



Course Development: Maintenance of Composite Aircraft Structures

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The Joint Advanced Materials and Structures Center of Excellence



Course Development: Maintenance of Composite Aircraft Structures



- Motivation and Key Issues
 - A dramatic increase in composite content in new aircraft development mandates additional knowledge in composite maintenance and repair for inspectors, technicians and engineers
 - Practitioners must have an appreciation of the major issues surrounding composite materials maintenance, in preparation for further study; course should be available for worldwide learning
- Objective
 - Students to be aware of the important issues surrounding composites' maintenance and repair
 - Grant to provide terminal course objectives (TCOs) for industry to 'standardize' introductory survey courses
- Approach
 - Web-based training, supplemented by regional 'hands-on' labs
 - Extensive industry involvement, including in-person workshops and teleconferencing.



FAA Sponsored Project Information



- Principal Investigators & Researchers
 - Charlie Seaton, Principal Investigator (Edmonds Community College)
 - Peter Smith, Documentation & organization (Consultant)
 - Dennis Vincent, Tech Support (Edmonds CC)
 - Laura St. John, Distance Learning (Edmonds CC)
 - Joe Hafenrichter (Boeing Phantom Works)
 - Chad Robson (Navy Cherry Point Composites)
 - Keith Armstrong, prerequisite course (Consultant)
- FAA Technical Monitors
 - Peter Shyprykevich
 - Larry Ilcewicz
- Other FAA Personnel Involved
 - Curt Davies
 - Peter Shyprykevich
- Industry Participation
 - Boeing (Al Miller, Joe Hafenrichter)
 - Heatcon (Eric Casterline)
 - Subject Matter Experts (Peter Smith, Keith Armstrong)



Discussion Points



- Curriculum Development Process
- Change in Scope of Work as a result of feedback from expert participants
- Key components of course
- Storyboard examples
- Challenges
- Timeline
- Summary
- Look Forward



Curriculum Development



- Concept: Incorporate latest teaching methods
 - Survey course, intended to provide platform for advanced study
 - Edmonds CC will offer as combination web-based + laboratory
 - 5 day course equivalent, 3 college credits, 50% hands-on laboratory
 - Audience: Engineers, Technicians, Inspectors
- Workshops
 - FAA/NRC Workshop in Washington DC (May 18 & 19, 2004)
Executive review of systematic, repair, NDI & training issues
 - FAA/Industry/Academia Workshop in Seattle, WA
(November/December 2004) *Establish course framework by identifying terminal course objectives*
 - FAA Workshop (tentatively in Chicago in Sept 2005)



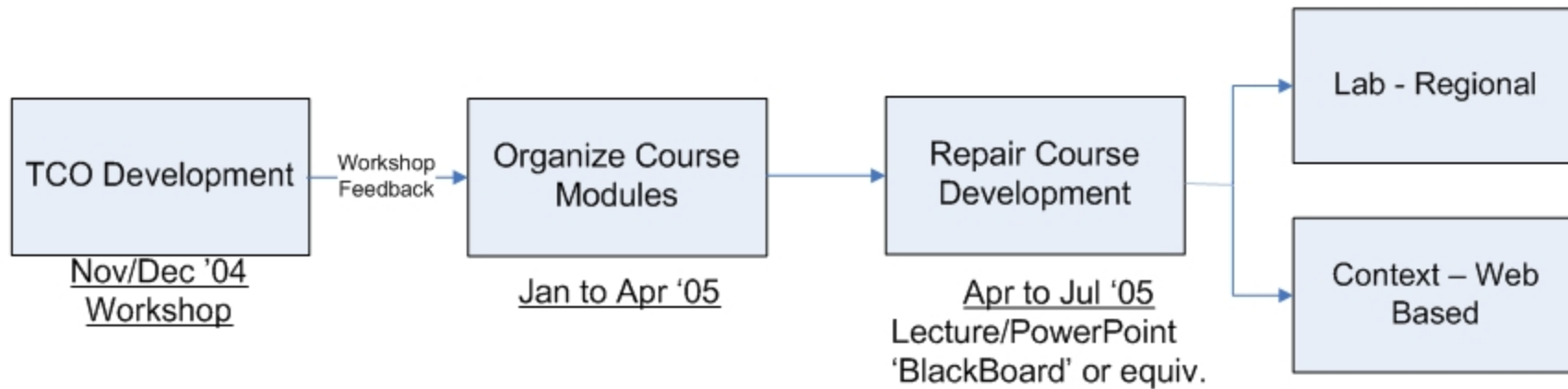
Curriculum Development Process



- November/December 2004 Workshop
 - ~60 expert participants, representing industry, government, academia
 - Identified ~450 skills for engineers, technicians, inspectors
 - Consolidated skills under 11 categories (terminal course objectives, or TCOs)
 - » Quantity of TCOs required addition of prerequisite course
- Feedback
 - Workshop report posted on AMTAS web-site for review: Jan 05
 - Workshop attendees invited to evaluate progress and provide suggestions via video conference: April 28, 2005
 - August/September 2005: Prototype class (or equivalent) for fine-tuning

