SIMULATION

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CAPT. FOSTER: The simulation working group followed the suggested discussion items listed in the symposium program, to wit: what simulation resources are available, what are the advantages, disadvantages, and shortcomings of simulators, how can simulators be used in cockpit resources management training (CRMT) by the small air carriers, and what research is needed to further develop simulation technology and the application of simulation in regional airline training programs? These are wide ranging topics and the group was hard-pressed to focus their discussion in view of the diversity of considerations that could and did arise. They ranged from all the problems with simulator specification, procurement, validation and use that have plagued the major air carriers over several decades to new problems related to the large diversity of aircraft, locale, and corporate size and operating style of the many regional airlines.

Many participants had little experience with the typical full-blown, motion-based training simulator utilized by the majors and the military services. However, there was sufficient expertise in the group for the purposes at hand and it soon became apparent that the over riding issues were not in simulation technology or training technology but in the prohibitive costs of sophisticated simulators and thus their very restricted availability to the regional airlines (RA). This led to a discussion of communal training facilities and cost sharing; fixed-based, non-visual simulators at affordable cost; and other training devices such as the use of hangared aircraft.

Two underlying themes were frequently articulated during these discussions: (1) The terminology used by the FAA in describing training apparatus was less than helpful. For instance, a fixed-base simulator is not a simulator but is to be referred to as a "training device". Thus a full-mission, motion-based simulator is a simulator, not a training device by exclusion. This arbitrary manipulation of semantics is difficult for the uninitiated and is unrealistic since it leads to an unproductive dichotomy of training apparatus into training devices and aircraft surrogates. (2) Never has it been more critical that a systems approach (logical) be taken in the specification of training media, whatever form they may eventually take, particularly large hardware items. The RA's do not have the

capital resources that the larger airlines have so must be in a position to buy only that which is necessary and sufficient to support their training goals and meet FAR's. The approach to training media specification must proceed from molar training needs to functional training requirements to hardware and software specification, i.e., from job elements to task elements to skill elements to device design. No costly "bells and whistle be included that do not contribute to the training goals.

The working group discussed the advantages and disadvantages of simulators for RA training. They were substantially similar to those for all airlines:

Advantages:

1. The safety involved in training in a simulator is both obvious and well established. Not only are training aircraft accidents reduced but very dangerous emergency operating procedures may be practiced safely and repetitively.

2. Given good preventive maintenance support they are reliable and available for scheduling training at any time.

3. They provide FAA-acceptable training and checking without having to use the aircraft. Their acceptability is increasing as is shown by the recent Part 121 rule allowing transition training to be accomplished with zero aircraft time.

4. They provide a good context for LOFT and Cockpit Resource Management Training (CRMT) in which realistic contingencies can be practiced and checked while observing crew interaction, procedures, decision-making, etc.

5. They are extremely cost effective when compared with aircraft training.

6. Training efficiency is considerably enhanced and standardization of procedures can reach a high level of excellence.

7. Related to the previous point, the development, practice, and evaluation of SOP and EOP is considerably facilitated.

8. Aircraft guidance and control procedures may be practiced safely under both normal and contingency environmental circumstances. These include, for instance, instrument flight procedures in severe

crosswinds and shears, and all categories of runway visual ranges and meteorological conditions.

9. They are also extremely valuable in new-hire evaluation, remedial training for slipping pilots, and, probably most importantly for the small airlines, can be partly amortized by contracted training to other users.

Limitations:

1. In some cases not all FAR related check credits are available.

2. Achieving simulator fidelity in its dynamic response is always troublesome because of difficulties in acquiring valid aircraft aerodynamic response data packages and further problems with their implementation and checkout.

3. There is always a problem with trainee acceptance of simulator training in lieu of aircraft training. This is mainly an initial response which, in most cases, fades with further trainee experience with the simulator as an integral part of the training program.

4. The compatability of the simulator with other elements of the overall training program is essential and is not always obvious, particularly when the aircraft itself is the major training device, as it usually is with the RA's.

