NEW COAST GUARD SIMULATORS: OUR FOUR YEAR EXPERIENCE

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In July of 1981, the U. S. Coast Guard awarded a contract to Sperry Corp. for two flight simulators. One simulator was for a recent addition to the Coast Guard inventory, the HU-25A. The HU-25A, a fixed wing Medium Range Surveillance (MRS), is a modified Falcon 20. The other simulator was for the HH-65A, a modified Aerospatiale Dauphin helicopter. The HH-65A was still in development when the simulator contract was awarded so the aircraft and simulator were being produced concurrently. The project officer for the HH-65A simulator was involved in the entire acquisition process - from draft specifications to ready-for-training date.

BACKGROUND

The U. S. Coast Guard is one of the armed forces of the United States and performs many peacetime functions, with the best known being search and rescue, aids to navigation (buoys and LORAN), law enforcement (drug interdiction, fisheries), the International Ice Patrol, and ice-breaking (Great lakes, Arctic, and Antarctic). The CG is about 36000 strong with 6000 officers and 1000 aviators. The Coast Guard has no undergraduate pilot training programs, most of their pilots are trained at Pensacola with the remainder coming via a "direct commission" route from the other services. Postgraduate pilot training is, for the most part, provided at Aviation Training Center (ATC) in Mobile, Ala. ATC provides training in the HU25A (which is a replacement for the HU16E and HC131). Training is also provided in the HH3F, the HH52A, and the latest addition to their fleet, the HH65A. ATC currently operates four flight simulators, one each for the HH52A, HH3F, HU25A, and HH65A. The HU25A and HH65A simulators were just recently accepted by the CG. This paper will primarily address the HH65A simulator acquisition.

AIRCRAFT PROCUREMENT

In April of 1977, a team was formed at Coast Guard Headquarters to acquire a replacement for the HH52A helicopter. The HH52A had been around since 1962 and was proving economically unfeasible to operate - hence the push to replace it. Four candidate airframes were initially considered: the Westland Sea Lynx, the Sikorsky S76, the Bell 222 and the eventual winner, the Aerospatiale SA366. Since the Coast Guard is rarely involved in a major aircraft procurement, they requested, and received, help from Naval Air Systems Command in virtually every aspect of the acquisition. Later, Westland and Sikorsky dropped out, and eventually AHC was awarded the contract for 90 SRR (Short-Range-Recovery) helicopters. Almost immediately after the award of the airframe contract, work began on acquisition of a simulator for this new helicopter.

SIMULATOR PROCUREMENT

The Coast Guard's experience has been overwhelmingly supportive of flight simulation as a cost-effective training tool. Mr. H. K. Povenmire, the training analyst at ATC, presented a paper at a previous ITEC conference which showed the significant savings which had been realized using the HH52A and HH3F simulators. Thus, a flight simulator for the new helicopter was planned for right from the beginning.

NTEC Involvement

In December of 1977, the Coast Guard sent a letter to NTEC requesting a conference to discuss the availability of NTEC assistance on the simulator procurement similar to the assistance NAVAIR provided during the helicopter procurement.

Several meetings were held in early '78, with the Chief of Naval Education and Training (CNET) to discuss this assistance. In June, CNET told NTEC that the request for assistance was approved. During that same month, CNETS issued a field task assignment to NTEC.

Specifications

In February of 1979, the Coast Guard awarded a contract to Seville Research Corp. (now Seville Training Systems) to draft the technical specifications for the helicopter simulator. By July, Seville had generated the specs and they had undergone revision due to a review by NTEC. In September, a specification review conference was held at ATC Mobile. Things proceeded fairly smoothly and in October the HH65A simulator procurement was combined with the HU25A simulator procurement. It was felt that both new simulators could share a lot of design commonality, e.g., the instructor stations, and if one contractor produced both, a considerable cost savings should ensue.

About this same time, the Congress told the Coast Guard to "follow A-76 policies" in regard to the HU25A simulator, so this created a little extra work along those lines. The Commerce Business Daily release was eventually published in December of 79.

Request for Technical Proposals

In January of 1980, the RFTP was released. Proposals were due on 3 April. In February, a pre-proposal conference was held at Coast Guard Headquarters. A couple of weeks later, one of the potential bidders, Reflectone, decided to "no bid". In April, only one proposal was received - from Sperry Secor, and thus the Coast Guard had to shift to a negotiated procurement. In May, the sole-source procurement was approved and in June, Sperry's cost proposal came in. It was for about 20 million. This was about nine million more than had been budgeted, so a reprogramming effort was begun. The request for reprogramming caused a few more delays however, and it wasn't until June that the reprogramming request cleared Congress. On 8 July 1981, the Coast Guard awarded a contract to Sperry for two simulators, one for the HU25A and one for the HH65A.

The author of this paper was the project officer for the helicopter simulator, so the following paragraphs will describe it rather than both simulator acquisitions.

Contract Requirements

The contract was for a firm, fixed-price and included a 34.5 month delivery for the helicopter simulator. The Coast Guard agreed to provide, as GFE, the data package for the simulator. This package was to be provided to the Coast Guard by the helicopter manufacturer, Aerospatiale Helicopter Corp.

The technical specifications were probably typical for a simulator of this type. "Best commercial practice" was felt to be adequate except in a few specific areas like documentation. The specifications required Sperry to provide "training unique" capabilities such as "freeze", demonstrations, record/playback, automated checkride, parameter freeze, parameter monitoring, store/reset, malfunction insertion, and control of environment. The specs also included requirements for the motion system, visual system, and ride-along instructor station.

Initial Data Deliveries

In late July the first package of simulator data was delivered to Sperry. Delays in the helicopter program had delayed the certification flight tests which were to also serve as the simulator data gathering flights. Basic design data was available, but criteria data such as performance and flying qualities graphs had not yet been provided. Since Sperry was in a "design" mode at this point, the lack of criteria data was not yet a big problem.

