Single-Pilot Workload Management in Entry-Level Jets

APPENDICES

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APPENDIX A

Demographic Data Questionnaire

Background Data

1. Age: Click here to enter age.

2. Gender (Please check one): Male ☐ Female ☐

3. (This question is being asked to make sure you will be able to fly in the simulator without problems.) When you fly, do you wear bi/tri focal glasses that have lined lenses (i.e. not progressive lenses) or those with anti-glare coating or transition lenses (automatically lighten or darken in different lighting conditions)?

   Yes ☐ No ☐

   a. If so, do you have the option of wearing glasses with lenses other than those listed above or contact lenses? Please check one.

      Yes ☐ No ☐

4. What is the aircraft configuration code/serial number of your Citation Mustang? Please check one:
   ☐ AF – Airplanes 510-00041 and on
   ☐ AG – Airplanes 510-001 thru -0040
   ☐ AH – 510-0001 thru -0065 incorporating SB510-34-02
   ☐ AI – Airplanes 510-0001 thru -0065 not incorporating SB510-34-02

5. What optional equipment do you have in your Citation Mustang? Check **all** that apply.
   ☐ Automatic direction finder (ADF)
   ☐ Chart view
   ☐ Traffic advisory system
   ☐ Synthetic vision system
   ☐ XM Radio / Audio Input Panel
   ☐ Iridium Handheld Satellite Phone Antenna and Port
   ☐ Seat customization (describe): Click here to enter text.

General Flying history

1. Check the type(s) of flying you currently do (check **all** that apply):
   ☐ Professional (e.g., airline transport pilot, corporate pilot)
   ☐ Instructional (i.e., flight instructor, mentor pilot)
   ☐ Personal Business
   ☐ Recreational
   ☐ Other (Please specify): Click here to enter text.

2. Number of total flying hours: Click here to enter total flying hours.

3. Number of jet hours flown as a single pilot: Click here to enter single pilot jet hours flown.

4. List all ratings and certificates held: Click here to enter ratings and certificates held.

5. What aircraft do you currently fly on a regular basis?
   Click here to enter aircraft.

6. How many hours have you flown in the last 3 months?
   Click here to enter hours.

7. How many hours have you flown in the past year?
   Click here to enter hours.

8. When was the last time you flew as a single pilot in a jet?
   Click here to enter date.

9. What geographical areas (parts of the country) do you generally fly in?
   Click here to enter areas.

Citation Mustang Flying History

1. When did you take delivery of your Citation Mustang jet?
   Click here to enter date.

2. When did you complete your initial training?
   Click here to enter date.

3. Have you completed any Citation Mustang recurrent training?

   Yes ☐ No ☐

   a. If so, when? Click here to enter date.

4. How many hours, if any, have you flown your/a Citation Mustang with a mentor pilot?
   Click here to enter hours.

5. How many hours have you flown your/a Citation Mustang in the last 3 months?
   Click here to enter hours.

6. How many hours have you flown your/a Citation Mustang in the past year?
   Click here to enter hours.

7. How many hours have you flown your/a Citation Mustang in the past year as a single pilot (without a mentor pilot on board)?
   Click here to enter hours.

Personal experience with Advanced Avionics and Automation

1. Please rate your overall **experience** using different types of advanced avionics/glass cockpits. (1=little experience to 5=very experienced) Please select only one.

   1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

2. Please rate your **experience** using the G1000 in the Citation Mustang or any other aircraft. (1=little experience to 5=very experienced) Please select only one.

   1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

3. Please rate your **skill level** using the G1000 in the Citation Mustang or any other aircraft. (1=little experience to 5=very experienced) Please select only one.

   1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

4. Please rate your **experience** using the G430/G530 or other similar Garmin IFR avionics systems. (1=little experience to 5=very experienced; if not applicable, please jump to question 5) Please select only one.

   1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

   Please list each type of Garmin IFR avionics system currently or previously used, in addition to the G1000: Click here to enter type.

   a. Please rate your **skill level** in using these other Garmin IFR avionics (not including the G1000). (1=not very skilled to 5=very skilled) Please select only one.

      1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

5. Please rate your **experience** using *other types* of advanced avionics (e.g. Avidyne, Chelton, etc.). (1=not very experienced to 5=very experienced; if not applicable, please jump to question 6) Please select only one.

   1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

   a. Please list each type of other advanced avionics system currently or previously used (not including any of the Garmin products).
      Click here to enter avionics systems.

b. Please rate your **skill level** in using these other advanced avionics systems (not including any of the Garmin products). (1=not very skilled to 5=very skilled) Please select only one.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

6. Rate your **experience** with using Flight Management Systems (FMS). (1=not very experienced to 5=very experienced; If not applicable, please jump to question 7) Please select only one.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

a. Please rate your **skill level** in using FMSs. (1=not very skilled to 5=very skilled) Please select only one.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

7. Rate your **experience** with stand alone autopilot/auto flight systems. (1= not very experienced to 5=very experienced; If not applicable, please place in return envelope & mail back to NASA). Please select only one.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

a. Please rate your **skill level** in using autopilot/auto flight systems (1=not very skilled to 5=very skilled) Please select only one.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

APPENDIX B

Advanced Avionics and Automation Questionnaire

Please answer these questions with regard to any and all types of advanced automation and displays with which you have experience – not just the automation and displays in your Citation Mustang.

1. Overall, how satisfied are you with advanced avionics (glass cockpits, i.e., PFDs and MFDs) (1=very unsatisfied to 5 = very satisfied)? Please select only one.

   1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

2. How would you rate the design of PFDs (1=poor to 5=excellent)? Please select only one.

   1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

3. What do you like best about PFDs?
   Click here to enter text.

4. What do you like least about PFDs?
   Click here to enter text.

5. If you could change anything with the design or functioning of PFDs, what would you change and how would you change it?
   Click here to enter text.

6. How would you rate the design of MFD (1=poor to 5=excellent)? Please select only one.

   1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

7. What do you like best about the MFD?
   Click here to enter text.

8. What do you like least about the MFD?
   Click here to enter text.

9. If you could change anything with the design or functioning of MFDs, what would you change and how would you change it?
   Click here to enter text.

10. What resources available through MFDs do you use the most?
    Click here to enter text.

11. What resources available through MFDs do you use the least?

Click here to enter text.

12. Describe a situation, if any, where advanced avionics or automation kept you out of trouble or was a significant help in dealing with the situation or a problem and how the avionics or automation helped.
    Click here to enter text.

13. Describe a situation, if any, where advanced avionics or automation caused you problems or inhibited your ability to deal with the situation or a problem and how the avionics or automation caused problems.
    Click here to enter text.

14. What is/are the easiest things about learning to use advanced avionics and automation?
    Click here to enter text.

15. What is/are the biggest hurdle(s) in learning to use advanced avionics and automation?
    Click here to enter text.

16. How challenging is it for the typical pilot to remain proficient in the use of advanced avionics and automation, and if so, why?
    Click here to enter text.

17. What strategies do you use or recommend to maintain proficiency in the use of advanced avionics and automation?
    Click here to enter text.

APPENDIX C

Citation Mustang And G1000 Cockpit Set-Up Preference Questionnaire

TIME/DATE

TIME FORMAT:	LOCAL 12hr ☐	LOCAL 24hr ☐

DISPLAY UNITS AND MAP DATUM

NAV ANGLE:	MAGNETIC(°) ☐	TRUE (°T) ☐
DIS, SPD:	NAUTICAL (NM, KT) ☐	METRIC (KM, KPH) ☐
ALT, VS:	FEET (FT, FPM) ☐	METERS (MT, MPM) ☐
PRESSURE:	INCHES (IN) ☐	HECTOPASCALS (HPA) ☐
TEMP:	CELSIUS (°C) ☐	FARENHEIT (°F) ☐
FUEL:	GALLONS (GL, GL/HR) ☐	LITERS (LT, LT/HR) ☐
POSITION:	HDDD°MM'SS.S" ☐	HDDD°MM.MM' ☐

AIRSPACE ALERTS

ALTITUDE BUFFER:	Factory Default (200ft) ☐	Preferred buffer: Click here to enter buffer.	
CLASS B/TMA:	Factory Default ☐	ON ☐	OFF ☐
CLASS C/TCA:	Factory Default ☐	ON ☐	OFF ☐
CLASS D:	Factory Default ☐	ON ☐	OFF ☐
RESTRICTED:	Factory Default ☐	ON ☐	OFF ☐
MOA (MILITARY):	Factory Default ☐	ON ☐	OFF ☐
OTHER AIRSPACE:	Factory Default ☐	ON ☐	OFF ☐

ARRIVAL AND AUDIO ALERTS

ARRIVAL ALERT:	Factory Default ☐	ON ☐	OFF ☐
ARRIVAL ALERT DISTANCE:	Factory Default (at destination) ☐	Preferred Distance: Click here to preferred distance.	
VOICE:	MALE ☐	FEMALE ☐	

