A Year in OSMA Quality Policy

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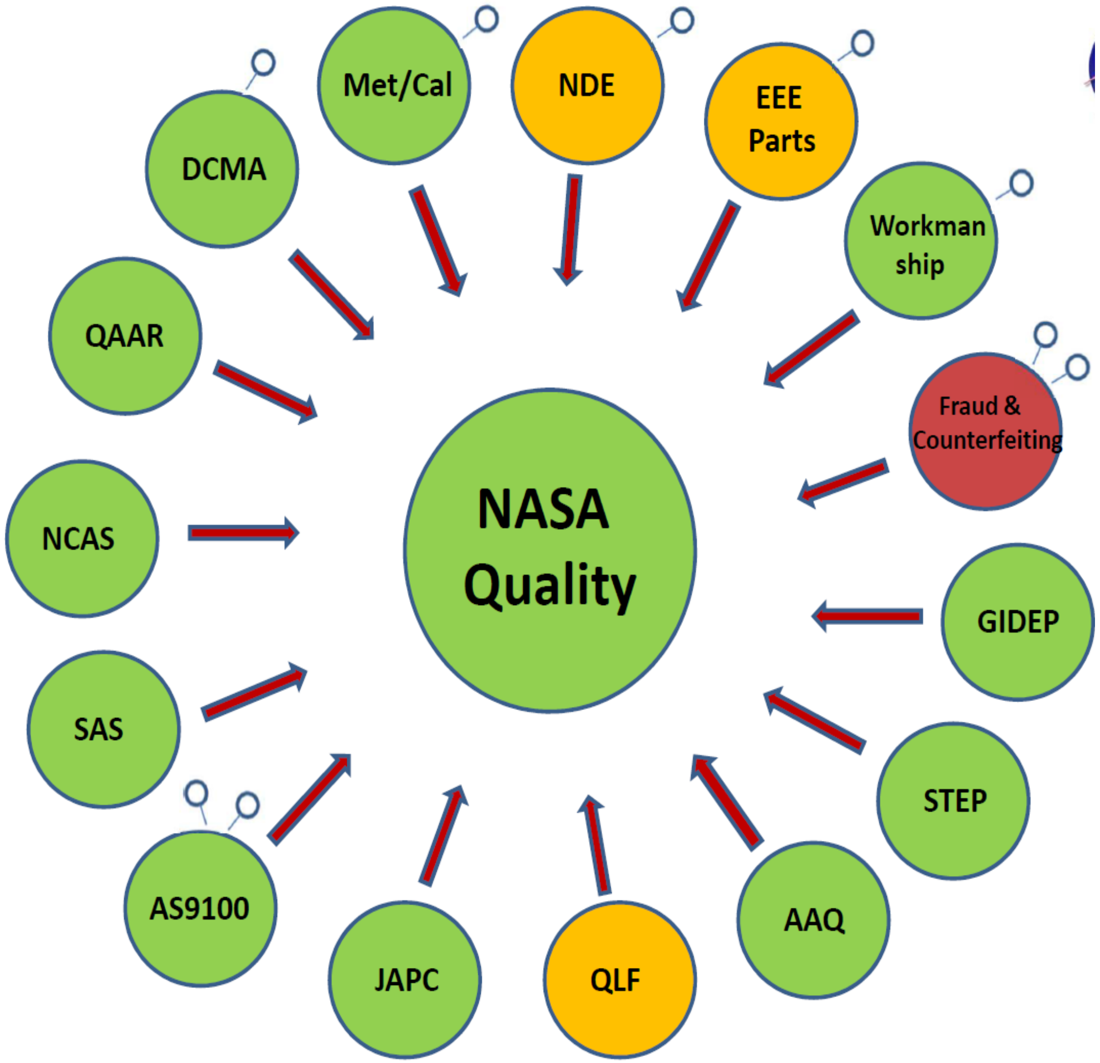
Standards and Requirements Division
Office of Safety and Mission Assurance
NASA Headquarters



