Federal Aviation Administration

FAA / CAAs “Composite Meeting”

- Workforce Education Initiatives -

Level II Safety Awareness Courses

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Singapore, Singapore
September 01-04, 2015

FAA / CAAs "Composite Meeting"
- WE & Safety Awareness Courses -

- Background - Workforce Education
  - ^ Composite Training Strategies (White Paper)
  - ^ Observations for Consideration
  - ^ FAA Workforce Education Plan
- Level II Safety Awareness Courses
  - ^ Composite Maintenance (CMT)
  - ^ Composite Structural Engineering (CSET)
  - ^ Composite Manufacturing (CMfgT)
- Courses Offering via NIAR/WSU (2015)
- Discussion

Background - Earlier Training Development

- Composite Team developed/offered training -

  - "Composite Material Qualification and Equivalency" [Workshop Sponsored by FAA/SAD, Supported by NASA/AGATE Consortium & NIAR/WSU; Sep/2000] [Lesson Plan retained by NIAR/WSU]

  - "Static Strength Substantiation of Composite Airplane Structure" [Workshop Sponsored by FAA/SAD; Sep/2001] [Lesson Plan retained by FAA/SAD]

  - "DER Recurrent Seminar - Composite Structure" [Seminar sponsored by FAA/AIR for Designee Management, Documents retained by Composite Team, 2004 -]

  - "Composite Course for Airframe Job Function Class" [Class sponsored by FAA Academy, Lesson Plan retained by FAA Academy]

Background - Composites Education Justification

Industry	Skill development via on-the-job training
FAA	Difficulties in recruiting staff with required skills
Education gaps	Talent pool versus identified institutions to address subject matter regarded as important in composites
Education delivery options	Classroom, laboratory, distance (on-line)
Educators	Availability of training expertise

FAA Biz Plan (2009) on “Composite Education Strategy” was initiated to provide roadmap for Workforce Education