Disadvantages:

1. In the case of the RA's the overwhelming disadvantage is the high initial cost of an aircraft-specific, full-blown simulator.

2. If the simulator is not bought outright but is shared with other users then accessibility, proximity, and availability may be areas of considerable problems.

3. The simulator must be housed in a simulator facility and it must be supported by appropriate technical and training personnel. This is a source of considerable cost and organizational planning and effort and would be crucial for small operators.

The working group considered the use of simulators in CRMT and recalled the many forms that that training has taken as evidenced by the content of the formal presentations in the symposium general assembly. It was acknowledged that this kind of training is given in sometimes very primitive simulations such as seating the Captain and First Officer next to each other in two chairs

and having a go at role playing. It is probably true that CRMT, like more conventional training, has to be phased, going from knowledge and information to part-task practice to full-blown crew interaction in a realistic cockpit with substantive scenarios. It was therefore agreed that simplistic simulations had a place in the scheme of things but were not within the purview of this working group.

The simulator was seen to be crucial to a qualitative CRMT program. The goal of CRMT is to instill attitudes and personal styles vis-a-vis colleagues that are conductive to good utilization of all the cockpit resources available to the crew. When these are not necessarily present but are trained into individuals then the question arises as to how deeply they have been ingrained. Individuals under stress are well-known to revert to primitive or "first-learned" forms of behavior. Behavioral modes only recently acquired will be the first to disappear. The simulator can provide the full context of operational contingencies and "stress" within which the tenacity of the new behaviors can be both exercised and assessed.

Related to the question of the durability of the CRMT is the need to provide for and encourage a pervasive awareness of CRM throughout the aircrew, training, and management complement. Line-oriented flight training (LOFT) offers a natural vehicle for the promotion and maintenance of this awareness and also for the CRMT itself. It would thus be a recommendation of the group that CRMT be made a part of LOFT.

It was felt that it was not necessary that the RA'S use a motion-based, full mission simulator for CRMT but that a necessary and sufficient device could be an alternative to a communal training facility. The training that would be possible in this device would be:

1. CRMT and LOFT

2. Normal, abnormal, and emergency operating procedures

3. Instrument proficiency, approaches, navigation

4. Systems operation

5. Transition, upgrade, and differences training

6. Some airman certification and FAA credit

Other alternatives need to be explored; finding other options is a worthwhile area of future technology exploration. One new development that appears to have a

great deal of promise as a solution to the peculiar problems of the RA's is the Rediffusion TRIAD III imbedded simulation approach. In this the real aircraft is used. The aircraft plugs into a computer which plugs into a three-screen projected visual scene. The aircraft equations of motion are programmed in the computer and the aircraft is flown like a simulator with all instrument indications responding as in the real world. Initial R&D costs have been high, but in volume production, it could compete with fixed-base simulations. Also, if cost sharing were to be utilized, it would be an even more appealing alternative.

MR. NELSON: Jim Nelson with Dash Air. The question that I have specifically and maybe someone in your group could give me some information on is how to approach FAA check credit for certain maneuvers with a ground training device in our training program, and after going through a lot of tedious back and forthness with our FAA office, we really didn't get any credit to speak of in the way of checking airmen. And I wonder what approach you can suggest to this. What our FAA gave as a basis for the limitation was a publication that the FAA had put out on simulators and ground training devices. And that was really about as far as it got. And I'm wondering if any of the operators have actually gotten some sort of check credit for instrument approaches, for instance, and what I could plan to do to implement some of those credits if, in fact, they have been granted.

CAPT. FOSTER: You grab the microphone, Dick. Maybe you can better answer that.

MR. COLLIE: I'm Dick Collie with the Regional Airline Association. Let me give it a try, because the Regional Airline Association for the last six months has had a committee working on this very thing, to ascertain what we could do to upgrade the level of training devices. We have made the FAA aware of what we are trying to do and what we think should be the end result of our efforts. We have formed a working committee, composed of representatives from simulator manufacturers, three industry representatives, one each from Metro, Air Midwest and Scenic Airlines, and initially we had FAA participation. However, for the last three or four meetings, we have not had any FAA participation.

