Flight Test in Complex Domain The Human Performance Challenge

1
00:00:00.240 --> 00:00:04.071
speaker. We have to thank Jeff. Jeff, please come.

2
00:00:05.180 --> 00:00:08.370
Because on short notice, you replaced

3
00:00:09.400 --> 00:00:13.180
Steve, that couldn't make it for his presentation.

4
00:00:14.480 --> 00:00:18.300
I think probably everybody knows Jeff, but just in

5
00:00:18.360 --> 00:00:21.420
case, I will say that you're a US

6
00:00:22.300 --> 00:00:23.080
Navy captain,

7
00:00:23.900 --> 00:00:24.240
retired.

8
00:00:24.340 --> 00:00:24.800
Retired.

9
00:00:24.920 --> 00:00:27.400
Yeah. You were anyways, but you never

10
00:00:28.440 --> 00:00:30.060
stop being a US Navy captain.

11
00:00:31.220 --> 00:00:32.180
And you worked for

12
00:00:33.720 --> 00:00:37.700
Lockheed Martin, on various programs, including the F-35,

13
00:00:38.340 --> 00:00:38.460
so

14

00:00:39.320 --> 00:00:40.040
great background.

15
00:00:41.000 --> 00:00:44.860
And I would say more importantly for today's presentation, you're also the

16
00:00:47.520 --> 00:00:48.700
boss of SFT.

17
00:00:50.120 --> 00:00:53.120
I wanted to say the president of SFT, and I think

18
00:00:53.180 --> 00:00:57.000
that's-- Okay, it says here, flight test in the complex

19
00:00:57.040 --> 00:00:58.720
domain, human performance challenge.

20
00:00:58.880 --> 00:01:02.160
So it's going to be about human performance and

21
00:01:03.360 --> 00:01:05.760
training, I guess also. Floor is yours.

22
00:01:06.220 --> 00:01:06.560
Thank you.

23
00:01:07.780 --> 00:01:09.060
It's great to be here.

24
00:01:09.960 --> 00:01:12.830
I'm really lucky to fill in right now, today,

25
00:01:13.520 --> 00:01:17.130
because everything we've heard today, I'm kind of like a

26
00:01:17.340 --> 00:01:21.220
cleanup hitter for what we had, and I'm going to just bring

27
00:01:21.300 --> 00:01:23.360

that to the forefront again.

28
00:01:25.680 --> 00:01:25.820
So

29
00:01:27.120 --> 00:01:30.880
flight testing is undergoing a shift with increasing

30
00:01:31.220 --> 00:01:35.160
complexity. We're moving from evaluating how humans control

31
00:01:35.260 --> 00:01:35.860
aircraft

32
00:01:36.760 --> 00:01:39.680
to how humans supervise aircraft,

33
00:01:40.580 --> 00:01:43.740
and in some cases, with AI making the decisions.

34
00:01:45.120 --> 00:01:47.360
And that shift has three consequences.

35
00:01:48.220 --> 00:01:48.560
First,

36
00:01:49.600 --> 00:01:53.180
risk increasingly emerges from interactions across

37
00:01:53.260 --> 00:01:55.700
systems rather than

38
00:01:56.060 --> 00:01:59.940
component behavior or component failures, as we

39
00:01:59.980 --> 00:02:03.660
heard earlier. Second, our analysis methods and tools

40
00:02:04.400 --> 00:02:08.301
are and must evolve so we can understand these system

41
00:02:08.361 --> 00:02:09.100
interactions.

42
00:02:10.581 --> 00:02:11.120
And third,

43
00:02:12.200 --> 00:02:14.980
the roles within flight test are changing.

44
00:02:15.980 --> 00:02:19.220
Test pilots are sometimes, maybe often now,

45
00:02:19.360 --> 00:02:22.540
transitioning from actuators to supervisors.

46
00:02:23.700 --> 00:02:26.650
And the role of the flight test engineer is

47
00:02:26.680 --> 00:02:30.200
expanding. They're placing greater

48
00:02:30.220 --> 00:02:33.450
importance on FTE capability.

49
00:02:34.540 --> 00:02:38.230
Now, the need for competent flight testers has

50
00:02:38.300 --> 00:02:42.240
always been there. That's not new, but with the

51
00:02:42.280 --> 00:02:43.790
increasing complexity,

52
00:02:44.720 --> 00:02:47.620
gaps in capability become more

53
00:02:47.660 --> 00:02:49.900
consequential and more visible,

54
00:02:51.040 --> 00:02:53.060

and that's the thread I want to talk about today.

55
00:03:02.240 --> 00:03:06.170
Across programs today, system behavior is increasingly defined in

56
00:03:06.200 --> 00:03:08.980
software. That's not news to any of us here.