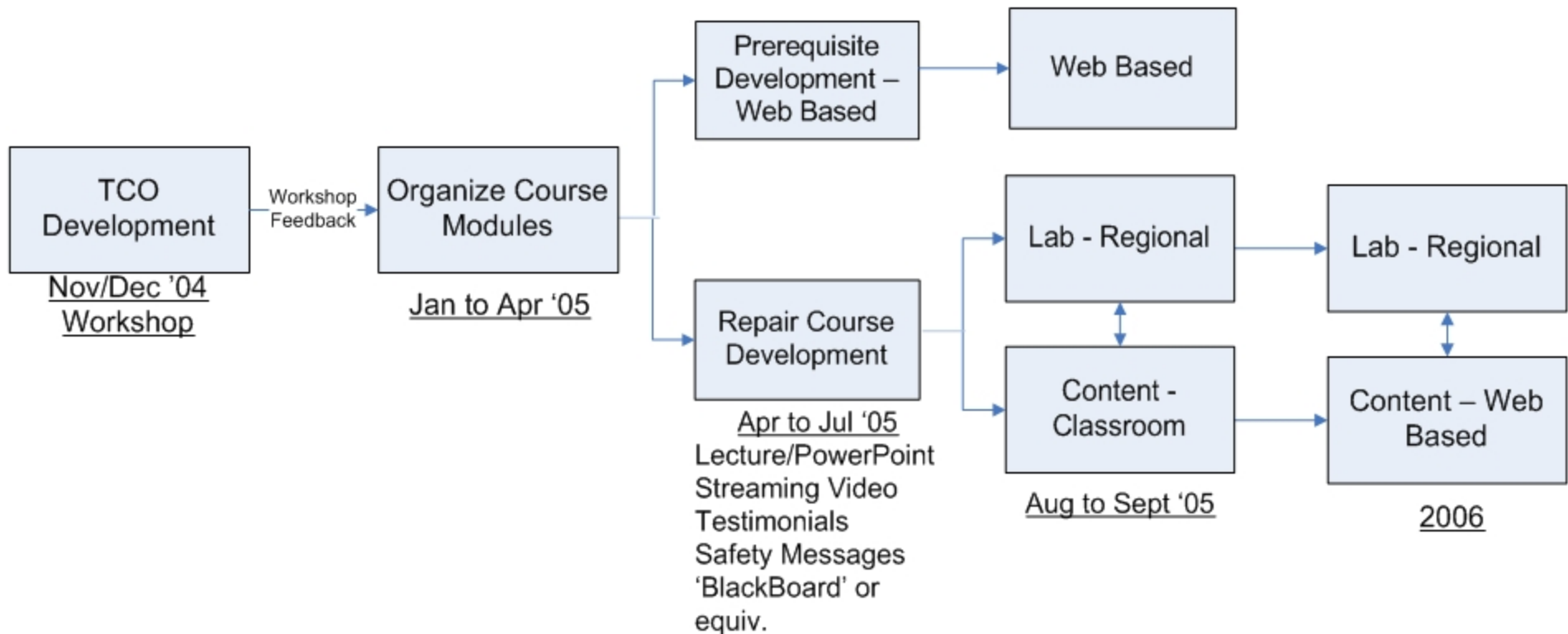


Original Statement of Work





Revised Statement of Work





Key Components: Terminal Course Objectives (TCOs)



- Prerequisite Course (content only)
- TCO [A] Understand basics of composite materials technology
- TCO [B] Understand the basics of composite materials maintenance and repair
- TCO [J] Understand other critical elements of composite maintenance and repair

