ICATEE Strategic Plan

Dr. Sunjoo K. Advani, Chairman

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This document outlines the strategy of the International Committee for Aviation Training in Extended Envelopes, ICATEE. The plan illustrates where ICATEE is today, its principle foundations, where industry requires ICATEE to be in the short and long-term, and the structure, resources and activities required to achieve this mission.

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Summary

Loss-of-Control In-Flight (LOC-I) accidents has for some years been the greatest threat to aviation safety in terms of hull losses and fatal commercial aviation accidents. LOC-I is being addressed by a number of working groups, spanning several individual disciplines and specific sectors or communities. These include the FAA rulemaking committees (Stall/Stick-Pusher Adverse Weather Aviation Rulemaking Committee SPAWARC, and Loss of Control Aviation Rulemaking Team LOCART), the NASA working group on upset simulation, the European Union project entitled Simulation of Upset Recovery in Aviation SUPRA, and an EASA working group on LOC-I. Each has a specific objective, and limited participation.

However the range and diversity of its members, and strong ties with their representative organizations, together with oversight from the RAeS and its established links to ICAO, have promoted ICATEE to the forefront of those working groups devoted to defining comprehensive training solutions to the LOC-I problem.

Since its inception in 2009, ICATEE has assembled a strong team of both developers and users of UPRT, and made significant progress towards achieving consensus on how to train commercial airline pilots in order to mitigate upsets. ICATEE's intended outputs, primarily a comprehensive UPRT Manual and enhanced the simulator standards document, will prescribe high quality, validated Upset Prevention and Recovery Training and make a major contribution to aviation safety. ICATEE's results are already being fed through other working groups and studies, and publicized at international conferences and forums.

This document outlines the proposed way forward for ICATEE. It provides a brief overview of the safety threat, the approach and methodology ICATEE has taken in identifying and analyzing the training deficits, the proposed solutions to meet the training needs, including an overview of the products and deliverables of ICATEE, and the long-term vision of ICATEE for the effective validation of the training requirements and the technical solutions proposed, and continuing to support ICAO and the National Aviation Authorities (NAAs) in the implementation of UPRT. It explains where ICATEE is today, and where it needs to be in the future in order to accomplish its mission.

ICATEE Mission

The International Committee for Aviation Training in Extended Envelopes was formed as a result of the FSG conference on Upset Prevention and Recovery held in June 2009. The mission statement of ICATEE is:

To deliver a comprehensive long-term strategy to reduce the rate of Loss of Control In-Flight accidents and incidents through enhanced UPRT.

ICATEE's approach is to develop training methodologies for Awareness, Recognition & Avoidance, and Recovery, primarily focusing on the prevention of upsets but recognizing that recovery action may also be needed and must be trained for.

Critical Success Factors

ICATEE has enjoyed a prominent role on the international stage due to several reasons:

1. Loss-of-Control In-Flight has been, and continues to be seen as a major safety threat to commercial aviation safety.

2. ICATEE has the ability to address both the training requirements as well as technical solutions

3. ICATEE approaches the problem of UPRT with a strong emphasis on the prevention part of training.

4. ICATEE's principles allow expert opinions to be heard, and to shape the outcome of its recommendations

5. The products of ICATEE are concrete, tangible, and supportable through their implementation; they are backed through sound principles. Where necessary, they will continue to be validated.

6. ICATEE's products are relatively independent of current documents, such as ICAO 9625 or FAR 25 Part 60

7. ICATEE has representations from all sectors of the commercial aviation industry, including regulators/government, end users (airlines) airframe manufacturers, training providers, simulator manufacturers and researchers.

8. ICATEE upholds the principle of respecting the airframe manufacturers recommended best practices with respect to the aircraft characteristics or training (e.g. stick-pusher equipped airplanes).

9. ICATEE is strongly focused on avoiding negative training.

10. ICATEE is established under highly-reputed the Royal Aeronautical Society, with a formalized mechanism for implementing FSTD recommendations.

11. ICATEE is quality-driven and is not driven by an expiration date or lack of support.

Loss-of-Control In-Flight (LOC-I)

LOC-I resulting from an aircraft upset is the number-one threat in commercial aviation today, in terms of the number of fatalities claimed during the past decade. An upset is defined as follows:
- Pitch angle exceeding 20 degrees nose up
- Pitch angle exceeding 10 degrees nose down
- Bank angle exceeding 45 degrees
- Within these parameters but at inappropriate airspeeds for the aircraft configuration and phase of flight.

