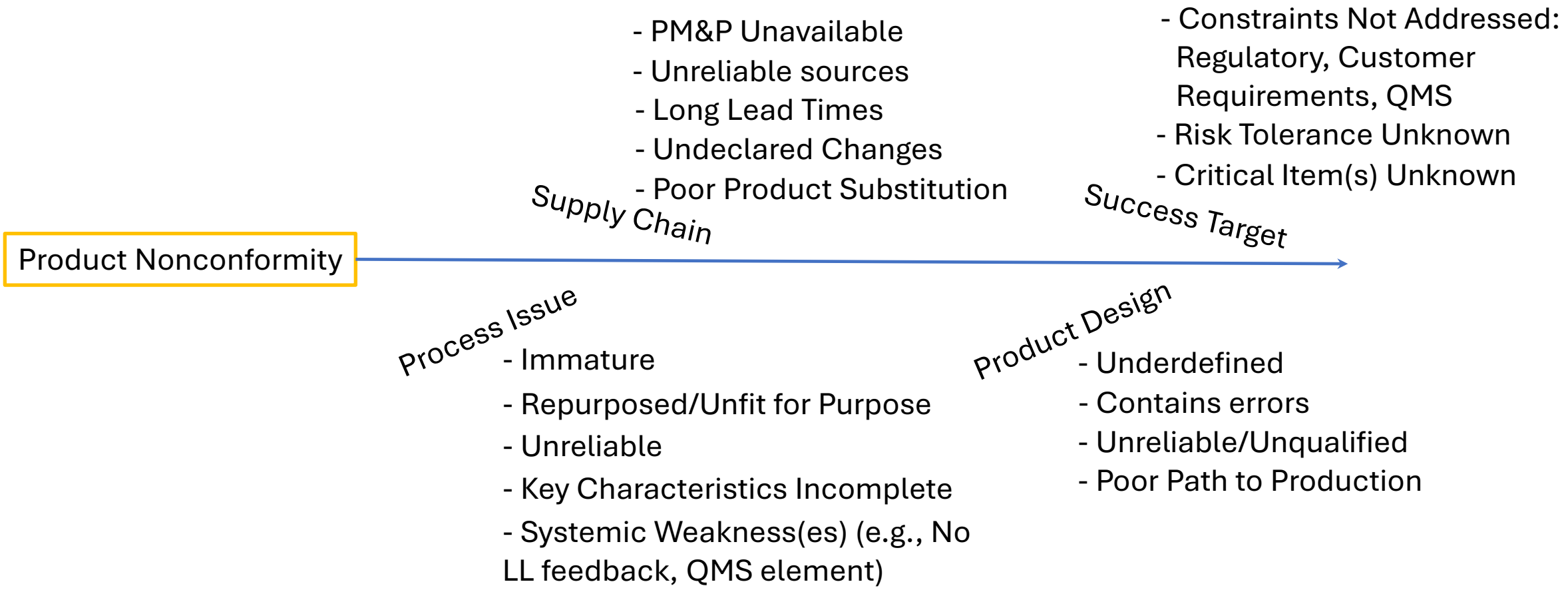
- White paper: Benefits/CDRL
- DoD/NASA adoption of guidance
- Standard incorporated in a contract

- *Late-cycle QA finds and **reacts** to nonconformities. Late-cycle problems are **more costly** to resolve.*
- *Reactive remedies risk latent defect escapes that affect Safety.*
- *Why do we do it? The FAR biases Government QA towards late-cycle QA.*
- *Great for COs but less effective for Cost, Schedule, and Regulatory targets*



- *RCCA costs and delays are perceived as a Quality problem regardless of the root cause.*
- *RCCAs often stop at proximate cause and don't perceive early lifecycle activities.*

- Root Cause can be created very early in the lifecycle. “If QA had only been involved early in the development….”
- What does that really mean? What work is that?
- **AS9145, *Requirements for Advanced Product Quality Planning and Production Part Approval Process, first published in 2016***



- Perception is new/more requirements = more cost
- New paradigms not easily embraced in AS&D contracting

APQP/PPAP Elements
Plans: Project Management, Supply Chain Management, Production (PPAP)
APQP Applicability and Scope, Performance Targets *
Requirement Constraints: Customer, Regulatory, QMS
Process Flow Diagram, BOM
Analyses: Feasibility, Capability, Capacity, PFMEA, Tolerance, Measurement Systems (MSA), Resources
Specifications & Documentation: Design, Requirements, Packaging & Labeling,
Control Plan: Critical Items*, Key Characteristics*, Flow Diagram, MSA, Packaging, Resources
Design Verification and Validation*
Risk Identification and Elevation*
First Article Inspection Report (FAIR)
First-party QA, Response to NCs
Reviews and Milestones, Deliverables and Approvals