- Composite Repair & Maintenance Course (content and laboratory)
- TCO [C] Understand Roles & Responsibilities
- TCO [D] Recognize composite damage types & sources
- TCO [E] Identify & describe information contained in documentations
- TCO [F] Describe composite laminate fabrication & bonded repair methods
- TCO [G] Perform a bonded composite repair
- TCO [H] Describe composite damage & repair inspection procedures
- TCO [I] Describe Composite laminate bolted assembly & repair methods




















Key Components



- Definition of terminal course objectives (TCOs)
 - Public domain
- Content Format
 - Traditional classroom (Prototype class or equivalent; possible follow-on)
 - Distance/web-based learning
 - Safety messages & testimonials in addition to content discussion (public domain)
- Laboratory
 - Initially conducted at Edmonds CC
 - Follow-on concept: Regional laboratories (equipment and bill of materials to be public domain)











Tuesday

Intro to Composite Maintenance & Repair Timeline

<p>Morning</p> <p> 8:00 to 9:50</p>	<p>Primary Mode[s]:</p> <p> Lecture</p> <hr/> <p>Supplemental Mode[s]:</p> <p> P. Pt Presentation</p> <p> Testimonial from Practitioner</p>	<p>Topics: <u>TCO [E] Identify & describe information contained in documentations</u></p> <p>E1: Describe requirements in material & process specifications and structural repair manuals</p> <p>E2: Demonstrate use of source documents</p> <p>E3: Identify & demonstrate use of regulatory documents</p> <p>E4: Understand the requirements and engineering approvals necessary for valid sources of technical information & maintenance instructions</p> <p>Fight Safety Message #3  Total Time: 1hr 50min</p>
<p>Morning</p> <p> 9:10 to 10:10</p>	<p> Intermission  Total Time: 20 min</p>	
<p>Morning</p> <p> 10:10 to 12:00</p>	<p>Primary Mode[s]:</p> <p> Lecture</p> <hr/> <p>Supplemental Mode[s]:</p> <p> P. Pt Presentation</p> <p> Video</p> <p> Testimonial from Practitioner</p>	<p>Topics: <u>TCO [F] Describe composite laminate fabrication & bonded repair methods</u></p> <p>F1: Understand the basics of composite laminate fabrication</p> <p>F2: Understand the basics of composite bonded repair</p> <p>F3: Describe the detailed processing steps necessary for laminate fabrication [factory], bonded repair [field], and Material Review Board (OEM)</p> <p>F4: Describe key characteristics and processing parameters for laminate fabrication</p> <p>F5: Identify typical processing defects which occur in composite laminate fabrication & bonded repair.</p> <p>Fight Safety Message #4  Total Time: 1hr 50min</p>
<p>Afternoon</p> <p> 12:00 to 1:00</p>	<p> Lunch  Total Time: 1 hr</p>	

Thursday

Intro to Composite Maintenance & Repair Timeline

<p>Afternoon</p>  1:00 to 2:50	<p>Primary Mode[s]:</p>  Lecture  Lab	<p>Topics: <u>TCO[I]: Describe Composite laminate bolted assembly & repair methods</u></p> <p>I3: Demonstrate composite drilling versus metal drilling I4: Describe process parameters which affect bolted repair quality & in-process controls necessary to avoid defects</p> <p> Total Time: 1hr 50min</p>
<p>Afternoon</p>  2:50 to 3:10	<p> Intermission</p> <p> Total Time: 20 min</p>	
<p>Afternoon</p>  3:10 to 5:00	<p>Primary Mode[s]:</p>  Lab	<p>Topics: <u>TCO[I] cont'd [LAB#5]: Perform bolted repairs of damaged thick laminates</u></p> <p>I5: Demonstrate & apply common damage removal, drilling & fastening techniques used for bolted repair & how to inspect them for acceptability I6: Verify correct fastener selection, inspect drilled holes, & check if fasteners were properly installed during bolted repair lab trials</p> <p> Total Time: 1hr 50min</p> <p>Fight Safety Message #8</p>