Education Progresses through Three Levels

Some FAA experts

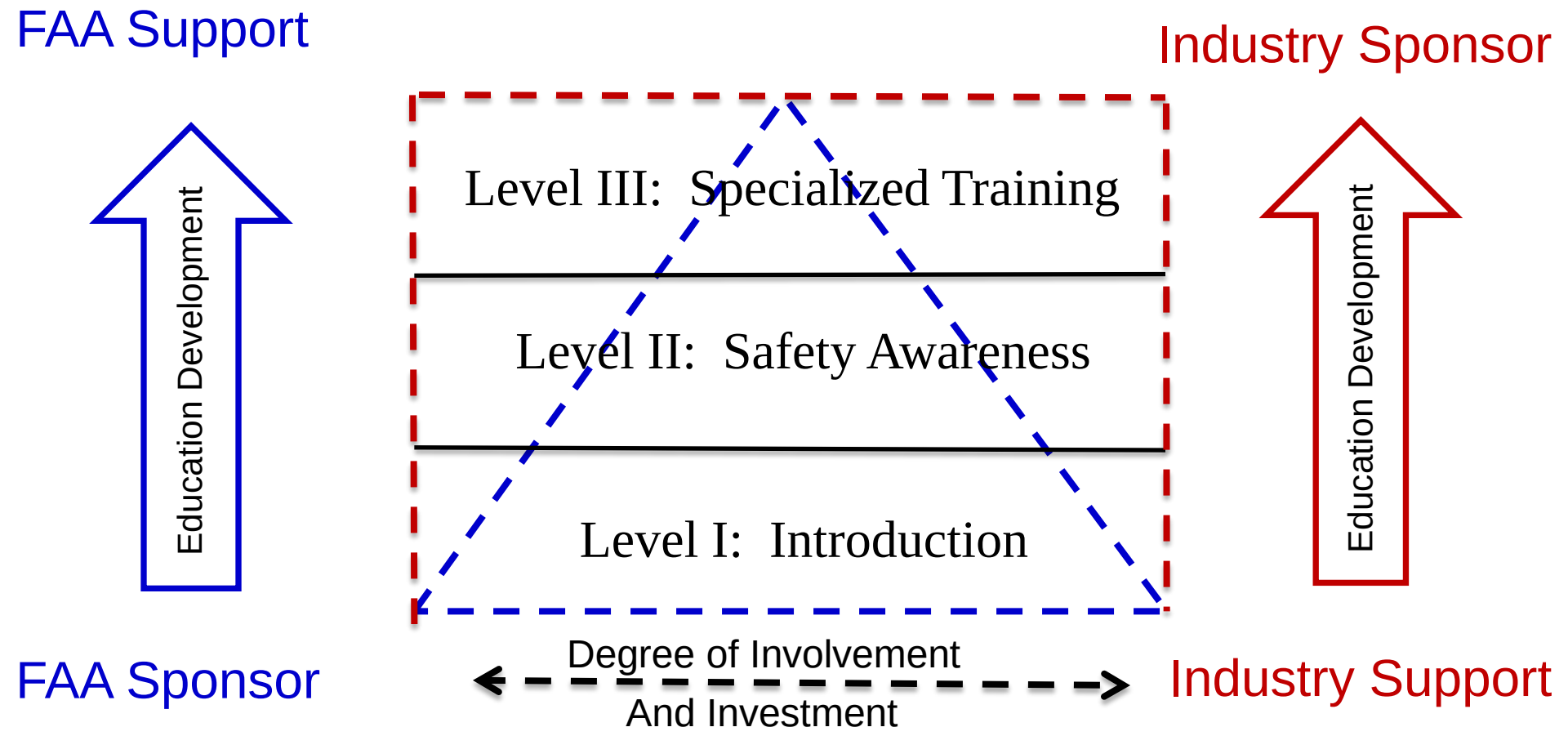
Increasing Specialization

Specialized Training (Level III)	→	1. Skill building in specific areas 2. Institutions responsible for training which have subject matter expertise 3. "Go-to" skills needed for successful applications
Safety Awareness (Level II)	→	1. **Composite safety focus, including hands-on laboratory** 2. **More details of regulatory guidance and industry practice** 3. **Highest level where most standards are currently possible**
Introduction to Composites (Level I)	→	1. Basics of composite technology 2. Intro to job roles & responsibilities (understand "what you don't know") 3. Certification basics

Most of FAA Workforce

Overview - FAA Composite Education Plan

FAA and Industry Participation in Development



Level I and Level II Course Development Initiatives

- Introductory courses (Level I)
  - CMH-17 Composite Certification and Compliance Tutorial developed in 2008, based on Chapter 3, Volume 3 (CMH-17)
  - Online course on composite basics developed as a prerequisite to Level II maintenance course (described below) in 2007
- Safety awareness courses (Level II)
  - Composite maintenance course developed from 2004 – 2007
  - Customization of the composite maintenance course developed in 2008 for FAA inspectors
  - Industry standard for teaching composite maintenance published through the Society of Automotive Engineers (2009): AIR 5719

Lessons Learned

Need more efficient approach (Don't include "masses" until end)

