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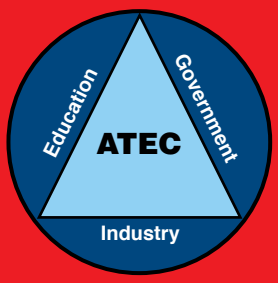

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Serving the Millennial Generation in Practice at a Four-Year Part 147 Aviation Maintenance Training Facility

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ABSTRACT
The journal entitled *Serving the Millennial Generation* is a collection of seven articles edited by Michael D. Coomes and Robert DeBard. Compiled in 2004, the journal begins with an overview of generational characteristics as well as some good information addressing the challenge of educating millennial students in today's higher education environment. Likewise, our university has developed a first year seminar directed at new and transfer students aimed at establishing good college skills and learning foundations. Our faculty is further guided by an internal publication entitled *Good Teaching Practices* compiled by experienced instructors outlining tried and true methods for effective conveyance of the vast body of knowledge relating to aviation maintenance technology. The purpose of this paper is to examine the application of the experiences and information shared in the serving the Millennials journal and other resources to educating aircraft maintenance technicians in a contemporary 4-year aircraft maintenance specialization program.

INTRODUCTION
Educating the millennial generation has become a challenge for Part 147 airframe and powerplant schools for the past decade. In many institutions, the cadre of instructors and staff consists of the baby boomer generation and generation Xers, categorized by year of birth (Codrington, 1997). From the author's experience, baby boomer instructors tend to favor conventional teaching methods using lecture, blackboard, PowerPoint and hands on techniques while the Gen Xer instructors tend to favor the more visually stimulating methods such as computer based training (CBT) and discussion with less reliance on blackboard or transparency presentations. According to McKeachie (2002), discussion methods are more effective than lecture as students tend to be more involved in what is going on than simply passive absorption of lecture material content. In an effective airframe and powerplant technology program, extensive hands-on training involving actual aircraft or well constructed trainers seems to best reinforce the learning process while giving students a level of experience similar that they would experience in the field. Perhaps the best approach has been a combination of these methods to alleviate the boredom of long dry lectures while keep the students engaged. We have seen that timely reinforcement of lecture and demonstration material using closely related laboratory projects works best in this regard.

Relating to the discussion at hand, material for this study is drawn from the journal: *Serving the Millennial Generation* edited by Michael D. Coomes and Robert DeBard. The articles contained in the journal provide a broad overview of topics relating to not only the educational process involving Millennials but also student life considerations. Historical and cultural influences on both the educators and educatees are also presented.

OVERVIEW OF THE GENERATIONAL STUDENT
Chapter One of the journal presents an overview of the generational model for understanding, working with and educating college students in general. Four generations are examined with emphasis on the most recent three as well as the characteristics of faculty and administrators who interact with these students on a daily basis. Characterized as the GI Generation (also known as the Greatest Generation), Baby Boomers, Generation X and the Millennial Generation these groups represent the evolution of the modern student since the early part of the last century (Coomes, and DeBard, 2004). Perhaps more than ever, millennial students are representative of a broad racial and financial diversity. The influx of foreign students, most notably from Saudi Arabia in our institution, has impacted our teaching methods from the standpoint of both language and cultural differences. While challenging, in the world-wide aviation community, good communication and cooperation is important in all aspects of the aviation field from aircraft maintenance to air traffic control.

Differences aside, the concept of a common student goal, namely to acquire an airframe and powerplant maintenance certificate, tends to mitigate many motivational detractors relating to diversity. That is not to say, however, that the concepts of being on time and present for class and timely completion of assignments is never an issue. Peer group influence is said to be important in the college experience (Newcomb, 1962). Again, the common thread pervades here as typically our student-fit into a vocational category as described by Kuh, Et al. (2000). Since our classes also tend to

comprise a mixture of Gen Xers and Millennials, the former tend to impart a greater sense of responsibility into the latter, some of whom seem to have a shorter attention span and therefore may be inattentive of even disruptive in class. Since many of our Gen Xers have come either out of the military or from employment in the aircraft service industry, they tend to anchor the class in the reality and importance of what is being discussed and will often scold the younger students if they do not behave appropriately in class. Also of importance here is for the instructor to set forth boundaries at the beginning of the class as to what constitutes acceptable and unacceptable classroom behavior.

We are fortunate to have the benefit of a publication entitled *Best Teaching Practices* that was formulated by a group of past instructors with a multitude of experience in maintaining appropriate classroom standards and decorum as well as providing quality instruction. Contained within its classroom management section is the concept that it is easier to begin the class with a stricter attitude and then ease up as the students understand their expectations rather than starting off easy and trying to harden things up as the semester progresses (Boyle, Et al.).

Lancaster and Stillman (2002), in their book *When Generations Collide*, indicate that Millennials tend to prefer working in a team environment rather than function individually. This concept appears to exemplify our current students as they are inclined to gravitate to teams of 3 – 4 individuals and work out a project or problem together rather than independently. This tendency is encouraged in the laboratory environment as larger classes have been necessitated by increased enrollment in our programs over the past several years. Since aviation maintenance is often practiced as a team effort, team development including working and playing well with others is important. Some of our instructors structure their laboratory projects with a student team leader responsible to the instructor with subordinates reporting to directly to the leader regarding their requirements, progress and problems. Likewise, on the job training and performance, while ultimately the responsibility of the instructor, provides leadership experience on behalf of the team principals who report each team member's contributions and progress to the instructor. This cooperative concept does not, however, diminish the importance of students learning what they need to know and practice as individuals operating within an interdependent and interactive working environment.

HISTORICAL INFLUENCES

While every generation has its defining events, the Millennials have experienced a two front mid-east war and perhaps the greatest tragedy in recent memory: 9-11. Primary modes of interaction with their peers have moved from land line phones to cell phones and Facebook type social media outlets. Each of these new forms of media has its place in the classroom if properly used although each is easily abused. Likewise, the wealth of knowledge easily available on the Internet through such sites as Wikipedia and Youtube as well as aviation maintenance related websites has greatly improved accessibility to a wealth of pertinent aviation maintenance associated material. Email is many of our faculty's medium of choice for faculty-student communication outside of class and carefully selected Youtube videos relating to aviation systems can be a valuable teaching tool. Both are easily accessible and portable through i-pad type devices as well as laptop computers. Considering that a recent Pew Project study indicated 70% of college student play video, Internet or computer games (Jones, 2003) the familiarity of Millennials with this media lends it well to use in the classroom.

While electronically connected, it is noted that early childhood experiences of the Millennials have been more restrictive and more tightly controlled then in previous generations. The concept of a stay-at-home mom sending the kids out to play all day with a lunch and dinner break is gone. This is perhaps due to the increased boldness and parental awareness of Amber-alert situations coupled with a setting in which both parents work or the increase in single parent families. Surprisingly this experience does not seem to have hampered the Millennials' propensity for team interaction as described above. However, the concern over helicopter parenting and the "everyone is a winner" concept of contemporary organized childhood sports may instill a sense of entitlement that precludes the pursuit of knowledge and investment of time necessary to the achievement of higher grades in an academic program.

A cultural trend of so called "New Puritanism" has likewise placed societal restrictions in an attempt to further shelter Millennials from situations or exposures considered to be unsafe with programs such as DARE (Drug Abuse Resistance Education), the updated motion picture rating system, V-chip installations in television sets, "safe sex" practices and the Communications Decency Act (Coomes, 2004). The benefit is these undertakings, whether practiced or not, do install an awareness of the rules such that their existence enhances mindfulness of the regulations that govern almost all aspects of aviation control, operation, and maintenance.

MILLENNIALS IN COLLEGE

Based on a National Center for Education Statistics study (Howe and Strauss, 2003), students currently attending college are more racially and ethnically diverse than ever before. While the number of Asian students in college has increased overall, our aviation technologies program has not seen a substantial increase in this group. Students from the mid-east, however, have increased substantially due to an agreement with the Arab-American Oil Company (ARAMCO) to provide airframe and powerplant training for their employees and now comprise approximately 10% of our student population. While this group has presented a number of challenges for the faculty and staff, overall they are above average achievers and strive to attain good grades with appropriate effort and academic honesty once they fully understand what is required for scholastic success in our program.

American millennial students have been characterized as Special, Sheltered, Confident, Conventional, Team-Oriented, Achieving and Pressured (DeBard, 2004). Concurrently, our staff has noticed some less than desirable traits in the attitudes and behaviors that seem to apply to a number of our millennial students. Some are becoming less willing to accept traditional lecture style classes, attempting to negotiate their way through their courses, being less agreeable to subjective evaluations and satisfied by average performance rather than striving to excel (Sullivan and Hannon, 2012). L. J. Sax in her article: *Our Incoming Students: What Are They Like?* describes the concept of underachievement as an unfortunate trend in that "lax standards in high school are a part of the millennial experience, despite indications that academic standards are tightening." Further, students are studying less while expecting higher grades for minimal effort (Sax, 2003).

Recently, these issues have prompted discussions among the faculty regarding development of a course designed to address and correct deficient academic behavior among our aviation technology students. In conjunction with Dr. Mark Amos and the Southern Illinois University Saluki First Year Initiative team, one such course has been developed for university-wide implementation and is required as a first semester undertaking. Basically a college skills and academic career development seminar, it is anticipated the course will help to mitigate any undesirable learning characteristics carried over from Millennials' secondary education experiences.