We have decided that we wanted to do something that's never been done before. We wanted to establish some performance parameters and tolerances for training devices, because, as the gentlemen said there are none right now. As a result, the FAA through its internal directives, only grants, regardless of the sophistication of the training device, a nonprecision approach for checking credit. There

may be some airlines that have more checking credit, or who have less checking credit, be that as it may, that's what the FAA directives say.

We've decided to look at all dynamic training devices and categorize those devices into a Level I training device, Level II training device and Level III training device. To make a long story short, the Level III training device would be a fixed base simulator that would meet the requirements of Advisory Circular 120-40 and that will make Ed Fell happy.

It will meet all the requirements of 120-40, the latest Advisory Circular on advanced simulation, except that we left out some of performance text required under lateral and longitudinal stability, such as dutch roll dynamics, stall stability and text of this nature that drive the cost of the device up to the point where it would no longer be cost effective.

We are going to justify what we have done and, present the package to the FAA and ask them to consider granting certain checking credits if you use this device. We hope this device will be priced at less than a million dollars. We may be overly optimistic, but there's no question in my mind, that the Level III Device can be brought into the market place for less than a million and a half dollars. We're talking about hydraulic control loading, not about pulleys and cables. We're talking about a good machine that will faithfully reproduce the airplane and do what it is supposed to do. It doesn't have motion or visual. It would be adaptable to motion.

The Level III training device would then be a replica of the airplane. We use the word replica instead of a duplicate, simply because we didn't want to drive the cost up by specifying actual control columns, seats, from the airplane. We wanted it to replicate the airplane rather than duplicate it. There's a big difference in the cost.

The Level II device would be a device which would approximate an airplane using off-the-shelf hardware. The cost of this device would be drastically reduced. A good example is the ATC-810 device at Scenic. This device was built to resemble a PA 31 and was converted to be representative of Cessna 402's and 404's. As a result it's been very effectively used in Scenic's program. They still only get a nonprecision approach for checking credit.

The level II device would use the aero package for a specific make and model airplane, not a class of airplanes. It would not have the fidelity of the Level III Device, because it would not be an exact replica of the cockpit but

it would have all the functions. You would be able to accomplish normal and abnormal emergency procedures, and LOFT training. It would do everything that the Level III would do except that the instruments might not be in exactly the same position.

Then we take the generic device, the Level I device which basically is an instrument trainer that you can use as a procedures trainer, you would get very limited credit for this level device. It's interesting that our task group elected to use the simulator requirements that were in effect before the advanced simulation program for the level I & II training device.

I'm sorry I took up so much time, but that's what we're doing, and we should have that package ready to go to the FAA within the next 45 to 60 days.

DR. LAUBER: Thank you, Dick. Any other questions or comments?

MR. HAMPSON: Brian Hampson, CAE. It's just a comment or a series of comments I want to make. First of all, it may be of interest for some of you to know that the civil aviational authority in the United Kingdom are presently reviewing requirements for simulator approvals, and on a draft document called CAP-453, they are looking at the approval of all sorts of training devices, not just simulators. There's a working party working on that in England at the moment, and you might find there's some spinoff for you there.

The next thing I wanted to say was that we talked about this $7 million simulator, and that is a simulator which represents a wide-bodied jet, possibly with an advanced cockpit layout, flight management system, and so forth. It is not necessary for the type of simulator that you want to think of in those terms. A breakdown of the prices -- one obviously can't be specific here -- but the breakdown of prices of that $7 million, about half of it is accounted by the motion system, the visual system and the aircraft components. A simulator which we built quite recently, the cost of the aircraft instruments and avionics and aircraft parts was greater that the total cost of the previous simulator bought by that company.

So this is an area where we should be looking, I think, to see if we can use simulated instruments or surrogate devices to take the place of the avionics components in modern aircraft.