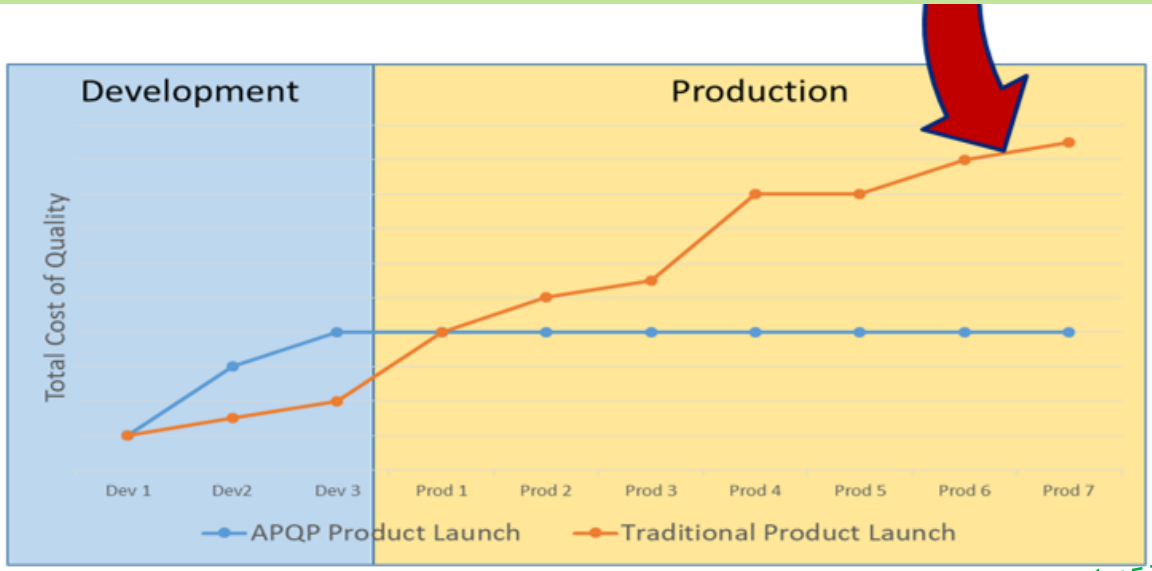
* Attuned to safety as a performance target

Product Production Approval Process (PPAP) record is a collection of documentation, specifications, and analyses that provides evidence of the suitability and control of a production process for a given design, set of requirement constraints, and set of Target criteria (e.g., FFF, cost, schedule, risk tolerance).

The above elements correlate to the existing AS9100 model and are not new or emerging techniques.

Cost of quality assurance function vs Cost of poor quality:

- *Expect highly complex system developments to have unplanned quality costs due to weak early lifecycle Quality involvement, especially for new, low-volume builds where Qualification replaces First Article Inspection.*
- *Cost of poor quality is not a budget line item, difficult to show "savings" when using AS9145.*
- *Growth in adoption of AS9145 by industry indicates the late vs early QA swap has a net cost advantage.*



Cost of poor quality

Nonconforming parts =
- Loss of sale of the part (-$)
- Reworking a part causes loss of time to make another part (-$)
- Customer experienced defects reduce confidence and satisfaction
- Directly affects the bottom line

Engineering effort=
- Redesign (industry average- $14,700 per change)
- Re-qualifications
- Escape investigations

Cost of quality assurance function vs Cost of poor quality

Resulting in lower cost of quality:

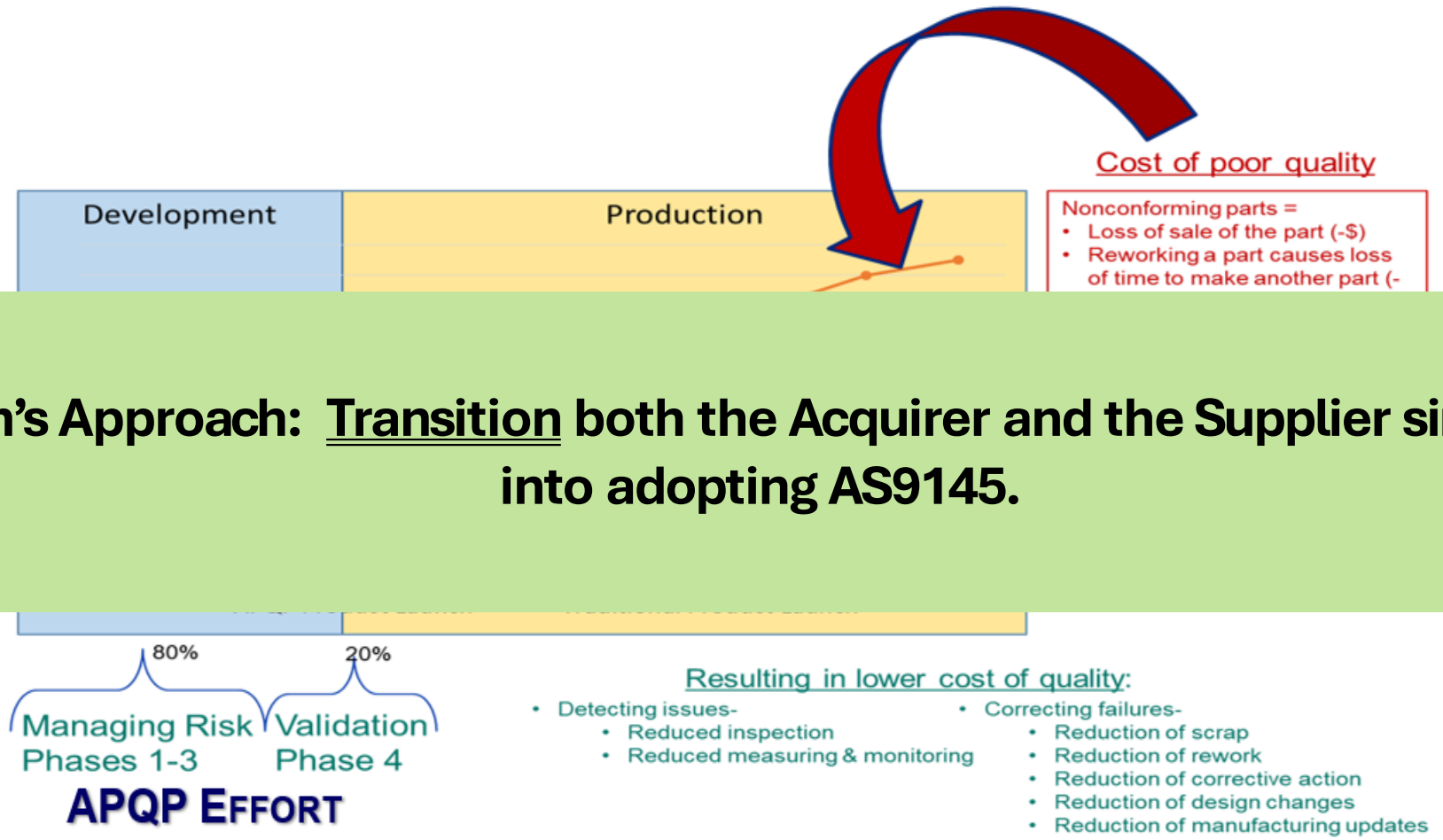
- Detecting issues-
  - Reduced inspection
  - Reduced measuring & monitoring
- Correcting failures-
  - Reduction of scrap
  - Reduction of rework
  - Reduction of corrective action
  - Reduction of design changes
  - Reduction of manufacturing updates

Trends in late-cycle QA cost reduction:
- *Risk-based surveillance*
- *Supplier-managed MRBs*
- *Delegated 2nd Party QA*

Upfront planning and risk avoidance yields significant downstream savings

APQP tools can be used in collaboration with traditional RCCA/BPSM efforts to identify & prioritize issues and confirm process capability.