NASA QA Model derived from existing policies, tools and external relationships

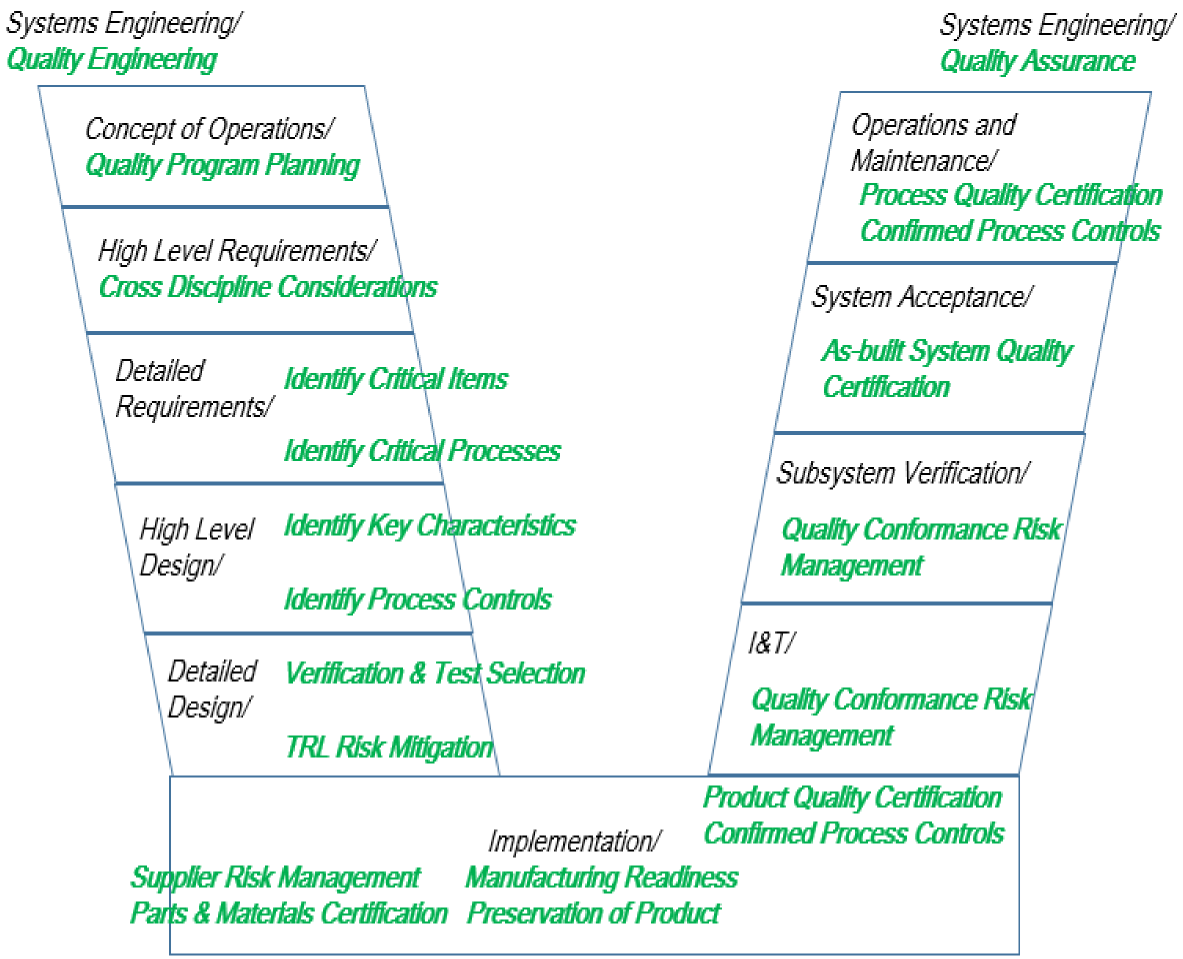
Need for strengthening a Program/Project lifecycle focus to facilitate:

- Responsibility for executing QE/QA *by* PMs through understanding requirements
- Prog/Proj QA planning: getting in early
- Prog/Proj Risk management