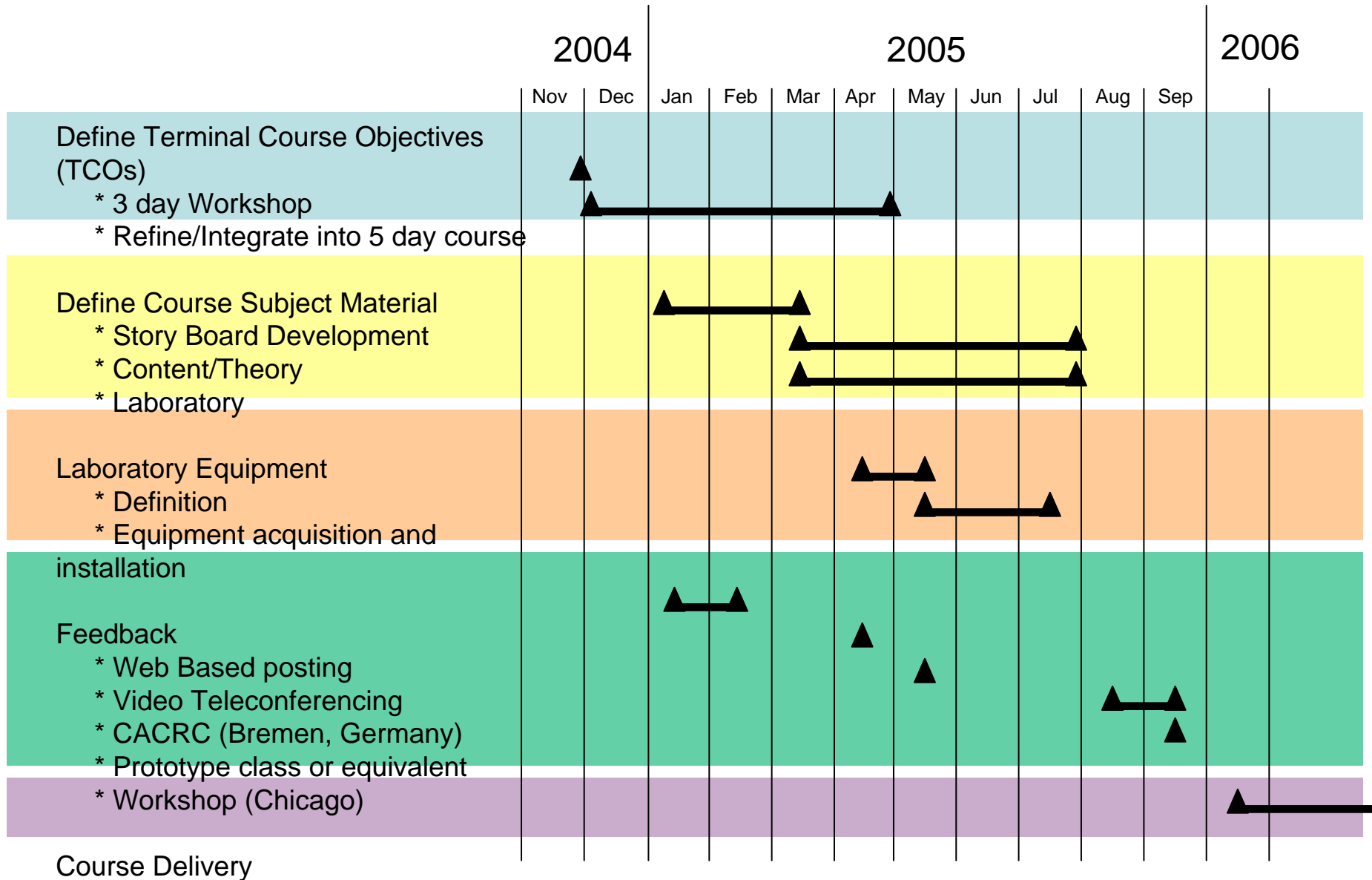


Challenges



- Videos of composite repair practice
- Testimonials (1 to 2 minutes)
- Continued involvement by experts
- Incorporation of non-proprietary structural repair manuals into course

Composites Maintenance & Repair Curriculum Development





A Look Forward



Benefits to the Aviation Industry

- The curriculum under development addresses the global community and is more generic, whereas Technical Training Providers (TTPs) are better equipped to address specific customer and operator needs, including proprietary information.
 - Curriculum has a different focus than (TTP's) such as Abaris and Alteon.
 - Focus of Course: awareness of repair issues from industry-based lessons learned
 - Focus of TTP's: vocational training & skills development
 - Curriculum is not intended to produce repair technicians, but prepares students for further (TTP) training by making them aware of the important issues surrounding composites' maintenance and repair.
 - For example, purchasing agents would gain considerable benefit from the survey curriculum.
- As a web-based formatted course, the curriculum can be utilized by the TTP's and taught at their facilities.
 - Added benefit: the amount of training at TTPs may be complemented resulting in increased enrollment.

Future needs

- Future activities will expand into specialty areas and standardize composite maintenance training