NAVIGATION STATUS BAR (MFD)

FIELD 1:	DTK ☐	ESA ☐	ETA ☐	ETE ☐	GS ☐	MSA ☐	TKE ☐	TRK ☐	VSR ☐	XTK ☐
FIELD 2:	DTK ☐	ESA ☐	ETA ☐	ETE ☐	GS ☐	MSA ☐	TKE ☐	TRK ☐	VSR ☐	XTK ☐
FIELD 3:	DTK ☐	ESA ☐	ETA ☐	ETE ☐	GS ☐	MSA ☐	TKE ☐	TRK ☐	VSR ☐	XTK ☐
FIELD 4:	DTK ☐	ESA ☐	ETA ☐	ETE ☐	GS ☐	MSA ☐	TKE ☐	TRK ☐	VSR ☐	XTK ☐

CDI, COM CONFIGURATION

GPS CDI:	AUTO ☐	MANUAL ☐	
SYSTEM CDI (if MANUAL):	1.0nm ☐	3.0nm ☐	5.0nm ☐
ILS CDI CAPTURE:	AUTO ☐	MANUAL ☐	

NEAREST AIRPORT

RNWY SURFACE:	ANY ☐	HARD ONLY ☐	HARD/SOFT ☐
RNWY MIN LENGTH:	Factory Default (0 ft) ☐	Preferred Length (0 ft to 25,000 ft): Click here to enter preferred length.	

FLIGHT INSTRUMENTS

PFD 1 WIND INDICATOR:	Factory Default ☐	HEAD/X-WIND ☐	ARROW/SPEED ☐	ARROW/SPD/DIR ☐	OFF ☐
PFD 2 WIND INDICATOR:	Factory Default ☐	HEAD/X-WIND ☐	ARROW/SPEED ☐	ARROW/SPD/DIR ☐	OFF ☐
BEARING 1 POINTER:	Factory Default ☐	NAV 1 ☐	GPS ☐	ADF ☐	OFF ☐
BEARING 2 POINTER:	Factory Default ☐	NAV 1 ☐	GPS ☐	ADF ☐	OFF ☐

MAP SETUP

PFD INSET:	Factory Default ☐	ON ☐	OFF ☐		
ORIENTATION:	Factory Default ☐	NORTH up ☐	Track up ☐	DTK up ☐	HDG up ☐
AUTO ZOOM:	Factory Default ☐	OFF ☐	MFD Only ☐	PFD Only ☐	All On ☐

Please fill out MFD ORIENTATION if you selected "PFD only" for previous AUTO Zoom setting.

MFD ORIENTATION:	Factory Default ☐	NORTH up ☐	Track up ☐	DTK up ☐	HDG up ☐	
MAX LOOK FWD:	Factory Default ☐	Preferred Number (0 to 99 minutes): Click here to enter preferred number.				
MIN LOOK FWD:	Factory Default ☐	Preferred Number (0 to 99 minutes): Click here to enter preferred number.				
TIME OUT:	Factory Default ☐	Preferred Time: Click here to enter preferred time.				
LAND DATA:	Factory Default ☐	ON ☐	OFF ☐			
TRACK VECTOR:	Factory Default (60sec) ☐	30 sec ☐	2 min ☐	5 min ☐	10 min ☐	20 min ☐
WIND VECTOR:	Factory Default ☐	ON ☐	OFF ☐			
NAV RANGE RING:	Factory Default	ON	OFF			

	☐	☐	☐			
TOPO DATA:	Factory Default	ON	OFF			
	☐	☐	☐			
	If you selected "ON" for "TOPO DATA" please indicateyour preferred MAX TOPO DATA RANGE (500ft -2000nm): Click here to enter range.					
TOPO SCALE:	Factory Default	ON	OFF			
	☐	☐	☐			
TERRAIN DATA:	Factory Default	ON	OFF			
	☐	☐	☐			
	If you selected "ON" for "TERRAIN DATA" please indicate your preferred TERRAIN DATA MAX RANGE: Click here to enter range.					
OBSTACLE DATA:	Factory Default	ON	OFF			
	☐	☐	☐			
	If you selected "ON" for "OBSTACLE DATA" please indicated your preferred OBSTACLE DATA MAX range: Click here to enter range.					
FUEL RING (RSV):	Factory Default (00:45 minutes)	ON	OFF			
	☐	☐	☐			
	If you selected "ON" for "FUEL RING (RSV)" please indicate your preferred FUEL RING RANGE: Click here to enter range.					
FIELD OF VIEW	Factory Default	ON	OFF			
	☐	☐	☐			
PFD INSET:	Factory Default	ON	OFF			
	☐	☐	☐			
PFD INSET DCLTR:	Factory Default	NO DCLTR	DCTLR (-1)	DCTLR (-2)	DCLTR (-3)	
	☐	☐	☐	☐	☐	
PFD INSET FUNCTIONS:	Factory Default	TRAFFIC	TOPO	TERRAIN	STRMSCP	NEXRAD	XM LTNG
	☐	☐	☐	☐	☐	☐	☐

MAP SETUP (OTHER)

MFD FLIGHT PLAN VIEW:	Factory Default	Narrow	Wide	CUM	Leg-Leg
	☐	☐	☐	☐	☐
TRAFFIC SYSTEM:	Factory Default	TIS			
	☐	☐			

CHART FULL SCREEN:	Factory Default ☐	Large ☐	Small ☐		

SYMBOL SETUP (LAND)

LAT/LON TEXT:	Factory Default ☐	None ☐	Small ☐	Medium ☐	Large ☐
LAT/LONG RANGE:	Factory Default (OFF) ☐	Max Display Range (up to 2000nm): Click here to enter max display range.			
FREEWAY RANGE:	Factory Default (300nm) ☐	Max Display Range (up to 800nm): Click here to enter max display range.			
NATIONAL HWY RANGE:	Factory Default (30nm) ☐	Max Display Range (up to 80nm): Click here to enter max display range.			
LOCAL HWY RANGE:	Factory Default (15nm) ☐	Max Display Range (up to 30nm): Click here to enter max display range.			
LOCAL ROAD RANGE:	Factory Default (8nm) ☐	Max Display Range (up to 15nm): Click here to enter max display range.			
RAILROAD RANGE:	Factory Default (15nm) ☐	Max Display Range (up to 30nm): Click here to enter max display range.			
LARGE CITY TEXT:	Factory Default ☐	None ☐	Small ☐	Medium ☐	Large ☐
LARGE CITY RANGE:	Factory Default (800nm) ☐	Max Display Range (up to 1500nm): Click here to enter max display range.			
MEDIUM CITY TEXT:	Factory Default ☐	None ☐	Small ☐	Medium ☐	Large ☐
MEDIUM CITY RANGE:	Factory Default (100nm) ☐	Max Display Range (up to 200nm): Click here to enter max display range.			
SMALL CITY TEXT:	Factory Default ☐	None ☐	Small ☐	Medium ☐	Large ☐

SMALL CITY RANGE:	Factory Default (20nm) ☐	Max Display Range (up to 50nm): Click here to enter max display range.			
STATE/PROVINCE TEXT:	Factory Default ☐	None ☐	Small ☐	Medium ☐	Large ☐
STATE/PROVINCE RANGE:	Factory Default (800nm) ☐	Max Display Range (up to 1500nm): Click here to enter max display range.			
RIVER/LAKE TEXT:	Factory Default ☐	None ☐	Small ☐	Medium ☐	Large ☐
RIVER/LAKE RANGE:	Factory Default (200nm) ☐	Max Display Range (up to 500nm): Click here to enter max display range.			
USER WAYPOINT TEXT:	Factory Default ☐	None ☐	Small ☐	Medium ☐	Large ☐
USER WAYPOINT RANGE:	Factory Default (150nm) ☐	Max Display Range (up to 300nm): Click here to enter max display range.			