Opportunity:

- SARD initiated roll-out of intention to consolidate NPDs and NPRs; convert some NPRs to STDs.
- Interest growing in model-based engineering

SARD: Safety and Assurance Requirements Division



Prog/Proj lifecycle based on systems engineering "V" model.
QA processes can be referenced to this model.
AS9100 language and structure cover QA processes relevant to Prog/Projs

AS9100 [Simple] Model

1	Plan	Quality Assurance Surveillance Planning
2	Analysis	Cross-Discipline Design Considerations
3	Analysis	Critical Items, Critical Processes
4	Analysis	Key Characteristics
5	Analysis	Process Controls
6	Analysis	Verifications & Tests
7	Analysis	Supplier Risk Management
8	Manufacturing Readiness	Traceability & Configuration Control
9	Manufacturing Readiness	Documentation & Records Control
10	Manufacturing Readiness	Process Change Control
11	Manufacturing Readiness	Special Process Qualification
12	Manufacturing Readiness	Metrology and Calibration
13	Manufacturing Readiness	Personnel Competency & Training
14	Supply Chain Management	CI/CP Assurance Flow-down
15	Production	Incoming Part and Material Certification
16	Production	Preservation of Product
17	Production	Verification of Process Controls Realized
18	Production	Product Quality Inspection
19	Risk Management	Risk Management Processes
20	Production	As-built Hardware Certification
21	Risk Management	Self Audit, 2nd and 3rd Party Audits

Program Cross-reference to QA Model
All Delegated Programs and Tasks

Plan	Quality Assurance Strategy & Planning		SAS	DCMA	Workmanship	MBMA	AS9100
Analysis	Cross-Discipline Design Considerations	NDE	AM		Workmanship		
Analysis	Critical Items, Critical Processes	NDE	AM	DCMA	Workmanship	Mech Sys QA	
Analysis	Key Characteristics	NDE	AM		Workmanship	Mech Sys QA	
Analysis	Process Controls		AM	DCMA	Workmanship	Mech Sys QA	
Analysis	Verifications & Tests	NDE	AM	DCMA	Workmanship		
Analysis	Supplier Risk Management	AM	SAS	DCMA	JAPC	Fraud & Counterfeit	AS9100
Manufacturing Readiness	Traceability & Configuration Control						
Manufacturing Readiness	Documentation & Records Control		SAS	DCMA			
Manufacturing Readiness	Process Change Control						
Manufacturing Readiness	Special Process Qualification	NDE			Workmanship		
Manufacturing Readiness	Metrology and Calibration	NDE	MetCal				
Manufacturing Readiness	Personnel Competency & Training		QLF	DCMA	Workmanship	Fraud & Counterfeit	AAQ
Production	Incoming Part and Material Certification	NDE			Mech Sys QA	Fraud & Counterfeit	
Production	Preservation of Product				Workmanship		
Production	Verification of Process Controls Realized			DCMA			
Production	Product Quality Inspection	NDE		DCMA	Workmanship		
Risk Management	Risk Management Processes	NDE				MBMA	
Production	As-built Hardware Certification			DCMA			
Risk Management	Self Audit, 2nd and 3rd Party Audits	JAPC	QAAR				

Simplified AS9100 Model

Plan	Quality Assurance Surveillance Planning
Analysis	Cross-Discipline Design Considerations
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Production	As-built Hardware Certification
Risk Management	Self Audit, 2nd and 3rd Party Audits