Educational partners must become self-sufficient

Composites Education

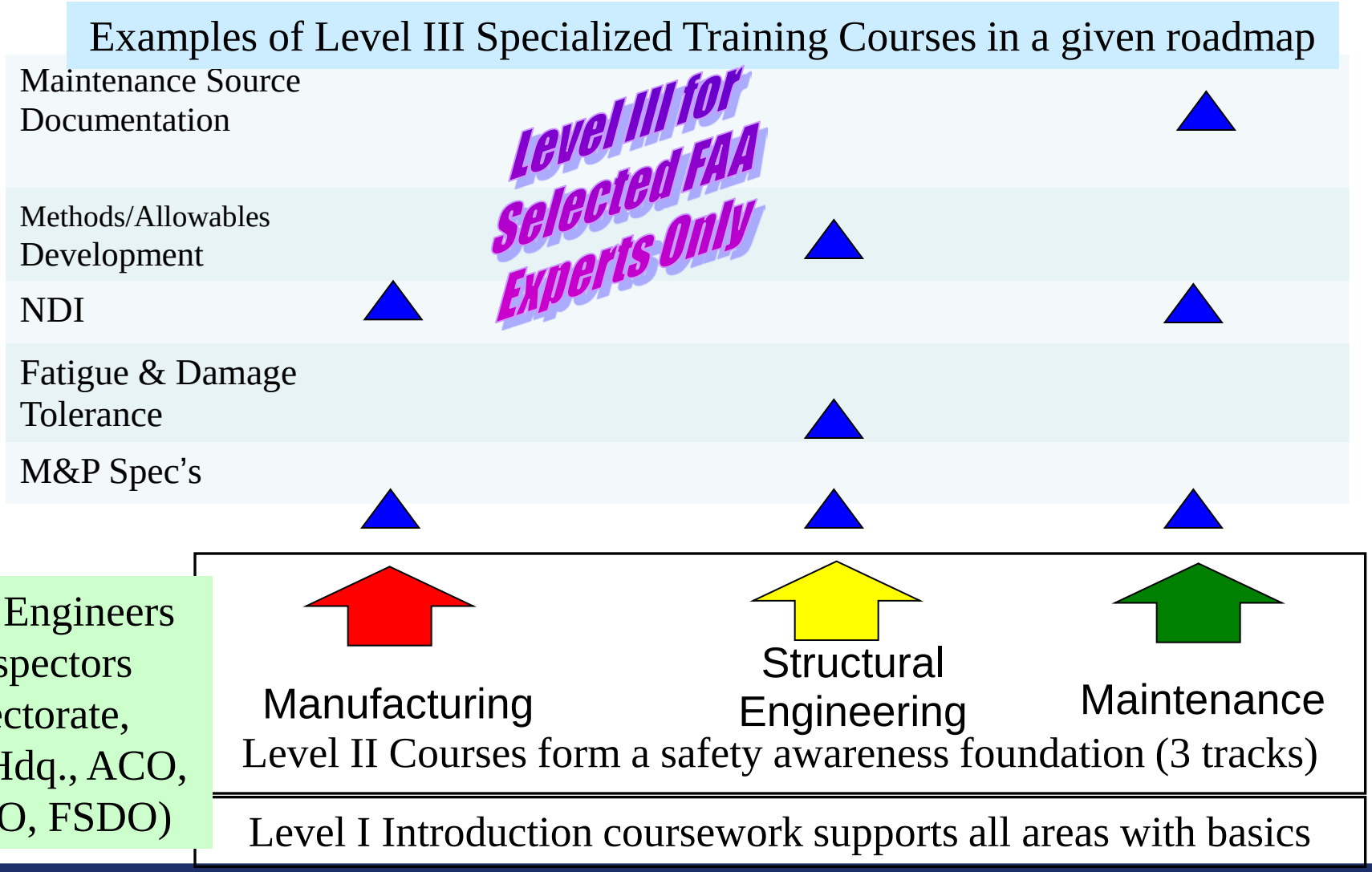
CMH-17 Composite Certification Basics (*6-hour Tutorial)*

- Based on New CMH-17 Chapter
- Available through CMH-17
- Content
  - Initial airworthiness (design and production certification)
  - Continued airworthiness (maintenance and modifications)
- Development process and implementation
  - Course objectives based on Chapter content (Aircraft Structure Certification & Compliance)
  - Input from subject matter experts, with focus on structural substantiation

    Larry Ilcewicz: FAA
    Simon Waite: EASA
    Hank Offermann: FAA (retired)
    Charles Seaton: FAA Coop. Agreement

Overview - FAA Composite Education Plan

Education roadmap illustration



Level III Training Topics (used in industry surveys)

Crash dynamics and energy absorption of composite airframe structures	Composite Structural Analysis & Test Protocol
Safety risk management	Tooling
Emerging material forms and processes (e.g., VARTM, RTM, Chopped Fiber, etc.)	Flammability and composite high temperature performance issues
Damage Types and Sources	Lamination Processes
Source Documentation	Resin Transfer Molding
Regulatory Requirements	Mechanical Assembly
Conformity Guidelines	Static Strength Substantiation
Bonded Composite Repair	Fatigue and Damage Tolerance
Inspection Procedures	Material Qualification
Laminate Bolted Assembly and Repair	Allowables and Design Value Development
Structural Bonding (composite and metal)	Material and Process Specifications
Environmental protection incl. lightning strike	Manufacturing Automation

Level III Training Topics Preferences (200 responses)

Bonded Composite Repair	68%
Static Strength Substantiation	66%
Fatigue and Damage Tolerance	63%
Allowables and Design Value Development	59%
Structural Bonding (composite and metal)	51%
Laminate Bolted Assembly and Repair	47%
Regulatory Requirements	43%
Inspection Procedures	36%
Damage Types and Sources	35%
Material and Process Specifications	33%
Composite Structural Analysis & Test Protocol	32%
Material Qualification	32%

Composites Education
Development – Delivery Options

- Classroom:
  - Traditional format which provides face-to-face interaction
  - Expensive, limited availability of experienced practitioners
- Online (Distance Learning):
  - Widely used for providing global access to students
  - Cost-effective
  - Students can select convenient time for participation
  - Wide availability of experienced practitioners in discussions (affordable expertise)
  - Requires computer literacy and internet access
- Laboratory:
  - Learning reinforcement of classroom/on-line teaching points
  - Expensive, compressed time-frame for awareness-level training (CMT, CSET, CMfgT)