In October, the author moved to Sperry's plant and became a resident government representative. He remained in-plant on a daily basis for the next three years.

Mockup Review Conference

In November, the mockup review conference was held. Seville, NTEC, the CG, and Sperry all met together for the first time and created the basic conceptual design for the new simulators. The design was partly old and partly new. The Coast Guard already knew what things they liked about the two helicopter simulators they had been operating for nine years; things like ride-along instructor station and CRT-driven controls. Those things were incorporated and things which hadn't proved out so well like computer-scored checkrides were modified. Dr. Caro of Seville contributed a CRT page hierarchy which has proven to be extremely effective and Mr. Povenmire described the new approach to checkrides which appears to have a lot of promise.

CRT Hierarchy. The CRT page hierarchy which was implemented organizes the approximately 150 CRT displays (pages) into a logical (and therefore easily-remembered) sequence. These pages are arranged into nine sections with the first page of each section, the index page for that section, having a one-digit page number (see figure 1). Each index page serves as only a table of contents for the remaining pages in that particular section. The "non-index" pages (see figure 2) have three-digit page numbers and contain numbered lines which provide the actual control function. For example, (refer to figure 1) the IC and CC (Initial Conditions and Current Conditions) index page, page 1, contains lines which list the pages in that section. Note the first line on page 1 is:

"00 Current Conditions"

This means that the CRT page which displays the simulated aircraft/environment's current conditions is page 100 (the first digit, "1", of the page number comes from the associated index page number). Similarly, the next line on page 1:

"01 Bates IC set 1"

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                                                        PAGE 1

                     INITIAL AND CURRENT CONDITIONS INDEX

00   CURRENT CONDITIONS

          INITIAL CONDITIONS

01   BATES FIELD/COAST GUARD RAMP (SHUTDOWN)
02   BATES FIELD/RUNWAY 14 (RUNNING)
03   BROOKLEY/RUNWAY 14 (RUNNING)
04   GULFPORT-BILOXI REGIONAL/RUNWAY 31 (RUNNING)
05   PENSACOLA NAS/RAMP AT BASE OPS (SHUTDOWN)
06   PENSACOLA NAS/RUNWAY 7R (RUNNING)
07   NEW ORLEANS NAS/USCG RAMP (SHUTDOWN)
08   NEW ORLEANS NAS/RUNWAY 04 (RUNNING)
09   NEW ORLEANS INTL (MOISANT)/GENRL AVIA. RAMP (SHUTDOWN)
10   NEW ORLEANS INTL (MOISANT)/RUNWAY 01 (RUNNING)
11   THE WILLIAM B.HARTSFIELD ATLANTA INTL/RWY 26 (RUNNING)
12   MOSBY AHP, DAHLONEGA, GA/HELO LANDING AREA
13   OVER DAHLONEGA, GA (NEAR MOSBY AHP)
14   UNIV. OF SOUTH ALABAMA MED. CTR. HELIPAD (RUNNING)
15   ON DECK FOOTBALL STADIUM
16   AIRBORNE SEMMES VORTAC
17   OIL RIG (ON DECK, RUNNING)
18   OIL RIG (AIRBORNE)
19   C.G. CUTTER (ON DECK, RUNNING)
20   FISHING VESSEL (50' HOVER)

          CHECKRIDE INITIAL CONDITIONS

21   BATES VFR TRAFFIC PATTERN
22   BATES ILS RWY 14 APPROACH
23   SAUFLEY VOR HOLDING PATTERN
24   NAVY PENSACOLA TACAN RWY 7R APPROACH
25   NAVY PENSACOLA GCA RWY 7R APPROACH
26   HOLDING PATTERN TEDDY INTERSECTION
27   GULFPORT-BILOXI REGIONAL VOR RWY 13 APPROACH
28   MOISANT INT'L RNAV RWY 01 APPROACH
29   CATCH
30   INSTRUMENT TAKEOFF

50   ZEROING PAGE
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Figure 1. Index Page

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                                                        PAGE 100
                     CURRENT CONDITIONS DISPLAY