There are three phases of upset beyond normal flight culminating in loss of control, which need to be clearly understood. These are outlined in Table 1.

Table 1 - flight phase definitions

Phase of Flight	Description of Flight Phase and Activity Required by Flight Crew	Training Requirements
Normal flight	Aircraft performing within its normal flight envelope. The crew should be aware of flight condition and aircraft state, and be able to anticipate potential threats.	Awareness
Upset condition (developing)	Flight within normal flight envelope but diverging in attitude or airspeed. This may trigger stall warning or other alerting systems. The crew should recognize the developing situation and avoid further escalation of the problem. Timely and correct action may be required. This may take the form of deciding to allow the aircraft automation to effect the return to normal flight, while the pilot monitors its effects, or crew intervention.	Recognition & Avoidance
Upset condition (developed)	Uncommanded flight outside the normal flight envelope. This will result in stall warning, stick pusher/shaker, and/or other alerting systems. The crew must take recovery action to return the aircraft to within normal parameters. Recovery can usually be effected by normal flying techniques with reference to primary flight instruments.	Recovery
Loss-of-Control	Significant and/or divergent departure from the normal flight envelope. This is likely to progress beyond warning and alerting system operation. The crew must recognize the nature of the departure, which may not be apparent from the primary flight instrument displays or out the window views. Recovery actions must take account of potential altitude loss and aircraft structural and control limits, and may require specific unusual attitude techniques.	Recovery, if possible

Clearly, the avoidance of upset conditions remains the highest priority for safe flight, and must be primary the training objective. However, based on the historical record and members' experience, ICATEE has concluded that training for avoidance *alone* does not work. While training providers have attempted to train pilots in this manner, airplanes have continued to enter into upset conditions, and many of these have progressed to LOC-I. The common thread is that the aircraft were in proper operating condition and the crews were adequately trained according to current techniques and to the current proficiency standards.

Therefore, the first objective of ICATEE was to identify the limitations of current training that lead to these deficiencies, and to develop both short and long-term strategies to remedy the training deficiencies both for existing flight crews, and at the initial licensing stage for new hires progressing though the training systems.

ICATEE Structure & Activities

In order to achieve its mission, ICATEE created two streams, as shown in Figure 2:
- Training and Regulations
- Research & Technology

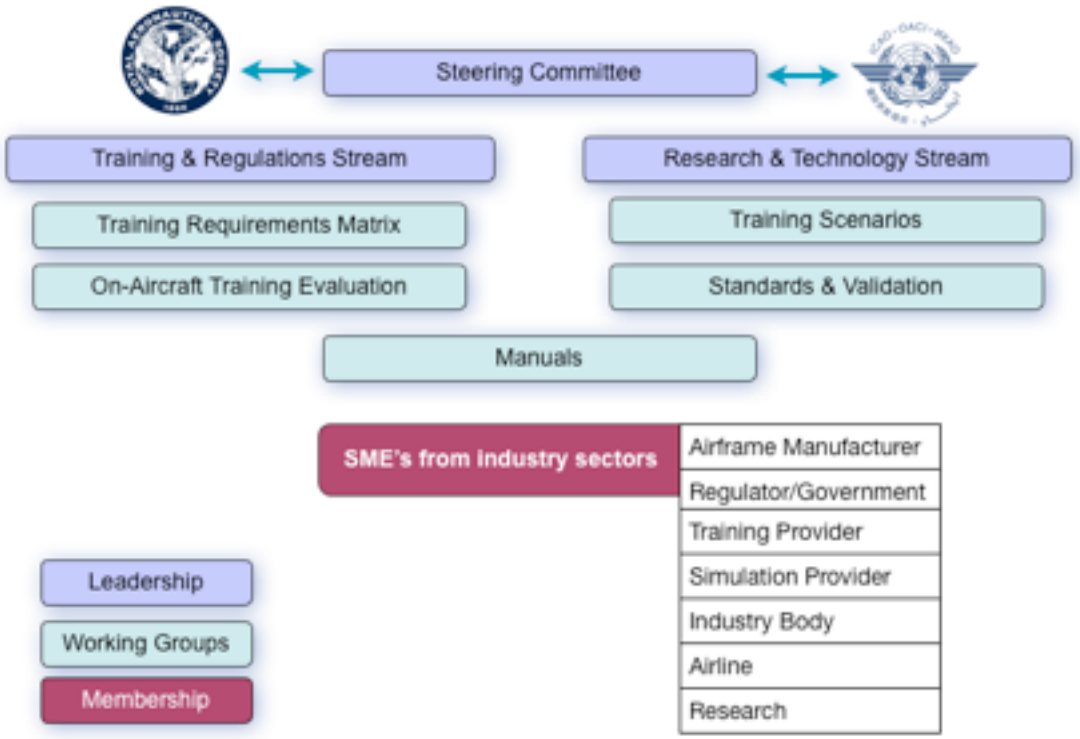

Figure 2 - ICATEE Structure

While these streams have operated in parallel, the Training & Regulations Stream has fed its work into the Research & Technology Stream to ensure that technical solutions are truly training-needs driven.

