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## **AC 2012-4452: DEVELOPING A SUCCESSFUL FRAMEWORK FOR ON-LINE DELIVERY OF NON-CREDIT ENGINEERING SHORT COURSES TO GLOBAL AEROSPACE PROFESSIONALS**

### **Dr. Soma Chakrabarti, University of Kansas**

Soma Chakrabarti is the Director of Center for Engineering and Interdisciplinary Professional Education at the University of Kansas Continuing Education. In this capacity, she is responsible for providing leadership and direction for future growth of Aerospace Short Course program, online engineering technology short courses, interdisciplinary bioengineering short courses, and engineering conferences. Prior to her present appointment, she served as the Director of Aerospace Short Course program within the same unit; developed both industry-academia and government-academia partnerships in Asia, Europe, Australia, and South America for engineering workforce development; and provided leadership in increasing international participation in professional engineering short courses presented by the University of Kansas. Before joining KU Continuing Education, she was the President and Chief Executive Officer of BioComp Systems, Inc., a University of Kansas spin-off, which developed a near-commercial quality prototype of a true 3-dimensional display system for biomedical visualization using National Science Foundation Small Business Innovation Research Phase I and Phase II grants. Chakrabarti was the Principal Investigator of both of these grants. She has taught chemical engineering and was an Associate Research Engineer in the Department of Chemical and Petroleum Engineering, and a Postdoctoral Researcher in the Department of Pharmaceutical Chemistry, both at the University of Kansas. She has a doctorate in biochemical engineering from the Indian Institute of Technology, Delhi.

### **Kimberly Anne Hunsinger, University of Kansas**

Kimberly Hunsinger is the Assistant Director of Center for Engineering and Interdisciplinary Professional Education at the University of Kansas Continuing Education. For the past eight years, her responsibilities have included marketing non-credit short courses, course material publication, and developing online aerospace short courses for professional engineers. Before coming to the University of Kansas, Hunsinger has worked in curriculum development and delivery for the Lawrence-Kansas Police Department, coordinated several learning and non-learning events worldwide, and worked as a freelance graphic and web designer. She holds a B.S. in journalism from the University of Kansas.

# **Developing a Successful Framework for Online Delivery of Non-Credit Engineering Short Courses to Global Aerospace Professionals**

## **Abstract**

For many years, non-credit engineering short courses have been successful in meeting the needs of worldwide aerospace engineering and aviation communities by providing traditional face-to-face training. As travel money became scarce in the industry and as the instructor pool grew older, computer-based courses and online delivery methods were introduced. This paper presents the failure and success of digitally delivered courses to globally dispersed professional aerospace engineers in terms of technical difficulty encountered in the production process and each delivery method, and assesses the courses with regard to the participants' learning outcomes. The first course on reliability and aircraft design analysis, introduced in 2002, was technically weak and was limited by delivery method in a disc format. In 2008, a rich multimedia based (animation, audio and video) airplane performance and certification course was introduced, but the production process was complicated and expensive, and the online delivery was limited by network bandwidth. A survey was then sent to attendees for specific feedback concerning content delivery. As a result, a simpler presentation framework for converting face-to-face short courses to online teaching modules was developed and introduced in 2011. These presentation modules, augmented by instructors-participants interactions, facilitated learning across the globe. A reusable template for online delivery of the course modules and a standardized workflow for the production of these modules have been formulated. The present modules address the needs of non-English speaking participants, the different learning styles of culturally diverse audience and the technical limitations encountered in participating countries.

## **Introduction and Background**

Aerospace Short Course Program at the University of Kansas Continuing Education has been delivering non-credit professional development courses on aircraft design, aircraft structures, flight control and avionics systems, aerospace compliance and aerospace project and process management for past 35 years. These short courses have been presented as face-to-face delivery mode in public and in-house offerings, the latter often customized to the needs of a client. The program instructors and staff traveled to many parts of the world to present these courses. Due to the nature of these courses, where participants learned mostly from face-to-face conversations with the instructors who drew case studies from their experiences or used a participant's case study as a discussion topic, these courses had been presented only face-to-face until 2003.