MILLENNIAL STUDENT DEVELOPMENT

As millennial students develop through their college experiences, a number of authors have articulated a number of defining characteristics predominant in their societal evolution (Coomes and DeBard, 2004). Quoting from Chapter 4 in the *Serving the Millennial Generation* text, these are as follows:

1. Structured Followers
2. Protected and Sheltered
3. Confident and Optimistic
4. Motivated and Respectful
5. Cooperative and Team-orientated
6. Pressured by Authority
7. Talented Achievers

Again, while these traits certainly appear to be acceptable if not admirable for the most part, they do not tell the whole story of student development from the first to fourth or fifth college year concluding in graduation. As described in the *Millennials in College* section above, our experiences with the evolving learning philosophies of Millennials include some difficulties and challenges, especially at the beginning of the college learning experience. Typically, by the third and fourth year, most deficiencies are overcome simply by the experience of less than desired outcomes in grade earnings, this often due to a low effort to outcome ratio coupled with poor attendance in class. Once the understanding is reached that good grades often require substantial effort, comments such as: "Why did I not receive and "A" grade" are replaced by "I really tried hard for the "A", but am glad to accept a "B". While the team approach to problem solving serves the Millennials well in laboratory and project completion efforts, early individual performance on knowledge tests often remains wanting. The capacity for students to realize that some things have to be done on their own sometimes comes with the price of a slow start toward the realization of academic excellence.

EFFECTIVE TEACHING

As outlined in the Southern Illinois University College of Applied Sciences and Arts *Best Teaching Practices* (Boyle, Et. al., 2008) include the following:

1. Tell the students what you are going to tell them,
2. Tell them, and
3. Tell them what you told them.

Echoed in the *Best Practices* are the concepts Chickering and Gamson (1987) articulated in their seven good practices for teaching in undergraduate education:

1. Encourage contact between students and faculty
2. Develop reciprocity and cooperation among students
3. Encourage active learning
4. Give prompt feedback
5. Emphasize time on task
6. Communicate high expectations
7. Respect diverse talents and ways of knowing

To these ends, our faculty makes itself available to students outside of class for at least six scheduled hours per week. Many use also Email, Facebook and personal web sites to communicate with students en mass or individually. To the second point in developing reciprocity and cooperation, each class is different and has its own internal dynamic. As described previously, the older, more seasoned students tend to set the tone for classroom behavior and decorum although in cases where poor performance and disruptions persist, faculty intervention may be required. Again, making the students' responsibilities for classroom behavior clear at the beginning of the semester is important to this end. Working in team activities, a trait many Millennials find appealing, can help in the learning process as well. Active learning through questions and answer sessions and open discussion promotes student-faculty interaction in the classroom. Keeping Millennials engaged has been a challenge so mixing up a lecture session with various delivery styles and methods may help to keep students attention on task.

Periodic performance evaluations in the form of lecture tests, quizzes and lab practicals likewise help to promote feedback. Most students desire to know how they are doing and encouragement through good test grades and public praise for a task or project performed well helps greatly in this regard. It is important to make students aware of any deficient performance early on so correction may be enacted sooner rather than later. We have noted in a few cases, certain students are not mentally ready to process complex material or are poorly prepared to deal with the oft times difficult nature of college level material. This is particularly evident in first year students. In these cases, the use of tutors can be most beneficial, especially if they are peers either currently enrolled or have recently completed the class causing difficulty. Instructors should be continually aware of how a class is doing overall so that likewise, a different approach to conveyance or review of the material may be enacted to promote more effective learning.

Use of time is an important concept and is taught in the Saluki First Year college skills course described above. The result of helicopter parenting and the constant engagement of Millennials in parental guided activities may have precluded them from learning effective time management. Balance of classroom participation with homework, outside employment or other extracurricular activates may be a new and unfamiliar concept and needs to be emphasized and practiced early on. While fraternity/sorority involvement and team sports can be an integral and rewarding part of the college experience, students sometimes need to be reminded that pursuit of their major field of study is top priority. At least twelve hours of study time is recommended per week or two hours of outside study for each hour of class (Kuh, 2003). As good grades may have come easily to Millennials in high school, it is critical that realistic expectations for academic success in college be conveyed to them in early in the higher education environment (Sax, 2003). Without this understanding, frustration can ensue degrading the efficiency of the learning process.

The diversity of leaning concept that different students learn in different ways is also a driver for conveying material though a variety of methods. Primarily, we attempt to reinforce lecture material with timely laboratory projects. We have noted most of our aviation maintenance technologies students learn most efficiently when they can embrace a concept by literally getting their arms around it and hands into it. Since we are categorized as a vocational program, this would follow. We have also found that self-directed after hours study sessions, often at one of the student's residences, have likewise improved understanding of difficult subject areas such as avionics. Such venues provide not only educational but also socialization opportunities and can also serve as an occasion for get-together indulgences, hopefully when the evening's study agenda is completed. As the *Serving the Millennials* journal maintains, instructors are encouraged to remain flexible and willing to employ different methods as required for the greatest effect (King, 2003).

SUMMARY AND CONCLUSION

In her essay entitled *Why Don't My Students think I'm Groovy? The New "R's" for Engaging Millennial Learners*, Christy Price of Dalton State College iterates five themes of her research regarding the engagement of Millennials in the learning environment (Price, 2009). These are:

1. Relevance
2. Rationale
3. Relaxed
4. Rapport
5. Research Based Methods

In light of Ms. Price's research, we have seen that relevance is important in that students want to know why they need to learn a specific area of knowledge. The concept of knowledge for knowledge sake, which the author experienced in his college career back in the '60s, does not appear to apply to the Millennials as a substantial answer. Explaining the need for establishing foundations of knowledge to build on in the understanding of more advanced related concepts has to be explained and may still not be fully understood until completion of the process. Explaining why things are done the way they are may help to persuade the millennial student to embrace the learning process as the instructor presents it. An established caring connection to students as an extension of parental interest and concern may help to build and maintain a rapport conducive toward sharing and retention of information as long as it is considered to be reliable and relevant. The need for constant engagement and perhaps the shorter millennial attention span necessitates utilization of various teaching methods and media in a fast moving environment.

In conclusion, it should be mentioned that the learning process applies to instructors as well as students. Experimentation with different methods for course delivery not only keeps instructors current but also tends to keep the students engaged. Use of timely student feedback can be of benefit in this area. With the challenge still remaining, however, educating millennial college students through understanding the way in which they perceive issues, interact with their peers and the world around them can facilitate the educational process.

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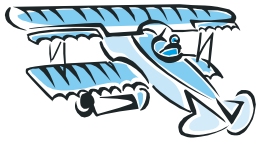
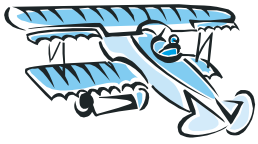
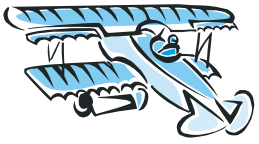
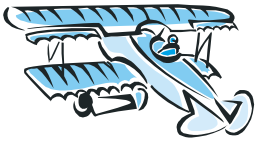

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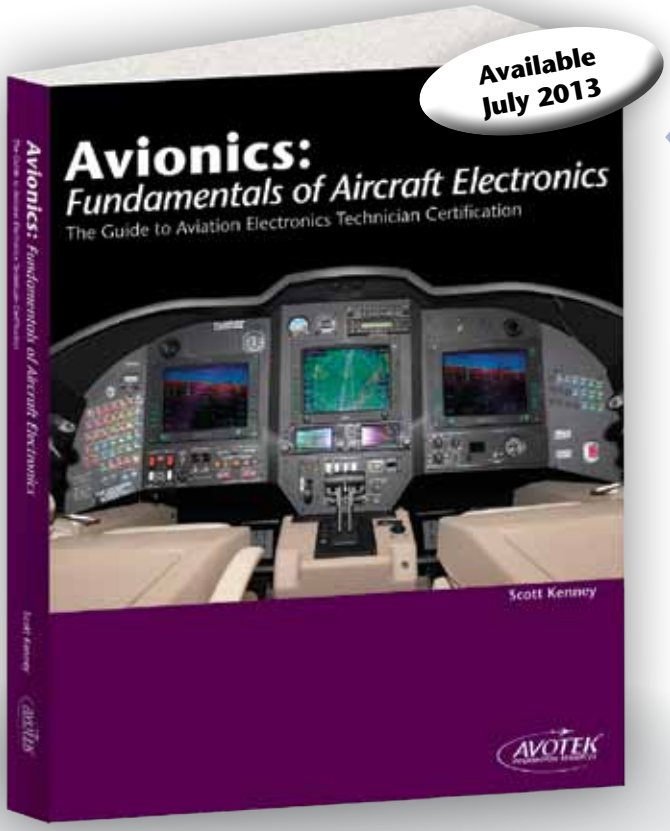

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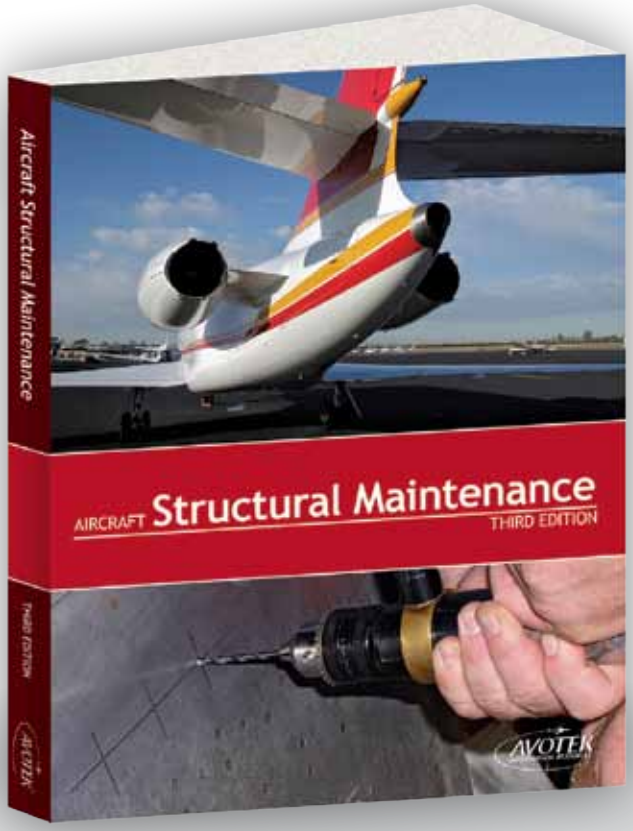

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Rotorcraft Manufacturer's Advancements in Producing a More Eco-Friendly Helicopter

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ABSTRACT
Manufacturers are attempting to design new and more eco-friendly technology that will allow helicopters to leave less of an environmental impact during the manufacturing, operational and retirement phases of the aircraft's life. Several initiatives and programs have been created that specifically target helicopters and the primary goals are to reduce carbon dioxide emissions, reduce the noise levels and protect humans and the environment from harmful chemical substances. Additionally, the objectives need to be met while not sacrificing safety, fuel efficiency, power available for operation, and airspeed.