          OWN AIRCRAFT                                   OTHER AIRCRAFT
01 LATITUDE (DEG)                 N30:42:06     INITIAL LATITUDE (DEG)              N30:30
02 LONGITUDE (DEG)                W088:15:14    INITIAL LONGITUDE (DEG)            W088:04
03 HEADING                              142   43 TIME OF INITIAL POSITION (LCL)      1015
04 ALTITUDE (FT)                        217   44 COURSE (DEG TRUE)                     270
   AIRSPEED (KTS)                         7   45 IAS (KTS)                               0
   TORQUE #1 (PERCENT)                   12   46 CURRENT LATITUDE (DEG)             N30:30
   TORQUE #2 (PERCENT)                   12   47 CURRENT LONGITUDE (DEG)           W088:04
   ROTOR RPM (PERCENT)                   95   48 ALTITUDE (FT)                        1500
08 TOTAL FUEL (LBS)                    1423
09 INTERNAL LOAD (LBS)                    0              CG CUTTER
10 INTERNAL LOAD STATION (IN)         153.0     INITIAL LATITUDE (DEG)              N30:05
11 SLING LOAD (LBS)                       0     INITIAL LONGITUDE (DEG)            W088:00
   GROSS WEIGHT (LBS)                  8273   53 TIME OF INITIAL POSITION (LCL)      1015
12 LONG CG (IN)                       153.6   54 COURSE (DEG TRUE)                     000
13 LAT CG (IN)                         -1.4   55 SPEED (KTS)                             0
   WHEELS (UP/DOWN)                    DOWN   56 CURRENT LATITUDE (DEG)             N30:05
   ROTOR BRAKE (ON/OFF)                 OFF   57 CURRENT LONGITUDE (DEG)           W088:00
16 EXT. POWER (0=NO,1=DC,2=AC,3=BOTH)     0   58 SEA STATE (0-5)                         1
   AIRCRAFT CLOCK (LCL TIME)           1031
                                                          CUTTER LIGHTS
          ENVIRONMENT                          61 HOMING BEACON (0-5)                     5
21 ALTIMETER SETTING (IN HG)          29.93   62 LINE-UP LIGHTS (0-5)                    5
   OAT                             73F/ 23C   63 DECK EDGE LIGHTS (0-5)                  5
22 SURF TEMP (DEG F, 0=MINUS)      73F/ 23C   64 HIFR LIGHTS (0-5)                       5
23 SURFACE WIND DIR (DEG MAG)           150
24 SURFACE WIND VEL (KTS)                 7             FISHING VESSEL
25 GUSTS (KTS)                            0     INITIAL LATITUDE (DEG)              N30:05
26 5,000 FT WIND DIRECTION (TRUE)       240     INITIAL LONGITUDE (DEG)            W088:40
27 5,000 FT WIND VELOCITY (KTS)          15   73 TIME OF INITIAL POSITION (LCL)      1015
28 VERT WINDS (FPS)                       0   74 COURSE (DEG TRUE)                     000
29 TURBULENCE LEVEL (0-3)                 1   75 SPEED (KTS)                             0
30 ICE (AUTO/OFF)                      AUTO   76 CURRENT LATITUDE (DEG)             N30:05
31 VISIBILITY (MILES)                   1.0   77 CURRENT LONGITUDE (DEG)           W088:40
32 FOG TOP (AGL, FT X 10)                20   78 SEA STATE (0-5)                         1
33 SCUD (YES/NO)                        YES   79 BOOM LIGHT INTENSITY (0-5)              3
34 CEILING (AGL, FT X 10)                40
35 CLOUD TOPS (MSL, FT X 100)            60               OIL RIG
36 HORIZON BRIGHTNESS (0-5)               5   81 LATITUDE (DEG)                     N30:05
37 AMBIENT LIGHT (0-5)                    5   82 LONGITUDE (DEG)                   W088:20
38 STARS (YES/NO)                       YES   83 LANDING LIGHT INTENSITY (0-5)           3

                                                          MISCELLANEOUS
                                              84 AURAL VOLUME (0-5)                      3
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Figure 2. Non-Index Page

tells the instructor that the CRT page which shows the parameters associated with initial condition set number one (aircraft shutdown at Mobile BATES Field) is page number 1Ø1.

With this as background, you can see how this hierarchy is used, in conjunction with the CRT to provide controls to the instructor. Basically, all changes to the simulation are effected using a five-digit number (address), a slash, and the desired new condition. The five digit address is made up of the index page number (first digit), the "non-index" page number (digits two and three), and the line number on the "non-index" page (digits four and five). Assume the instructor wants to turn the horizon "off" in the visual scene. He uses a hand-held keypad to enter "1ØØ". This causes page 1ØØ, the current conditions page, to be displayed (see figure 2). He scans down page 1ØØ until he sees the line:

"36 Horizon Brightness (Ø-5) 3"

This tells him that the line he wants to change is line number 36 and that the current brightness is level three. He then types in "1ØØ36/Ø" which in essence means: on page 1ØØ, line 36, change the value to zero. When this command is entered, the horizon goes dark.

Checkride. The new checkride approach which was decided upon is equally innovative. Basically, it involves establishing ten maneuvers. Any checkride is then composed of up to five of these maneuvers arranged in any sequence. Each maneuver is made up of discrete legs which have up to four scored parameters. The maneuvers selected are shown in figure 3.

For example, checkride #1 is made up of maneuvers 23, 24, 29, 3Ø, and 25. The checkride therefore involves those five maneuvers joined by periods of "free flight" during which no computer monitoring occurs. Flying this checkride would include a period of free flight during which the student would takeoff and fly to

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                                                  PAGE 600