In 2002, there were two incidents that sparked a discussion whether a couple of these classes could be delivered digitally. The training money from aerospace organizations was slowly evaporating as companies handled the post-September 11 financial catastrophes, and the instructor of an extremely popular short course titled "Reliability and 1309 Design Analysis of Aircraft Systems" that primarily focused on the compliance related design aspects of an aircraft,

suddenly was not able to travel due to health issues. This was a time when many universities were increasingly delivering online short courses, so online conversion of this face-to-face course was chosen as the obvious route to overcome both the challenges. This would also enable the organizations to keep the employees at work while helping them to acquire professional development needed for their projects without spending the travel money associated with a public course attendance. This would be especially useful for smaller organizations, which could not afford an in-house class.

This paper describes the approaches undertaken to digitally deliver this and each subsequent professional aerospace engineering short course to globally distributed audience, the technical difficulties faced in the production processes associate with the face-to-face to online conversion of these courses, how the challenges were overcome, and finally how a simple framework or process workflow was developed. The technical difficulties in the production process and the delivery methods were assessed hand-in-hand with the post-event evaluations done by the participants. Even months after a participant had finished a class, he/she was questioned about his/her learning process, technical difficulties and the learning outcomes. For a global audience, cross-cultural communication without a face-to-face interaction was considered for subsequent development of courses. However, there was no structured workflow for these processes used in this continuing education unit until 2010, when reusable templates and standardized processes were established. We will now describe each of these steps that we had taken to establish such processes and how the delivery methods have evolved over the years.

### **Project 1: Reliability and 1309 Design Analysis Computer Based Course**

Process: In 2002, although many universities had already started developing online non-credit professional engineering courses<sup>1, 2</sup>, the staff associated with the development of this computer-based course (the term they used at that time) neither had any formal training for the developmental process nor did they complete any market research on what was expected of a technical short course delivered via internet. This course was originally recorded by having the instructor deliver the class in Lawrence in front of a classroom. The plan was to present the slides and exercises with the recorded audio; however, some video was recorded, too. The slides with exercises were processed step-by-step to match the associated audio recordings. There was no animation, and long lecture segments were delivered using RealPlayer media with a supporting website. The instructor, while working from home due to his health conditions, always interacted with the students by e-mails. There was a discussion board with threads for separate topics; however attendees rarely participated in a discussion, because they were enrolling at different times and not many of them had the same question. The course was of 28 hours of lecture and three exercises. The students were asked to successfully complete these exercises before a certificate of completion with Continuing Education Units was used. Students could enroll from anywhere and take classes at anytime; group enrollments were encouraged. At times, a group of people from the same company would enroll and allocate a course hour each day for 28 consecutive days. The slides and audio were streamed (using RealMedia) in their conference rooms.

Issues related to the presentation: One of the major problems was that due to security and firewall issues with many client companies, the streaming media format was blocked and students could not listen to the course lectures at work. In response, the course managers put the entire website/RealMedia presentation files on a CD and sent it with the course materials. Figure 1 shows screen captures from the CD presentation material. The second issue this entire computer-based presentation was its sustainability and management. No thought had been put into who would maintain the website and monitor the discussion boards. As a result, the associated links quickly became outdated. The third issue was quality; the designers of the site and media files had no background in the online delivery. Further, the slide shows were long and image quality was poor. The fourth issue was that no standard evaluation process was used. Evaluations were done separately and the student feedbacks were often obtained via the forwarded e-mails from the instructor.