57
00:03:09.020 --> 00:03:12.900
Not just augmentation, but control logic,

58
00:03:13.300 --> 00:03:14.269
decision-making,

59
00:03:15.080 --> 00:03:18.540
and mission execution, and that changes where

60
00:03:18.580 --> 00:03:22.100
risk lives. It often emerges from

61
00:03:22.180 --> 00:03:23.360
software interaction,

62
00:03:24.720 --> 00:03:28.000
automation logic, and system integration.

63
00:03:33.180 --> 00:03:36.790
Traditionally, much of flight test evaluated

64
00:03:36.820 --> 00:03:40.230
pilot aircraft interactions, and we asked,

65
00:03:40.690 --> 00:03:44.560
"Can the pilot control the aircraft safely and

66
00:03:44.580 --> 00:03:45.250
effectively?"

67
00:03:46.260 --> 00:03:48.160
Today, that emphasis is shifting.

68
00:03:51.760 --> 00:03:55.280
We are increasingly evaluating how humans supervise

69
00:03:55.340 --> 00:03:57.640
systems that control the aircraft.

70
00:03:58.230 --> 00:04:01.950
Automation executes control laws, shape the

71
00:04:02.020 --> 00:04:05.700
behavior, and AI may make decisions.

72
00:04:06.730 --> 00:04:09.920
Test control is no longer confined to the cockpit.

73
00:04:10.340 --> 00:04:13.430
In some scenarios, the FTE directs and

74
00:04:13.520 --> 00:04:15.640
controls the test maneuver.

75
00:04:16.560 --> 00:04:19.620
Boeing has given talks about automated test maneuvers.

76
00:04:19.981 --> 00:04:23.880
I just recently visited Embraer in Brazil, and they do the

77
00:04:23.960 --> 00:04:25.920
same thing with the test conductor

78
00:04:26.880 --> 00:04:30.580
executing those maneuvers and the pilot serving as a safety

79
00:04:30.650 --> 00:04:31.100
observer.

80
00:04:32.260 --> 00:04:36.170
In others, particularly UAV operations, the evaluation

81
00:04:36.200 --> 00:04:39.080

is run by a test conductor from a control room.

82
00:04:39.700 --> 00:04:41.740
Sometimes there isn't even a pilot on the team.

83
00:04:42.640 --> 00:04:46.310
So the pilot isn't always the actuator, and the cockpit is not

84
00:04:46.380 --> 00:04:49.900
always the center of control. In many cases,

85
00:04:50.520 --> 00:04:51.320
the system is,

86
00:04:52.160 --> 00:04:55.640
and that changes the test problem for these

87
00:04:55.700 --> 00:04:56.300
vehicles.

88
00:04:58.860 --> 00:05:02.160
So if you know General Beaker Wickerd, he recently put out

89
00:05:02.220 --> 00:05:04.840
an article about Bayesian

90
00:05:05.740 --> 00:05:09.460
factors, and in that, he said flight testers are professional risk

91
00:05:09.480 --> 00:05:12.990
managers operating under uncertainty, and we've talked about that

92
00:05:13.000 --> 00:05:16.990
today. We operate in an environment where not everything is

93
00:05:17.000 --> 00:05:17.570
predictable,

94
00:05:18.580 --> 00:05:21.750
not everything is modeled, and not everything

95
00:05:22.780 --> 00:05:24.320
behaves as expected.

96
00:05:25.700 --> 00:05:29.620
Today, uncertainty increasingly comes with how systems

97
00:05:29.660 --> 00:05:30.220
interact,

98
00:05:31.080 --> 00:05:32.880
software, automation,

99
00:05:33.740 --> 00:05:34.540
and humans.

100
00:05:35.860 --> 00:05:39.700
And those interactions are harder to anticipate

101
00:05:39.770 --> 00:05:42.760
and harder to reason through in real time.

102
00:05:44.300 --> 00:05:48.240
And that difference matters because it changes how well

103
00:05:48.380 --> 00:05:51.540
traditional methods and tools work.

104
00:05:53.260 --> 00:05:55.960
I don't know where that is. Are we there? We're there. Okay.

105
00:05:59.620 --> 00:06:03.460
Okay.Now, flight test has always depended on

106
00:06:03.540 --> 00:06:07.270
human judgment. What's changed is how often

107
00:06:07.320 --> 00:06:11.000
that judgment is the limiting factor.

108
00:06:11.120 --> 00:06:14.920

Flight test is increasingly operating in a complex

109
00:06:14.960 --> 00:06:18.750
domain where cause and effect are not fully

110
00:06:18.860 --> 00:06:20.480
knowable in advance.