The purpose of this paper is to educate the reader and audience about the technology and associated designs that are being evaluated by several helicopter manufacturers, which are mostly in Europe. Some of the manufacturer's designs and initiatives that will be discussed include those of Agusta Westland, Eurocopter, and Sikorsky.

An overview will be provided for each of the helicopter manufacturers that will include the technology advancements and eco-friendly programs that are being pursued and the resulting impact that it could have within the rotorcraft industry and on the environment.

INTRODUCTION
There have been no truly dramatic changes within the helicopter industry for the last several decades when it comes to designing and commercially producing a helicopter that is more environmentally friendly throughout the aircraft's life and produces a decrease in the level of noise that is emitted during flight.

Several programs and initiatives have been created with the goal of making helicopter more eco-friendly. One of the largest initiatives, called Clean Sky, is taking place in Europe through a coordinated effort among several major manufacturers that include Agusta Westland and Eurocopter. American commercial helicopter manufacturers, such as Sikorsky, are also attempting to produce light helicopters that have no emissions due to the development of electric motors that could be used as an alternative to the internal combustion engine.

CLEAN SKY
Clean Sky is an aeronautical research program that was launched in Europe with a mission to develop advanced technologies that will significantly increase the environmental performances of aircraft and result in less noise and better fuel efficiency. The Clean Sky Joint Technology Initiative was created in 2008 as a partnership between the European Commission and the aviation industry. The current schedule reflects that the partnered members have committed themselves to work together until December 31, 2017. The three major aviation companies associated with rotorcraft include Agusta Westland, Eurocopter and Rolls-Royce.

By the year 2020 the objectives for the overall aviation industry within Europe are to reduce carbon dioxide (CO2) emissions by 50%, reduce NOx emission by 80% and reduce noise perception by 50%. NOx is a generic term for mono-nitrogen oxides that includes NO (nitric acid) and NO2 (nitrogen dioxide) that are produced from the reaction of nitrogen and oxygen gases in the air during combustion.

As shown in Figure 1, a total seven of Green Rotorcraft (GRC) projects have been identified by the program. The responsibilities to conduct the necessary research and development in order to comply with the requirements of each project have been divided among the various manufacturers that have committed themselves to the program's goals and objectives.

A helicopter's main rotor design primarily determines how much power is required and it is also one of the major contributors to the amount of noise that is created during operation. One of the challenges is to improve upon the

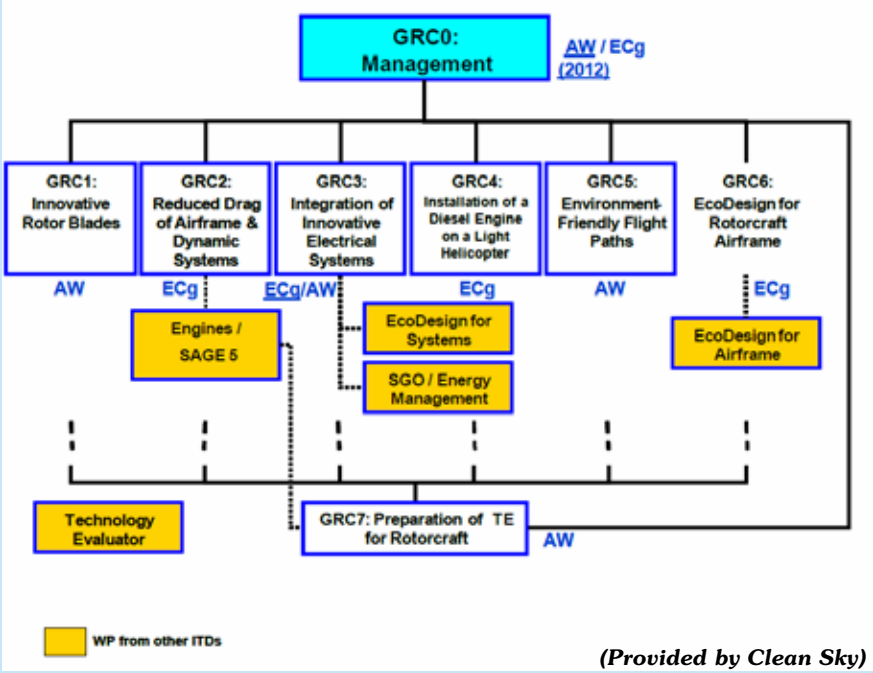

Figure 1. Clean Sky GRC Program Overview

efficiency of rotor blades and reduce the noise generated by the main rotor system. Goals of GRC1 include an 8% reduction in the power required in a hover and as a result decrease the fuel needed for operation, a 3% reduction in the power required while in cruise flight and a 6 decibel reduction in the noise level that is created during an approach. The helicopter manufacturers are looking at new technologies or further advancements with ongoing research that will provide the desired minimum improvements for the rotor system.

The focus for GRC2 is to analyze the current airframe and rotating parts that do not provide lift. Following the analysis, designs will be created to reduce the overall drag that is primarily introduced in forward flight with a slightly nose down attitude of the rotorcraft. Additionally, research will be conducted by further evaluating the designs and checking the efficiency of the engine's air inlets to ensure that maximum performance is not being compromised.

One of the goals in GRC3 includes the development of high performance electrical systems with the eventual goal of eliminating hydraulic fluid systems. This would mean that electrical motors could be utilized for electro mechanical actuation of the primary flight controls as well as landing gear retraction and extension. There will also be an attempt to design a system providing an alternative for ground taxiing a helicopter without the rotor spinning as a way to increase safety and save fuel. Additionally, conventional mechanical tail rotors would be replaced with electric tail rotors and the aircraft brake systems would be activated electrically instead of the current hydraulic brake systems that are being used. Benefits would include the removal of associated drive shafts and gearboxes while decreasing aircraft vibration levels, noise and gross weight. The advantages of using high performance electrical systems could result in large cost savings over the life of the aircraft, increase safety and decrease pilot workload and fatigue.

A breakthrough in technology for diesel engines will be required in order to obtain the necessary low specific fuel consumption and very low power to weight ratios that are targeted by the organization in GRC4. There are two goals that have been generated relative to the installation of diesel engines on light helicopters. The first goal is to fly an existing light helicopter with a diesel engine and validate the benefits of lower gas emissions. Clean Sky expects to see the fuel consumption reduced by at least 30%. The second step is to test an advanced helicopter manufactured by Eurocopter that has been specifically designed to be powered by an even more advanced diesel engine with exhaust systems that will remove additional pollution and they will be manufactured by Austro Engine in Austria. Afterwards, the organization then expects to see an additional decrease in fuel consumption, CO2 emissions that will be reduced by 40%, and a reduction of NOx emissions up to 50%. The current schedule reflects having completed these two goals sometime during the latter part of 2014.

The project that is taking place in GRC5 looks at trying to improve upon an aircraft's flight path. An aircraft's fuel consumption and the resulting production of CO2 and NOx are largely dependent on the flight conditions. Clean Sky is creating a database of information for different aircraft that includes the amount of emissions based on the flight parameters and associated speed, engine torque, and revolutions per minute (RPM). This information can then be used to try and optimize an aircraft's flight path and relevant flight conditions. A second part being looked at relative to

the aircraft's flight path is the noise footprint that is produced especially around more densely populated areas. Flight path procedures can be modified to reduce the perceived noise heard on the ground. This could include departures, low level flight, approaches and the rate of climbs and descents. Software is being developed for on-board systems that can be used by the pilot and automatically adjust the flight path for noise reduction measures.

Addressing the environmental impact as a result of aircraft manufacturing, maintenance, and retiring them from service and the products used for the three different phases of the aircraft's life are scrutinized in GRC6. Studies are being conducted to look at the raw materials and energy sources used during an aircraft's life from start to finish and see if viable alternates can be used that are less harmful to our environment and are still considered being economically sound. As an example, two demonstrators will be produced that utilize a helicopter door and a tail cone that are manufactured from composite thermoplastics which are considered to be ecolonomic materials and result in a reduced weight and cost less to produce. Composite thermoplastics are also considered to be a fully recyclable material. Also included as part of the demonstrators there will be gearbox housings and transmission shafts that are not manufactured with traditional cadmium plating, chromate primers, and some steel components. Instead, "greener" paints and chemicals will be used as well as new anodizing processes and the use of thermoplastic composites. Our ecology will be considered during every process for manufacturing the parts, how the parts will be maintained and how the parts will be disposed of when they can no longer remain in service.

