JOINT ADVANCED MATERIALS & STRUCTURES CENTER OF EXCELLENCE

Guidelines for Formulating and Writing Process Control Documents and Process Specifications for Advanced Materials

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NIAR Wichita State University
National Institute for Aviation Research

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- Motivation and Key Issues
  - Aircraft manufacturers and airlines are investigating methods to reduce manufacturing costs and increase operational efficiency by using a variety of advanced materials.
  - Major OEMs beginning to incorporate new processes for part manufacturing into existing products and future products.
  - Need for a general standardization of what should be expected in a PCD and Process Specification.
  - Give guidance to new OEMs and existing ones seeking certification programs with advanced materials.
  - Establishing and proving material process control is a critical component in certification of advanced materials.
  - Give regulatory agencies (FAA, EASA, etc.) a template to allow for easier review across the aviation industry.

To meet the demand of future aircraft travel, the commercial fleet will need to increase 7% over the next 20 years.

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A Center of Excellence AMTAS Advanced Materials in Transport Aircraft Structures

Overall Program Information

- **Technical Monitor**: Ahmet Oztekin
- **FAA Sponsor**: Cindy Ashforth

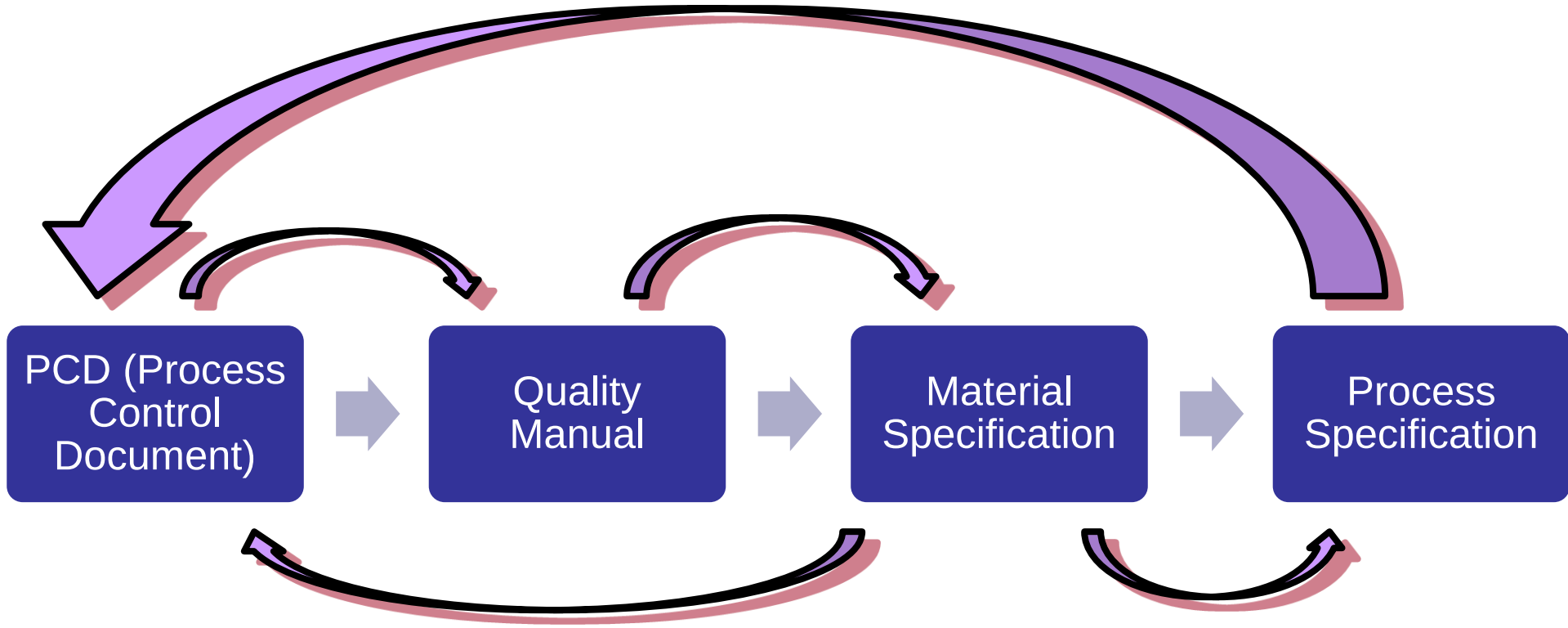
- **NIAR Contacts**: John Tomblin, Royal Lovingfoss, Rachael Andrulonis

- **Industry Partners**: Toray (Tencate), Solvay, Spirit, Fiber Dynamics, Boeing, Stratasys, Axiom, GE, Teijin (Toho Tenax), Rolls Royce, and Meggitt

- **Overall Goal**
  - Primary goal: To develop a process specification guideline document that gives both general and material specific guidance.