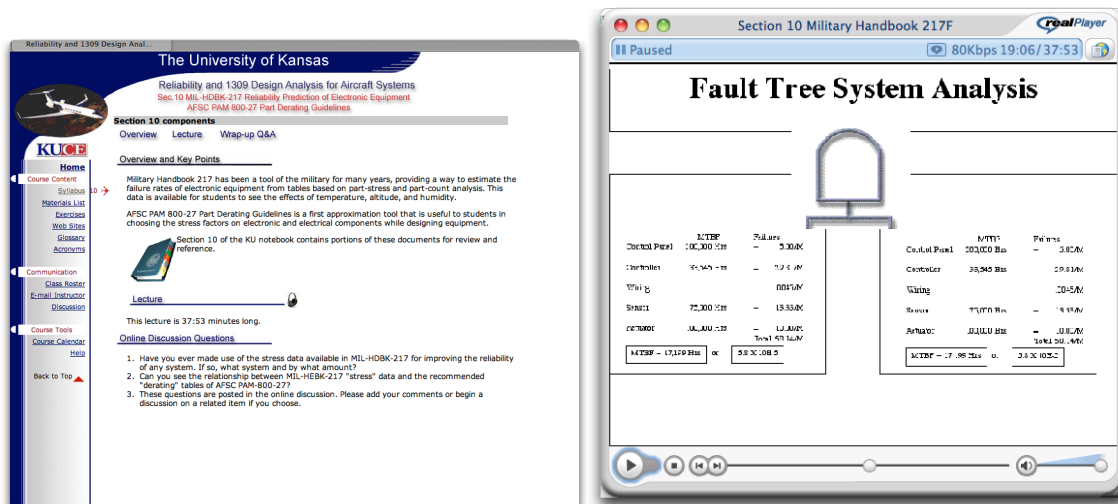


Figure 1. Screen captures of first 1309 course. Each section started with an overview. Interestingly, the online discussion questions did not work but the same questions were often sent to the instructor by e-mail. Also shown is an example of the RealMedia screen with slide and audio.

Outcome of the course: The course still ended up receiving good evaluations and was very popular, mainly because of the quality and uniqueness of the materials, and the instructor's interaction with the attendees via e-mails. However, many complaints were received regarding technical difficulties encountered by the students during the course and that presentation media and reference links were not up-to-date. Students learned from the lectures but also learned from their interaction with the instructor, and often requested a face-to-face conversation. Video conferencing was considered but technical difficulties at that time and time zone issues with globally distributed participants did not allow such interaction.

## Project 2: Aircraft Performance: Theory, Applications and Certification

Process: With the lessons learned from Project 1, the next online or computer based course was approached differently. Although the course on Aircraft Performance was recorded in a