As part of GRC7, the rotorcraft technology advancements and the lessons that are learned from GRC1 through GRC6 are taken and implemented into a technology evaluator. The technology evaluator is comprised of mathematical models that use software looking at the benefits gained from the different stages of testing and evaluation from the six green rotorcraft projects. The environmental benefits are then analyzed for implementation recommendations to the manufacturers that will use the data for the manufacturing, maintaining and retiring of rotorcraft. (Clean Sky, 2013)

AGUSTA WESTLAND

As a member of the Clean Sky Joint Technology initiative, Agusta Westland is one of the primary rotorcraft manufacturers given the responsibilities of researching and developing external noise reduction, cleaner and more efficient use of power, and flight paths that are considered to be more environmentally friendly. Additionally, they are also responsible for studying tiltrotor concepts, as they are currently completing the final requirements for producing and fielding the AW-609 tiltrotor aircraft. (Agusta Westland, 2013)

Part of Agusta Westland's research as part of GRC1 involves the development of a full scale rotor blade that includes piezoelectric actuators and allows the blade to actively twist during operation. By changing the shape of the rotor blade it will improve the blade's performance and reduce the noise that is generated during flight. Another design approach being investigated is to develop a new passive rotor blade that will have a different twist and/or anhedral in order to increase performance and decrease the noise that is generated during operation. These designs are being developed and will then be tested on a whirl tower for data collection. (Clean Sky, 2013)

As previously mentioned, one of the Clean Sky objectives in GRC3 is to develop and design high performance electrical systems. Agusta Westland is the primary helicopter manufacturer given this task. Their first goal is to replace hydraulic systems with electrical systems that do not unacceptably sacrifice the overall weight and cost of the aircraft. Their second objective is to develop electrical systems that are more efficient and can reduce carbon and other harmful emissions during operation. This will require electrical system development that is more advanced and efficient than what is being utilized in today's helicopters. The idea is that if the electrical system requirements are lower, than the engine power needed for them to operate is less which results in a lower engine fuel consumption and less emissions during operation. The systems that would be affected were previously discussed under the Clean Sky initiative goals and objectives.

Agusta Westland is the helicopter manufacturer as part of GRC4 that will investigate the installation of diesel engines on light helicopters in order to benefit from the lower specific fuel consumption and radically reduce emissions from CO2 and NOx. They will be developing guidelines for proper selection of the engine needed based on requirements for power, weight and fuel consumption. The engine will also have to meet certain criteria for emissions, noise and vibrations produced during operation.

Another project within GRC6 that has been undertaken by Agusta Westland is to look at reducing overall airframe drag that is created by helicopters and tiltrotors during flight. Both passive and active drag reduction techniques are being evaluated for use on the rotor hub, fuselage, empennage, tiltrotor wings and engine installations. Five different aircraft have been selected for evaluation to include the AW109, AW101, AW609 and two NH90s. Areas that will be concentrated on will include changing the shapes of the airframe and components, adding vortex generators, altering the exhaust, blowing of the trailing edge and the addition of controllable surfaces and laminar airfoils for use during forward flight. Once the proposed design modifications have been generated they will be tested in wind tunnels for evaluation.

The normal manufacturing, operational, repair and retirement phases for an aircraft are being carefully scrutinized in order to identify methods that leave less of an impact on the environment. Organic surface treatments are being assessed to replace zinc chromate and cadmium plating which are two of the primary substances that the organization will attempt to replace. Materials are be evaluated that can be recycled once the aircraft has been retired from service. (Agusta Westland, 2013)

EUROCOPTER

Eurocopter has a dedicated technology program called Bluecopter technology. The main areas being investigated by Eurocopter are Blue Edge blades, ways to reduce aerodynamic drag in forward flight, improved materials and processes, installation of a high compression diesel engine for light helicopters and Blue Pulse rotor blade technology. With improvements within the main areas of investigation, CO2 and NOx emissions can be reduced, internal and external perceived noise emissions can be reduced, more efficient overall designs can be produced, and less hazardous substances can be utilized in order to help protect our environment during the manufacturing, operational, and retirement phases of the aircraft. (Eurocopter Press Release, 2010)

As seen in figure 2, the Blue Edge rotor blades that have been developed by Eurocopter have a double swept design and they are very different than traditional rotor blades. The noise that is commonly associated with helicopters in flight is largely due to what is called blade-vortex interaction (BVI). As the blade is rotating, it is creating a vortex and the next blade impacts the vortex creating noise. Eurocopter has been testing the Blue Edge blade on an EC155 helicopter since 2007 and have proven that the blades can reduce the noise by half when the aircraft is in a descent. An overall reduction of 3 to 4 decibels has been demonstrated. (Professional Pilot, 2010)

Figure 2. Eurocopter Blue Edge Rotor Blade

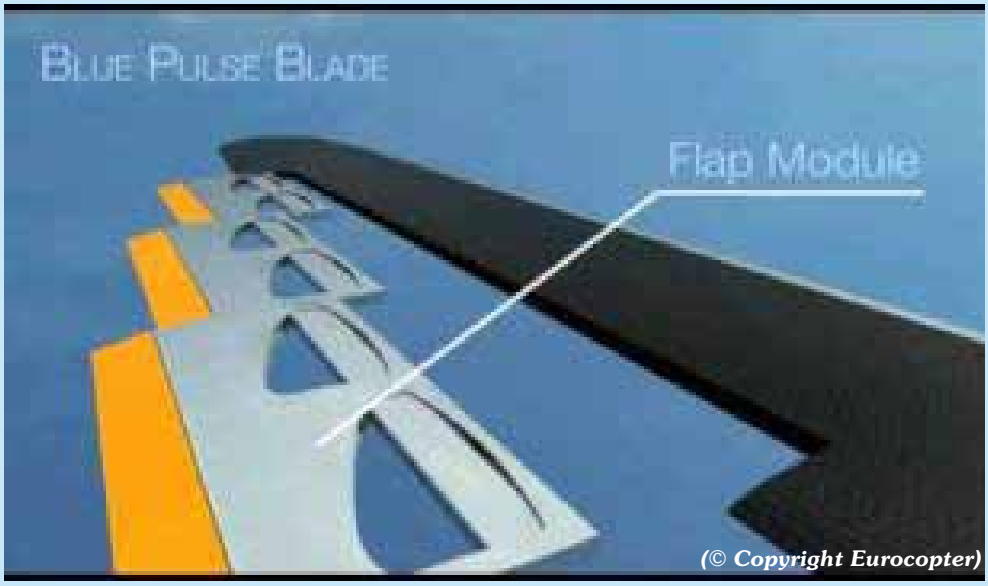

Figure 3. Eurocopter Blue Pulse Rotor Blade

The Blue Pulse rotor blade shown in Figure 3 has been tested on the Eurocopter EC145 helicopter and it too can be used as an additional noise reduction system. The rotor blade is equipped with three piezoelectric actuators installed within each rotor blade that control flap modules located on the trailing edge. The flaps modules are actuated between 15 and 40 times per second in response to the rotor blade tip vortices that are created during flight. The result is a reduction of noise of up to 7 decibels and a dramatic reduction of vibrations that are normally created by the rotor system. Advantages of the vibration reduction include a smoother ride and it also extends the service life of sensitive components installed on the aircraft. (Professional Pilot, 2010)

SIKORSKY

Several parties have been researching the use of an electrically powered helicopter. In 2010, Sikorsky announced a project called Firefly, as shown in Figure 4, which was developed by modifying their existing S-300C model helicopter. The engine was replaced by an electric motor and digital controller along with two battery packs that supply the power for the motor. Each battery pack consists of 150 individual 45 amp-hour lithium-ion cells and they are mounted on both sides of the helicopter. The battery packs run at 370 volts and are designed to provide enough power for a 15 minute flight with a single pilot and no passengers. (Zolfagharifard, 2010)

The Firefly was originally scheduled for its first flight in the latter part of 2010 or in early 2011. At this time, the Firefly aircraft has still not flown. An independent French engineer has designed and flown a small helicopter with two counterrotating rotors for 6 minutes using lithium-ion batteries mounted under the pilot's seat. (Schneider, 2012)

The benefits of an all electric aircraft are reduced noise, vibrations created by the internal combustion engine, and possible introduction of hazardous fluids to the environment. The Firefly is being developed by Sikorsky as a stepping stone to hopefully manufacture future light helicopters that have zero emissions and are considered to be simple, reliable and affordable. (Sikorsky, 2013) The biggest challenge is to acquire a power source that is lightweight and can support flight for a longer duration. (Zolfagharifard, 2010)

(Courtesy of Wikimedia)

Figure 4. Sikorsky Firefly

CONCLUSION

Upon completion of the Clean Sky coordinated effort in Europe by its members at the end of 2017, the goal is that the technological advances will be incorporated into the various manufacturers' designs and part of the aircraft being produced by no later than the year 2020. Aviation manufacturers within Europe have teamed up and are combining their resources and expertise in order to make a bold effort for combating the pollutants that are being introduced into our environment on a daily basis. At what monetary cost will this be made possible and can the aircraft operators afford to purchase their technology? This remains to be seen but the technology advances that could come out of their efforts could change the aviation industry as a whole.

The effort between the aircraft manufacturers within the United States does not appear to be as coordinated as far as working together to identify methods for producing a more eco-friendly product. On a smaller scale, it seems that U.S. companies are individually researching many similar alternatives that are being investigated in Europe with a lesser defined schedule or goal for completion.

As with other industries, the aviation industry needs to continue to design and incorporate engines that emit lower levels of pollutants, helicopters that can be operated more quietly and efficiently, chemical and treatment processes that are less harmful to our environment and lighter weight and stronger materials that can be recycled upon retirement of the aircraft. Technological advances will need to be accomplished at a cost that is affordable to the operators and customers in order to succeed with the production of a more eco-friendly helicopter.