ICATEE Membership

Table 2 indicates the participant groups and affiliations in ICATEE.

Category	Participants
Organization	RAeS-FSG, ICAO
Airframe Manufacturer	Boeing, Airbus, Bombardier, Embraer
Regulator/Government	FAA, NTSB, IATA (ITQI), Transport Canada, CAA, EASA, Russian CAA
Training Provider	CAE, FlightSafety, Boeing Flight Training, APS, CALSPAN, Embry-Riddle
Simulation Provider	CAE, FlightSafety, Thales, Opinicus, ETC, Bihrle
Industry Body	ALPA, IFALPA, ATA, BBGA
Airline	KLM, Alaska, Flybe, FedEx, Air Canada, Lufthansa, Lufthansa CityLine
Research	AIAA MSTC, NASA, UTIAS, NLR, TNO, IDT, DLR, U Liverpool, SOS, Volpe

Main Activities in ICATEE Streams

The **Training and Regulations Stream** was primarily assigned to develop a comprehensive training requirements matrix, comprised of the learning objectives, placement of training, frequency of training, training methodologies and training tools related to the prevention of and recovery from upsets. This matrix is considerably different from the ICAO 9625 training matrix because it focuses on academics, on-aircraft and simulator-based training. Note that the "on-aircraft" training is aimed at the initial licensing level.

The Training Requirements Matrix specifies 157 training elements, for which each of the following is specified:
- Hazard Priority
- Training Element
- Academic or Practical
- Device Level
- Licensing Level
- MPL Phase
- Learning Objective
- Remarks
- Training or Training-to-Proficiency
- Recurrency of Training
- Training Cycle

The Matrix has been divided into the following categories, each of which addresses training elements as described above:
- Awareness
- Prevention
- Recovery

Then, license-specific requirements are specified, allowing the verification of proficiency at each respective level:
- PPL
- CPL
- IR
- TR
- MPL

The ICATEE Training Requirements Matrix indicates that FSTD's can be applied to the majority of learning objectives for UPRT. Some of the elements can be performed in either an FSTD or a suitable aerobatic-capable aircraft, enabling flexibility to the delivery of that training. A small (seemingly disproportionate) but essential portion of the learning elements must, however, be acquired in aerobatic-capable aircraft, as simulators are not capable of providing the fidelity required (g-cueing magnitude and accuracy). While this deviates from most professional training, its delivery (described later) makes this both an effective method of risk mitigation, and is an essential element of the ICATEE strategy.

The Regulations side of the first stream has maintained close contact with the regulatory community, namely by participating in both the FAA Aviation Rulemaking Committees on "Stick Pusher and Adverse Weather" (April 2011) and "Loss of Control" (called the LOCART committee, in April 2012). In the second ARC, specific questions were posed regarding the placement of training and qualification in both aircraft and simulators,

The **Research & Technology Stream** (also called the R&T Group) has performed a thorough analysis of the technological requirements for UPRT. While these have so far focused on the FSTD,

there are also considerations for the use of alternative "non-standard" training devices. The primary development in 2011/2012 has been the specification of the graduated approach.

This involves, chronologically:

1. Improved use of existing FSTD's for the standardization of upset prevention scenarios (surprise scenarios within the validated flight envelope)
2. Enhanced feedback through the IOS to flag the possible (negative) use of inappropriate controls as well as validated envelope violations, upset prevention and recovery scenarios during training exercises
3. Enhanced representative aero models, improved pilot stimulation, stall recovery training; and upset recovery scenarios.

These requirements and the learning objectives on which they are based are given in Table 3.

PHASE	Short-term	Medium-Term	Long-Term
Time scale	2012-2013	2013-2015	2014-2017
Learning Objectives	• Recommend standardization of training for exercising prevention scenarios • Address current highest threat situations that can be better trained in today's devices	• Recommend recovery as well as prevention scenarios. • Ensure negative training is strongly mitigated, by arming the instructor with information on the operation of the a/c w.r.t. the flight test validated, wind-tunnel or extrapolated data envelopes. • Provide feedback on aircraft loading during recovery maneuvers	• Recommend fully-developed stall "exposure" through controlled exercises led by instructors, to teach effective stall recovery. • LOFT exercises that would follow (for training and checking) would require similar recovery procedures at first onset of stall.