Future

1.1. Purpose	For consistent implementation of 8730.5 for NPR 7120.5-managed missions in the interests of mission success
1.2 Applicability	NPR 71.20.5 Missions
2. Applicable Documents	
3. Acronyms and Definitions	
4.1 Document Precedence	
4.2 Tailoring [of the requirements herein]	
5. QMS for work at NASA Centers	
6.1 QE/QA Planning	Resources, Personnel, Risk strategy, Supplier strategy
6.2 Design Considerations & Review	Critical Items Identified
	Key attributes defined
	Verifications defined
	Implementations Plans
	Criteria for Product Acceptance defined
	Design Risk mitigation
6.3 Production Readiness	Material and Item ID, Traceability and Configuration Control
	Documentation and Documentation Control
	Special Process Qualification
	MetCal
	Preservation of Product
6.4 Production: Hardware Manufacturing	1st Party Inspection and Verification
	Parts and Materials Quality Certification
	2nd Party In-Process Verification of Quality Conformance
	Product Acceptance
6.5 I&T	
6.6 Launch and Mission Ops	
7 External Supplier Quality Management	Requirements flow down
	QMS
	Supplier Audits and Assessments
	GIDEP and NASA Advisory screening
	Product Acceptance
8 Risk Management	Manufacturability of nonstandard designs
	Managing Quality Nonconformances
	Program/Project's QA program stability
	Supplier process changes
9 Key Decision Point Deliverables	MCR/KDP A; SRR/MDR/SDR/KDP B; PDR/CDR; KDP C; SIR/KDP D; LRR/KDP E
10 Required Technical Standards	
11 Government Contract Administration	FAR guidance, inputs required for executing QA surveillance, etc.
12 Protocols for Working with DCMA	LODs, Budgets, Changes
Appendix A Counterfeit Control Plan Guidance	
Appendix B Contract/SOW scope considerations for critical items	
Appendix C Data deliverables considerations	

Simplified AS9100 Model

Future

AS9100 / Lifecycle model used as basis for QA policy rewrite and consolidation

Lifecycle review deliverables used to proactively drive use of high-value quality engineering and assurance practices

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How to create achievable requirements that are addressed in the institutional domain? (Do they belong in same doc?)

- AS9100 QMS
- Data management (collection, sharing, trending)
- Supply chain management

KDP Success Criteria and Deliverables

	SMS Criteria	Product>	A	B	C	D	E	F	G	H	I	J	K	L	M	R	N	O	P	Q
MCR/KDP A	Roll Up		●	●	●	●	●	●	●			●		●	●	●		●	●	
	1. Mission Objectives defined and clear	n/a																		
	2. Mission concept meets stakeholders' objectives	n/a																		
	3. Technically feasible, rough cost estimate		x	x		x	x	x	x			x		x	x					
	4. Candidate systems analysis	n/a																		
	5. Need for mission defined	n/a																		
	6. Cost & schedule credible						x													
	7. Comply w/applicable Center Reqmts			x	x													x	x	
	8. TBD, TBR items	n/a																		
	9. Alternate techical solutions							x												
	10. Technical planning				x						x							x	x	
	11. Software	n/a																		
	12. Spectrum management	n/a																		
SRR/MDR/SDR/ KDP B	Roll Up		●	●	●	●	●	●	●		●							●	●	●
	1. Function and performance requirements trace up to mission objectives	n/a																		
	2. Requirements & plans sufficient for entering phase B		x	x	x	x														
	3. Requirements allocation process assigns requirements to lower levels				x	x		x	x		x									
	4. Interfaces with internal and external entities identified							x	x											
	5. Preliminary V&V approach		x		x			x												
	6. Major risks identified and being addressed			x														x	x	
	7. Comply w/applicable Center Reqmts				x															
	8. TBD, TBR items	n/a																		
	11. Software	n/a																		
	12. Spectrum management	n/a																		

A	QA Plan, compliance matrix
B	Waiver status
C	SMAP
D	CIL approach, CIL
E	Budget & Schedule
F	Tech dev & Manufacturability planning
G	Supply Chain Map
H	Design & QE Products
I	Procurement/GCQA/Acceptance
J	Supplier Assessments
K	Production Readiness
L	CM
M	Data & Records Management
R	Tech Dev & Manufacturability Risks
N	Quality Results: NCs and Certification
O	Supplier Risks
P	Quality Risks
Q	Self Audit

SRR Success Criterion 3: The project utilizes a sound process for the allocation and control of requirements throughout all levels, and a plan has been defined to complete the requirements definition at lower levels within schedule constraints.