                    CHECKRIDE CONTROL

01   CHECKRIDE MANEUVER SEQUENCE     23/24/29/30/25
02   CHECKRIDE                          OFF

                    DATA

11   CHECKRIDE NUMBER                    1
12   CLASS NUMBER                        0
13   HOME STATION                        0
14   QUALIFICATION HELD                000
15   STUDENT ID                       0000
     DATE                          31MAR85
```

Figure 3. Checkride Maneuvers

Pensacola, holding at the Saufley VOR (maneuver 23), free flight to the initial approach fix for the TACAN runway 7R approach at NAS Pensacola (maneuver 24), free flight to the next maneuver and so on.

Each maneuver has certain gate conditions which, when met, enable collection of performance data. For example, the gate for maneuver 23 is defined by a latitude, radial off Saufley and aircraft heading (refer to figure 4). The instructor will ensure that the student performs his initial free flight so as to satisfy the gate criteria and start the collection of data for those parameters listed under leg two. The student flies all the legs and finally meets the criteria for the maneuver end conditions (leg 11 in this case) at which time performance monitoring ceases until the gate conditions for the next maneuver are met.

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                                                                      PAGE 623
                              CHECKRIDE MANEUVER 23
                          HOLD NORTH ON R349 SAUFLEY (NUN)
LEG TIME  DESCRIPTION                  SCORED PARAMETERS                                    CORRELATION
    LEFT      GATE ENTRY CONDITIONS                       OPTIMUM      RANGE               GRAPHS
 1  5:0  PRIOR TO INITIAL STATION PASSAGE
              R349 +/- 5 DEG AND       -                  -            -                    -
              SOUTH OF N30-30-00 AND   -                  -            -                    -
              HEADING 149-189 DEG      -                  -            -                    -
 2  2:0  AFTER ENTRY, BEGIN SRT TO 1ST OUTBOUND LEG
              R169 +/- 90 DEG AND      ALTITUDE           3000' MSL    2200-3200' MSL       ALL
              HEADING 124-214 DEG      HEADING            -            169-349 DEG
                                       TIME               -            0-90 SEC
                                       RATE OF TURN       3 DEG/SEC    0-6 DEG/SEC R
 3  2:0  FIRST OUTBOUND HOLDING LEG
              R274 +/- 15 DEG AND      ALTITUDE           3000' MSL    2000-3200' MSL       ALL
              HEADING 319-19 DEG       AIRSPEED           70 KTS       50-90 KTS
                                       HEADING            349 DEG      319-019 DEG
                                       TIME               -            0-90 SEC
 4  2:0  BEGIN SRT TURN TO 1ST INBOUND LEG
              RT TURN >2 DEG/SEC FOR   ALTITUDE           3000' MSL    2000-3200' MSL       ALL
              >5 SEC  AND              RATE OF TURN       3 DEG/SEC    0-6 DEG/SEC R
              HEADING 349-359 DEG      HEADING            -            349-169 DEG
                                       TIME               -            0-90 SEC
 5  2:0  FIRST INBOUND LEG
              R351 +/- 7 DEG AND       HEADING            169          140-200 DEG          ALL
              HEADING 139-199 DEG      AIRSPEED           70 KTS       50-90 KTS
                                       RADIAL             349          344-354 RAD
                                       TIME               -            0-90 SEC
 6  2:0  BEGIN SRT TURN TO 2ND OUTBOUND LEG
              R169 +/- 90 DEG          ALTITUDE           3000' MSL    2000-3200' MSL       ALL
                                       RATE OF TURN       3 DEG/SEC    0-6 DEG/SEC R
                                       AIRSPEED           70 KTS       50-90 KTS
                                       TIME               -            0-90 SEC
 7  2:0  SECOND OUTBOUND LEG W/ WIND CORECTION
              R274 +/- 15 DEG          ALTITUDE           3000' MSL    2000-3200' MSL       ALL
                                       AIRSPEED           70KTS        50-90 KTS
                                       HEADING            349 DEG      319-019 SEC
                                       TIME               -            0-90 SEC
 8  2:0  BEGIN SRT TURN TO 2ND INBOUND LEG
              R354 +/- 5 DEG AND       ALTITUDE           3000' MSL    2000-3200' MSL       ALL
              RT TURN >2 DEG/SEC FOR   HEADING            -            349-169 DEG
              >5 SEC                   RATE OF TURN       3 DEG/SEC    0-6 DEG/SEC R
                                       TIME               -            0-90 SEC
 9  2:0  SECOND INBOUND W/ WIND CORRECTION
              R351 +/- 7 DEG AND       HEADING            169          140-200 DEG          ALL
              HEADING 139-199 DEG      AIRSPEED           70KTS        50-90 KTS
                                       RADIAL             349 DEG      344-354 DEG
                                       DIST FM NUN        -            0-1.5 NM
10  0:0  WEATHER CHANGE
              R169 +/- 90 DEG          -                  -            -                    -
              CHANGE CEILING: 400' OVERCAST,  RVR: 3/4 NM              -                    -
11  0:0  END CONDITIONS
              R169 +/- 90 DEG          -                  -            -                    -
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Figure 4. Maneuver Description

There are three interesting aspects of this design. First, after the checkride is completed, the instructor uses correlation graphs to debrief the student (See figure 5). Second, statistical data such as mean

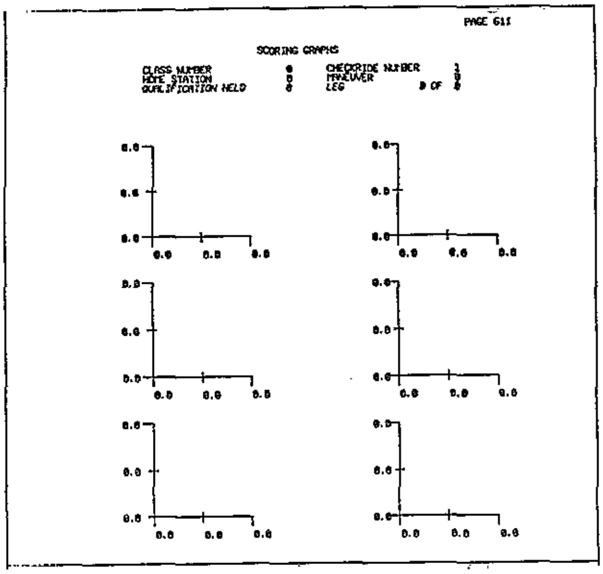

Figure 5. Correlation Graph

deviation from optimum airspeed is stored on disk and later transferred to mag tape. This statistical data will be used for long-term analysis of general trends, e.g. increasing tendency to fly faster than optimum, as opposed to specific critiques of individual pilot performance. Last, since the HH65A has a flight director which can be programmed to fly specific airspeeds, altitudes, and even maneuvers (e.g. holding, ILS approaches), the student has to be prohibited from using the flight director when he is flying a checkride. Without this prohibition, the checkride would merely evaluate how well the flight director computer can perform a maneuver rather than how well the student can perform the maneuver on his own.

During the mockup conference, the physical arrangement of the cockpit and instructor station was also determined. The layout has survived virtually intact.

Design Review