111
00:06:21.720 --> 00:06:25.440
Most of our traditional risk management methods were built for the

112
00:06:25.500 --> 00:06:26.700
complicated domain.

113
00:06:27.620 --> 00:06:31.380
They remain valuable, you've heard about some of those today, but they're no longer

114
00:06:31.420 --> 00:06:34.960
sufficient to fully characterize risk in the

115
00:06:35.040 --> 00:06:37.240
complex domain.

116
00:06:42.600 --> 00:06:46.530
Tom Curry talked about this yesterday with Bob Barton and

117
00:06:46.620 --> 00:06:50.250
Starr Hughes' paper, which I can provide a copy to those who are

118
00:06:50.300 --> 00:06:53.730
interested. And it comes from something called the

119
00:06:53.820 --> 00:06:54.520
Cynefin

120
00:06:55.940 --> 00:06:58.680
quadrants. Has anybody heard of the Cynefin framework?

121
00:07:00.040 --> 00:07:03.840
A few of you. Well, the Cynefin framework helps illustrate the difference

122
00:07:03.880 --> 00:07:07.200
between the complicated and the complex domains.

123
00:07:07.460 --> 00:07:10.300
In the complicated domain on the upper right,

124
00:07:11.080 --> 00:07:14.740
cause and effect relationships exist, even

125
00:07:14.780 --> 00:07:18.100
if statistical analysis is required.

126
00:07:18.880 --> 00:07:21.360
Traditional engineering methods work.

127
00:07:24.180 --> 00:07:27.860
However, in the complex domain, upper left,

128
00:07:29.060 --> 00:07:32.960
unknown unknowns and non-deterministic behaviors

129
00:07:33.040 --> 00:07:36.820
exist. Cause and effect may only become

130
00:07:36.880 --> 00:07:37.320
clear

131
00:07:38.140 --> 00:07:39.940
after the event has occurred.

132
00:07:42.700 --> 00:07:46.620
In the complex domain, there are four behaviors.

133
00:07:47.780 --> 00:07:51.710
Emergence, which are novel properties or behaviors that arise from

134
00:07:51.860 --> 00:07:55.720
simple interactions between individual components of

135

00:07:55.760 --> 00:07:56.860
that complex system.

136
00:07:58.000 --> 00:07:59.360
Can someone give me an example?

137
00:08:02.180 --> 00:08:05.980
Flutter, right? Flutter's one of those. Nonlinear behavior.

138
00:08:06.820 --> 00:08:09.660
Outputs are not proportional to inputs.

139
00:08:11.040 --> 00:08:15.030
And then sensitivity to change. Even small changes in the

140
00:08:15.080 --> 00:08:19.020
design of a complex system or a test maneuver

141
00:08:19.060 --> 00:08:22.690
can produce large differences and even novel differences,

142
00:08:23.000 --> 00:08:26.910
sometimes adverse, that are often experienced that

143
00:08:26.920 --> 00:08:29.800
totally you couldn't have thought of it ahead of time.

144
00:08:31.620 --> 00:08:32.980
Non-failure hazards

145
00:08:34.020 --> 00:08:36.220
is the final one, where all the elements

146
00:08:36.880 --> 00:08:40.740
function as designed. Can

147
00:08:40.780 --> 00:08:42.841
you think of one that fits that?

148
00:08:45.860 --> 00:08:46.300
Software.

149
00:08:47.200 --> 00:08:48.160
Software doesn't break.

150
00:08:49.020 --> 00:08:51.740
We just didn't anticipate the complex outcomes.

151
00:08:53.300 --> 00:08:57.020
So in the complex domain, the approach becomes

152
00:08:57.080 --> 00:08:57.540
probe,

153
00:08:58.600 --> 00:08:59.280
observe,

154
00:09:00.080 --> 00:09:00.680
and learn,

155
00:09:02.140 --> 00:09:05.820
which means discovery becomes as important as

156
00:09:05.830 --> 00:09:09.369
analysis. Flight testing is increasingly

157
00:09:09.440 --> 00:09:11.339
operating in this domain.

158
00:09:14.960 --> 00:09:18.000
Here's an example of how test philosophy is changing.

159
00:09:18.860 --> 00:09:22.640
Traditionally, learning occurs within a predicted framework.

160
00:09:23.540 --> 00:09:24.620
We build models.

161
00:09:25.820 --> 00:09:29.760
We define an envelope, and we validate that expected

162

00:09:29.840 --> 00:09:30.320
behavior.

163
00:09:31.760 --> 00:09:35.730
At Anduril, I recently had the opportunity to visit Anduril, and I was

164
00:09:35.760 --> 00:09:39.140
briefed on their approach, a different approach for their UAVs.