SYMBOL SETUP (AVIATION)

ACTIVE FPL RANGE:	Factory Default (2000nm) ☐	Max Display Range (up to 2000nm): Click here to enter max display range.			
ACTIVE FPL WPT TEXT:	Factory Default ☐	None ☐	Small ☐	Medium ☐	Large ☐
ACTIVE FPL WPT RANGE:	Factory Default (2000nm) ☐	Max Display Range (up to 2000nm): Click here to enter max display range.			
LARGE APT TEXT:	Factory Default ☐	None ☐	Small ☐	Medium ☐	Large ☐
LARGE APT RANGE:	Factory Default (250nm) ☐	Max Display Range (up to 500nm): Click here to enter max display range.			
MEDIUM APT TEXT:	Factory Default ☐	None ☐	Small ☐	Medium ☐	Large ☐

MEDIUM APT RANGE:	Factory Default (150nm) ☐	Max Display Range (up to 300nm): Click here to enter max display range.				
SMALL APT TEXT:	Factory Default ☐	None ☐	Small ☐	Medium ☐	Large ☐	
SMALL APT RANGE:	Factory Default (50nm) ☐	Max Display Range (up to 100nm): Click here to enter max display range.				
SAFE TAXI RANGE:	Factory Default (3nm) ☐	Max Display Range (up to 20nm): Click here to enter max display range.				
INTERSECTION WPT TEXT:	Factory Default ☐	None ☐	Small ☐	Medium ☐	Large ☐	
INTERSECTION WPT RANGE:	Factory Default (15nm) ☐	Max Display Range (up to 30nm): Click here to enter max display range.				
NDB WAYPOINT TEXT:	Factory Default ☐	None ☐	Small ☐	Medium ☐	Large ☐	
NDB WAYPOINT RANGE:	Factory Default (15nm) ☐	Max Display Range (up to 30nm): Click here to enter max display range.				
VOR WAYPOINT TEXT:	Factory Default ☐	None ☐	Small ☐	Medium ☐	Large ☐	
VOR WAYPOINT RANGE:	Factory Default (150nm) ☐	Max Display Range (up to 300nm): Click here to enter max display range.				
CLASS B/TMA RANGE:	Factory Default (200nm) ☐	Max Display Range (up to 500nm): Click here to enter max display range.				
CLASS C/TMA RANGE:	Factory Default (200nm) ☐	Max Display Range (up to 500nm): Click here to enter max display range.				
CLASS D RANGE:	Factory Default (150nm) ☐	Max Display Range (up to 300nm): Click here to enter max display range.				
RESTRICTED AIRSPACE RANGE:	Factory Default (200nm) ☐	Max Display Range (up to 500nm): Click here to enter max display range.				

MOA (MILITARY) RANGE:	Factory Default (200nm) ☐	Max Display Range (up to 500nm): Click here to enter max display range.
OTHER/ADIZ RANGE:	Factory Default (200nm) ☐	Max Display Range (up to 500nm): Click here to enter max display range.
TFR RANGE:	Factory Default (500nm) ☐	Max Display Range (up to 2000nm): Click here to enter max display range.

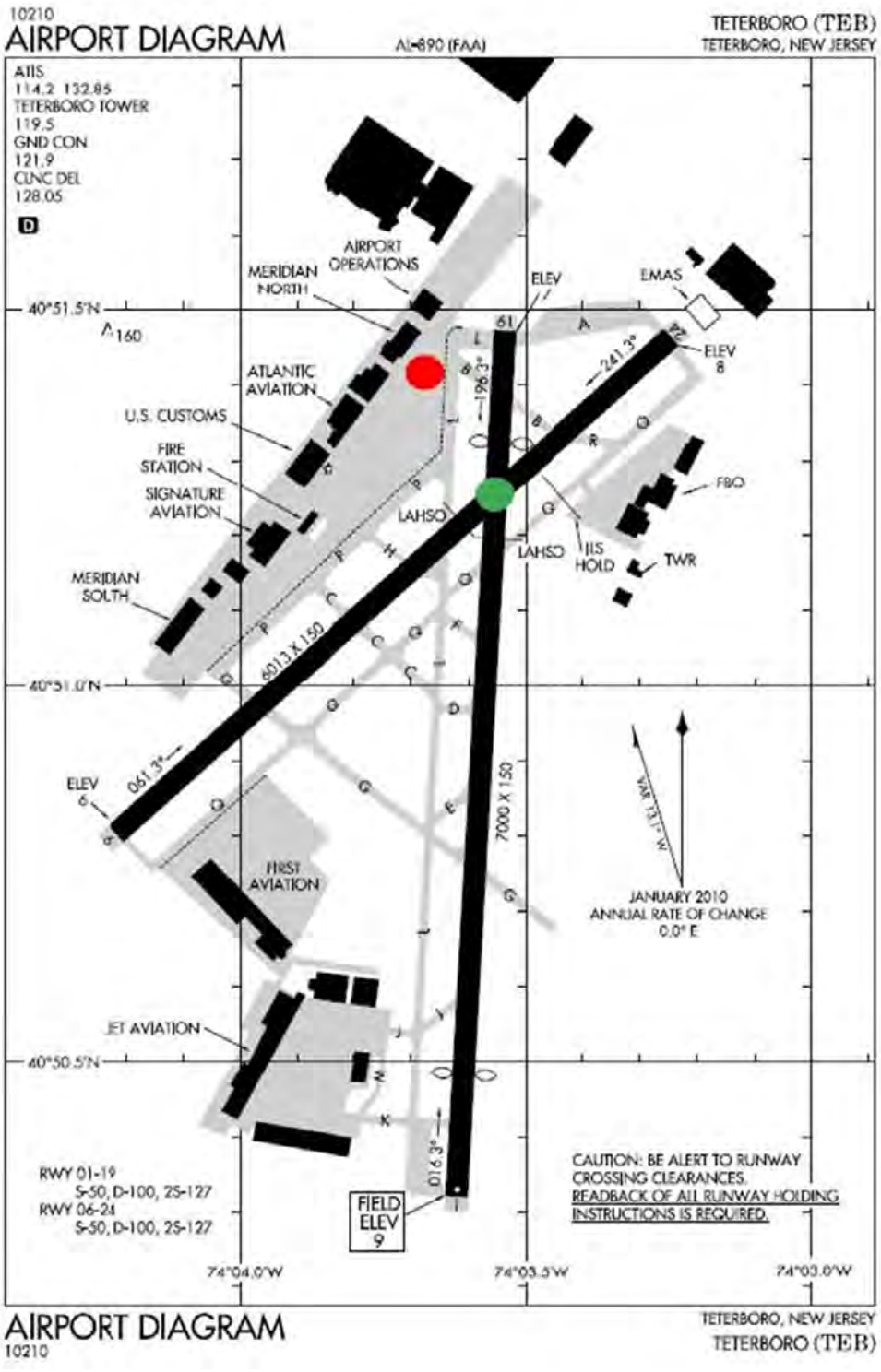
APPENDIX D
Pilot Briefing Package

Flight Package for Leg 1 KTEB-KMTN

Introduction to flight

- Flight: This is a two leg flight taken for personal business from Teterboro, NJ (KTEB) to Martin State Airport (KMTN) in Baltimore, MD to pick up a package and then on to Hot Springs/Ingalls Field, VA (KHSP) for leg two. You are the only person on board, there are no passengers.
- Today's Date is: Tuesday, September 18, 2010
- Propose Time of Departure from KTEB: 9:00 a.m. (local) (1300Z)
- Aircraft location at KTEB: Parked on ramp close to runway for the sake of communications (red spot). However, position of the simulator will be on runway 24 at the intersection of runway 19 (green spot). See the airport diagram on the next page depicting your location starting point.
- Planned aircraft parking at KMTN: Transient parking

Location on the Ramp at KTEB



Navigation Log

KTEB to KMTN: TC=230° : MC= 242° : ST. LINE= **142nm** : AIRWAY=**145nm** : Extra=**2%**

Winds Aloft	FL220 ISA(-29) Comp	FL200 ISA(-25) Comp	FL180 ISA(-21) Comp	FL160 ISA(-17) Comp
BIGGY	240/045 +06 -044	230/044 +09 -042	230/046 +09 -044	230/044 +18 -042
MXE	230/045 +07 -044	225/047 +10 -046	220/047 +10 -045	220/048 +08 -046
Avg. Trip Winds=>	- 44 Headwind	- 44 Headwind	- 44 Headwind	- 44 Headwind
FLT TIME==>	**0:30 @ 337TAS**	**0:31 @ 330TAS**	**0:32 @ 320TAS**	**0:33 @ 310TAS**
Fuel Burn==>	**600 Lbs**	**616 Lbs**	**633 Lbs**	**650 Lbs**

FIX	ST	LAT/LON	InB/Out	Leg	Rem	Fuel Burn Leg	Fuel Burn Tot.	Leg	Rem	ETE	WX
KTEB 108.4 TETERBORO	NJ	N4051.0W07403.7	---/250	0	145	100	100	0:00	0:31	0:00	
BIGGY	NJ	N4025.2W07458.4	248/237	49	96	166	266	0:10	0:21	0:10	134.72
MXE 113.2 MODENA	PA	N3955.1W07540.2	236/240	44	52	150	416	0:09	0:12	0:19	134.72
MURPH 113.2/240/43		N3927.9W07623.1	240/197	43	9	150	566	0:09	0:03	0:28	134.72
KMTN BALTIMORE	MD	N3919.5W07624.8	200/---	9	0	50	616	0:03	0:00	0:31	