SMS Success Criteria (For SMA TA concurrence)	Evaluation Points (For developing the technical basis for concurrence)	Evaluation Points related to Quality Engineering and Assurance
The project utilizes a sound process for the allocation of SMS-related requirements throughout all levels.	● Technology development plan for identifying all **nonstandard key attributes** is complete.	**F. Technology Development and Manufacturability plan**
	● Allocation of SMS-related requirements is validated via test or analysis as ensuring satisfaction of parent SMS-related requirements, throughout all levels of system decomposition.	
The project utilizes a sound process for the control of SMS-related requirements throughout all levels.	● There is a single, authoritative, **configuration-controlled repository** for all SMS-related requirements.	
	● Requirement parent/child relationships are explicit and configuration-controlled.	**L. CM plan execution**
	● Changes to SMS-related requirements are made through a formal configuration-controlled process that ensures proper adherence to, and allocation of, system-level SMS requirements.	
A plan has been defined to complete the SMS-related requirements definition at lower levels within schedule constraints.	● The plan indicates that SMS-related requirements at lower levels will be defined in-tandem with systems engineering analyses and decision-making.	
	● The plan indicates that SMS-related requirements at lower levels will be baselined within system development schedule constraints.	
	● There are sufficient staff and resources to complete SMS-related requirements definition at lower levels within schedule constraints.	
	• **Flow down of quality requirements** is successful both for in-house production and for external suppliers at all tier levels	**C. SMAP** **D. CIL approach** **I. Procurement and GCQA plan**
	• Strategy determined for execution and **administration of contracts** and associated FAR and NFS quality clauses	**I. Procurement and GCQA plan**

NPR 8705.4, Risk Classification for NASA Payloads

Lead: Tony Diventi, OSMA Reliability and Maintainability Technical Fellow

Team: Agency-wide

Tasks: Refreshing document to clarify how it is to be used, to classify risk level and to respond to risk classification with SMA strategy and requirements tailoring

- PM/SE community want more specificity to understand cost implications: QA compliance matrix
- "Critical Item/Process" must be distinguishable from "Non-critical" for Class C and Class D
- This model continues to assume all hardware is custom-designed, custom-manufactured
- Desire to include cubesats though they are normally majority standard components (not "custom")
- For systems that cannot be repaired and the mission repeated; not for DNH or R&D

	CLASS A	CLASS B	CLASS C	CLASS D
Quality Assurance NPD 8730.5 NPR 8735.2 (NPR 8735.1)	Formal quality assurance program including closed-loop problem reporting and corrective action, configuration management, performance trending, and stringent surveillance. GIDEP failure experience data and NASA Advisory process.	Formal quality assurance program including closed-loop problem reporting and corrective action, configuration management, performance trending, moderate surveillance. GIDEP failure experience data and NASA Advisory process.	Formal quality assurance program including closed-loop problem reporting and corrective action, configuration management, tailored surveillance. GIDEP failure experience data and NASA Advisory process.	Closed-loop problem reporting and corrective action, configuration management, GIDEP failure experience data and NASA Advisory process. Other requirements based on applicable safety standards.

QA Requirements for Airworthiness

Lead: QETF

Team: Steven Foster, Alan Wallace, Julie Bond, AFRC

Tasks:

- How does airworthiness relate to OSMA QA policy?
- How to capture this as a NASA baseline (NPR, STD)?

NASA
National Aeronautics and Space Administration

Office of Inspector General
Office of Audits

NASA's Parts Quality Control Process

March 29, 2017

Report No. IG-17-016

Recommendations:

1: Expand current NASA data sharing structure to integrate supplier databases with parts databases.

4: Collaborate with Office of the Chief Engineer (OCE) to identify parts history information of common interest and modify Electronic Parts Applications Reporting and Tracking System (EPARTS) data structure to accommodate that information and to link to supplier information databases.

5: Examine the feasibility of further expanding NASA's parts and supplier data collection efforts to include contractor maintained data regarding parts and suppliers utilized in NASA contracts.