165
00:09:40.180 --> 00:09:44.000
Test becomes the primary means of discovering

166
00:09:44.010 --> 00:09:47.160
system behavior, not just validating it.

167
00:09:48.400 --> 00:09:51.100
And in some cases, hardware loss is acceptable.

168
00:09:52.220 --> 00:09:56.080
And that's just part of the learning. That's not traditional validation.

169
00:09:56.960 --> 00:09:59.760
It's system learning through experimentation.

170
00:10:00.840 --> 00:10:04.520
And approaches like this place greater demands on the

171
00:10:04.720 --> 00:10:06.940
judgment of the flight test team.

172
00:10:11.200 --> 00:10:14.160
These are the three pillars. We've seen them before.

173
00:10:14.180 --> 00:10:17.530
They define effective, safe, and efficient flight testing,

174
00:10:17.960 --> 00:10:21.380
relevant methods and tools, competent flight test

175
00:10:21.400 --> 00:10:22.100
professionals,

176
00:10:23.320 --> 00:10:26.420
and an organizational culture that prioritizes the other two

177
00:10:27.740 --> 00:10:28.130
pillars,

178
00:10:28.940 --> 00:10:32.700
and where flight testers are trusted

179
00:10:32.740 --> 00:10:34.940
and influential. We've heard about that today.

180
00:10:35.760 --> 00:10:39.710
What's changing is how much stress is being placed on each of

181
00:10:39.760 --> 00:10:43.640
these pillars in the complex systems, especially the

182
00:10:43.680 --> 00:10:46.940
people middle pillar. But I want to start with the methods pillar,

183
00:10:48.460 --> 00:10:49.900
because we've heard about that today.

184
00:10:54.580 --> 00:10:58.520
Now, traditional hazard analysis methods like the three shown here,

185
00:10:58.960 --> 00:11:02.840
failure modes effects analysis, the risk matrix,

186
00:11:03.430 --> 00:11:06.990
and the test hazard analysis are extremely valuable,

187
00:11:07.800 --> 00:11:11.420
especially for what is understood or deterministic.

188
00:11:12.220 --> 00:11:15.540
But they struggle to discover interaction in

189

00:11:15.580 --> 00:11:17.080
interaction-driven hazards.

190
00:11:17.980 --> 00:11:21.660
Modern complex systems often fail

191
00:11:21.700 --> 00:11:23.020
through interactions

192
00:11:24.080 --> 00:11:27.750
between software modules, between humans and

193
00:11:27.800 --> 00:11:28.480
automation,

194
00:11:29.340 --> 00:11:32.250
and between subsystems behaving correctly

195
00:11:33.240 --> 00:11:35.580
but interfacing unexpectedly.

196
00:11:37.100 --> 00:11:40.800
These methods shown here, including maybe the fourth method at the

197
00:11:40.900 --> 00:11:42.840
top is us getting together as a group,

198
00:11:43.960 --> 00:11:47.880
are not designed well or they're certainly not optimized

199
00:11:47.920 --> 00:11:49.560
for complex system behavior.

200
00:11:53.280 --> 00:11:57.180
As a result, we have new methods that have been developed or are
emerging.

201
00:11:57.960 --> 00:12:01.820
System theoretic approaches like STPA, which Dunes talked about

202
00:12:01.880 --> 00:12:04.884

yesterday.Knowledge boundary

203
00:12:04.944 --> 00:12:08.384
methods that monitor system excursions

204
00:12:08.444 --> 00:12:12.294
from what you've known using multiple models, not

205
00:12:12.344 --> 00:12:16.004
just individual components like alpha, beta, or a

206
00:12:16.064 --> 00:12:16.544
stress.

207
00:12:17.984 --> 00:12:19.844
And then model-based test engineering.

208
00:12:20.524 --> 00:12:23.794
And finally, AI-assisted analysis, including

209
00:12:23.794 --> 00:12:26.304
tools employed during test

210
00:12:26.424 --> 00:12:30.144
execution. At a recent SFT symposium, we

211
00:12:30.184 --> 00:12:33.104
heard from a U.S. Air Force team that used AI

212
00:12:33.684 --> 00:12:37.544
to near real-time generate empirical test

213
00:12:37.584 --> 00:12:41.424
models as the data came in. It allowed them to reduce the

214
00:12:41.444 --> 00:12:45.404
number of test points by about 10%, which paid for

215
00:12:45.444 --> 00:12:46.904
the development of that tool.

216
00:12:48.184 --> 00:12:51.764
Now, all of these help us understand interactions,

217
00:12:52.204 --> 00:12:53.764
not just component behavior.