Level III Teaching Format Preferences

Online Teaching	85%
Laboratory	52%
Classroom	42%

Note: Respondents generally indicated that the content might dictate teaching format (e.g. inspection procedures best taught in laboratory; Level II courses most suitable for online)

Education Challenges

- Demand for practitioners with composites expertise exceeds the supply
- Proprietary nature of composites conflicts with the adoption of standard practices – education focuses on standard practices
- Cost and student availability of training
- Negative implications
  - Increased competition for practitioners
  - Dependence on OJT → Narrow knowledge base
  - Limited availability of experienced teachers
  - Limited training budgets

Education Needs

- Awareness of safety implications for decision-makers (Level II)
- Specialized training, utilizing the resources of multiple learning institutions (Level III)
  - Connecting R&D and education increases relevance of both
  - Interactions among coop students, professors, and industry provides depth and balance to content
  - Industry is integral to the Level III development
- Training resources
  - SMEs, Multimedia, low-cost and accessible formats
  - Case studies

Learning Effectiveness

Increasing learning effectiveness and retention by adding meaning to content in courses includes:

- Subject matter experts (SMEs) involvement brings relevance to classroom. SMEs can:
  - Approve content during course development
  - Participate in online discussions and case studies
  - Assess course effectiveness
  - Assist in laboratory experience
- Case studies for online/classroom discussions
  - Students learn by ‘self-discovery’
  - Based on actual experiences
  - Interaction with SMEs enhances learning experience

Thoughts for Sharing
Basis for proposed strategic training plan

Composite practice for airframe structures

- Expanded use of composites in new aircraft development
- Proprietary nature of composites
- Lack of experienced regulatory personnel
- Industry on-the-job training dependence

Safety awareness

- Emphasized in Level II training
- Understanding the unique properties of composite materials and resulting safety challenges
- Enabling practitioners to *'ask the right questions'*, *'know what you don't know'* and *'identify bad practice'*

More efficient technology transfer for highest levels of competency and critical R&D advances

Thoughts for Sharing
The gap between regulatory/industry needs and existing education

Some gap exists in Level I and II courses of relevance to professionals involved in composite airframe safety and certification tasks, e.g.,

- Lacking regulatory and guidance emphasis

A substantial gap occurs at Level III (specialized training) with regard to:

- Emphasis on ‘real world’ challenges
- Meeting the needs of composite applications
- Some company-specific, proprietary courses exist

Thoughts for Sharing
Delivery options & involvement of experts

Delivery options – objectives to consider

- Accessibility and convenience to students
- Cost
- Resources (institution, industry, subject matter experts)

Subject matter experts (SME)

- Assure continued industry relevance
- Limited participation in development & delivery

Best used for development advice and as discussion participants

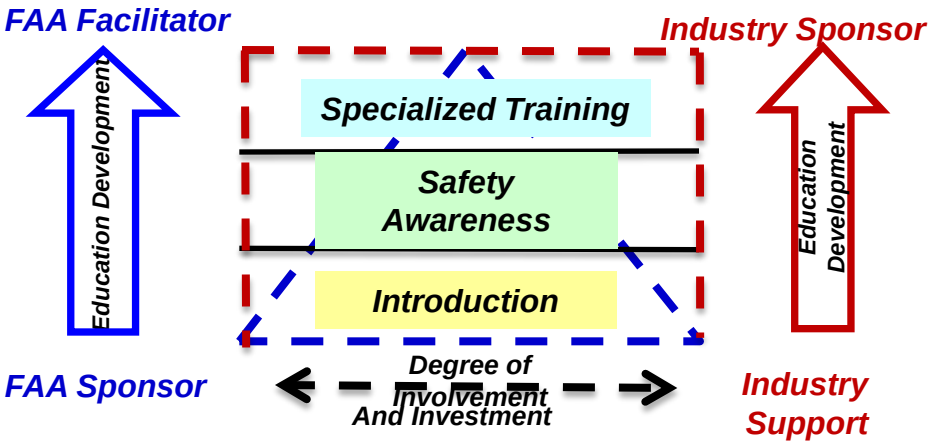
- More readily available and affordable for on-line education

Workforce Educational Initiatives

FAA AVS Composite Training

- FAA composite training strategy using existing courses, FAA COE & industry support [White Paper – Sep/2009]

  Courses to support airframe engineering, manufacturing and maintenance functional disciplines



- Incl. three levels of competency:

I) Introduction (common to all functional disciplines)