Fuel hourly method: 616

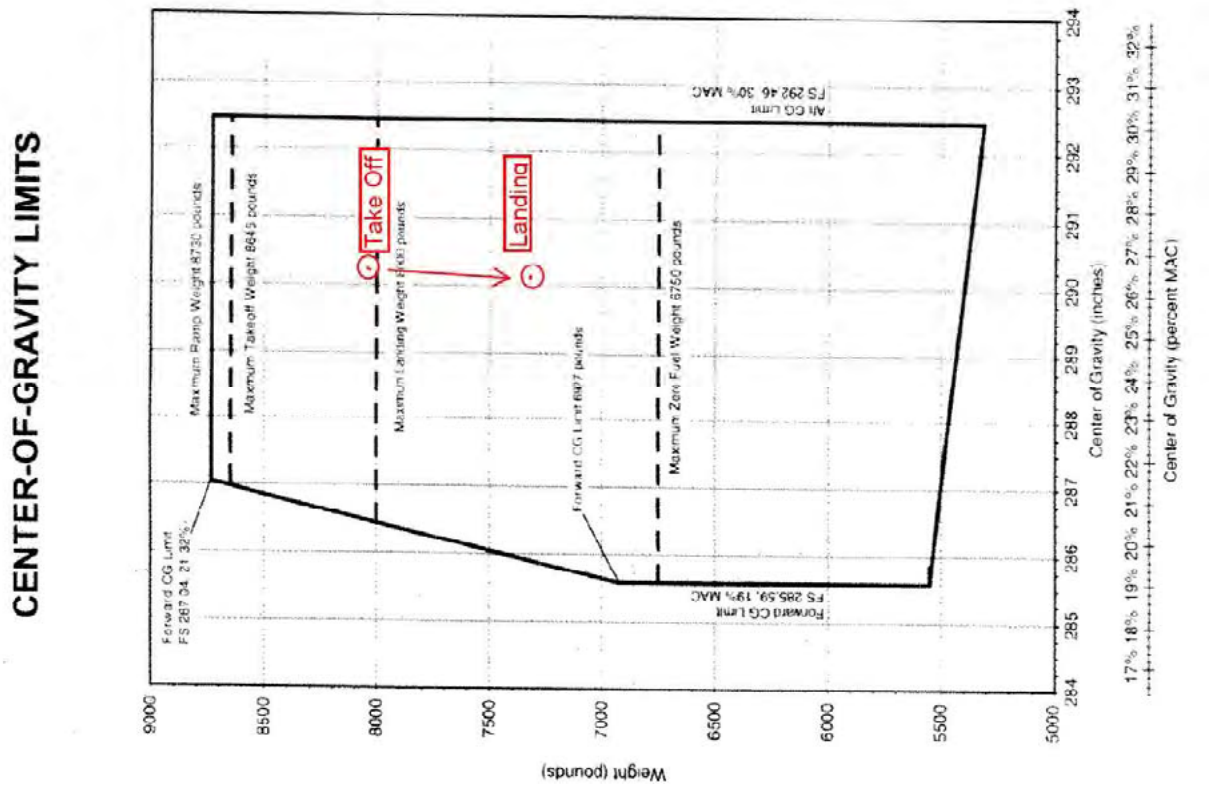
09/10	Sunrise	Sunset
KTEB	7:11	18:12
KMTN	7:20	18:11

Weight and Balance

Weight Limitations for Cessna Mustang C510			
Maximum Design Ramp Weight	8730 lbs	Maximum Design Landing Weight	8000 lbs
Maximum Design Takeoff Weight	8645 lbs	Maximum Design Zero Fuel Weight	6750 lbs

Item	Weight (lbs)	Arm (inches)	Moment/100 (in-lbs)	Maximum Limit Weights
BOW of A/C	5,344.00	296.13	15,825.19	
Pilot	170.00	182.80	310.76	
Nose Baggage	80.00	96.00	76.80	
Fuel	2,500.00	291.72	7,293.00	
Taxi Fuel	-85.00	296.47	-252.00	
Zero Fuel weight	5,594.00			6750 = OK
Take Off Weight	**8,009.00**		**23,253.75**	8645 = OK
Enroute Fuel Burn	-616.00	291.72	-1,797.00	
Landing Weight	**7,393.00**		**21,456.75**	8000 = OK

Take Off Weight	**8,009.00**	**CG =**	**290.35**	OK
Landing Weight	**7,393.00**	**CG =**	**290.23**	OK



Boston Area Forecast (FA)
Forecast updated: 1200 UTC

BOSC FA 181200
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 191200
CLDS/WX VALID UNTIL 191200...OTLK VALID 181200-191200
ME NH VT MA RI CT NY LO NJ PA OH LE WV MD DC DE VA AND CSTL WTRS

SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN.
TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS.
NON MSL HGTS DENOTED BY AGL OR CIG.

SYNOPSIS...BROAD UPR TROF CONTS FM THE MID/LWR MS VLY INTO THE
GLFMEX. TROF WL SHFT SLOLY EWD. STNR FNT CONTS FM THE MD/VA CSTL
WTRS-VA/NC BORDER-ERN TN-SRN MS. BY 12Z WK LOW WL BR OVR SWRN NC
WITH STNR FNT ENEWD TO MD/VA CSTL WTRS. WK CDFNT WL EXTD FM THE
LOW SWWD TO SRN AL. DEEP MOIST AIRMASS EXTDS FM THE MID ATLC RGN
TO THE SERN US. MSTR WL SPRD SLOLY NWD INTO PA/NJ-EXTRM SE NY AFT 06Z.

ME NH VT
SCT060 SCT CI. 00Z SCT CI. OTLK...VFR.
MA RI CT
SERN MA...BKN010-020. TOPS 040. BKN CI.
OTLK...MVFR CIG.
CT/RI...SCT050 BKN CI. 05Z SCT050 BKN120. TOPS FL180. OYLK...VFR.
RMNDR MA...SCT CI. 04Z BKN CI. OTLK...VFR.

NY LO
NERN NY...SCT050 SCT CI. 00Z SCT CI. OTLK...VFR.
LONG ISLAND/EXTRM SERN NY...SCT010 BKN020. TOPS FL200. 05Z SCT030
BKN120. OTLK...VFR.
RMNDR SERN NY...BKN CI. OTLK...VFR.
WRN NY/LO...SCT CI. OTLK...VFR.

PA NJ
SERN PA/SRN NJ...SCT010-020 OVC030. TOPS FL200. WDLY SCT -SHRA.
BECMG 1218 BKN010-020 OVC030. OCNL VIS 3-5SM -RA BR. OTLK...IFR
CIG RA BR.
NERN PA/NRN NJ...SCT010 BKN CI. BECMG 0306 BKN010. TOPS FL200.
OTLK...VFR BECMG MVFR CIG SHRA AFT 11Z.
SWRN PA...BKN040-050. TOPS 080. BKN CI. BECMG 0306 BKN030 OVC100.
TOPS FL220. OCNL VIS 3-5SM -SHRA BR. OTLK...IFR CIG SHRA BR.
NWRN PA...SCT050-060 BKN CI. 05Z SCT-BKN040-050. TOPS 080. BKN
CI. OTLK...MVFR CIG.

OH LE
SERN OH...BKN020-030 OVC100. TOPS FL200. OCNL VIS 3-5SM -SHRA BR.
OTLK...MVFR CIG SHRA BR.
SWRN OH...SCT120 OVC CI. OTLK...VFR.
NRN OH/LE...BKN CI. OTLK...VFR.

WV
BKN-OVC030-040 LYRD TO FL220. OCNL VIS 3-5SM -RA BR. TIL 02Z ISOL
-TSRA EXTRM S. CB TOPS FL400. OTLK...IFR CIG SHRA BR.

MD DC DE VA
WRN MD/NWRN VA...OVC020-030 LYRD TO FL250. OCNL VIS 3-5SM -RA BR.
OTLK...IFR CIG RA BR.
SWRN VA...BKN010-020 OVC030. TOPS 250. SCT -SHRA/-TSRA. CB TOPS
FL420. BECMG 0003 OVC030-040 LYRD TO FL250. OCNL VIS 3-5SM -SHRA
BR. OTLK...IFR CIG SHRA BR.
FAR S CNTRL/SERN VA...BKN020 BKN100. TOPS 150. SCT -SHRA/-TSRA.
CB TOPS FL420. BECMG 1218 BKN010-020 OVC100. TOPS FL240. OCNL VIS
3-5SM -SHRA BR. OTLK...IFR CIG SHRA BR.
RMNDR ERN VA/ERN MD/DC/DE...BKN-OVC010-020 LYRD TO FL250. OCNL
VIS 3-5SM -RA BR. OTLK...IFR CIG RA BR.