218
00:12:54.584 --> 00:12:55.724
And wait, there's more.

219
00:13:00.244 --> 00:13:03.964
The Air Force Flight Test Center for the last two years has been developing

220
00:13:03.974 --> 00:13:07.184
something called AFTA, and it's a large

221
00:13:07.264 --> 00:13:11.224
language model program, and you were introduced to one for the flight test

222
00:13:11.264 --> 00:13:11.674
safety

223
00:13:13.184 --> 00:13:16.464
database as well. It uses a retrieval

224
00:13:16.604 --> 00:13:20.064
augmentation generator, a RAG, to only

225
00:13:20.524 --> 00:13:23.484
take those documents that are

226
00:13:23.544 --> 00:13:26.124
applicable to the subject at large.

227
00:13:27.004 --> 00:13:30.984
And initial trials have shown improvements in risk

228
00:13:31.064 --> 00:13:32.724
identification, and it

229
00:13:33.644 --> 00:13:37.234
can create THAs, it can create test plans, test cards,

230
00:13:37.544 --> 00:13:39.884
and now the latest version has workflow.

231
00:13:40.964 --> 00:13:44.884
And if you're interested in seeing this, I've given demonstrations about this

232
00:13:44.984 --> 00:13:48.424
at previous talks. I'm happy to show that to you.

233
00:13:48.484 --> 00:13:52.444
It's public domain. They have a public domain outside their firewall, which

234
00:13:52.504 --> 00:13:54.624
you can go experiment and play with.

235
00:13:56.124 --> 00:13:59.904
Now, the large language models, as been discussed, they

236
00:13:59.984 --> 00:14:03.884
augment our analytical capabilities.

237
00:14:03.944 --> 00:14:07.764
They're great assistants, like an invaluable new

238
00:14:07.784 --> 00:14:11.684
member of the test team. They can provide insights we might not

239
00:14:11.724 --> 00:14:15.604
have thought about, new perspectives, and they can also help us

240
00:14:15.664 --> 00:14:16.364
work faster,

241
00:14:17.564 --> 00:14:20.584
but they're incapable of accountability.

242
00:14:25.784 --> 00:14:29.724
And what's coming even next is agentic agents.

243
00:14:30.044 --> 00:14:33.454
Beyond large language models, these tools are

244
00:14:33.504 --> 00:14:37.344
emerging. They extend our analytical capability,

245
00:14:38.124 --> 00:14:41.404
and they speed up our processes even more.

246
00:14:41.833 --> 00:14:45.704
And agentic agents are going on some of the autonomous aircraft that are

247
00:14:45.764 --> 00:14:46.724
now being tested.

248
00:14:47.944 --> 00:14:50.074
But they still don't replace human judgment.

249
00:14:50.814 --> 00:14:54.804
The effectiveness of any method, STPA, model-based

250
00:14:54.844 --> 00:14:57.004
test engineering, or AI,

251
00:14:57.904 --> 00:15:01.624
still depends on the capability of the test professionals who

252
00:15:01.644 --> 00:15:02.184
employ it,

253
00:15:03.724 --> 00:15:05.604
which brings us to the people dimension.

254
00:15:06.884 --> 00:15:10.794
Given the complexity, the system interaction challenges, and

255
00:15:10.844 --> 00:15:14.734

these emerging tools, it's more important than ever that

256
00:15:14.864 --> 00:15:18.494
all flight testers receive appropriate training and

257
00:15:18.584 --> 00:15:19.604
professional development.

258
00:15:20.864 --> 00:15:21.844
And to achieve that,

259
00:15:22.864 --> 00:15:24.924
get what I call the four C's.

260
00:15:31.644 --> 00:15:32.664
All right. The four C's,

261
00:15:33.484 --> 00:15:34.064
competence,

262
00:15:34.864 --> 00:15:35.544
confidence,

263
00:15:36.424 --> 00:15:37.564
courage, and commitment.

264
00:15:38.824 --> 00:15:42.204
Right. Competence comes from formal education,

265
00:15:43.504 --> 00:15:44.024
training,

266
00:15:44.884 --> 00:15:45.784
and experience.

267
00:15:48.104 --> 00:15:51.904
Courage comes from practicing your trade

268
00:15:52.304 --> 00:15:54.824
successfully under supervision.

269
00:15:57.044 --> 00:15:58.344
I said confidence does that, yeah.

270
00:15:58.604 --> 00:16:00.554
Courage comes from the

271
00:16:01.444 --> 00:16:02.084
decision,

272
00:16:03.194 --> 00:16:06.784
the ethical decision to make data-driven judgments

273
00:16:07.684 --> 00:16:11.624
when even when you're under pressure, and Kevin told us about some of the kind

274
00:16:11.664 --> 00:16:12.864
of pressures you can be under.