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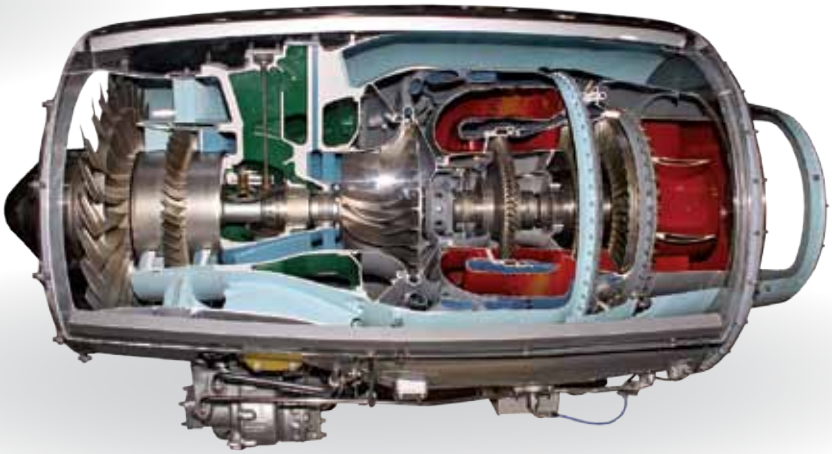

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Cost/Benefits of Blended Winglets Using Emissions Trading System Impacts

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INTRODUCTION

Aviation Technology has an important opportunity with the advent of emissions trading. The US does not have an emissions trading system, but Federal Aviation Administration has a goal to sustain aviation growth and protect the environment. For instance, the FAA has a goal to reduce carbon dioxide (CO_2) emissions by 2020 to a level at or below the emission in 2005 (FAA, 2012a). As of January 1, 2012, aviation is now included in the European Union (EU) Emissions Trading System (ETS) after the International Civil Aviation Organization (ICAO) failed to implement the mandated global scheme for aviation (Duffy, 2011). In an effort to mitigate the climate impacts of aviation, the EU decided to impose a cap on CO_2 emissions from all domestic and international flights – from or to anywhere in the world – that arrive at or depart from an EU airport. For instance, if flying non-stop from Chicago to Athens, the emissions for the entire flight are assessed, not just the portion of the flight over EU airspace. As of November 2012, the EU has decided to delay the implementation of the EU ETS for international flights until after the ICAO meeting in late 2013 that is to address a global solution for ETS. In the EU ETS, emissions for flights are capped through emission allowances. Emissions allowances also have a monetary value and are traded, within limitations. While the United States, China, and other countries are actively fighting to stop the EU assessing ETS charges, the European courts have upheld the ETS. Individual airlines are assessed CO_2 emissions based on the amount of fuel spent from pushback to takeoff to flight to arriving at the terminal. Airlines plan to pass this cost on to the consumer. The advent of emissions becoming a cost for airlines also provides opportunity for aviation technology professionals to justify the cost of fuel-saving aircraft modifications and innovations. This paper introduces the emissions trading system, describes a cost/benefit analysis using blended winglets, and suggests methods for inclusion in aviation technology classes.

EU EMISSIONS TRADING SYSTEM (EU ETS) SIMPLIFIED

The EU ETS system is a cap and trade system that limits the total amount of CO_2 emissions in terms of tradable credits, as opposed to a taxation system that would add a cost to fuels with no limitation on emissions. Beginning in January 2005, the EU Emissions Trading System covered only the heavy energy using industrial plants that are also responsible for nearly half of total EU CO_2 emissions (European Commission, 2012). As of January 2012, emissions are monitored from all flights arriving or departing from an EU airport in the 27 EU Member states plus Iceland, Liechtenstein and Norway. In December 2011, the European Court of Justice decided against some US airlines and their trade association in their suit to stop the inclusion of aviation in the EU ETS. In November 2012, the EU decided to delay implementation of the EU ETS for international flights until ICAO meets in late 2013 to discuss a global solution to emissions. However, the EU ETS is still applicable to flights within the EU. As with the industrial plants, airlines receive tradable allowances covering a certain level of CO_2 emissions from their flights per year. At the end of each year, airlines must surrender the number of allowances equal to their actual emissions in that year. Airline operators use a market to buy and sell their emission allowances cost-effectively. If an airline's actual emissions are lower than their allowances, surplus allowances may be sold or held to cover future emissions. If emissions are expected to exceed allowances, the airline can either take measures to reduce their emissions or purchase additional aviation emission allowances on the market from companies that have reduced their emissions (European Commission, 2012). Because emissions are now a cost, there are opportunities for investing in more efficient technologies or operational practices if purchasing allowances is too costly.

The total quantity of allowances to be allocated to aircraft operators is determined based on the average of the annual

emissions from years 2004, 2005 and 2006 (European Commission, 2012). The total quantity of allowances to be allocated in 2012 was planned to be equal to 97% of the estimated historical aviation emissions of the European Environment Agency (EEA), with further reductions planned through 2020. In July 2011, the EEA-wide cap for aviation was set at 221,420,279 metric tons (over 488 billion lbs) of CO_2. The calculation of historical aviation emissions is based on data from Euro control (the European Organization for the Safety of Air Navigation) and actual fuel consumption information provided by aircraft operators. Fuel consumption by auxiliary power units (APUs) on aircraft at airports was estimated. There may be changes to the EU ETS or a global ETS after the ICAO meeting in 2013 (European Commission, 2012).

Using the following formula, CO_2 emissions in metric tons from aviation activities may be estimated by:

CO_2 emissions = Fuel consumption in metric tons * emission factor

In this equation, fuel consumption may be estimated with fuel volume consumed in liters and a standard density factor of 0.8 kg/liter and 1000kg per metric ton. Emission factors are 3.10 for AvGas and 3.15 for Jet A1 or Jet A in metric tons of CO_2 /metric ton of fuel (The Commission of the European Communities, 2009). Alternately, the number of kilograms of CO_2 may be found by using a factor of 9.75 kg CO_2 per gallon for Jet A or 8.31 kg CO_2 per gallon for Avgas (EPA, 2011).

CO_2 emissions = Jet A Fuel consumption in gallons * 9.75 kg/gallon * 1 metric ton/1000 kg

CO_2 emissions = Avgas Fuel consumption in gallons * 8.31 kg/gallon * 1 metric ton/1000 kg

This brief introduction is meant to provide basic information on EU ETS. More complete information and extensive explanations may be found at the European Commission website www.ec.europa.eu. In addition, the websites for the FAA, International Air Transport Association, and International Civil Aviation Organization have in-depth information on carbon emissions from aviation activities.

AIRFRAME MODIFICATIONS: BLENDED WINGLETS AND SHARKLETS

One way of reducing fuel consumption and emissions is the use of airframe modifications that reduce drag and improve airplane performance. The wings of some aircraft are being modified to add wingtip devices and other aircraft are now built with wingtip devices, such as the one in Figure 1. Many older model 737, 757 and 767 Boeing aircraft have been modified to add winglets, and 737-700, -800, -900ER have winglets as original equipment. Boeing flight test data demonstrated that blended winglets lower block fuel consumption and carbon dioxide (CO_2) emissions by up to 4 percent on the 737 and up to 5 percent on the 757 and 767 (Freitag & Shulze, 2009). Block fuel is the amount of fuel consumed during a mission from engine start to engine shutdown. (Airlines.net, 2012) Freitag and Shulze (2009) report a fuel savings for a 737-800 with 162 passengers on a 1000 nautical mile flight are estimated at 3.5%. For a single 767 airplane saving 4%-5% results in a reduced jet fuel consumption of 500,000 U.S. gallons per year. This translates into an annual reduction of more than 4,790 tons of CO_2 for each airplane Blended winglets improve takeoff performance on the 737, 757, and 767, allowing lower takeoff thrusts that result in lower emissions and lower community noise. Estimates of savings vary depending on the aircraft, load, route, and other factors as shown in Table 1 (Freitag & Shulze, 2009). An article in Boeing's Aeromagazine has much more detail on the winglets and how these devices work to improve aircraft performance (Freitag & Shulze, 2009).

Figure 1. Example of a Wingtip Modification

Airbus has installed wingtip fences and larger winglet type devices on the A300, A310, A330, A340, and A380 as described on their website www.airbus.com. By improving take-off performance, these devices are reported to lower emissions and noise (Airbus, 2012). Airbus' newest wingtip devices providing aerodynamic improvements are called Sharklets and are installed on the A320s. Some of the benefits cited by Airbus include reduced fuel consumption and emissions, increased range and payload, lower maintenance costs, and better take-off performance and rate-of-climb among others. With Sharklets, revenue payload may increase by 500kg (1,102lbs) or an additional 100nm range at the original payload. If Sharklets perform as expected, fuel consumption by be reduced by 3.5% or more, representing an annual CO_2 reduction of approximately 700 metric tons per aircraft (Airbus, 2012).

Table 1

Sample estimates of fuel savings on airplanes equipped with blended winglets

Aircraft	Nautical Miles	Estimated Fuel Savings Percentage
737-800	1,000	3.5%
757-200	1,000	3.2%
767-300ER	3,000	4.4%

Note. Fuel numbers in lbs. Adapted from (Freitag & Shulze, 2009).

Table 2

Winglet Prices

Aircraft	**Base Price Uninstalled**
737-700/800/900	$1,000,000
737-300/500	$590,000
757-200	$1,055,000
757-300	$1,185,000
767-300 ER/F	$2,265,000

Note. Adapted from (Aviation Partners Boeing, 2011). All prices are stated in U.S. Dollars and are subject to escalation from January 2012 using U.S Bureau of Labor Statistics producer price index: WPU142 – "aircraft and aircraft equipment".

A sample of winglet prices are reported in Table 2 (Aviation Partners Boeing, 2011). Blended winglets for a 767-300 ER/F cost $2,265,000, plus approximately $500,000 for installation, giving a total of $2,765,000. Table 3 provides a savings analysis, in fuel and CO_2 emission credits, assuming the plane consumed 5,000,000 gallons of fuel in one year. Estimated costs for Jet A are $3.19/gallon (International Air Transportation Association, 2012) and CO_2 are $9.14 (Intercontinental Exchange, 2012) per metric ton using costs and currency conversions for April 2, 2012. Prices for metric tons of CO_2 are expected to change as they are a tradable item. The payback period is estimated at 5.6 years. The payback period will decrease as the amount of fuel is increased per year; for example 10,000,000 gallons of fuel consumed will have a payback period of 2.8 years. This cost/benefit analysis only looks at the economic benefits and does not attempt to quantify the environmental or social costs and benefits. The installation of winglets may occur during a heavy check, but may add days to a C-check. The increased cost of downtime, if any, for the aircraft is not included.