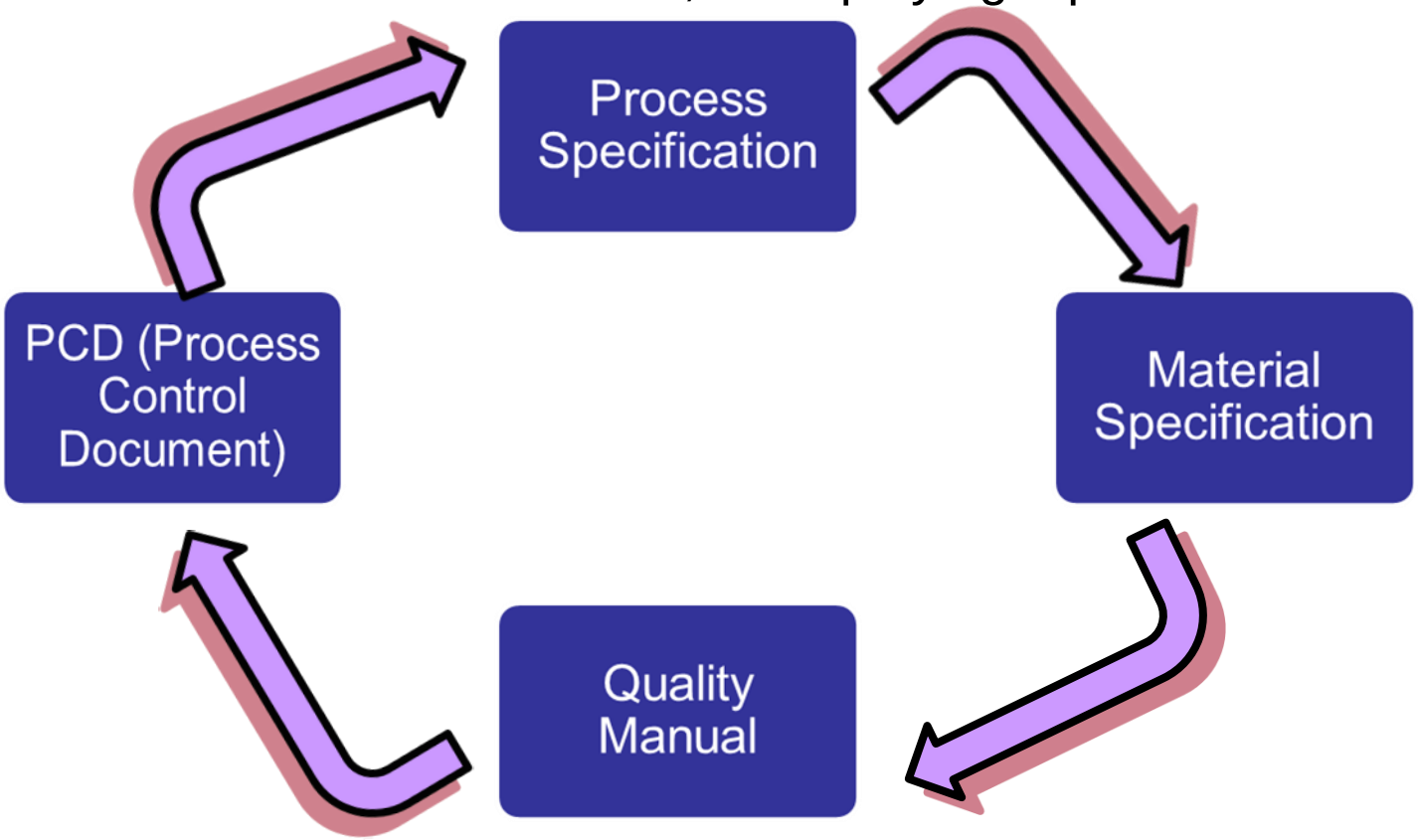
Overall Technical Approach

- Understand the hierarchy of PCD, Quality Manual, Material Specification, and Process Specification.
- Work with industry partners to understand their input.



Technical Approach Outcome

- The Quality Manual, PCD, Process Specification, and Material Specification are all inter-woven, each playing a part.