275
00:16:13.764 --> 00:16:16.204
And finally, commitment comes from the shared belief

276
00:16:17.404 --> 00:16:20.724
in continuous professional improvement and peer

277
00:16:20.784 --> 00:16:23.404
accountability. We've heard about all these today.

278
00:16:24.404 --> 00:16:27.884
Together, these qualities define the professional ethos

279
00:16:28.384 --> 00:16:29.894
of the ideal flight tester,

280
00:16:30.824 --> 00:16:34.084
and they shape culture. To

281
00:16:34.584 --> 00:16:38.504
develop these attributes, organizations must employ

282

00:16:39.484 --> 00:16:42.904
professional ethos of an ideal flight tester. I'm sorry.

283
00:16:43.424 --> 00:16:45.644
Must employ professional ethos of an

284
00:16:46.484 --> 00:16:49.024
ideal tester, and to develop these attributes,

285
00:16:49.894 --> 00:16:51.904
we must have ongoing professional development.

286
00:16:53.424 --> 00:16:57.344
Now, here's the key word. Inconsistency in these attributes in flight

287
00:16:57.404 --> 00:16:57.824
test

288
00:16:59.304 --> 00:17:00.184
is a risk driver.

289
00:17:02.384 --> 00:17:04.004
So here's the challenge that I've seen.

290
00:17:06.424 --> 00:17:07.224
Our community

291
00:17:08.805 --> 00:17:09.344
faces is

292
00:17:11.464 --> 00:17:15.085
that this is our challenge. FTE training standards and

293
00:17:15.144 --> 00:17:18.325
development vary widely across the industry.

294
00:17:18.504 --> 00:17:21.664
I've traveled to Europe, South America,

295
00:17:22.164 --> 00:17:25.364
across the U.S. visiting chapters and organizations.

296
00:17:25.624 --> 00:17:29.444
There's some great organizations, but there's ones where FTEs are

297
00:17:29.484 --> 00:17:29.904
dying

298
00:17:31.164 --> 00:17:34.944
for more training and some where they just don't have what they need.

299
00:17:35.884 --> 00:17:39.204
That's the challenge. This variability leads to

300
00:17:39.284 --> 00:17:41.764
inconsistent levels of analytical capability,

301
00:17:42.864 --> 00:17:46.824
operational awareness, and safety judgment, and it's a risk

302
00:17:46.884 --> 00:17:47.324
driver.

303
00:17:48.564 --> 00:17:52.444
The SFT recommended practices is an initiative, an

304
00:17:52.484 --> 00:17:54.304
attempt to address that gap.

305
00:17:55.524 --> 00:17:59.094
Recommended practices defines organizational

306
00:17:59.584 --> 00:18:00.244
competency,

307
00:18:01.364 --> 00:18:02.364
career progression,

308
00:18:03.404 --> 00:18:05.304
and professional expectations

309

00:18:06.164 --> 00:18:07.444
to encompass the four

310
00:18:07.524 --> 00:18:13.934
C's.The

311
00:18:13.994 --> 00:18:17.894
goal of a recommended practices is to define holistic

312
00:18:18.014 --> 00:18:21.944
FTE competency frameworks that include all slices in this

313
00:18:21.974 --> 00:18:25.874
pie. Yes, we have academics, but it's academics with

314
00:18:25.954 --> 00:18:29.874
evaluations. We have on-the-job training, but it

315
00:18:29.954 --> 00:18:31.754
also includes formal mentoring

316
00:18:32.694 --> 00:18:33.014
and

317
00:18:34.054 --> 00:18:34.734
currency.

318
00:18:36.234 --> 00:18:38.514
One that sometimes is missing is airmanship

319
00:18:39.374 --> 00:18:43.094
as a mandatory aspect, and there's many ways to get airmanship

320
00:18:43.174 --> 00:18:46.914
acumen. And of course, the final one is ongoing professional

321
00:18:46.974 --> 00:18:47.554
development.

322
00:18:51.494 --> 00:18:51.654
Now,

323
00:18:53.554 --> 00:18:56.514
what I'm saying here is not something that's regulatory.

324
00:18:56.854 --> 00:18:59.054
They're voluntary from the organizations.

325
00:18:59.854 --> 00:19:03.654
But within that organization, they're mandatory for the FTEs.