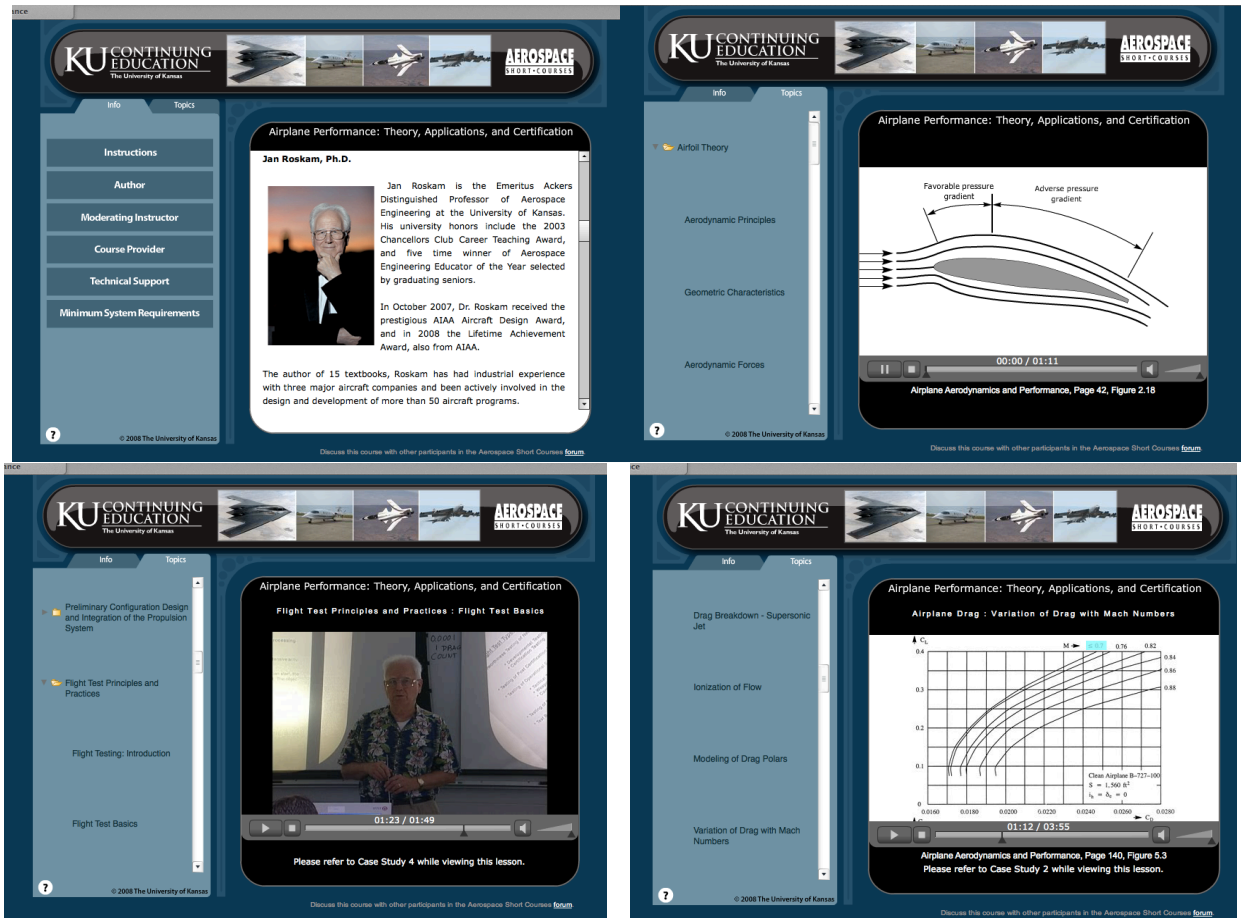


Figure 2. Screen captures of Aircraft Performance course shows effective but complicated use of animation, audio, video and graphics.

classroom presentation just before its face-to-face delivery was discontinued in 2003, the technical difficulties encountered in Project 1 and the limitation of the media delivery within firewall enabled company-owned computers prevented us from embarking on another project for a few years. During this time, a thorough customer research was done. The prospective participants wanted anytime, anywhere, fully online, multimedia-based course in which they wanted to interact with the instructor via e-mail or discussion threads. Therefore, for this course, a multimedia developer was hired, appropriate technology (hardware and software) was acquired, and multimedia components (audio, video, graphics and animations) were derived either from the previous recording or course materials, or separately designed using Adobe Creative Suite software programs. Adobe Flash was used as the main software for designing complete online presentation of the materials. Long lectures were broken in short topics and subtopics, animations were used to describe aerodynamics, equation parts were highlighted using animations, and several videos where the instructor discussed real world examples were introduced as parts of the course. Instead of three separate exercises, a project was used as an assessment method for course completion. Although discussion threads were present on the course website, participants preferred e-mail as the main communication method even if a group of attendees from the same company were taking the course at the same time. Figure 2 shows four screen captures of this course. The course was introduced in 2008 and within a few months

it gained popularity especially among participants from emerging countries who could not travel to the United States.

Issues related to the presentation: The two major problems encountered were that the course development process was very long and expensive. It took an enormous amount of time to put together this 5-day face-to-face course in an online format with a combination of animation, audio, video and graphics. The long process time also resulted in outdated examples which were eventually removed and new materials had to be incorporated.

Outcome of the course: This completely online rich multimedia based instruction received rave reviews for its technical capabilities and accurate animated description of physics and mathematics behind aircraft design. The instructor and the multimedia designer worked together to bring authenticity in the class. The moderator managed the project solutions very effectively via e-mails before a certificate of completion was issued. The evaluations were 90% positive for instruction, multimedia quality and interaction. Some students, however, requested for simpler interface on the web and smooth presentation was limited by network bandwidth in emerging or developing countries, or at some remote locations. For program management point of view, the technical issues were difficult to resolve as only an experienced Adobe Flash designer could fix it.

### **Project 3: Redesigning the Reliability and 1309 Course**

In 2009, more online conversions of face-to-face courses were contemplated. Again, surveys were conducted about the types of courses that would be chosen for online conversion, and the multimedia aspects of the online delivery were evaluated with respect time necessary, expenses encountered and technical expertise required for such advanced multimedia based courses. The survey results indicated that a simpler, less time consuming process needed to be introduced. Since the first course (Reliability and 1309 Design Analysis) needed an update, it was chosen as a test bed.