Table 3

Example of Economic Cost/Benefit Analysis in U.S. Dollars

Initial Investment

Aircraft	Modification Cost	Installation Cost	Total Cost
767-300 ER/ F Winglets	$2,265,000[a]	$500,000	$2,765,000

Savings from 3% Fuel Consumption Reduction

From	To	Price per Unit	Annual Savings
Fuel Consumption 5,000,000 gallons	Fuel Consumption 4,850,000	3.19/gallon[b]	$478,500
CO_2 emissions 48,750 Metric Tons	CO_2 emissions 47,288 Metric Tons	$9.14/metric ton[c]	$13,363

$2,765,000 / $491,863 = 5.6 years for payback based on fuel and CO_2 emission savings

Payback Period = Initial Investment Cost / Total Annual Savings

Note. [a](Aviation Partners Boeing, 2011). [b](IATA, 2012). [c](Intercontinental Exchange, 2012).

To get a better idea of the amount of carbon dioxide estimated for flights, Table 4 displays CO_2 emission calculations for round trip flights from and to cities in the US and Europe. These figures are based on information provided by the ICAO Carbon Calculator on the ICAO website www.icao.int (International Civil Aviation Organization, 2012). This calculator estimates the carbon dioxide generated by airline passengers based on the fuel consumption by the aircraft typically on the route, cabin capacity, load factor, and other factors. In addition, estimates for a 3.5% and a 4.0% reduction in fuel consumption are shown in Table 4.

Table 4

Estimated Carbon Emission Reduction Analysis with CO_2 amounts based on the ICAO Carbon Calculator

From	To	Distance Round Trip	Round Trip CO_2 Emissions[a]	3.5% CO_2 Reduction per Flight[b]	4% CO_2 Reduction per Flight[b]
London, (LHR)	New York (JFK)	11,076km (6,882 mi)	725 kg 1,595 lbs	25 kg 55 lbs	29 kg 64 lbs
Chicago, (ORD)	Frankfurt (FRA)	13,930km (8,655 mi)	918 kg 2,020 lbs	32 kg 70 lbs	37 kg 81 lbs
Dallas/Fort Worth, (DFW)	Paris (CDG)	15,864km (9,857 mi)	1,039 kg 2,286 lbs	36 kg 79 lbs	42 kg 92 lbs
Rome (FCO)	Miami (MIA)	16,644km (10,342 mi)	1,083 kg 2,383 lbs	38 kg 84 lbs	43 kg 95 lbs
San Francisco, (SFO)	Madrid (MAD)	18,652km (11,589 mi)	1,536 kg 3,379 lbs	54 kg 119 lbs	61 kg 134 lbs

Note. Distance Rountrip in km and round trip CO_2 emissions in kg from ICAO Carbon Calculator (ICAO 2012). Factor to convert from km to mi 0.621 from U.S. Department of Transportation Federal Highway Administration (U.S. DOTFHA, 2003) [b]Factor to convert from kg to lbs 1/0.45359 from Environmental Protection Agency (EPA, 2004).

CONNECTIONS TO PART 147 PROGRAMS AND AET PROGRAMS

Aviation Technology professors may wish to consider ways to include emissions information in their courses in Part 147 programs and aeronautical engineering technology programs. One idea to consider is to add coverage of blended wingtip modifications in airframe structures courses, such as those courses that cover labs for 14 CFR Part 147, Appendix C, 1. Airframe Structures, number 25, "assemble aircraft components, including flight control surfaces" (FAA, 2012b). A suggested place to start in freshman level courses is to use the two-page NextGen and The Environment flyer (FAA, 2012a). The flyer briefly introduces emission reduction goals in noise, air quality, climate, energy, and water quality. A discussion with students in class could be guided by the instructor to help students to brainstorm ideas on how to solve aviation challenges and to connect their courses to aviation in a global business environment. In addition, wingtip modifications and emissions goals could be included in classes discussing STCs, aircraft modifications, fuel efficiency, piston engines, gas and turbine engines, and emissions related to engine performance. Other courses in aviation management or flight could also include emissions discussions in their courses on airline operations, maintenance operations, aviation regulations, or aviation finance. Using examples in class related to the headlines in aviation publications can demonstrate that a career in aviation requires life-long learning.

While the EU ETS currently affects flights only within Europe, reducing fuel consumption is a goal of aviation companies around the globe. By reducing fuel consumption, aviation emissions may also be reduced. If ICAO develops an emission trading scheme or other emission limitation scheme, then aviation companies from nations across the globe will be involved. By understanding more about emissions, aviation students are exposed to regulations and jargon from the FAA and agencies in other nations. This knowledge may lead to an aviation technology graduate being more valued in their future careers.

CONCLUSION

The EU Emissions Trading Scheme imposes added costs for airlines and air travelers within Europe, and international flights to and from Europe if the ETS delay is rescinded after the late 2013 ICAO meeting. At the same time, EU ETS provides an added opportunity for aviation technicians to devise modifications to aircraft, engines and operational methods that reduce fuel consumption and emissions. An important member of an emissions reduction team is an aviation technology graduate who has the in-depth knowledge of aircraft operation and maintenance. These people may work to reduce fuel consumption and emissions by making recommendations for changes in maintenance, operations, and future modifications of aircraft. As aviation is a global business, it is important for students to be prepared to participate in discussions that include regulations from the US and other nations. In addition, aviation students should be prepared to be an active life-long learner as aviation regulations and technologies are expected to change throughout their careers.

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BIOGRAPHIES

Mary E. Johnson is an Associate Professor in Aeronautical Engineering Technology at Purdue University. She is Assistant Department Head for Graduate Studies and Research. Her research interests include aircraft engine emissions, process improvement, and aviation sustainability.

Alan Gonzalez is a graduate student in Aviation and Aerospace Management at Purdue University. He plans to complete his MS in May 2013. His research interests are in emission trading schemes and their effects on US and global airlines.

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Conference Vendors

Awards and Scholarships

John Wing of Wing Arrow Products presenting student book sets.

Karl Stoltzsus, Jr. presenting the Dale Hurst Scholarship

Ivan Levi Instructor of the Year, Fred Dyer, presented by Ray Thompson, ATEC President

James Rardon AMT Student of the Year, Maria Libert, Aviation Institute of Maintenance (Chesapeake, VA)

Awards and Scholarships

2013 NRF-Administered Awards and Scholarships

STUDENT RECOGNITIONS		
Recognition	Sponsor	2013 Receipent(s)
James Rardon AMT Student of the Year	**Northrop Rice Foundation (NRF) and Aviation Technician Education Council (ATEC)**	**Maria Liberto** Aviation Institute of Maintenance (Chesapeake VA)
Aviation Maintenance Training Scholarship (Value: $1,000)	**Aeronautical Repair Station Association**	**Andrew Kocarnik** Iowa Western Community College
Aviation Maintenance Book Sets (Value: $250 each)	**Avotek LLC**	**Jeff Lackey** Aviation Institute of Maintenance (Kansas City) **Trevor Merriweather** Aviation Institute of Maintenance (Irving TX) **Andrew Vandenberg** Spokane Community College **Kolade Bakare** Aviation Institute of Maintenance (Irving TX) **Brian Butler** Aviation Institute of Maintenance (Kansas City)
Aviation Maintenance Training Scholarship(s) (Value: as noted)	**Northrop Rice Foundation (NRF)**	**Douglas Rand** ($1000) Tulsa Tech **Jesse Dye** ($750) Cincinnati State Technical and Community College **George Powell** ($750) Atlanta Technical College **David Montes** ($500) Aviation Institute of Maintenance (Irving TX)
Snap-On Tool Certificates (Value: $4,000 each)	**Snap-On Incorporated**	**Nicholas Bright** Michigan Institute of Aviation and Technology **Carille Carlton** Trident Technical College **Jennifer Johnston** Aviation Institute of Maintenance (Kansas City) **Richard Mendez** Greenville Technical College **Ryan Stahlbusch** Middle Tennessee State University

Awards and Scholarships

2013 NRF-Administered Awards and Scholarships

STUDENT RECOGNITIONS (Continued)

Recognition	Sponsor	2013 Receipent(s)
Aviation Maintenance Book Sets (Value: $320 each)	**Wing Aero Products, Inc.**	**Christie Swehla** Aviation Institute of Maintenance (Irving TX) **Joseph Haddad** Teterboro School of Aeronautics

INSTRUCTOR RECOGNITIONS

Recognition	Sponsor	2013 Receipent(s)
Helicopter Maintenance Training Scholarship (Value: Variable)	**American Eurocopter**	**Nathan Ariel Holes** Spokane Community College
Dale Hurst Financial Assistance Scholarship (Value: to $1,500)	**Avotek LLC**	**Wm. David E. Parish** Portland Community College
King Air Maintenance Course Scholarship (Value: $7,200)	**FlightSafety International**	No Applications
Aviation Upgrade Training Scholarship(s) (Value: to $1,000)	**Northrop Rice Foundation (NRF)**	No Applications
Boeing 737-700 Avionics or Systems Training Course Scholarship (Value: Variable)	**Southwest Airlines**	**Flavio Camacho** Teterboro School of Aeronautics

SCHOOL RECOGNITIONS

Recognition	Sponsor	2013 Receipent(s)
Aviation Maintenance Training System (Value: $12,280)	**Nida Corporation**	**Aviation Institute of Maintenance (Kansas City)**
Model 53025 Start Pac Power Supply (Value: $500)	**Rotorcraft Enterprises**	**Pennsylvania College of Technology**

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Initial Review of an i>clicker Student Response System in an FAR Part 147 Program

Karen J. Sullivan
Southern Illinois University Carbondale
Keven R. Mitchell
Southern Illinois University Carbondale

In January 2013, faculty in the Department of Aviation Technologies at Southern Illinois University Carbondale were encouraged by findings that new generations of students learn more effectively with the use of a student response systems (SRS) and, therefore, began using i>clicker technology in some of their Bachelors of Science in Aviation Technologies courses. Some courses in the FAR Part 147 subjects have adopted the SRS for the SIUC Spring 2013 semester. This article demonstrates the benefits of implementing the i>clicker into the lecture portions of two courses in the program, the grading and record keeping capabilities, lessons learned by the faculty that participated and ways to setup the i>clicker system in classrooms.