In January of 1982 the first design review was held. All the normal items were discussed, but two are worthy of note. One, it was decided that "multiple visual data bases" would be used in the same geographic area. For example, in the Mobile area there are four "visual areas of interest" where hovering will be accomplished: Bates Field, Brookley Field, a helipad at the USA Medical Center and a generic football field. Rather than distribute the limited number of surfaces among these four areas, four separate visual data bases (which all cover the Mobile area and have identical geographic boundaries) were built. All of these data bases also share the same light point configuration and differ only in the location of the surfaces which make up the expected landing area. In other words, when flying from Bates to the football field, the student first sees the surfaces for the Bates airport when he departs Bates. Then, while enroute the football field, the instructor changes the displayed visual scene from Bates to the football field (this causes the student to fly into clouds for about ten seconds). When the visual change is complete, the light point pattern has not changed, so the student cannot perceive any difference in models, but the surfaces that previously made up the airport environment at Bates are now being used to model the football field. A fishing vessel visual data base was designed which can be used for hoist training. A model of a 270 foot CG cutter was also designed and will be used for ship landing training. The second noteworth item was a suggestion by Sperry's program manager that the Coast Guard consider purchasing a complete spare computer in lieu of just purchasing selected computer components. This was attractive not only because it was cheaper, but also because it provided a computer which could be used for developmental purposes.

Visual Data Base Reviews

In February, the first of several visual data base reviews was held at Rediffusion's plant in Arlington, Tx. The visual models are a mix of "library" models, or models developed for another customer, and CG-unique models. At this first session, only library models were reviewed. One interesting item which was implemented is a "generic" airport which can be located anywhere in the problem world. In effect, this provides hundreds of visual airport data bases rather than just a few "fixed" airports. The library model chosen for the generic airport was Sacramento Metropolitan. Sacramento was chosen because it had a single runway with instrument approach lighting on one end, a very nice terrain environment, and nearby city lighting. In operation, the instructor geographically positions the generic airport using CRT controls, (see figure 6) establishes the runway heading, etc. and then once the student flies into the generic airport data base, he sees the generic airport visual scene and can shoot an approach and land. As an aside, note that this CRT page also provides the ability to fly an ILS approach to this airport in addition to all the normal non-precision approaches, e.g. VOR, TACAN, ADF.

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AIRPORT DATA

GENERIC AIRPORT

	RUNWAY CONDITIONS	
01		
02	RVR (FT X 100)	99
03	VASI (ON/OFF)	ON
04	REILS INTENSITY (0-5)	3
05	RUNWAY LIGHTS INTENSITY (0-5)	3
06	APPROACH LIGHTS INTENSITY (0-5)	3
07	STROBE LIGHTS INTENSITY (0-5)	3
10	ILS SELECT	0
	TOUCHDOWN POINT LOCATION	
11	LATITUDE (DEG)	N00:00:00.0
12	LONGITUDE (DEG)	E000:00:00.0
13	ELEVATION (FT)	0
14	RUNWAY HEADING (DEG MAG)	0.0

Figure 6. Generic Airport Control Page

Progress Review

In March, the first Progress Review was held. At this review, Sperry revealed that the available data on the HH-65A Automatic Flight Control System and Flight Director system was very inadequate. After the Coast Guard requested this data from Aerospatiale, who in turn, talked to their subcontractor Rockwell-Collins, the Coast Guard was advised that Collins did not want to provide the data to a potential competitor. However, the Coast Guard's contracting officer was convinced that the data Sperry needed on the AFCS/Flight Director was absolutely necessary and due to the Coast Guard as part of the simulator data package AHC had agreed to provide. Eventually, in September of '82, AHC provided the data.

Trainer Preliminary Evaluation

On the 22nd of March the first Trainer Preliminary Evaluation was held. At this time the Trainer Criteria Report (TCR) was reviewed by the Coast Guard with Sperry. The TCR established the baseline engineering design of the simulator and acceptance of that report constituted simulator design freeze. About the only problem this arrangement presented was that some engineers did not use the best data source when they prepared their TCR sections, i.e. they used a preliminary, draft version of the pilot's handbook in lieu of the more accurate simulator data report.

Contract Field Services

In April, Sperry was advised by the Coast Guard that seven contract field service (CFS) personnel would be adequate for the on-site maintenance function for both simulators. Sperry did not feel that this would be an adequate number of CFS personnel, but a CFS contract was eventually negotiated which included seven CFS personnel and which guaranteed 90%+ availability.

Visual Field-of-View

In May, Sperry/RSI was provided with the Coast Guard's desired visual display orientation. The orientation chosen (see figure 7) was based on the following rationale. The forward displays were oriented to provide sufficient cues for normal approaches to a running landing and subsequent ground taxi. The quarter display was oriented with it's long axis vertical in order to provide hover cues. The side display was oriented with it's long axis vertical in an attempt to provide cues for hoist operations.

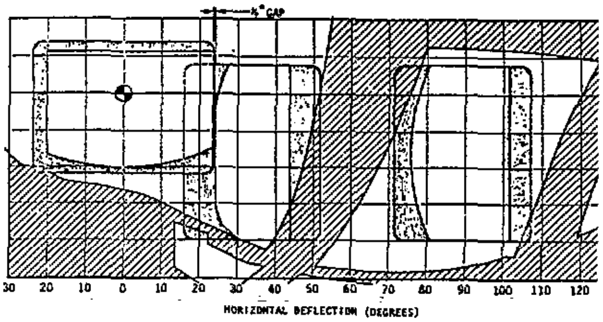

Figure 7. Pilot's Field of View

Competition for Aircraft Parts

Also in May, Sperry requested assistance in improving the delivery dates on some aircraft avionics units which were to be used, unmodified, in the simulator. These items included actual flight instruments. Luckily, Collins agreed to provide these items early enough to support hardware/software integration, but the word to the wise is: "include simulator parts requirements in all aircraft planning efforts - including, if necessary, assigning the simulator a proxy number on the assembly line.

On-Board Computer Simulation

Continuing with the subject of simulator avionics; Sperry originally planned to use the actual aircraft on-board computer in the simulator. Collins, the manufacturer of the computer, also felt this approach was feasible because the computer had a built-in test port which allowed external inputs and appeared to be the perfect avenue for "stimulation". After the simulator design began to mature however, it was decided to abandon this approach and to totally emulate the on-board computer in software. The reason behind this change in approach was that the simulator unique requirements like freeze, slew, geographic lat/long repositioning, etc. all created too alien an environment for the actual aircraft computer.

Malfunctions