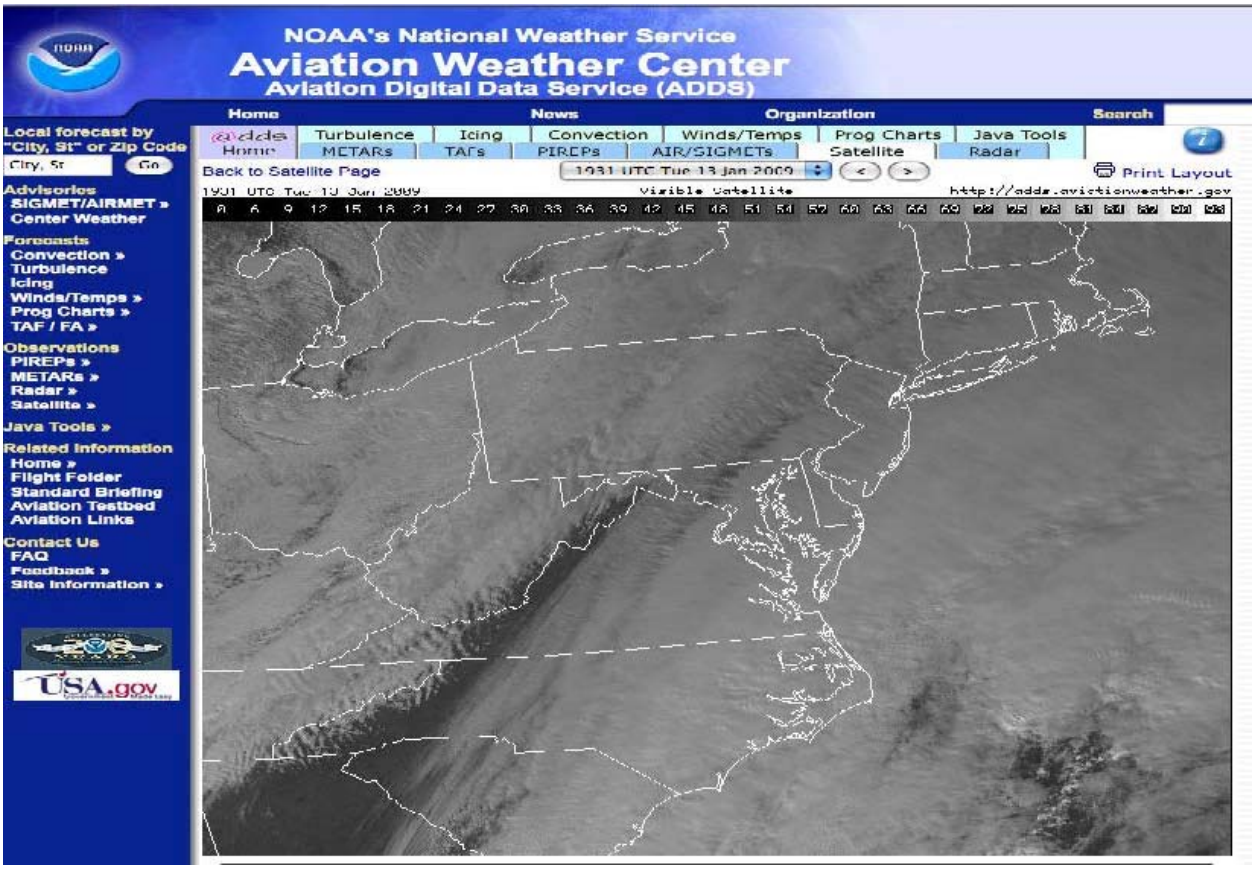
CSTL WTRS
S OF CYN...BKN010-020 BKN-OVC100. TOPS FL200.
SCT -SHRA.
OTLK...IFR CIG SHRA BR.
BTN CYN AND ACK...BKN015-025 OVC100. TOPS
FL200. WDLY SCT -SHRA.
OTLK...MVFR CIG SHRA BR.
N OF ACK...SCT-BKN010-020. TOPS 040. OTLK...IFR
CIG OFSHR..VFR
NEARSHR.

AIRMET MTN OBSCN...PA WV MD VA
FROM HAR TO 40SSE PSK TO HMV TO 40S HNN TO
40SE AIR TO HAR
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD
21Z.

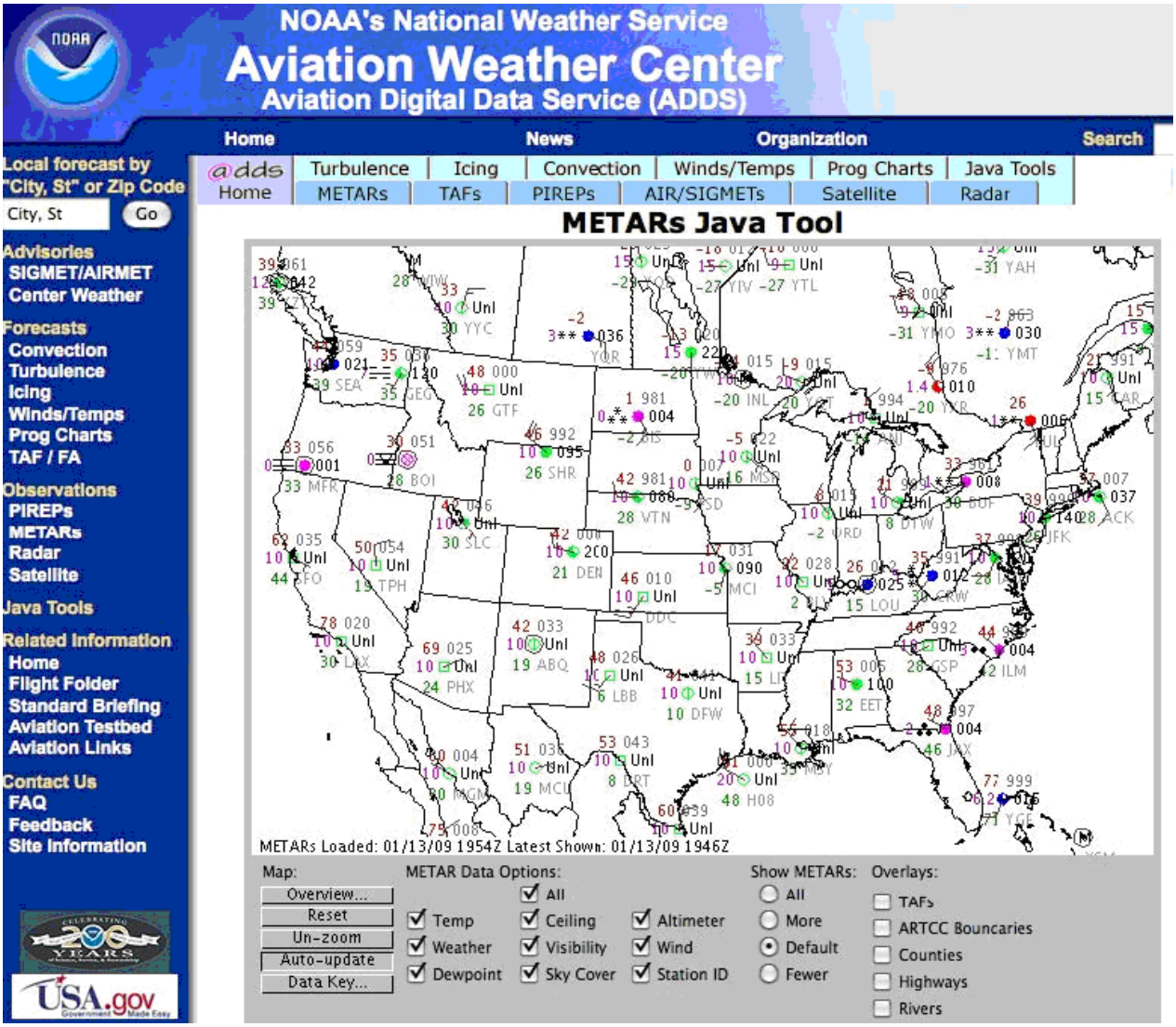
AIRMET TURB...VT NY LO PA OH LE WV
FROM YSC TO 20SSW ALB TO 30SSW PSB TO HNN TO
CVG TO FWA TO DXO
TO MSS TO YSC
MOD TURB BLW FL180. CONDS CONTG BYD 21Z
THRU 03Z.

FRZLVL...RANGING FROM 120-140 ACRS AREA
  120 ALG 40S FWA-20ENE ERI-MSS-40NE MSS
  140 ALG 30S HNN-30W SAX-20SSE MLT-30ENE HUL

Current Conditions: Satellite



Current Conditions: METAR



KTEB Terminal Weather

METAR KTEB 181253Z 22009G15KT 2SM -RA BKN005 OVC008 20/17 A29.85

Teterboro 1253 Zulu automated weather, wind is 220° at 9 gusting to 15, visibility 2 miles in light rain, 500 broken, 800 overcast, temperature 20, dew point 17, altimeter 29.85.