Character traits of the new Millennial generation learner indicate that it's becoming increasingly more difficult to engage students during lecture style classes (Taylor, 2011), however, one study found that student's attitudes when, using i>clickers in the classroom, seem to improve because such use can encourage participation in discussions with classmates (Keller, 2007).

The i>clicker SRS has shown positive results in both small and large classrooms such as improved attendance and motivation, and higher interactivity (Lea, 2008), all of which are great benefits for traditional style lectures where newer Millennial students are struggling to maintain their focus. At SIUC Aviation Technologies, class sizes range anywhere from twenty to fifty, and are mostly comprised of students that are 25 years of age or younger. Aviation Technology lectures are designed to introduce practical theories and principals to students before they attempt to perform hands-on projects in laboratory settings, so keeping them engaged is very important, not only for effective learning, but also for safety reasons.

The three classes from which these observations were obtained are general and airframe subjects: Aircraft Hydraulics, Aerodynamics and Metals Processing. Each class has two hours of lecture each week and four, two and three hours of laboratory, respectively. Students in these classes are typically in their first or second year of the four-year program.

Although there are many aspects that can be discussed in regards to i>clicker use, this article focuses on the following issues that this faculty initially recognized during their first semester of use: attendance, testing/quizzing, feedback and setup.

ATTENDANCE

As we all know, FAR Part 147 programs are required to keep strict attendance records for students enrolled in these classes. With class sizes nearing fifty students, the traditional act of taking attendance by calling role can take away from precious time during a fifty-minute lecture. In addition, tardy students may require instructors to interrupt lecture to adjust their records accordingly. i>clickers can allow students to "check-in" on their own by answering an official "Who's here?" quiz at the beginning of the class.

SIUC Aviation Technologies' FAA approved curriculum considers students arriving after the start of class, less than ten minutes late, as tardy. Any student arriving after ten minutes into the class is counted as absent. Tardiness can be recorded just as easily with i>clickers by opening two "Who's here?" questions; one within the first minutes of class, followed by the second, which remains open until ten minutes into the hour. Anyone arriving after the close of the second "Who's here?" question will appear as absent in the i>grader. However, instructors must be mindful when tallying points from i>clicker sessions, that students who arrive more than ten minutes late are still able to answer any i>clicker questions that may have been asked during the remainder of the class. These adjustments would have to be manually made to those students' grades.

The i>clicker session times are also recorded in the i>grader software that accompanies the SRS. For proof of time when attendance and tardy records are obtained during classes, faculty can generate summary reports that will indicate the start and stop time of each "Who's here?" question

automatically with the i>grader. This tool can be useful if disputes between students and faculty were to occur over missed time in class or if an FAA PMI were to request to review attendance recording procedures.

TESTING/QUIZZING

In addition to the "Who's here?" quiz, students can take traditional quizzes and tests using the i>clicker. Test questions can be displayed as PowerPoint slides on a classrooms display system while student's answers are recorded by the SRS. i>clickers can answer multiple questions per slide, so the instructor can create slides with one question at a time or as many that will fit onto the slide.

A concern with testing in this manner is the increased ability of students to cheat. Being a handheld device, students don't typically lay the i>clicker flat on their desk when in use, instead, holding them near to their person, or in their laps. With one twist of the wrist, this can create an increased visibility of which button is pressed or which answer is displayed on the i>clicker screen to students seated nearby. For large classes, ample space between seats may not be an option to solve this problem. Testing and/or quizzing with i>clickers may be better suited for use in smaller size classes.

i>clickers 2 can only be used to answer matching and multiple choice questions, to rank or order lists, or to give numerical value answers, which prevents instructors from being able to write open-ended questions for tests and quizzes. However, using them for reviewing the FAA written test questions works well.

As with attendance taking, instructor's must be aware of the possibility that a student may have multiple i>clickers in the class, using one to answer questions for a student who is absent. The best solution in this case is simply to count the number of students in attendance and compare to the recorded number of respondents.

FEEDBACK

Before the start of a new subject it is possible to ask a few questions to determine the level of instruction needed or as a baseline for comparison later at the conclusion of the new subject. The i>clicker SRS allows the instructor to immediately show the class the correct answer to questions asked during lectures, sample results chart is shown in figure 1. Students can instantly see how they compare to the other students in class, allowing them to gauge their progress. Furthermore, in this faculty's experience, students rather enjoy seeing the classes overall response to questions. In addition to the feedback being immediate, there is also the added benefit of the student's feedback being anonymous, rather than students having the fear of verbally giving an incorrect answer in class.

The instructor also benefits from this immediate feedback, knowing whether the topic has been adequately covered or possibly needs to be readdressed. For students and instructors alike, assessing students understanding directly after topics are introduced, can be much more effective than waiting days or weeks for test and quiz results.

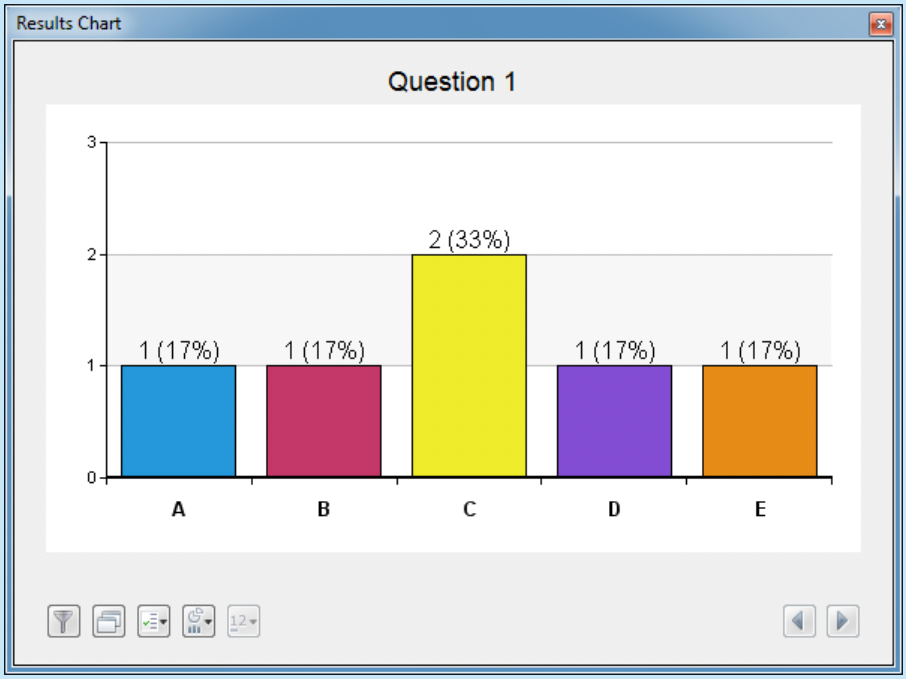

Figure 1, Sample results charted for Question 1

SETUP

As shown in figure 2, each instructor received a startup kit from i>clicker with a base receiver unit, USB flash drive with i>clicker and i>grader software loaded on it and two i>clicker 2 SRS units. The student's unit is white and the presenter's unit is blue. The presenter's unit has additional features enabling the start and stop of shows and questions, along with a built-in laser pointer and PowerPoint slide changer. Having the white, student unit allows the instructor to test the effectiveness of the i>clicker integration into their presentation during course development.

Figure 2, The i>clicker System

The initial setup for using the i>clicker system in the classroom is fairly straightforward by first connecting the i>clicker base receiver's USB connector to your computer system, that uses Windows or Macintosh based operating systems, and then connecting power. To begin installation of the i>clicker software onto the computer, insert the provided USB flash drive into the computer's USB port, then locate and double click on the appropriate folder titled iclicker Windows or Macintosh. The program should start and with the use of i>clickers User Guides obtained from their website, you can follow step by step instructions for the set up of your specific course.

In our case, the base receiver units are set up in several neighboring classrooms, so to eliminate any possible interference of information from other classes, varying frequency bands are used. This is easily accomplished by setting the base receiver unit in each classroom to a different frequency to use during instruction and posting the frequency of each room for students to set their i>clicker unit to. Students also have access to a User Guide from the i>clicker website, in addition, there are simple, common use instructions on the back of each i>clicker SRS unit that can easily be referenced during class.

For grading, the presenter simply downloads the i>grader software from the provided USB flash drive to their personal computer. Again, there is software provided for both Windows and Macintosh operating systems. The USB flash drive collects the data from the i>clicker session in the classroom and automatically transfers it for use with the i>grader functions. i>clicker also provides User Guides for i>grader use on their website. During set up of the i>clicker/i>grader course, instructors have the option of syncing with their institution's Learning Management Systems (LMS) as shown in figure 3, which will align any points received during class from the SRS with the class roster from the LMS.