About this time it also became obvious that simultaneous development of the aircraft and simulator created another problem - malfunction simulation. One of the strengths of the current simulator program in the HH52A and HH3F simulators is the ability to provide realistic malfunction symptoms. With a new aircraft, there is no historical data base which describes malfunction symptoms. Instead the systems have to be analyzed and educated guesses made on what the most likely failures are. Then an analytical attempt is also made on the symptoms of these malfunctions. In this case, AHC provided a failure modes and effects analysis (FMEA) but often the indications were qualitative, not quantitative in nature and rarely was there a comprehensive description of indication changes over time, e.g. the amount of main gear box torque increase with a bearing failure in the MGB. Aural and vibratory cues were also sketchy. Since there may not be any safe way of obtaining actual data on some of these life-threatening malfunctions/emergencies, this problem will probably exist for any simulator which is developed concurrently or even shortly after the aircraft.

Facility

In November of 1982 the ground was broken for the building which was to house the two new simulators. Two bad things happened during construction. One was the reaction pads for the motion system were poured two inches too low and the other was the rear wall of the high bay was too close to the motion system. Both were eventually resolved satisfactorily.

Data Problems

By early 1983 some data inconsistencies and voids were surfacing. A big problem was engine transient data. An engine math model was available but it did not run in real time and it only simulated steady state conditions. While the steady state data was useful for building lookup tables, etc., it was inadequate for describing how the engine instruments changed during a start, hover climbout, etc. To acquire this engine "transient" information, video tapes of instrument dynamics were recorded. Unfortunately, the field of view had to be so large to include all the instruments that the resolution was not good enough to allow discernment of the actual instrument reading. Finally, data traces which plotted this information was obtained.

Another data problem was that the avionics suite specifications often clearly described what happened when all the buttons were pushed correctly but were mute on what happened if the wrong button was pushed. Here's where access to an aircraft would have been invaluable. Luckily, even though an aircraft wasn't available, a lot of these kinds of questions were answered using Collins' hot mockup.

In-Plant Assistance

During this time period, daily presence in-plant of the government representative was to prove extremely valuable. The Contracting Officer and his boss had given him fairly wide-ranging authority. He was able to interface directly with the Coast Guard Aircraft Program Office (APO) at Aerospatiale's factory in Texas. The APO was responsible for delivery of the new helicopters (just as he was responsible for delivery of the simulator). Their knowledge, experience and assistance was a critical ingredient in keeping the simulator moving along in spite of all the problems. Typically, whenever a question came up on "how the aircraft operated", the govt. rep. was able to call APO and get the answer the same day.

Preliminary Inspection

By November, it looked like combined Contractor-Government Inspection would begin after the first of the year. January 1984 arrived but Sperry was still not ready for preliminary inspection. Some systems had been integrated but others like the critical 1553 avionics bus were not ready for test. Another problem was the Acceptance Test Procedure (ATP).

Acceptance Test Procedures. The ATP was a compilation of individual test sections with each section being devoted to a separate element of the simulator. The motion system had a section, the visual system had a section, and all the aircraft systems had their own sections, for example, fuel, landing gear, hydraulics, etc. Since the ATP tested every part of the simulator, the procedures it contained had to be written before preliminary inspection could begin. Sperry wisely chose to have each system modeller write the ATP sections that covered their particular systems, but since these people were also performing software debug and verification during this period, late '83 - early '84, the ATP was slow in coming. It was eventually decided, in the interest of time, to begin preliminary inspection without a complete ATP. Obviously it was planned to test those sections which were written first and while that process was continuing, the remaining sections would be produced. By the end of March the first ATP sections had been submitted for government review. In May preliminary inspection began.

Combined Inspections. The preliminary inspection was a combined contractor and government inspection. During contract negotiations, combining the two normally separate tests, contractor preliminary inspection and government preliminary inspection, into a single inspection was discussed. The primary advantage, it seemed, would be a savings in time and money. Since the government acceptance team was in-plant all the time, it seemed that there was no need for Sperry to conduct a preliminary inspection to make sure it was appropriate to have the government acceptance team come to the plant and conduct their testing. It was hoped that this approach would save several weeks. Since preliminary testing took over nine months, the jury is still out on whether any time was truly saved.

During preliminary inspection, the simulator project officer (i.e. govt. rep.) was aided tremendously by personnel from the APO. These individuals provided that knowledge of the aircraft which he lacked and which is so essential for a good test of whether the simulator flies like the aircraft.

Discrepancy Reports. About 9ØØ Discrepancy Reports (DRs) were written on the trainer during CGPI. An unexpected problem which occurred during CGPI was that sometimes when a DR was corrected, it would cause another problem in either the same system or even perhaps in another system. This was especially alarming because the "new" problem might go undetected if the "other system" had already been tested. In order to minimize the adverse effect of this problem, a decision was made to retest all of the aircraft systems sections of the ATP during final inspection on-site.

Reliability Demonstration

In February 1985, preliminary inspection was completed and the reliability demonstration was conducted. Actually, the reliability demo served two purposes. The first was to test the reliability of the simulators and the second was to give the Coast Guard instructor cadre training in the operation of the simulators. Since the simulators had been operating virtually 24 hours a day for the previous nine months, there was not too much concern about the reliability demo and in fact, Sperry passed with flying colors.

On Site

In April, the simulator arrived on site in Mobile and was installed. Final inspection began in June and the trainer was conditionally accepted on 28 August 1985 - a little more than four years after contract award and luckily, only about two months after the HH-65A transition courses had begun at ATC.

Even though the project had its ups and downs, it has two positive aspects. One is that even though Sperry and the project officer had their differences of opinion, they were able to maintain a congenial working relationship and never lost their mutual respect for each other. The second, and most important thing, is that by providing realistic emergency procedures training, the simulator will save the lives of Coast Guard aircrews and by providing realistic operational procedures training it will also help save the lives of you, their clients.