Source: Boeing/Kohring

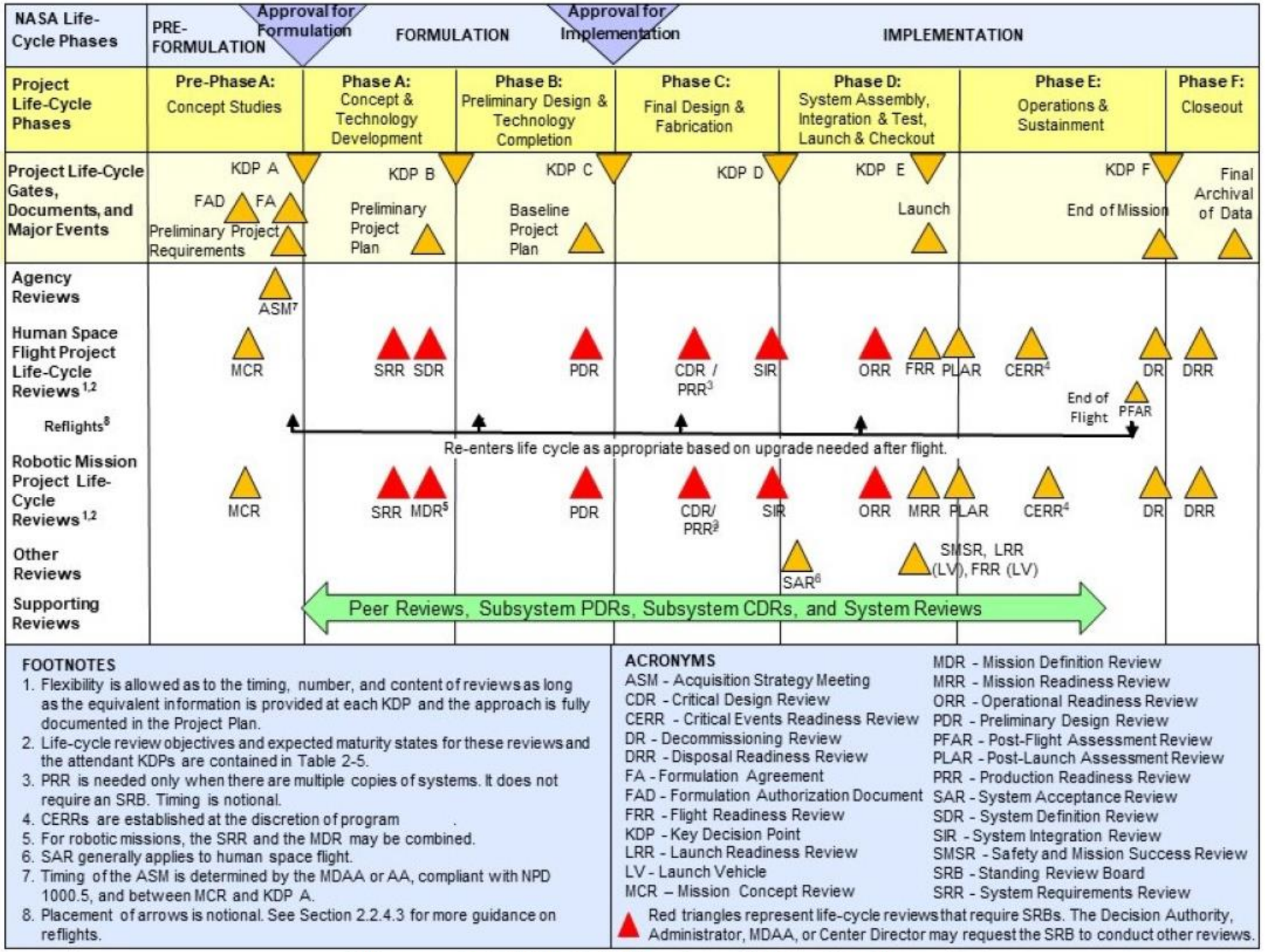


JSQC Team's Approach: Transition both the Acquirer and the Supplier simultaneously into adopting AS9145.

Upfront planning and risk avoidance yields significant downstream savings

APQP tools can be used in collaboration with traditional RCCA/BPSM efforts to identify & prioritize issues and confirm process capability.

- Compel Programs to report AS9145 results during Dev phases.
- Programs use DRDs to pull data in from supply chain.



FOOTNOTES

1. Flexibility is allowed as to the timing, number, and content of reviews as long as the equivalent information is provided at each KDP and the approach is fully documented in the Project Plan.
2. Life-cycle review objectives and expected maturity states for these reviews and the attendant KDPs are contained in Table 2-5.
3. PRR is needed only when there are multiple copies of systems. It does not require an SRB. Timing is notional.
4. CERRs are established at the discretion of program
5. For robotic missions, the SRR and the MDR may be combined.
6. SAR generally applies to human space flight.
7. Timing of the ASM is determined by the MDAA or AA, compliant with NPD 1000.5, and between MCR and KDP A.
8. Placement of arrows is notional. See Section 2.2.4.3 for more guidance on reflights.