Self-study intro content for composite basics/terminology

CMH-17 V3C3 (+Tutorial) on composite certification & compliance [Aug, 2008]

II) Safety Awareness (courses for each functional discipline)

Skills needed for FAA workforce supporting composite applications

FAA development status summarized on the following charts

III) Specific Skills Building (most courses developed by the industry)

Specialized skills needed in the industry & some FAA experts

Level II Safety Awareness Courses

- Maintenance Safety Awareness (CMT)
  [International Standard: CACRC AIR5719]
  - FAA-led course development completed [9/2008]
  - FAA Audience: Flight Safety Inspectors [Content: 60 Hours]
  - AFS-500 class-room version available to FAA [Since 2009]
    ~ 500+ AFS Inspectors trained to date through FAA contract with ABARIS
  - On-line version available to the industry
- Structural Engineering Safety Awareness (CSET)
  [Sponsored by FAA R&D, AIR-520]
  - First course offering through Wichita State Univ. (WSU) [4/2013]
  - FAA Audience: Airframe Engineers & Delegations [Content: 80 Hours]
  - Available to the industry through WSU.
- Manufacturing Safety Awareness (CMfgT)
  [Sponsored by FAA R&D, AIR-520]
  - Completion of course development [9/2014]
  - FAA Audience: Manufacturing Inspectors [Content: 60 Hours]
  - First course offer through Wichita State Univ. (WSU) in FY15.

FAA Collaboration With NIAR/WSU

- FAA development budgets have many research projects through NIAR/WSU (incl. course developments, leading to WSU continuous education business opportunities)
- NIAR/WSU has derived strategies and working relationships for FAA continuous education coursework
  - Marketing should lead to sufficient numbers of students and class longevity once reputation is established and students realize benefits
  - Past CSET, CMfgT & CMT sessions have led to an understanding for future offerings (student needs, interests and background)
- FAA Instructor involvement benefits both the FAA (reduced student costs) and NIAR/WSU (regulatory presence)
- Current contracted instructors have long-standing NIAR/WSU & FAA relationships (research & training development initiatives)

Offering via Wichita State University (2015)

http://webs.wichita.edu/?u=CONTED&p=/PublicEngineeringCourses/

Composite Manufacturing Technology (CMfgT) Course

- **Course Description:** This course will provide students with a technical knowledge of composite manufacturing to a level that allows them to better and more proactively identify deficiencies on the factory floor that have safety implications. This course was developed by Wichita State University in collaboration with key industry experts and the Federal Aviation Administration. Students will study advanced topics during an on-line, interactive learning experience via Blackboard. Teaching methodology includes online discussions facilitated by subject matter experts, relevant documentation, and audio/visual aids. Depending on prior knowledge and experience, students will spend approximately eight hours per week reviewing materials, participating in online discussions, and testing their knowledge. Depending on the students skill set and back ground the time investment may fluctuate a bit. The course will conclude with a 2-day hands-on laboratory.
- **Intended Audience:**

  - MIO/MIDO inspectors participating in the certification of composite structures.
  - FAA designees, international civil aviation authorities and engineers responsible for quality system development, approval and oversight of manufacturing processes for composite structures.
- **Course Delivery Method**: Online with a hands on lab
- **Course Length**: Approximately 9 weeks
- **Course Start Dates**: March 2, 2015

Offering via Wichita State University (2015)

Composite Structural Engineering Technology (CSET) Course

- **Course Description:** This course will provide students with an awareness of safety issues related to engineering, manufacturing, maintenance, and certification of composite materials associated with civil aircraft structures, in accordance with AC 20-107B (Composite Aircraft Structure). This course was developed in collaboration with Wichita State University, key industry experts, and the Federal Aviation Administration. After finishing a 1-week period of self-study of fundamental composites and successfully completing an examination, students study more advanced topics during an on-line, interactive learning experience via Blackboard. Teaching methodology includes online discussions facilitated by subject matter experts, relevant documentation, and audio/visual aids. Depending on prior knowledge and experience, students will spend up to ten hours per week reviewing materials, participating in online discussions, and testing their knowledge. The course will include a 2.5-day hands-on laboratory, which is optional but highly recommended.
- **Intended Audience:**
  - FAA Directorate/ACO engineers & industry designees participating in the certification of composite structures.
  - Engineers at aerospace companies who are involved in designing and analyzing composite structures
  - International Civil Aviation Authorities and their designees responsible for certification of composite structures
- **Course Delivery Method:** Online with an optional hands on lab
- **Course Length:** Approximately 12 weeks
- **Course Start Dates:** May 18, 2015