Process: This time, no instructor video or complicated animation was used. Each slide was prepared in Microsoft PowerPoint diligently with minimum or no animation. Only the best audio recordings were used. A reusable Adobe Captivate template was generated where, with minimum supervision, even an entry-level designer could incorporate audio, slides and very simple animations to complete a segment of the course. Course lectures were segmented, too, to retain student engagement. The template allowed easy fixing of Internet links and course references, which often became outdated. Closed captions were introduced by transcribing the audio; this was especially used for a global or non-English speaking audience. No animations were used for graphs or equations; instead the important parts in those were highlighted. Adobe e-Learning Suite, specifically Adobe Dreamweaver for web interface design, Adobe Soundbooth for audio editing, Adobe Photoshop for graphics processing and Adobe Captivate for presentation were used. Some additional illustrations were prepared using Adobe Illustrator. Simpler presentations using Adobe Flash plug-in for any web browser enabled easy uploading without consuming high bandwidth. The exercise structure remained same but presentation style was different and did not require any additional software.

**Issues and Outcomes:** This simpler presentation (Fig 3, screen captures of redesigned 1309 course) gained popularity almost immediately and very positive feedbacks were received. There was no change in instructor-participant interaction methods. Since Flash was already used as a web browser plug in, no complaints related to technical issues were received. This workflow (Figure 4) now became a template and used as a framework for future courses.

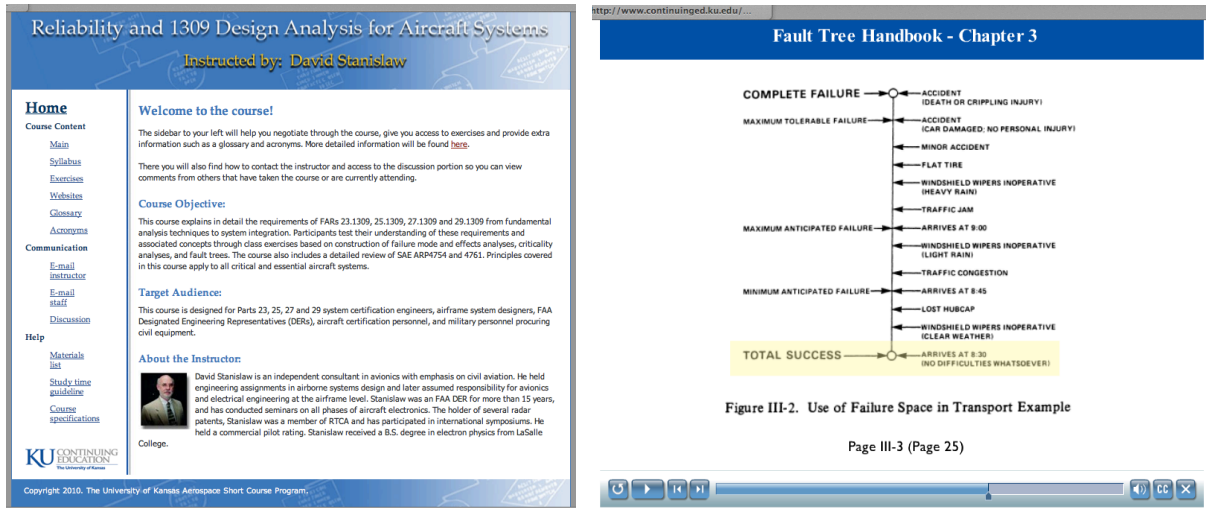


Figure 3. Screen captures of redesigned Reliability and 1309 Design Analysis course.

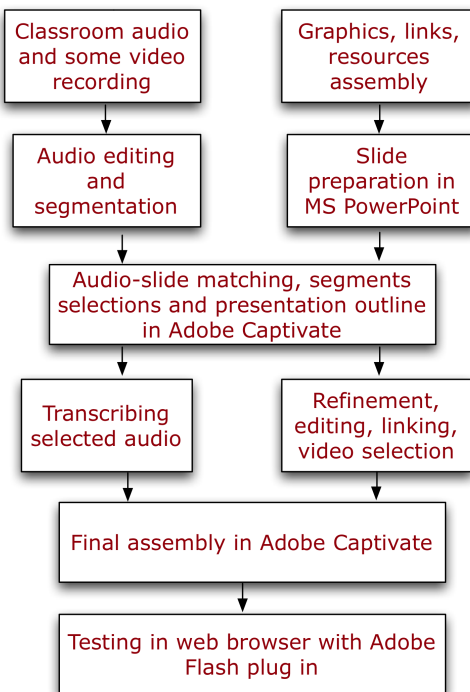


Figure 4: Flowchart for deliverable online course using canned or free software.