During our initial launch of the i>clicker SRS system, the individual course syllabi called out the requirement of i>clicker version + or 2 SRS units for students to obtain. However, in the coming Fall semester 2013, our University will begin issuing Android based tablets to all incoming freshmen. With the use of tablets and smartphones, a strong wireless network has been set up to ensure connectivity in every classroom to facilitate student participation. Students will now have the option to download a web>clicker application (App) on line. The web>clicker iOS App is compatible with iPhone, iPod Touch, and iPad running iOS 5.1.1 or later while the web>clicker Android App is compatible with Android devices running Android OS 2.3.3 or later. The web>clicker version for laptops is also available and requires a minimum browser of Microsoft Internet Explorer 7.0, Mozilla Firefox 14, Apple Safari 5.1, Google Chrome 21, or any other fully compatible browser. The decision to allow web>clicker in classrooms is at the discretion of the instructor and has to be enabled, on the receiver base unit, by the instructor for use in their classroom (Experience web>clicker, n.d.).

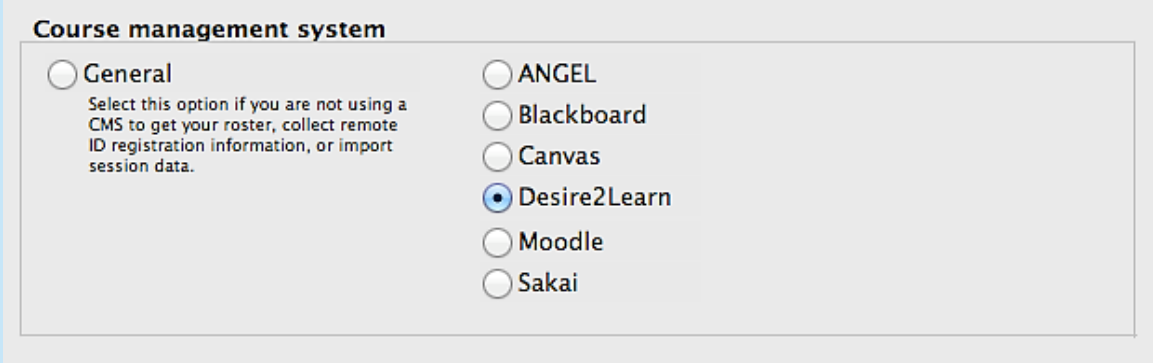

Figure 3, Sync options available for Leaning Management Systems

In conclusion, from a user's stand point, it is refreshing to see that i>clicker makes easy to access and follow User Guides available on their website, which greatly facilitates their use at your institution. The i>clicker SRS can offer exciting new options to increase class participation and improve comprehension with minimal interference with FAR Part 147 program rules. In fact, some functions available with the i>grader software may even serve to make record keeping simpler and more organized and uniform. Of course, instructors must do their due diligence to assure themselves and their PMI that they have eliminated any avenues for dishonest use by students. As practices similar to university issued tablets increase, and as i>clicker upgrades their product through new versions of the i>clicker and web>clicker, the level of effectiveness of an SRS with newer generations of students has great potential.

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ATEC Update

PRESIDENT'S REPORT – Raymond Thompson

After every ATEC conference, the board assesses the conference, your feedback, and reflects on how to make improvements in the coming year. A large focus at the 2013 conference was Part 147 change. We appreciated the input and a revised version of the curriculum will be made available for member comment prior to submission to the FAA.

The key to greater involvement and transparency of operations is by improved communication. ATEC will continue to improve communication via the website and direct mail and email. However, we are limited to communicating to those who we are aware of. Each institutional member has a designated contact person. Past that, we need your help to gather the contact details for all those who work at a AMTS so we can be assured that everyone receives updates. Please go to www.atec-amt.org and click Contact Us at the bottom of the homepage. Select Business Office and provide your details to be added to the contact list.

The coming year will be busy. We look forward to continuing our work together to change Part 147.

Best – Raymond Thompson

ATEC CONFERENCE AND MEMBERSHIP

ATEC membership stands at 100 institutional and 20 industry members.

63 schools were represented at the conference. There were 112 registrants. 19 companies exhibited at the 2013 conference.

ATEC COMMUNICATIONS COMMITTEE – Paul Herrick

The Communications Committee of ATEC has been primarily continuing its work to improve the organization's web presence.

The Committee would like to receive feedback on the website in the areas of:

- Look, feel, organization, arrangement, etc.
- Functionality
- Timeliness
- Responsiveness (thru contact forms)
- Shared Curricular Materials (see: http://www.atec-amt.org/shared-curricular-materials.html)
- Use of media (pictures, video, etc.)
- Member ads/postings (see: http://www.atec-amt.org/postingsads.html)
- Future features:
    - E-commerce
    - Blogs
    - Discussion Boards
    - Surveys/Polls
    - Subscriptions:
        - Website updates
        - Email notifications/newsletters
    - Social media
    - Limited use of 3rd party advertising
- And anything the membership would like to see

Feedback can be given through the website directly to the Committee using an online form at: http://www.atec-amt.org/comm-comm-submit.html.

In addition to this web work, the Committee is reviewing and evaluating *all* forms of communication used by the organization. The goal of this review and evaluation is to determine the appropriate type, frequency and priority of communication to best serve the membership.

GOVERNMENT RELATIONS COMMITTEE – Andrew Smith

In August 2012 – AMTS in Oklahoma visited with Mr. Smith concerning the integration of Human Factors curriculum into their General curriculum classes.

September – ATEC Board met and Board Members of the FAA Working Group (at FAA HQ) continued their activities. Also, Board Members held face to face meetings with Helicopter Association International HAI (www.rotor.com) and the Aeronautical Repair Station Association ARSA (www.arsa.org) both in Alexandria, VA followed by weekend Board meetings in Washington DC/Crystal City, VA.

Human Factors curriculum and FAA Airman testing in HF continues to be reasons for phone calls, emails and website inquiries. New test guides are updated and for the most part HF questions on General computerized knowledge tests have transitioned smoothly.

AFS-600 was considering a transition of Form 8610-2 into an electronic processing system, but due to cutbacks this plan is on hold.

The Oral & Practical testing review group (FAA/Industry) completed their work and the FAA was developing a random generator for practical projects like the oral question generator, again with cut backs, there has been no work on this advancement.

Recently FAA Airworthiness Safety Inspectors received information that one day per pay period will be a mandatory day off with no pay: again a sign of government cut backs.

Aside from items listed GR Committee has been quiet, a good sign in the regulatory arena.

INSTRUCTIONAL MATERIALS COMMITTEE – David Jones

In the past, this committee has been dedicated to acquiring donations and the right to distribute educational materials developed primarily by the aircraft manufacturers and making copies available to the ATEC membership. This has resulted in a decent sized library of audio-visual presentations representing a number of aircraft and related subjects. Unfortunately, our litigious society has made the manufacturers very reluctant to allow us to use new materials. This has effectively dried up our source.

ATEC has chosen to look toward our own membership for instructional materials that schools are willing to share. While schools are certainly not in the same category as aircraft manufacturers we must address copyright issues and ensure that the material we make available to our membership are in fact free to be distributed. The ATEC website has undergone a major overhaul, and a section has been set aside to provide access to member-provided materials. We are examining a variety of processes by which we can ensure that copyright and intellectual property laws are followed. We look forward to having additional material available to our membership next year. Keep an eye on the website!

MEMBER RELATIONS COMMITTEE – Amy Kienast and Ryan Goertzen

1. Develop 10 new industry contacts
    a. Organizations: RACCA, HAI, AABI
    b. Industry: American Eagle, Price Induction Turbo Fan Engines, ATEQ Corporation, Premier Aircraft Services
    c. In discussion: Trans States Airlines, RAA, Skywest Airlines, Allegiant Airlines, Jet Blue Airways

2. Increase vendor participation at the annual conference

    With the help of all the board members, new exhibitors at the 2013 conference included: American Eagle, HAI, Price Induction, Inc, Matco Tools, Premier Aircraft Services, ATEQ, AABI

3. Develop new marketing materials

    A new brochure has been created about ATEC and was debuted at the Helicopter Association International Conference in February 2013. Copies are included in this mailing.

4. Develop a content management portal

    President Thompson spearheaded this effort and documents have been uploaded to the new ATEC web site. The Member Relations committee will work on promoting this to membership and assisting where needed.

5. Develop four educational webinars

    a. Lead Source Generation and Start Rate Strategies, Troy Harris, January 2012
    b. Teaching Beyond the Dirty Dozen Poster, Ryan Goertzen and Dr. Bill Johnson, September 2012
    c. Part 147 Change is Coming, Dr. Raymond Thompson, March 2013
    d. Part 147 Change is Coming, Dr. Raymond Thompson, March 2013

6. Member contact system

    Stage 1- Member Relations oversaw a project to contact as many schools as possible to get updated contact information. The business office updated the database they use for member outreach. Additional calls still need to be completed to reach the remainder of the members.

    Stage 2- Member Relations provided a presentation to the board regarding a formal contact system such as Mail Chimp or Constant Contact. Recommendations were made by the presenter.

    Stage 3- ATEC board will review the pros/cons of moving to a formal contact system that has opt in/opt out procedures to stay compliant.

7. Increase industry-based scholarships- ATEC continues to partner with Northrop-Rice Foundation for the scholarship process and the committee has decided there is an adequate number of scholarships for students and instructors to apply for at this time. Initial discussions have been started with some of the airlines about offering additional scholarships. The committee is looking for member feedback on any additional scholarships that instructors/students would be interested in.

8. Develop an Industry Advisory Board

    This goal has been transferred to the FAA 147 Working Group. As a part of the original ARAC recommendation concerning the development of an industry panel to advise on curriculum modification to 147 educational requirements this goal will continue as a task assigned to ATEC organizationally to develop and fulfill.

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We will make the changes on the website once we receive your information.

ATEC WEBSITE PASSWORD (Keep in a Safe Place)

A protected section of the website has been designed for members only. The password is "atecnew".

ON-LINE AD POSTINGS

Don't forget to post your ads, position announcements, swaps and trades on www.atec-amt.org.

Click on "Member Services".

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