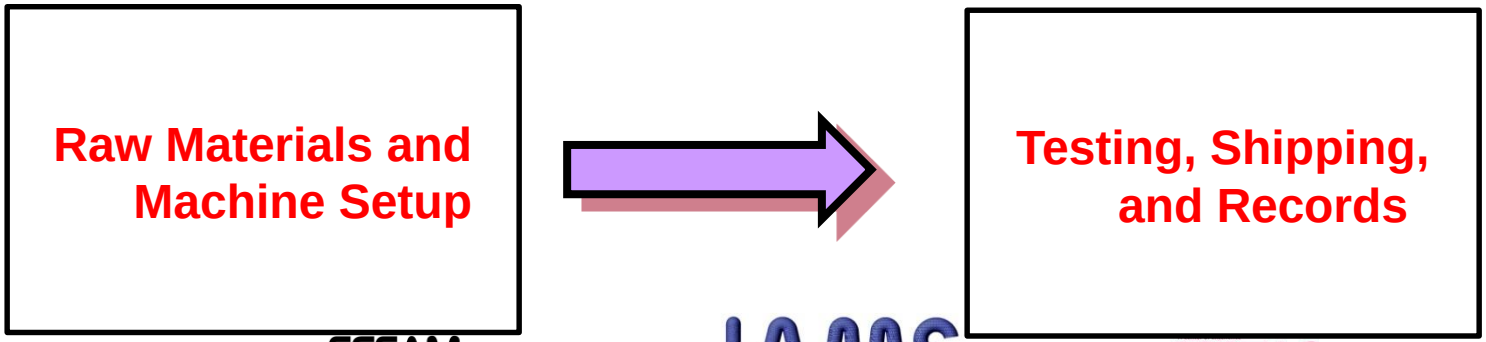


Technical Approach - Objectives

- Recommended content for a process specification.
- Understanding which sections will include information from the PCD, Material Specification, and Quality Manual.
- Similarities and differences of processes for different material types.
- The flow of the process document.
- Work with industry partners to understand their input.

Task 1: Process Specification Sections and Flow

- Introductory Information - Title Page, Revision History, Table of Contents, Introduction, Acronyms/Definitions, and Reference Documents.
- Raw Materials – how to procure, store, inventory, material specification, and deal with non-conforming products.
- Product Manufacturing – Raw Materials, Environmental Conditions, Machine Settings (temperature, time, pressure, vacuum, feed rate, speed, etc.), Tools, Post-Processing Techniques (bonding, surface prep, paint, lightning strike, etc.), In-Process Testing, Non-conforming Product, Personnel Training.
- Finished Product Packaging – Package Type, Measure Type, Labeling, Package Orientation, Shipping Documents.
- Storage of Finished Product – Environmental Conditions and Storage Life.
- Testing of Final Product – Which tests, How many replicates, Data storage, CoCs, Retains.
- Shipping of Final Product – Special Instructions, Environmental Conditions, Inventory release.
- Record Retention – Which records must be kept and for how long.



Task 2: Incorporating Industry Feedback

- Work Instructions
- Company specific Test Methods
- Personnel Training documents
- MRB processes
- Inspection Reports (calibrations, daily checks of equipment, etc.)
- Cleaning Procedures
- And many more.

Task 3: Advanced Materials

- **General Guidelines** – An outline that includes information that should be included for any material system.
- **Specific Guidelines** – Additional information by material type:
  - Thermoset Polymer Matrix Composites (PMC) – Prepreg
  - Thermoplastic Polymer Matrix Composites (PMC) – Prepreg/Semi-preg
  - Reinforced RTM Composites
  - Adhesives – Paste and Film
  - Ceramic Matrix Composites (CMC)
  - Non-Metallic Additively Manufactured Materials (Polymers)

Project Status

- **General Outline**
  - Completed
  - Will have final review once the rest of the document is complete.
- **Current Activity**
  - Third review is occurring now for all material types except Adhesives.
  - Adhesives section is in progress, ECD of June 14, 2019
- **Future Activity**
  - Complete the Adhesives Outline.
  - Update all outlines per review feedback.
  - ECD of July 31, 2019

Looking Forward…

- Additional Material Outlines
  - Add material outlines to the document as needed.
    - Core
    - Metallic Additively Manufactured Materials
    - Combination of Advanced Materials
    - Materials not yet known

- Continue to revise as new advancements are made
  - Heat treatment methods
  - Fiber placement methods
  - New bonding processes/surface treatments
  - ?

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Questions or Comments?

Thank You!

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