KTEB 181200Z 1812/1912 23009KT 2SM -RA BKN005 OVC008
FM181500 23012KT 5SM -RA SCT010 OVC020
FM190100 24010KT 5SM BKN010 OVC020
FM190800 26015KT P6SM BKN010 OVC020

Teterboro NJ [KTEB] terminal forecast issued at 8:00am EDT (1200Z), valid for 24 hours

8:00am EDT (12Z) wind 230 at 9 knots, visibility 2 miles, light rain, 500 feet broken, 800 feet overcast

11:00am EDT (1500Z) wind 230 at 12 knots, visibility 5 miles, light rain, 1000 feet scattered, 2000 feet overcast

9:00pm EDT (0100Z) wind 240 at 10 knots, visibility 5 miles, 1000 feet broken, 2000 feet overcast

4:00am EDT (0800Z) wind 260 at 15 knots, visibility 6 miles, 1000 feet broken, 2000 feet overcast

KTEB NOTAMS

TEB 11/031 **TEB** AD ALL IN PAVEMENT LGTS AND ELEVATED GUARD LGTS OTS

TEB 04/069 **TEB** RWY 1 REIL CMSND

TEB 07/065 **TEB** RWY 1 PAEW 1300 S AER 1030-2100 MON-FRI WEF 1007191030

TEB 02/065 **TEB** OBST BRIDGE UNKN (624 AGL) 5 E (4051N7357W) LGT OTS WEF 0902231208

TEB 11/006 **TEB** OBST CRANE 237 (230 AGL) 1 S AER 6 FLAGGED/LGTD

TEB 11/032 **TEB** OBST CRANE 65 (60 AGL) .6 SSW AER 1 LGTD/FLAGGED 1200-2100 DLY TIL 1011122100

TEB 11/030 **TEB** NAV RWY 19 ILS LLZ OTS WEF 1011101139

UAR 04/009 **TEB** AIRSPACE JAIKE TWO ARRIVAL... EXPECT TO CROSS JAIKE WAYPOINT AT 13,000 FEET.

USD 07/209 **TEB** AIRSPACE TETERBORO SIX DEPARTURE CHANGE RWY 24 DEPARTURE ROUTE DESCRIPTION TO READ: TAKE-OFF RWY 24: CLIMB HEADING 240 TO 1500, THEN RIGHT TURN VIA HEADING 280, CROSS TEB 4.5 DME AT 1500 (NON-DME AIRCRAFT CROSS COL R-011 AT 1500), CLIMB AND MAINTAIN 2000, THENCE...

TEB 05/146 **TEB** TWY K NONMOVEMENT AREA BOUNDRY NONSTD MARKING

TEB 11/020 **TEB** TWY B EDGE LINES W RWY 1/19 NONSTD

TEB 08/037 **TEB** RAMP ATLANTIC AVIATION RAMP FENCING 56 FT LONG BY 160 FT WIDE ADJ HANGER 3 LGTED

Weather En route METARs

KCDW 181253Z 23010G14 3SM -RA BKN006 OVC009 20/16 A2984

KSMQ 181253Z 22010KT 4SM SCT020 BKN030 21/16 A2985 RMK AO2

KDYL 181253Z 210KT 4SM RA SCT010 BKN030 OVC040 20/15 A2985 RMK AO2

KTTN 181253Z 20009KT 2SM BR BKN007 OVC015 18/16 A2988

KPTW 181253Z 00000KT 1SM OVC008 15/14 A2984 RMK AO2

KPHL 181253Z 17010KT 4SM BR BKN009 OVC020 20/15 A2990

KMQS 181253Z 16015KT 5SM FEW035 OVC040 15/09 A2990 RMK AO2

KILG 181253Z 14009KT 2SM BR BKN005 OVC015 18/16 A2985

KAPG 181253Z 14009KT 2SM BR BKN005 OVC015 18/16 A2985

KBWI 181253Z 13013KT 3SM BR SCT008 OVC010 18/16 A2989

KDCA 181253Z 14008KT 4SM BR SCT009 OVC011 17/13 A2989

Weather En route TAFs

KTTN 181200Z 1812/1912 17009KT 2SM BR BKN005 OVC015
FM181500 18010KT 4SM -RA SCT008 OVC020
FM190100 17010KT 5SM BKN010 OVC020
FM190800 16010KT P6SM BKN010 OVC020

KRDG 181200Z 1812/1912 17009KT 3SM BR BKN006 OVC008
FM181500 18010KT 4SM -RA SCT008 OVC010
FM190100 16010KT 4SM BKN080 OVC010
FM190800 16010KT 5SM BKN080 OVC010

KILG 181200Z 1812/1912 17012KT 3SM BR BKN006 OVC008
FM181500 18010KT 4SM -RA SCT008 OVC010
FM190100 17010KT 4SM BKN080 OVC015
FM190800 16010KT 5SM BKN080 OVC015

KBWI 181200Z 1812/1912 22012KT 5SM BR BKN020 OVC060
FM181500 18010KT 5SM SCT020 OVC070
FM190100 21010KT 5SM SCT050 OVC090
FM190800 21010KT P6SM SCT080 BKN100

KDCA 181200Z 1812/1912 22012KT 5SM BR BKN020 OVC060
FM181500 17015KT 5SM SCT020 OVC070
FM190100 22010KT P6SM SCT040 OVC080
FM190800 22005KT P6SM SCT080 BKN100

Notices to Airmen: FAA Plotweb Airway

NEW YORK ARTCC

FDC 8/5594 ZNY FI/T AIRWAY ZNY ZOB. J190 SLATE RUN (SLT) VORTAC, PA TO BINGHAMTON (CFB) VORTAC, NY MAA FL380 EXCEPT FOR AIRCRAFT EQUIPPED WITH SUITABLE RNAV SYSTEM WITH GPS.

FDC 8/4929 ZNY FI/T AIRWAY ZBW ZNY. V408 LAKE HENRY (LHY) VORTAC, PA TO SAGES INT, NY MAA 15000 EXCEPT FOR AIRCRAFT EQUIPPED WITH SUITABLE RNAV SYSTEM WITH GPS.

FDC 8/2384 ZNY NY.. FI/T AIRWAY ZNY. J95 GAYEL INT, NY TO BUFFY INT, PA NA.

FDC 8/1389 ZNY FI/T AIRWAY ZDC ZNY. J42- 191 DAVYS INT, NJ TO ROBBINSVILLE (RBV) VORTAC, NY MAA 29000 EXCEPT FOR AIRCRAFT EQUIPPED WITH SUITABLE RNAV SYSTEM WITH GPS.

FDC 6/8776 ZNY CT.. FI/T AIRWAY ZBW ZNY. J42 DME REQUIRED AT SANTT INT.

FDC 6/1470 ZNY NY.. FI/T AIRWAY ZNY. V433 TICKL INT, NY TO LA GUARDIA (LGA) VOR/DME, NY LGA R-225 UNUSEABLE. LA GUARDIA (LGA) VOR/DME, NY TO DUNBO INT, NY LGA R-06 UNUSEABLE.

FDC 6/1269 ZNY FI/T AIRWAY ZNY. V36 HAWLY INT, PA TO NEION INT, NJ LGA R-322 UNUSEABLE.

FDC 6/1267 ZNY FI/T AIRWAY ZNY. J106 STILLWATER (STW) VOR/DME, NJ TO LA GUARDIA (LGA) VOR/DME, NY LGA R-298 UNUSEABLE.

FDC 6/1266 ZNY FI/T AIRWAY ZNY. J70 STILLWATER (STW) VOR/DME, NJ TO LA GUARDIA (LGA) VOR/DME, NY LGA R-298 UNUSEABLE. LA GUARDIA (LGA) VOR/DME, NY TO KENNEDY (JFK) VOR/DME, NY LGA R-166 UNUSEABLE.

FDC 6/1247 ZNY NY.. FI/T AIRWAY ZNY. V451 LA GUARDIA (LGA) VOR/DME, NY TO NESSI INT, NY LGA R-075 UNUSEABLE.

FDC 6/1245 ZNY NY.. FI/T AIRWAY ZBW ZNY. V6- 445 NANCI INT, NY TO LA GUARDIA (LGA) VOR/DME, NY LGA R225 UNUSEABLE.

FDC 6/1243 ZNY NY.. FI/T AIRWAY ZNY. V475- 487 LA GUARDIA (LGA) VOR/DME, NY TO DUNBO INT, NY LGA R-068 UNUSEABLE.

FDC 6/1238 ZNY NY.. FI/T AIRWAY ZNY. V123 RENUE INT, NY TO LA GUARDIA (LGA) VOR/DME, NY LGA R-225 UNUSEABLE. LA GUARDIA (LGA) VOR/DME, NY TO RYMES INT, NY LGA R-044 UNUSEABLE.

FDC 6/1237 ZNY NY.. FI/T AIRWAY ZNY. V157 RENUE INT, NY TO LA GUARDIA (LGA) VOR/DME, NY LGA R-225 UNUSEABLE. LA GUARDIA (LGA) VOR/DME, NY TO HAARP INT, NY LGA R-044 UNUSEABLE.