326
00:19:08.774 --> 00:19:11.854
To be recognized by SFTE as an

327
00:19:11.894 --> 00:19:15.864
organization with our recommended practices,

328
00:19:16.354 --> 00:19:19.724
they must have a documented career progression plan from

329
00:19:19.754 --> 00:19:23.194
novice to practitioner to leader to mentor

330
00:19:23.854 --> 00:19:27.584
that accommodates each flight test engineer's background, including

331
00:19:27.654 --> 00:19:30.514
ongoing competency evaluations.

332
00:19:30.574 --> 00:19:33.914
The idea is similar to other professions, teachers,

333
00:19:34.554 --> 00:19:37.554
doctors, lawyers, and pilots.

334
00:19:38.414 --> 00:19:40.514
Again, the goal is not regulation.

335
00:19:40.754 --> 00:19:44.394
It's professional consistency that meets the

336

00:19:44.474 --> 00:19:45.834
organizational standards.

337
00:19:50.934 --> 00:19:52.004
So our strategy

338
00:19:52.954 --> 00:19:56.474
is to advocate for it, which is what I'm doing here today, and it's to

339
00:19:56.514 --> 00:19:59.574
recognize organizations that possess strong

340
00:19:59.654 --> 00:20:01.664
training and development,

341
00:20:02.514 --> 00:20:06.404
and provide incentives for other organizations to do the same,

342
00:20:06.824 --> 00:20:10.714
and promote those organizations as model places for flight

343
00:20:10.774 --> 00:20:11.894
test engineers to work.

344
00:20:13.474 --> 00:20:17.324
And fortunately, a little bit of a push and encouragement, we're

345
00:20:17.414 --> 00:20:21.014
also working to get regulatory endorsement and

346
00:20:21.074 --> 00:20:21.824
working with

347
00:20:23.194 --> 00:20:24.674
Addison Tower and the FAA.

348
00:20:25.614 --> 00:20:28.804
In the next version of 404026,

349
00:20:29.594 --> 00:20:33.324
recommended practices will be noted as a best practice, which could

350
00:20:33.354 --> 00:20:37.274
encourage organizations. I was also contacted when I was in the

351
00:20:37.354 --> 00:20:41.254
UK by the MOD. They like this idea to

352
00:20:41.654 --> 00:20:45.394
augment their Article 2370, their test and evaluation

353
00:20:45.434 --> 00:20:49.224
guidelines. They want this as a best practice that's a little bit more

354
00:20:49.354 --> 00:20:50.604
flexible that

355
00:20:51.594 --> 00:20:55.214
organizations can say, "We are training correctly."

356
00:20:55.314 --> 00:20:58.104
So hopefully we get more of this

357
00:20:58.114 --> 00:21:01.604
regulatory endorsement. Again, it's not

358
00:21:01.634 --> 00:21:05.034
regulation, but it's acknowledgment that it's good for

359
00:21:05.054 --> 00:21:06.834
organizations to have standards.

360
00:21:07.874 --> 00:21:11.054
And then most importantly, at the end, the key is

361
00:21:11.134 --> 00:21:14.554
integration with the Flight Test Training and Education Council.

362
00:21:14.634 --> 00:21:17.054
How many know about FTTEC?

363

00:21:18.894 --> 00:21:21.094
Not enough. So,

364
00:21:21.974 --> 00:21:23.494
I'm going to talk about that a little bit.

365
00:21:25.854 --> 00:21:26.474
Okay, so

366
00:21:27.514 --> 00:21:31.334
FTTEC is a global collaboration of flight test volunteers from

367
00:21:31.434 --> 00:21:34.994
industry, government, and academia. It started about two years ago.

368
00:21:35.134 --> 00:21:35.994
Pat Hutchinson

369
00:21:36.954 --> 00:21:40.814
briefed it at SETP, and we have hosted

370
00:21:40.894 --> 00:21:43.934
it on SFTE, and we work with Stu Chia.

371
00:21:44.414 --> 00:21:48.274
Kevin is here as well. He's helped develop some of the curriculum

372
00:21:48.314 --> 00:21:52.094
for this. The idea is to develop and share training

373
00:21:52.154 --> 00:21:55.854
resources across the flight test industry that are

374
00:21:55.914 --> 00:21:59.134
shareable. And if recommended

375
00:21:59.254 --> 00:22:02.794
practices provides the framework, then

376
00:22:02.914 --> 00:22:06.034
FTTEC provides the resources for

377
00:22:06.094 --> 00:22:08.974
organizations to get some of this training.

378
00:22:09.014 --> 00:22:12.794
And if you go to the website, you'll see some

379
00:22:12.954 --> 00:22:15.234
public courses are coming online soon.

380
00:22:15.594 --> 00:22:19.334
You will see reference material, and not only the

381
00:22:19.394 --> 00:22:22.774
test pilot schools, but several other third-party

382
00:22:22.834 --> 00:22:25.434
opportunities to get formal training.