6: Evaluate current part and supplier database system architectures to determine the cost and benefits of establishing an Agency-wide database system as opposed to maintaining current decentralized database systems.

2: Investigate causes of gaps in Supplier Assessment Systems (SAS) reporting and formulate remedial actions to ensure compliance with SAS reporting requirements.

3: Identify supplier performance information of common interest and modify Supplier Assessment System (SAS) data structure to accommodate such information.

8: Review a representative sample of Prog/Proj QA surveillance plans to identify deficiencies and best practices and revise policy to include quantification and documentation of nonconformance and control risks for ensuring surveillance activities and resources are commensurate with part criticality and overall accepted project risk.

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Tra… nd to link to
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5: … ta collection
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6: … rmine the
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maintaining current decentralized database systems.

Sharing information about supplier/product risks ***before*** they become crosscutting.

Digital Transformation

- Access to systems separated by firewalls and ownership boundaries
- Correlating related data/content
- Analysis of data/content that provides information
- Continuously absorbing new sources of data/content

2: Investigate causes of gaps in Supplier Assessment Systems (SAS) reporting and formulate remedial actions to ensure compliance with SAS reporting requir…

3: Identify supplier performance info… S) data structure to accommodate such information.

Who uses SAS data and how?

8: …
p… s
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Surveillance Plans

- Design and use of Surveillance Plans is not standard.
- Surveillance Plans evolve over the lifecycle, as subcontractors become identified
- Everything treated as critical though this prevents tailoring based on risk

Digital Transformation (DT) Initiative

Lead: NASA Chief Technologist

Champion: Agency Program Management Council (APMC)

Team: NASA Programs, HQ Orgs, Centers

Tasks: DT Vision, External Inventory, Internal Inventory, Case Studies, Gap Analysis, Recommendations.

Timeline: May 2018 – April 2019

QA Metrics Project

Lead: OSMA QETF

Team: Will Walker, JSC Engineering; Pete Checklick, KSC SMA

Tasks: Research reporting and sources of prog/proj QA data; Design common data structure; Pilot DT experiment with NCR repositories

Timeline: November 2018 – September 2019

Common Data Record Structure for EEE Parts

Lead: NASA EEE Parts Manager, Jonny Pellish

Team: Aerospace Corp., G-11

Tasks: Coordinate common data structure to facilitate data sharing for risk management

Model Based Mission Assurance

Leads: John Evans and Tony Diventi, OSMA; Steve Cornford, JPL; Richard Stutts, MSFC

Team: Cross Agency

Tasks: MBMA use cases for SMA disciplines, 2nd NASA Workshop

Timeline: 2017 –>

To be presented by Sean Beckman

SAS and JAPC Development

Lead: OSMA QETF

Team: Cheryl Corbin, JSC QA; Tony Guttierez, JPL QA

Tasks:

- Who is using SAS data and for what?
- Downloading Nadcap manufacturer certification lists into SAS
- Are JAPC assessments reducing audits?

Analysis	**Cross-Discipline Design Considerations**
Analysis	**Critical Items, Critical Processes**
Analysis	**Key Characteristics**
Analysis	**Process Controls**
Analysis	**Verifications & Tests**
Analysis	**Supplier Risk Management**

Criticality and Surveillance Plans

Lead: OSMA QETF

Team: DCMA; Valle Kauniste, JSC SMA; Julie Bond, AFRC SMA; QAWG

Tasks:

- Research:
  - No clear standard approach
  - DCMA LOD form often used as baseline
  - Some approaches start with a 100% list and subtract over time with risk-management activities
  - “Critical”, “Complex”, “Noncritical”, “Non-complex” too ambiguous to apply (see NF 1707, NPD 8730.5)
- Provide more guidance via DCMA Letter of Delegation (LOD) form (NF 1430B) and NPR 8735.2
- Redesign or remove use of critical and complex language
- Refresh NF1430 and NF1707
- DCMA-NASA Charter