FSTD requirements	• Upset Prevention Scenarios
	• Surprise Upsets within Envelope
		• Feedback through IOS:
		  • Envelope feedback
		  • Inappropriate controls
		• Upset Prevention and Recovery Scenarios
		• Additional Surprise Upsets
			• Advanced Aero Models
			• Pilot Cueing (buffet, motion)
			• Stall Recovery Training
			• Remaining Surprise Upsets

It is felt that the greatest value lies in the short-term deployment of standardized scenarios and clear definitions of the learning objectives. This will be achieved through the ICATEE Upset Prevention and Recovery Training Manual.

ICATEE Stall Training Strategy

The long-term requirement for the training of recovery from fully-developed stalls is provided through two steps:

Firstly, by exposing the candidate in a fully-controlled manner (through the instructor) on the encounter of a stall, one can “illustrate” the aircraft handling at the stall. The several possible indications leading up to a stall are shown, including:
- aircraft system stall warnings
- buffet
- reduced lateral control
- increased instability
- stall roll-off

This is conducted in a non-penalty manner, and through very limited exposure. Appreciation of the various warnings, and understanding the danger of the stall, is the primary goal. In no case are the aircraft warning or protection systems artificially disabled. In the case of a stick-pusher equipped airplane, the stall is considered to occur “when the pusher fires”.

Secondly, during the training and/or checking exercise, the candidate is required to initiate recovery at the first indications of stall, having been exposed to several such indications in the earlier “exposure”. The candidate is primarily taught that, despite the unpredictable nature of the stall, recovery must be immediate and at the first indication. In reality, during operational flight, the first indication of the stall could very well be the stall itself (or protection device firing), due to “uncalibrated” or unintended control inputs near the edge of the envelope.

The above two elements are core to the ICATEE training strategy. The correct interpretation presentation and delivery of these requirements is essential to avoid ineffective, or, more dangerously, negative training.

Training Placement

A major development within ICATEE has been the definition on how the training is conducted, for both current pilots (many of whom have a military background with an exposure to the all-attitude/all-envelope aircraft), and new-hire career pilots. For the latter, ICATEE is recommending that a small amount of quality-assured on-aircraft training take place, preferably in aerobatic-capable aircraft. This should be combined with simulator based training in both a maneuver-oriented training and line-oriented (scenario-based) training-to-proficiency manner.

For **ALL** pilots, ICATEE recommends that the basic academics related to UPRT become part of the training curriculum. This is again defined in the ICATEE UPRT Manual, defined below.

To illustrate the UPRT paradigm, ICATEE has developed the process defined in Figure 1. New-hire pilots would be presented with a limited element of on-aircraft training. Current pilots would receive a MOFT session, dedicated to UPRT, followed by the standard LOFT (or, under AQP an LOE) proficiency check, incorporating ICATEE-recommended UPRT elements and scenarios. ALL pilots would be required to receive the Academics portion regarding the aerodynamics and flight dynamics of upsets.

ICAO UPRT Manual

The industry-developed Airplane Upset Recovery Training Aid, published in 1998, defines several aspects of aerodynamics, stability and control and airplane performance for pilots in developing awareness with the intention of preventing upsets. ICATEE learned, however, that this document is limited to large swept-wing jets. Clearly, upsets also occur in smaller aircraft, such as turboprops. Hence, ICATEE’s Manuals team is developing a revised version of the training aid, with delineated sections pertaining to:

a) pilots
b) instructors
c) training providers
d) regulators

Each of these sections will provide guidance regarding the content and recommended best practices for the assurance of high-quality training. It is this Manual that will be presented to ICAO, with the expected date being October 2012.

ICAO intends to publish this document as a Manual (with the working title “Manual of Upset Prevention and Recovery Training”. It will be referred to in ICAO Annex 1 and Annex 6. Specific text will be added to ICAO Manual 9868 PANS-TRG, defining the MPL-related aspects of UPRT as defined by ICATEE. Appropriate and relevant wording needs to be defined in other documents as well, concerning classical CPL training and checking.