CHRONOLOGY OF EVENTS

1978

Jan	
Feb	
Mar	
Apr	
May	
Jun	NTEC Assistance Approved
Jul	
Aug	
Sep	
Oct	
Nov	
Dec	

1979

Jan	
Feb	Contract With Seville for Specs
Mar	
Apr	
May	
Jun	Specifications Finalized
Jul	HH-65A Aircraft Contract Awarded
Aug	
Sep	Specification Review Conference
Oct	Combined HU-25A & HH-65A Sim. Procrmts
Nov	
Dec	Commerce Business Daily Release

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Jan	RFTP Released
Feb	Pre-Proposal Conference
Mar	
Apr	Technical Proposal Rcvd From Sperry
May	Sole Source Approved
Jun	Cost Proposal Received
Jul	
Aug	DCAA Audit Received
Sep	Began Reprogramming Effort
Oct	
Nov	
Dec	

1981

Jan	
Feb	
Mar	Began Negotiations
Apr	
May	
Jun	
Jul	HH-65A Simulator Contract Awarded
Aug	
Sep	
Oct	
Nov	Mockup Review Conference
Dec	

	1982	
Jan	First Design Review	
Feb	First Visual Design Review	
Mar	First Progress Rvw/Trnr Prelim Eval	
Apr		
May	Established Field of View	
Jun		
Jul		
Aug		
Sep	AFCS Control Laws Received	
Oct	Design Freeze	
Nov	Began Facility Construction	
Dec		
	1983	
Jan		
Feb	Data Voids, Inconsistencies Appear	
Mar		
Apr		
May	Install Wiring, Begin Hardware Install	
Jun		
Jul	Began Installation of Visual System	
Aug		
Sep		
Oct		
Nov		
Dec		
	1984	
Jan		
Feb		
Mar	Received First ATP Sections	
Apr		
May	Began Contractor/Govt Prelim. Inspect.	
Jun		
Jul		
Aug		
Sep		
Oct		
Nov		
Dec		
	1985	
Jan		
Feb	End of CGPI, Began Reliability Demo	
Mar	Teardown, Ship, Install On-Site	
Apr		
May		
Jun	Began Final Inspection	
Jul		
Aug	Simulator Conditionally Accepted	
Sep		
Oct		
Nov		
Dec		

COMPUTER-BASED INSTRUCTION: ARE YOU READY?

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Summary

Throughout the education and training communities of the Armed Forces, automated technologies are increasingly being introduced. The faculties and staffs of all the services are changing management practices and instructional strategies in response to the addition of new computerized systems. Impacting management, trainers, and students, these new technologies must be introduced based on defined requirements and through well planned technology transition programs. Major problems face the traditional faculty and staff: changing course designs and management procedures, developing computer literacy, obtaining expertise to maximize technology capabilities, and solving organizational and personnel problems inherent with the introduction of new technologies. Historical evidence shows that where management has failed to establish user acceptance in advance of system delivery, program success seldom occurs. Overselling and improper training often led to improper use or rejection of earlier technology advances, such as television, sound-slide and programmed instruction. With the advancement of microcomputer technology, education and training applications are rapidly increasing. The new technology has many benefits to offer educators and trainers, but successful application depends on faculties and staffs willing to accept and knowing how to use it. In the United States Air Force Air Training Command, new training programs are being designed for managers, supervisors, instructors, and course developers to prepare them for the new technologies. These initiatives are highlighted so other agencies can also plan training interventions for their faculties and staffs.

Introducing CBI Technology

> "The problem related to the effective implementation of computers as instructional tools is a general lack of knowledge about what they can do and how they work...(Educators) will resist the unknown. Few individuals are able to use tools of which they have little knowledge or even less use." (Caldwell, 1982, pg 36)

Successfully introducing computer technology to the training environment is one of the challenges facing training managers today. While new technologies have been introduced to educational and training systems in the past, today's managers frequently forget to review the lessons learned from those past experiences. They tend to build into their plans the same mistakes others have previously made. Computer-based instruction (CBI) is increasingly becoming a part of our training systems. It is impacting students, instructors, course designers, and training managers in ways permanently altering their behaviors and responsibilities.

The advantages of automated technology frequently dictate the introduction and use of CBI. Over time, technology costs are cheaper than people costs (Reynolds, 1982). Most of the advantages of programmed instruction are found in well designed CBI...immediate feedback, standardized instruction, branching to meet individual and remediation needs, just to name a few. The speed, volume, exportability and interactive characteristics of automation also are convincing arguments for incorporating CBI technology in a new or existing training system where these advantages are found efficient and educationally effective. Despite these and other apparent advantages, some major problems must be solved as plans are made to introduce CBI technology.

With the advent of automated technology in training, management practices and procedures are changed. Management flexibility is usually compromised in such a way the changes become irrevocable, successful use requires greater and continuous management imposed discipline of information reporting and processing, and reliance on computers causes management and training to cease when computer failure occurs (TIG Brief, 1983, pg 16). Because of management concern for computer utilization, course developers tend to focus on opportunities to use the computer despite the availability of less costly and more effective traditional media. "In choosing any medium for instruction, the designer should ask 'Which elements of the instruction are best supported by which elements of the media?' This elementary, but true, design principle is frequently violated in the computer medium" (Edwards and Tillman, 1982, pg 19). The quality of automated training is a function of course design, software, and instructor ability to deliver. Further, the quality of educational computing depends on the software and the way in which the use of that software is integrated into the overall curriculum (Komoski, 1984).

Managers must recognize that their staffs may not have computer or scientific literary skills necessary to easily accept, manage, and use CBI systems. Much has been written about the literacy problems facing young people who will soon enter the military (Orr, 1983), and trainers and educators throughout the national education system have similar problems (Stone, 1983). Training staffs, including commanders, managers, training developers, and instructors, must confront these problems when (1) developing computer management procedures and practices (guidance for system security, staff training, hardware/software definition and acquisition, site preparation, system administration, etc), (2) making course development decisions (selection of instruction strategies that optimize computer and authoring system capabilities), and (3) affecting instructor behavior changes (from dispenser of information to facilitator of information transfer). As these issues are addressed, organizational structure and personnel classification changes may be necessary to accommodate management and training tasks required to "make" the automated system work.