The third thing that I wanted to talk about was the Triad concept. It's something which we in our group

discussed as well, and here, as in the case of many other areas of aviation, what we need is more cooperation between the various groups of the industry. The Triad simulator has for general commercial use at the moment one drawback, and that is one needs to modify the aircraft in order to make the system work. But this could very easily be changed if the avionics industry as a whole planned for the training requirement when they were designing their avionic units. It's a much easier task in the design of the avionic units to bring out circuits to a plug or socket on the external part of the box rather than sometime later have to modify, and we all know the problems involved in modifying aircraft instruments, modifying boxes with respect to certification of them.

The need for the avionics manufacturers to recognize the training requirements I believe is paramount. We are finding in the Phase III simulators that the big airlines are buying -- and, in fact, the Phase II simulators -- that sophisticated flight management systems and triplex system for training pilots and this type of thing are restricting the ability of the simulator to be used in its normal role. If you put the black box out of the aircraft, you immediately find that you have problems in repositioning the simulator because the black box was never designed on the airplane to enable rapid repositioning. The same sort of thing is seen with other simulator attributes such as speedup or slowdown or record and replay. None of these things can be done if you use the black box as designed at the moment. I know that the Boeing Company and the simulator manufacturers and some of the airlines have been putting pressure upon the avionics manufacturers to take these requirements into account when they design the equipment to with. I think that we all should be putting pressure on them.

DR. LAUBER: Ed Carroll?

CAPT. CARROLL: I think it's more in the line of a comment. Frank, the expression that you used or the indication you gave about a cooperative approach is one I would encourage probably in all areas of this training whether it's the kind of thing they're talking on the Triad or whatever. Anything you do in a cooperative sense will minimize the need for your manpower and your resources to be used. I think drawing the example from the bigger carriers, one of the big mistakes that they've made over the years is that they've all established their own training centers, and, therefore, they have a duplication of equipment, staffing and so on. I would think in light of what's taken place in the industry today, they might have to reassess that in years to come and see if they shouldn't go to a centralized approach, themselves. So I would encourage,

before you make the same mistakes that the bigger ones have made as they've gone along, is that you encourage as much as you can in the way of cooperation regionally so that you don't have to travel from east to west to get it done, whatever the name of that town was that you used.

The other comment I would like to make at the risk of telling Dick Collie and his task force that maybe they should start all over again is that my experience with the FAA has been very, very good from the standpoint of if you bring them an intelligent proposal they're not hide-bound to all the regulations that have existed in the past, but they're willing to listen to a new approach. I'm afraid I sense a little bit of what I just heard from Dick, which is a lot of good work, but I think it's based upon a concept that we have had in the past that you must have a Phase I, Phase II, Phase III approach. Perhaps that's not necessarily true when you take an industry of your type to where if you do it on a cooperative basis and you have individual concerns of what has to be done, that maybe you can go to them and say this is what we intend to accomplish with this particular approach. If anything, just take most of it out of the airplane rather than all of it out of the airplane. I think you might find that they're receptive because their approach has always been greater safety and efficiency as far as the pilots are concerned and the population for environmental protection, et cetera. I don't think they'd ever be hide-bound to regulations that exist right now or something in the past that they based things on and that you therefore had to perpetuate that same approach. That's what I think I sense. I might be wrong, but that's the first impression I get. I would encourage, perhaps an individual and novel approach rather than looking at past history.

DR. LAUBER: Thank you Ed. Any other questions or comments?

I, like Ed, think that one of the key things that you people identified in your discussions yesterday was the notion of pooling your individual and limited resources in order to take advantage of what otherwise might be unavailable to you as individual airlines. I think that's an important direction to take for your industry. Thank you very much.

The third working group dealt with similar issues, and specifically, they were directed to focus on the question of low cost training aids and devices. Clearly there's going to be some overlap between the two working groups, but I'm always amazed at how little overlap there actually is. The industry chairman for Working Group III is Jim Lawver from Scenic Airlines and Al Lee from NASA was his co-chairman.