ICATEE Deliverables and Release Process

Currently, much of the basic work on the **UPRT Manual** is well under way. The content, when assembled, will be reviewed by the leadership of ICATEE, followed by general release to the ICATEE membership. This is expected in October of this year. Thereafter, the document will be presented to the LSB of the RAeS after which it will be handed over to Henry Defalque of ICAO.

A **Precis of the UPRT Manual** is currently being prepared in order to give any interested parties an insight into the detailed content. This should be available by 15 May 2012.

The primary outcome of the UPRT Manual will be a recommendation that all future pilots be offered a UPRT Endorsement. We also strongly recommend that a qualification standard be established and required for UPRT instruction, in order to mitigate negative training consequences.

The same process will generally apply to the **Simulation Standards Document** and the **Research & Technology Report**. The latter is expected to remain an RAeS Publication.

After the main documents have been created, a brief document describing the **UPRT data requirements for FSTD's** will be produced. This will be destined for IATA.

ICATEE Process - Current and Future

During the development of the above products, ICATEE has engaged its team of experts through meetings and telecoms on a regular basis. The Training Requirements Matrix was developed through weekly telecoms involving five to ten participants over a period of 18 months. The Research & Technology group has developed its products through group telecoms involving approximately five to ten participants over a period of two years, and continues this regular weekly interchange.

Number	Date	Location
1	11-09	London
2	03-10	Washington DC
3	04-10	Orlando
4	06-10	London
5	11-10	Oklahoma City
6	03-11	Mesa, Arizona
7	04-11	Daytona Beach, Florida
8	04-11	Orlando
9	06-11	Amsterdam
10	08-11	Seattle
11	09-11	Montreal
12	11-11	London
13	04-12	Lutz, Florida

ICATEE general meetings have taken place at several locations, in order to facilitate travel for our many participants, and to perform evaluations of candidate training solutions, simulator configurations specific to UPRT, and to interact with specialists from specific organizations. Meetings have been held at the following locations:

Current Activities and Open Issues

ICATEE's current activities include

a) Development of the Training Manuals.
b) Editing the Research & Technology report
c) Defining the process by which the Training Matrix can be further validated
d) Interfacing with ICAO for the hand-over of the training materials
e) Participation by groups and individuals in other UPRT-related working groups

Current open items include

a) Final definition on how to deal with stall prevention training in stick-pusher equipped aircraft
b) Definition of pilot stimulation requirements
c) Addressing the issue of skills degradation by defining a long-term crew assessment plan
d) Creating proper MPL language for ICAO 9868 (PANS-TRG)
e) Specification of on-going research activities related to loss-of-control in-flight, including:
    i. Manual control in fourth-generation aircraft. This is being conducted primarily via a 3 year EU project beginning in September 2012, under the EU's 7th Framework Programme, granted to several of the ICATEE participants, including NLR, DLR, IDT, Airbus, and Boeing Europe. It was initiated by the ICATEE chairman.
    ii. Use of non-standard simulation devices (continuous-g, disorientation and other devices)
    iii. applying objective motion cueing to UPRT-related events

Future of ICATEE

While the delivery and acceptance of ICATEE's reports and recommendations will end its initial phase, it is anticipated that considerable future work will be needed to maintain, develop, and promote UPRT training and documentation. Future activities of ICATEE will therefore include the following:

1. Reviewing feedback from industry on the implementation of UPRT in FSTD's.

2. Review proposed changes to the UPRT Manual and simulator standards from industry.

3. Monitor the Research activities as recommended by the current Research & Technology group, and act as the bridge toward eventual implementation of the findings.

4. Continue to help industry to promote UPRT.

5. Develop appropriate standards for lower-level devices, and (possibly) for rotorcraft.

The vision of ICATEE is to maintain the strong network in UPRT in order to support industry in the implementation of the several recommendations made by our team. The domain-specific knowledge on UPRT and its delivery is unique and cannot be addressed by a single person, company or third party. It is also essential for the Royal Aeronautical Society to maintain some level of oversight on this subject, in order that the implementation is supported by those who developed these recommended best practices.

It is expected that users of the ICAO manuals (training providers and NAA's) will provide domain-specific feedback to ICAO, with questions regarding the implementation or practical issues encountered during training. These may be related to specific aircraft.

ICAO has requested that ICATEE maintain its unique assembly of UPRT expertise in order to support further implementation of the recommendations, review feedback from industry and occasionally provide updates to the Manual. While the process may formally operate through the ICFQ, there is a strong need to maintain the ICATEE network. Application of our work to other areas of the industry (business aviation and rotorcraft, for example) may require further consideration.