FDC 4/9357 ZNY NY.. FI/T AIRWAY ZNY ZBW. V139-268-308 DUNEE INT, NY TO SARDI INT, NY DEER PARK (DPK) VOR/DME MRA 5000 AT KOPPY INT, NY.

FDC 4/9343 ZNY NY.. FI/T AIRWAY ZNY V374 VOLLU INT, NY TO GAYEL INT, NY MEA 5000.

FDC 4/9182 ZNY NJ FI/T AIRWAY ZNY V312 LEGGS INT, NJ TO PREPI INT, OA FOR NON-DME EQUIPPED AIRCRAFT MEA 3000.

FDC 4/6630 ZNY PA.. FI/T AIRWAY ZNY. V36 DOMVY INT, PA TO HAWLY INT, PA NA.

FDC 4/3616 ZNY FI/T AIRWAY ZNY ZDC V210 PROPP INT, PA TO YARDLEY (ARD) VOR/DME, PA MOCA 1700.

APPENDIX E
Post-Study Interview Questions

Advanced Automation and Single-Pilot Operations
in Very Light/Entry Level Jets
Post-Study Interview and Debriefing

Overall Feedback:

1. How does the amount and kind of planning/preparation you did for the familiarization flight compare with the amount and kind of planning/preparation you did for the study flights? *(more/less/the same – if more or less, ask why)*

2. How does the amount and kind of planning/preparation you did for the two study flights compare with what you normally do when you are going to make an IFR flight? *(if different from what they normally do, ask how different and why)*

3. Have you ever flown in the Oklahoma area and/or landed at Clinton-Sherman or OKC before?

    a. If so, how did this scenario flight compare with the flight(s) you took? *(weather, traffic, operational environment and tasks, etc?)*

4. Have you ever flown in the New York or Washington, DC areas and/or landed at TEB or MTN before?

    a. If so, which airports/airspace and how did this scenario compare with the flight(s) you took? *(weather, traffic, operational environment and tasks, etc?)*

5. Do you have much experience flying in mountainous terrain/landing at mountain airports? Have you ever landed at Hot Springs/Ingalls Airport (HSP) before?

    a. If yes *(to either question)*, how did that portion of the study scenario compare with your previous experiences? *(weather, traffic, operational environment and tasks, etc?)*

6. Overall, how do you feel about your flights today, both the Oklahoma flight and the study flights on the east cost? *(looking for an assessment of their own performance)*

    a. *Oklahoma (familiarization) flight:*

    b. *East coast (study) flights (both legs):*

7. In the study scenario, you flew two legs, the first from TEB to MTN and the second from MTN to HSP. How would you compare the two legs in terms of workload?

    a. How about in terms of difficulty of flight or operational tasks?

8. In the first leg from TEB to MTN, were there any tasks that you found to be particularly challenging, and if so, why?

    a. How about in the second leg from MTN to HSP?

9. In the first leg (TEB to MTN), were there any tasks that you found to be particularly easy, and if so, why?

    a. How about the second leg (MTN to HSP)?

Workload:

10. In this study we were particularly interested in how single pilots manage workload in jets during flights. Overall, how do you think that went?

11. How would you describe your approaches to workload management during the two flights *(get information about each flight and study scenario leg separately, and/or compare or contrast the approaches within the flights and legs, were any differences intentional/ planned, etc.)*?

    a. How does this compare with the way that you typically approach workload management when flying IFR? *(make sure you get information about how they typically approach workload management during regular IFR flights)*

12. Was there anything about the tasks you had to complete in the familiarization scenario that changed your approach to workload management in the study scenario? *(If yes, what were the tasks and how did they influence your workload management strategy?)*

a. Was there anything about the tasks you had to complete in the first leg (TEB to MTN) that changed your approach to workload management in the second leg (MTN to HSP)? *(If yes, what were the tasks and how did they influence your workload management strategy?)*

13. *(with regard to responses to Question 12)* What techniques or strategies worked best?

14. *(with regard to responses to Question 12)* What techniques or strategies didn't work out as well as hoped?

15. Were there times you felt behind or task saturated?

    a. If so, when,

    b. why do think that was, and

    c. what did you do to deal with it?

Automation:

16. As you know, we are also very interested in how automation and advanced technology is a help or hindrance. To what degree (and how) would you say that automation and advanced technology helped you with the tasks you faced while flying the two legs of the study scenario?

17. Were there specific features or resources within the G1000 or the Mustang that were particularly helpful? If so, what were they and how were they helpful?

18. To what degree (and how) did automation and advanced technology cause you problems or hinder you with the tasks you faced while flying the study scenario legs?

19. Were there specific features or resources within the G1000 or the Mustang that were particularly problematic? If so, what were they and how were they problematic?

20. To what degree would you say you are familiar with the full range of resources available through the G1000 and the multiple ways to use the G1000 to accomplish the same tasks?
21. To what degree would you say you use the full range of resources available through the G1000?

    a. Which features do you use the most?

    b. Which features do you use the least?

    c. Are there any particular features of the G1000 that you find particularly easy to use? If so, what are they and why do you feel they are easy?

    d. Are there any particular features of the G1000 that you find particularly difficult to use? If so, what are they and why do you feel they are difficult?

    e. If you were going to re-design the G1000 what would you change, add, or delete from it and why?

Closing:

22. If you were to fly these flights again, would you do anything differently? If so, what would you do differently and why?

23. Before coming here to participate in this study, did you do any sort of special preparation, study, or review that you wouldn't normally have been doing already? If so, what did you do?

24. Do you have any other comments, thoughts, or suggestions you would like to make regarding single-pilot workload management, automation use, or this study in general?

Thank you very much for participating in this study and providing us this very important information. Your involvement and feedback will benefit the industry greatly. Thanks!

APPENDIX F
Observed "Best Practices" and Other Things to Consider

Best Practices

Non-event specific observations:

- **Speed control:**
  - The Cessna Citation Mustang, like any other turbine aircraft, has the potential to exceed required airspeeds. Several pilots, when approaching a level off altitude, placed their hands on the thrust lever. This is a great practice as it helps remind the pilot to be mindful of airspeed upon reaching altitude.

  - When using FLC for a vertical mode altitude change, and already flying at a speed well above the desired FLC speed, many pilots appeared to understand that if they simply selected a lower climb speed and engaged the autopilot, the aircraft would abruptly pitch in an attempt to reach that speed. To prevent this, they selected VS mode and began the climb in that mode. Once they were within 10 knots or so of their desired target climb speed, they then changed to FLC providing a smooth transition and one that was more predictable for ATC.

- **Altitude awareness:**
  - In an effort to be mindful of altitude awareness, a few participants called out loud "one to go" or "one thousand" to go. Airlines teach their crews this method to help instill awareness that they should be closely watching the AP to see if it is going to capture the level off. When flying manually, an audible call-out also serves as a reminder to pilots that in a few seconds (depending on climb rate) they soon need to begin leveling off the aircraft. Many instructors teach that when this call is made, no other tasks are to be completed until the level off is complete.

  - **A**fter receiving a new altitude clearance, most of our participants not only placed the new altitude in the altitude reference window as quickly as possible but also began to climb or descend immediately to get the aircraft heading in the proper direction. Then they read back the clearance to the controller and/or completed other chores as required. This is a good workload management technique and has the added benefit of being quickly responsive to ATC.

- **Workload management:**
  - When a clearance contained multiple directions (e.g., change, altitude, heading, and contact a new controller) some participants did not always complete these tasks in the order that they were given. They had a workload strategy that entailed

completing those tasks that could be completed quickly first, such as entering a new radio frequency in the standby selector, and then focused on other more complicated tasks such as route or AP mode changes.

- If the participant was unable to correctly program the G1000 (such as for the reroute or instrument approach) or needed more time, he often requested vectors until programming could be completed. Although possibly not always desirable from the standpoint of ATC, this strategy was an appropriate response to the problems encountered.

- Several participants chose to reduce their airspeed at different points to provide more time to complete a task.

- **Positional awareness:**
  - Many participants utilized the large map on the MFD with "own ship" displayed to help maintain positional and geographic awareness. Similarly, several had "own ship" displayed on the MFD instrument approach plate for KHSP.

- **Flight path control:**
  - When in heading mode and receiving clearance for a new heading from ATC, most participants immediately and typically while the controller was still talking, changed the heading bug to the new heading. Thus, before the controller even finished talking, the aircraft was already turning to the new heading. Not only does this rapid response help ATC with separation, but this places one of the most important components of common ATC clearances "off the table," so to speak, and prevents forgetting.

  - Prior to departure several pilots dialed in the frequency of the instrument approach being used at the departure airport into a navigation radio. This practice can greatly reduce workload should the need for an immediate return to the airport after takeoff arise.