ACRONYMS

ASM - Acquisition Strategy Meeting
CDR - Critical Design Review
CERR - Critical Events Readiness Review
DR - Decommissioning Review
DRR - Disposal Readiness Review
FA - Formulation Agreement
FAD - Formulation Authorization Document
FRR - Flight Readiness Review
KDP - Key Decision Point
LRR - Launch Readiness Review
LV - Launch Vehicle
MCR – Mission Concept Review
MDR - Mission Definition Review
MRR - Mission Readiness Review
ORR - Operational Readiness Review
PDR - Preliminary Design Review
PFAR - Post-Flight Assessment Review
PLAR - Post-Launch Assessment Review
PRR - Production Readiness Review
SAR - System Acceptance Review
SDR - System Definition Review
SIR - System Integration Review
SMSR - Safety and Mission Success Review
SRB - Standing Review Board
SRR - System Requirements Review

▲ Red triangles represent life-cycle reviews that require SRBs. The Decision Authority, Administrator, MDAA, or Center Director may request the SRB to conduct other reviews.

Figure 2-5 NASA Project Life Cycle

Deliverable Requirement Descriptions (DRDs) are directive and prescriptive means for acquiring data.

AS9145 DRDs introduce acquirers and suppliers to better planning techniques.

Phase-in approach: full conformity to AS9145 will not be required (though can distinguish a more mature supplier!)

AS9145 DRD Starter Pack

No.	Title	Relevant Requirements in AS9145
1	Industrial Base and Supply Chain Risk Inventory	4.1.5
2	Manufacturability Risk Inventory	4.3.2.2, 4.4.6, 4.5.4 (PFMEA)
3	Engineering/Design Adequacy	4.4.4.1(DFMEA), 4.4.3 (Design V&V Plan)
4	Design-to-Manufacturing Plan	4.5.5(Process KC identification), 4.6.3(MSA)
5	Statistical Process Control	4.6.5 (SPC)

DRD Content Example

2: Manufacturability Risk Inventory

The contractor shall submit **evidence of a manufacturing risk assessment** in the form of a documented Manufacturing Risk Assessment. The assessment shall include an assessment for each assembly or raw material; COTS parts do no need to be assessed. **Each part that is identified as high risk (e.g., immature verification and validation methods for raw or processed materials, unknown reliability for novel constructions, immature or lack of verification methods or metrology, immature or low availability of capital equipment or fixturing, or a new assembly that is more than 50% different from something already produced) must have risk assessment**. Include parts where production capacity cannot be verified to meet requirements. The sourcing risk assessment shall include likelihood and consequence severity ratings (e.g. 1 to 5), and a summary of planned risk mitigations for each risk. Industrial base risks that are of particular relevance should be considered for inclusion. The assessment shall identify the methods used for internally identifying / eliciting risks, the associated criteria for assessment, and any requirements detailing when risks require associated handling / mitigation actions. The supplier shall **present the Manufacturing Risk Assessment at each Milestone Review**. Products deemed high risk must have an associated risk analysis/assessment (e.g. PFMEA).

The manufacturing risk baseline shall be **updated and reported at quarterly technical reviews and at each major program review as long as high-risk items remain**. In addition, the supplier shall provide detailed status to the customer of any mitigation steps that are not meeting plan. The supplier shall flow down this manufacturing risk management requirement to their sub-tier suppliers who are producing raw materials or assemblies.

Reference:

Department of Defense Manufacturing and Quality Body Of Knowledge **-** Section L.1 Manufacturing Management Requirements
Department of Defense Early Manufacturing and Quality Engineering Guide – Section 1.2 Early Manufacturing Overview
Department of Defense Early Manufacturing and Quality Engineering Guide – Section 3.7 Manufacturing Feasibility Assessments
Department of Defense Producibility and Manufacturability Engineering Guide – Section 6.1.1 Manufacturing Feasibility Assessments
AESQ RM13145 APQP and PPAP within Aerospace – Section 5.10 Assess Feasibility

Deliverable	Milestone Review Presentation
Specification	Contractor format
Date of First Submittal	At Systems Requirements Review
Date of Subsequent Submittal	At each Milestone Review

Does not bias RFPs only to current industry users of AS9145

Acquirers will have to blend this content into their preferred format.

JSQC is exploring how DoD and NASA Handbooks can push this content to RFP teams.

Take Aways

- Poor early lifecycle QA is a likely risk to late-cycle cost and schedule stability for low volume, highly complex hardware developments.
- AS9145 organizes early lifecycle best QA practices into a standard approach and is attuned to safety performance targets.
- Chicken or the egg? Acquirers and suppliers will have difficulty introducing AS9145 into an RFP/Proposal if both “sides” aren’t positioned to do so simultaneously.
- A small group of DRDs can be used to phase in a more common usage of early lifecycle QA.
- DoD handbooks are promoting AS9145 techniques and can be used for increasing knowledge about how and when to use them.
- JSCQ Task Group is pursuing opportunities for inserting the recommended DRD language into RFP tools used by the DoD and NASA.