The Research & Technology Group has defined what is possible with current technology, however there is additional need to continue to pursue research activities. Subjects include:
- development of representative stall models
- specification of motion cueing and buffet requirements, including objective measures
- validation of specific matrix elements through additional research.

Since the Research & Technology Group has been able to identify these open issues, some of its participants will continue to pursue these topics through specific research programs, with the intention of future application into training. This also requires ICATEE to be available to evaluate potential concepts from a training benefits perspective, and support industry in their potential implementation.

The actual monitoring of instructor standards and the delivery of on-aircraft training is expected to occur from external organizations as ICATEE is not interested in "policing" the actual application of UPRT. The organization expected to take on this role is the Upset Prevention and Recovery Association (UPRTA), led by ICATEE's training matrix leader, Randall Brooks.

During the thirteenth meeting of ICATEE, held in Lutz, Florida on 16 and 17 April 2012, each participant was asked to suggest whether they felt the need for the maintenance of ICATEE in the

future. A unanimous vote indicated there is a strong interest - and commitment - in continuing the activities in the future. It was agreed that current open issues, such as the stall training requirements in stick-pusher equipped aircraft, be resolved as quickly as possible.

While the high intensity of the activity will reduce, there is a strong impetus to continue to monitor feedback from industry (training providers and operators) regarding practicality and effectiveness, and regulation (ICAO, FAA and other) regarding the implementation of ICATEE's recommendations in routine practice. Since ICAO has requested that ICATEE develop and maintain a Manual (rather than a guidance Circular), and because of the specific knowledge required for UPRT, ICATEE must remain intact in the years to come. The ability for ICAO and the FAA to call upon our group's expertise must remain available, if we are to maintain the high-quality standard which ICATEE was intended to establish in this area.

Future ICATEE Structure

It is intended that ICATEE will continue in the future as an expert and non-partisan working group, under the oversight of the RAeS exercised through the LSB, and reporting initially to the Flight Simulation Group as it currently operates.

Sunjoo Advani wishes to continue as Chairman of ICATEE due to his long-term commitment to developing and researching upset prevention and recovery training, and strong industry network.

The ICATEE Steering Committee will be comprised of the Chairman and up to 3 members. These are currently Peter Tharp and Gordon Woolley.

The ICATEE Chairman will report to the FSG during each FSG meeting, and provide on an annual basis an Annual Report as well as an update to the Strategic Plan.

One seat on the ICFQ is to be maintained, by the ICATEE Chairman or a duly-appointed representative, to deal with FSTD-specific issues.

ICATEE will hold one general meeting each year in concert with a FSG-sponsored conference, at 4 Hamilton Place. Alternative meeting locations may be recommended by ICATEE committee members for consideration, and may depend on opportunities to evaluate simulation implementations, research programs, or to connect these meetings with other conferences like WATS, FSEMC or AIAA-MST. Sub-meetings may also be held to address specific subjects. In any case, it is expected that the frequency of the meetings will be kept to maximum two per year.

The ICATEE Streams will continue as they are currently assigned - one to address Training Requirements, and the other to review Research and Technology issues. The assigned Co-Chairmen of these groups have also expressed their interest in continuing their roles. These are:

- Capt. Bryan Burks, Training & Regulations Stream
- Dr. Jeffery Schroeder, Research & Technology Stream

ICATEE will continue to support training and simulation related activities in industry as follows:

By invitation, ICATEE will be present (whenever feasible) in the FAA LOCART Rulemaking Committee, and other forthcoming Aviation Rulemaking Committees.

ICATEE will maintain links with UPRTA and other working groups involved in Loss-of-Control In-Flight. If necessary, ICATEE will participate in their deliberations by telecom or in person.

ICATEE Website

Through the volunteer efforts of some of its members, ICATEE has developed a website (www.icatee.org) by which the content can be managed. The site is based on WordPress (see wordpress.org), enabling the content to be easily updated. Updates are frequently carried out, and include news articles on LOC-I, meeting announcements, etc.

The ICATEE website shall continue to be maintained. Eventually, some of the ICATEE deliverables could be provided through the website. Technical papers and presentations can also be downloaded from the website.

The ICATEE website can also provide an opportunity to promote the activities of ICATEE, as well provide as links to other on-going work in the RAeS.

Acknowledgments

The author and chairman of ICATEE would like to humbly thank his Steering Committee, the Flight Simulation Group, the members of ICATEE, and the Royal Aeronautical Society for their enthusiastic dedication and collaborative, energetic spirit in this most exciting and challenging working group.