## Project 4: Success of the Framework, Durability and Damage Tolerance of Aging Aircraft course

Using the tested template, a short course on the durability of aircraft structures was converted from a face-to-face presentation to online delivery. This course was chosen because the instructor could not travel for personal reasons and the demand for the course increased in far-flung places. Also, this course was short and minimum animations were required. The course was produced in a short time and was introduced in 2011. This course has quizzes as an assessment method and an e-mail based communication method is being used. Feedback has so far been positive and we anticipate receiving the first set of formal evaluations at the end of June 2012. The screen captures of this course (Figure 5) shows the same look and feel as in the redesigned 1309 course.

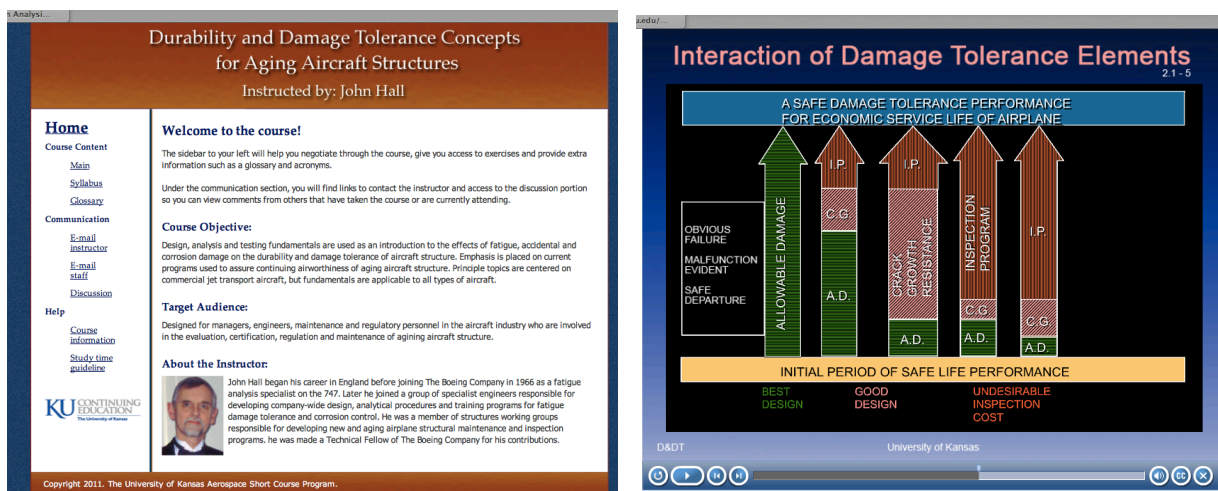


Figure 5. Screen captures of online delivery of Durability and Damage Tolerance course

## Conclusion and Future Projects

While a rich multimedia-based online course received positive feedback for visual presentation of complex materials in understandable learning modules, the complexity of the process, timely maintenance of the web-based learning materials and the unavailability of network bandwidth to display the materials in some emerging countries were the decisive factors in opting for a simple template and standardized workflow that would be easy to use. Similar conclusions were reached by Modesitt<sup>3</sup> and at present, this continuing engineering education program is converting another short course on aircraft corrosion for online delivery using this workflow and template.

The major future challenge in presenting these online courses will be the adaptability to mobile device environment. The increase in the use of iPad and other tablets as delivery platforms as well as the discontinuation of the development of Flash for mobile browsers for non-iOS mobile systems are the determining factors for developing our future online course delivery framework. Also, as the end user becomes more sophisticated in the online learning atmosphere, developing easy-to-use, yet engaging delivery systems will be an important priority. Rapidly evolving



mobile and Internet technology presents yet another project management challenge as we strive to keep up-to-date with the latest technology. These are some of the main challenges that the program administrators must overcome to meet the needs of the professional engineering workforce.

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