Historically, managers have had difficulty introducing new technology to the training community. Resistance from trainers has often been great, primarily because they did not fully understand the purpose, process or procedures for the new technology. Resistance to change is a phenomenon common to most people. By understanding a new technology and its implications for one's environment, concerns regarding changes to job tasks, career security, and even one's self-confidence can be minimzed. Further, proper staff preparation can promote enthusiasm for the change and therefore enhance the successful introduction of a new technology. Many potentially successful systems have eventually disappeared or suffered from inappropriate use because managers have failed, in part, to consider this human element.

Video technology, sound-slide methods and programmed instruction experienced early enthusiasm from instructional technologists knowledgeable of their teaching potential. Yet, in observing learning systems today, one finds few examples of effective video, sound-slide or programmed instruction activities. In fact, within faculty and staff training systems, training managers, course designers, and instructors give limited attention to these technologies. Some studies have shown that 60 percent of the micro-computers used for training are used for drill and practice (Training/HRD, Dec 1982, pg 10), and "only 5 percent of the hundreds of programs have been judged to be of truly high quality, while more than half have been judged not worth recommending" (Komoski, 1984, pg 244). Courseware/software, designed to be more than an "automatic page turner," manages student activity, directs behaviors, tutors and provides meaningful feedback to students and instructors alike. This, not drill and practice, is effective computer use in training and education. A process that helps to ensure well designed courseware/software for instructional uses is programmed instruction (Edwards and Tillman, 1982), but this method is seldom seen in today's training systems.

It is the responsibility of management to prepare faculty and staff for the aquisition, delivery and use of new technologies (Williams, Bank, and Thomas, 1984). Within the Air Training Command, the technical training community recognizes the need to prepare its faculty and staff for CBI technology. Needs assessments conducted at Sheppard AFB revealed requirements for training Air Force and Air Training Command personnel in computer-based training concepts. Personnel were not familiar with CBI technology, computer literacy skills were low, and many staff members resistant to introducing CBI to their training activity. Existing faculty and staff training programs did not address management, course design and instruction issues relative to automated technologies. Courses on instructional systems design, management of instructional systems and instructor training were noticeably void of information on automation. Based on these findings, emphasis was given developing and revising faculty and staff training programs to prepare personnel for employing automated training or training management activities in their work environments.

New Programs

Working in coordination with the USAF Occupational Measurement Center and the Standards and Policy Directorate, DCS/ Technical Training, Air Training Command, Randolph AFB, Texas, the Sheppard AFB staff initiated development of three training programs giving emphasis to manager, designer, and instructor needs in the field of CBI. In addition to and concurrent with this action, staff training was obtained through other government agencies, contractor services, and workshops and seminars available through the conferences of professional societies. The three courses being developed by the Sheppard staff, however, are to serve specific needs for faculty and staff personnel who must teach and manage Air Force training systems employing CBI technology...and these needs go beyond those serviced by training available through these other sources. The following is a synopsis to each of these three new/revised courses.

Computer-Based Instruction (CBI) Staff Orientation Course

This course is designed to train commanders, division chiefs, branch chiefs, training developers, and other Air Force and Department of Defense personnel on CBI. The scope of training includes familiarization with computer processes, CBI applications, management concerns involving CBI systems. The course provides field trips to selected agencies and organizations that use computers in support of instruction and training management functions. Course length is 24 academic hours.

Computer-Based Instruction (CBI) Designer Course

The CBI Designer Course will provide training to Air Force and other Department of Defense personnel having CBI development responsibilities. The scope of training includes computer familiarization, computer operation, instructional system development principles, programmed instruction, computer assisted instruction (CAI) planning, CAI development techniques, and CAI lesson production. Projected course length is 160 academic hours.

Technical Training Instructor Course

This course, when complete, will train USAF instructors entering technical training systems. It will be an updated version of the current 27-day training program now taught at each of the six Air Training Command technical training centers. The revised course will introduce the technical training instructor to CBI technology through embedded CAI application. New lessons are being added which will develop the instructor's CAI terminology and application skills and prepare the new instructor for teaching/managing students in a CBI environment.

Conclusion

New technologies are being delivered to education and training systems across the Armed Forces, and their success hinges on a trained and accepting audience. It is the objective of the USAF Air Training Command's technical training community to ensure these new technologies perform as advertised when introduced to the Air Force environment. They will, if the faculties and staffs are prepared to receive them. Implementation of Air Training Command's three new training programs is projected for late FY 1986. These new courses will provide the Air Force community with instruction preparing managers, course designers and instructors to effectively work with CBI. New faculty and staff training policies have also established requirements for selected personnel to receive CBI training. Through new courses, use of training from other sources, and regulatory requirements for faculty and staff personnel to receive training, the faculties and training staffs of the Air Training Command will be ready for CBI.

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