- **General aircraft operation:**
  - A few pilots used quietly audible "self-talk" during their flights. This can help to better encode ATC instructions in memory and create a specific intention to complete a task at a later time as a countermeasure to prospective memory failure. Audible self-talk may also reinforce monitoring for expected AP/aircraft behavior and set requirements, such as those for a stabilized approach. We believe that such a technique is particularly beneficial during single pilot operations.

- **Automation:**

- There was a very high use of the autoflight system by our participants. Many remarked that the use of an AP was paramount in such a high performance aircraft. Using this system appropriately greatly reduced the workload for our participants, particularly in busy airspace such as the northeast corridor.

- When most participants input a new altitude or heading, they entered the target value in its entirety right away. For example, when cleared climb to 8,000 ft MSL, the participant did not interrupt entering in the altitude until 8,000 ft was displayed in the altitude reference window. We think this is a good practice, even though other tasks may be waiting to be performed. Some who interrupted this task before completion (for example, suspending altitude entry when having only dialed in up to 6,800 ft), sometimes forgot to come back to finish the task. An important part of workload management is in deciding which tasks should be completed in their entirety before moving on to the next and which should be broken into subtasks and interleaved with other tasks.

Event 1 – Setting up for a BWZ VOR radial intercept:

- **G1000 programming:**
  - Those pilots who simply placed BWZ VOR in front of BIGGY in their flight plan had the fastest correct method of programming the radial intercept. After accepting this change and selecting NAV mode on the AP control panel the aircraft was ready to intercept.

- **FD malfunction:**
  - If the participants were unable to correctly fly the departure out of KTEB because of the unscripted FD malfunction, most wisely reported their problems to the controller and requested vectors for the departure. They also asked for vectors to BIGGY instead of trying to program the radial intercept. This was a good use of load shedding to manage an unexpected event. Additionally, reporting such a problem can prompt ATC to monitor the aircraft a bit more closely to ensure separation and ATC will generally be more prepared to offer additional help, if requested.

  - During the FD malfunction, it appeared that all pilots so afflicted load shed the requirement to complete the climb checklist so they could focus on controlling the aircraft. This represented good task prioritization.

  - When the FD malfunctioned and the AP followed suit, several participants immediately disconnected the AP. This was prudent as it clearly could not be

trusted and continuing to change modes or other settings would have been potentially dangerous, especially so close to the ground. Priorities were well placed by controlling the aircraft first then trouble-shooting.

- When the FD failure occurred, at least one participant very quickly tried to gain altitude to get the aircraft as far away from the ground as possible to troubleshoot the problem.

- **Departure:**
  - Although the TEB 6 departure was a vector departure that is loaded into the G1000, many participants had the TEB VOR tuned in to a navigation radio in case there was a problem or loss of GPS signal (e.g., momentary jamming such as those sometimes reported by aircraft at Newark Liberty International Airport).

Event 2 - Course reroute at MXE and meeting a crossing restriction at DQO:

- **G1000 programming:**
  - Given the close proximity to MXE when the reroute clearance was given, time to program the reroute was of the essence. Some participants realized that they would not be able to enter the entire route before the turn to DQO at MXE, so they first just entered DQO after MXE in their flight plans so that the turn would be caught. They seemed to appreciate that the most important part of getting the reroute entered was to insert the next fix. When time is short and workload is high, inserting new waypoints one at a time while interleaving other tasks may be necessary. Unless the legs between waypoints are very short, pilots will generally be able to enter them faster than they can be crossed, even when interleaving other tasks. Although this strategy may be necessary on occasion, it is probably not ideal, since it increases vulnerability to forgetting to insert all the new waypoints.

  - Some participants programmed a VPTH descent to meet the crossing restriction at DQO at the same time that they added DQO to their flight plans. This eliminated the need to reselect DQO later after completing other tasks associated with the reroute (e.g., entering the rest of the reroute, deleting old waypoints) to complete that programming. This also ensured the descent to meet the crossing restriction was initiated on time, even if the pilot was engaged in other tasks.

Event 3 - Expedited Descent:

- **Traffic avoidance:**
  - When ATC alerted the participants to traffic, after looking outside and seeing they were in IMC, most looked at the traffic display to determine their proximity to the other aircraft.

- **Automation use:**
  - Several of the participants disconnected the AP when issued the expedited descent and manually flew the reversal of the vertical profile. Although it is possible that rapidly "coming off" of automation and quickly reversing the vertical profile could lead to a loss of control from vestibular illusions, a trained instrument pilot should probably be able to do this safely. None of our participants appeared to have any difficulty with this maneuver.

  - Most of the participants who disconnected the AP when issued the expedited descent re-engaged the automation after the descent was initiated to prevent descending through the level-off altitude and to provide a more stable descent profile for ATC.

  - Turning off the autopilot and manually initiating the expedited descent resulted in a more timely response and smaller altitude gain than leaving the AP engaged and programming the descent via the AP. Additionally, the time compression when first initiating an expedited descent may make a participant vulnerable to making an error in AP mode selection or level off altitude selection.

Event 4 - Meeting a crossing restriction and preparing for an instrument approach while assisting with lost pilot communications to ATC:

- **Crossing restriction:**
  - The majority of pilots chose to program the crossing restriction prior to MOL using VPTH. This left additional cognitive bandwidth to focus on helping the lost pilot and/or preparing for the approach.

- **Approach into KHSP & Lost Pilot:**
  - In order to better control the tempo of the events occurring while assisting the lost pilot and the pending approach at KHSP, a few participants slowed their airspeed while descending from 16,000 ft. MSL. Additionally, one considered asking for a hold and others requested vectors or a different IAF to give them more time to prepare for the approach at KHSP.

Other Things to Consider

- **Automation utilization:**
    - During manual flight, if the FD is displayed but unprogrammed through the mode control panel, it will command the last programming that it received in both lateral and vertical modes. For example, when heading mode was last used, if the heading bug is not moved to a new position, the FD will command a turn in the direction where the heading bug was set. Similar FD commands will be made relative to altitude changes and aircraft pitch. Hence, a pilot could be manually flying a climbing turn to the right with the FD commanding a descending turn to the left. This can be extremely disorienting and, when in IMC, it could possibly lead to a loss of control. When manually flying, we suggest either de-selecting the FD and using raw data on the PFD for both vertical and lateral awareness or programming the FD.

    - We observed some participants allowing the autoflight system to default to ROL or PTCH mode because they had not selected either a lateral or vertical mode when engaging the AP. This suggested that they did not verify two things on the navigation status box at the top of the PFD: 1) that the mode selected was accepted, and, 2) that the mode selected made sense with the other modes displayed. Automation use can be thought of as having a two-way conversation. The autoflight buttons are the way the pilot communicates with the automation; the navigation status box is the automation's way of communicating with the pilot.

- **Checklist use:**
    - From our observations, it appeared that several participants were less than diligent with regard to checklist usage. We do not know if this was a common practice for them or if they were more lax in this area because it was simulator study. We strongly support the use of checklists during flight. We recommend that pilots actually refer to printed normal checklists for most if not all phases of flight rather than relying upon memory for their completion (Dismukes & Berman, 2010).

- **Chart usage:**
    - It appeared that some participants had no chart back-up available for the G1000 MFD screen. Most reported that they typically use several sources of chart back-ups, such as paper or an iPad. We strongly support having multiple back-up sources readily available.

- **Communication:**
    - The majority of our participants did not monitor 121.5 on their 2nd communication radio, though this may be because they were in a simulator participating in a study. Although not required by FARs, this is an accepted best practice in the industry and one typically taught by instructors.

- **G1000 programming:**
    - Several participants utilized the VOR and OBS to capture the BWZ radial, which was an acceptable strategy for accomplishing that task. However, this strategy would have required them to shift from GPS to ground-based navigation sources and then back again upon reaching BIGGY—a multistep process which could be vulnerable to error. Additionally, BIGGY was not identified on the BWZ radial by DME or another source so pilots would have had to watch the moving map closely and rapidly shift from ground-based navigation to space-based to continue flying the route after passing BIGGY. This could easily have been missed, especially if contact from ATC or other flight duties occurred during this time.

- **FD malfunction:**
    - During the FD malfunction some participants pulled back on the yoke with the AP still engaged without selecting control wheel steering (CWS). Most CFIs teach this should only be done if the AP cannot be disconnected. Engaging in a tugging match with an autoflight system is a dangerous practice and can greatly increase the chance of a loss of control.

    - None of the participants who experienced the FD failure consulted the QRH to see if there was a checklist for malfunctioning FD or AP available after they had established control of the aircraft. Consulting the QRH for anomalies is good practice, even if pilots think an appropriate checklist does not exist or if they think they have completed all the steps on one that does.

- **Instrument approaches:**
    - It is a good idea to always think of the DH or MDA for an approach as containing two numbers—the altitude and the altimeter setting—and to re-confirm the second when setting the first. Having done so would have kept many participants from landing at KHSP with an incorrect altimeter setting.