Refreshing NASA's and DCMA's Processes for QA Portion of Contract Administration

Valle Kauniste, JSC SMA, NASA Liaison to DCMA on behalf of OSMA

- Roles and responsibilities of key parties
- Initial Letter Of Delegation (LOD) technical content development; Prep and Issuance Process (i/a/FAR 42, NFS 1842)
- Changes to LODs within a fiscal year
- LOD Execution
- Closing an LOD Appendix B (1430B)
- Budget process
- Required training

Outcome

- Charter to record NASA-DCMA agreements about how processes are to work
- "Shall" statements in NASA and DCMA policies that create commitment to content in the charter

Drivers

Common and robust understanding of current processes

R&Rs of different leaders within DCMA and NASA

Flexibility and constraints when establishing LOD requirements

Technical and financial intention when defining requirements

→ Incomplete or evolving surveillance plans

→ QA data returned to NASA

Forecasting management issues

OSMA oversight of execution, problem resolution

Quality Engineering Applied to Developing Technical Standards

Analysis	**Cross-Discipline Design Considerations**
Analysis	**Critical Items, Critical Processes**
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Analysis	**Verifications & Tests**
Analysis	**Supplier Risk Management**

NDE/AM

Lead: Eric Burke, LaRC

Team: Agency-wide

Tasks:

- Wide range of foundational developments in-process for AM
- Excellent NSC Webinar, December 11, 2018: nsc.nasa.gov > Resources > Video Library > Scroll down
- NASA representation for AM at Nadcap

Workmanship

Lead: Alvin Boutte, GSFC

Team: Agency-wide

Tasks: To Be Presented

Analysis	**Cross-Discipline Design Considerations**
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Analysis	**Verifications & Tests**
Analysis	**Supplier Risk Management**

Mechanical Systems Quality Assurance

Lead: Mike Viens, GSFC

Team: Dave Beverly, JSC; Wayne Gamwell, MSFC; Andrew Glendening, GSFC; Alejandra Perez, GSFC

Tasks:

- Articulate minimum key quality attributes of products and processes for mechanical part and interconnect manufacturing
- Articulate the minimum inspections and tests required to verify mechanical part or interconnect quality
- Articulate prohibited or required design conditions (materials, geometry, configurations)
- Integrate technical standards used by NASA in requirements language

- Coordinate and publish NASA-STD-6008A, NASA FASTENER PROCUREMENT, RECEIVING INSPECTION, AND STORAGE PRACTICES FOR SPACEFLIGHT HARDWARE

Manufacturing Readiness	Traceability & Configuration Control
Manufacturing Readiness	Documentation & Records Control
Manufacturing Readiness	Process Change Control
Manufacturing Readiness	Special Process Qualification
Manufacturing Readiness	Metrology and Calibration
Manufacturing Readiness	Personnel Competency & Training

Metrology and Calibration

Lead: Ken Matthews, KSC

Team: Agency wide

Tasks: Increasing excellence within NASA-operated MetCal labs

- Proficiency testing: torque, thermocouple calibrator, RF coax attenuator, platinum resistance thermometer (PRT)
- Training courses into STEP
- On-site technical support and training

Academy of Aerospace Quality

Lead: Mike Kelly, NSC; Alice Smith, Jeff Smith, Auburn University

Team: Agency wide and Academic volunteers

Tasks: Open source introductory training for quality for space systems

- Re-evaluating and realigning content to a cubesat or university student team audience (not traditional space project teams)
- Offering "curricula" collections of courses that provide a focus: management, technical

Quality Leadership Forum

Final thoughts…..

Lifecycle models make QE/QA discipline more accessible to those outside of SMA.

Need to create strong relationships and understanding with program managers and systems engineers while maintaining discipline leadership (“independence”).

If we want to build in quality, we need to show what the early work looks like, its cost, and its products

We need to provide a way to review progress all along the lifecycle:

- not just at SMSR (just before launch)
- not depending solely on daily SMA TA awareness and dissenting opinion

We will continue to face “we’ve always done it that way” until we are able to use data for feedback and analysis. Need analysis automation:

- QA strategic plan trades
- Supplier risk
- Cumulative risk from tailoring, waivers, NCs