383
00:22:28.034 --> 00:22:31.914
I believe recommended practices is the most transformational initiative

384
00:22:32.054 --> 00:22:33.774
SFT is undergoing right now.

385
00:22:35.174 --> 00:22:38.114
But it's not a panacea. Everybody here

386
00:22:38.914 --> 00:22:41.194
gets it, and I need you

387
00:22:42.034 --> 00:22:45.834
to take it back to your organizations, to your clients, and

388
00:22:45.874 --> 00:22:46.714
help them get it.

389
00:22:48.134 --> 00:22:51.934
Together, we can do this because it's a cultural

390

00:22:52.074 --> 00:22:55.674
shift. It's not a financial problem. It's a cultural problem.

391
00:22:57.474 --> 00:23:01.034
But as you would all agree, the rewards can be profound.

392
00:23:03.754 --> 00:23:04.114
Okay.

393
00:23:05.074 --> 00:23:05.254
So

394
00:23:06.114 --> 00:23:08.694
there's the challenge, the go-to, the action item.

395
00:23:10.154 --> 00:23:13.714
Assess your organization's FTE development approach.

396
00:23:14.494 --> 00:23:16.134
Identify gaps in the training,

397
00:23:17.194 --> 00:23:18.754
progression, and evaluation.

398
00:23:19.854 --> 00:23:23.774
Go online to sft.org, go down to resources, look

399
00:23:23.994 --> 00:23:27.934
under recommended practices, look at the rubric, and decide where

400
00:23:27.974 --> 00:23:28.934
you may have the gaps.

401
00:23:29.894 --> 00:23:31.934
Decide if you want to apply for recognition.

402
00:23:32.934 --> 00:23:35.954
Last year when we kicked off this program, our inaugural

403
00:23:36.554 --> 00:23:40.274
organization was the 412th Test Wing at Edwards Air Force Base.

404
00:23:40.894 --> 00:23:41.914
And then this last

405
00:23:43.294 --> 00:23:47.174
November, we recognized Gulfstream, and not for public

406
00:23:47.214 --> 00:23:51.114
dissemination, but at the June SFT European

407
00:23:51.234 --> 00:23:53.754
conference, I will be announcing the DLR.

408
00:23:54.634 --> 00:23:58.474
We have four other organizations that I know that

409
00:23:58.534 --> 00:24:00.234
have their applications in work,

410
00:24:01.074 --> 00:24:04.994
but I want more. My goal is by 2028

411
00:24:05.004 --> 00:24:08.954
to have 12 of these, and if we

412
00:24:08.974 --> 00:24:12.924
get to 12, and we have a critical mass to tell everybody else, "You need
to do

413
00:24:12.954 --> 00:24:13.174
that,

414
00:24:13.214 --> 00:24:18.162
too."Okay.

415
00:24:18.942 --> 00:24:21.122
So technology's going to continue to change.

416
00:24:21.902 --> 00:24:24.662
Flight testing's going to continue to evolve.

417
00:24:25.522 --> 00:24:29.122
Software will grow more complex. Automation and

418
00:24:29.182 --> 00:24:30.782
AI will expand,

419
00:24:31.602 --> 00:24:33.961
and new analytical tools will evolve.

420
00:24:35.662 --> 00:24:39.562
But the central challenge remains human performance and judgment.

421
00:24:40.412 --> 00:24:41.352
The question is:

422
00:24:42.342 --> 00:24:46.322
Are we adequately developing and maintaining our test

423
00:24:46.402 --> 00:24:48.602
professionals? Because in the end,

424
00:24:49.522 --> 00:24:51.042
the better prepared they are,

425
00:24:51.902 --> 00:24:55.442
the safer and more effective all our programs, and for those who are in
the

426
00:24:55.482 --> 00:24:59.042
aircraft, their pink bodies will be. Thank you very much.

427
00:25:10.942 --> 00:25:11.342
All right.

428
00:25:13.402 --> 00:25:14.382
Thank you very much.

429
00:25:15.882 --> 00:25:16.302
So,

430

00:25:18.122 --> 00:25:20.542
I see some questions coming from the left here

431
00:25:21.542 --> 00:25:21.882
already.

432
00:25:28.282 --> 00:25:32.002
Thank you for the presentation, Jeff, and I appreciate it when anybody

433
00:25:32.012 --> 00:25:35.542
advocates for FTEs to be more than just self-loading ballast, so

434
00:25:36.342 --> 00:25:37.002
thank you for that.

435
00:25:38.182 --> 00:25:42.172
I noticed a couple places in your presentation where you stress the

436
00:25:42.282 --> 00:25:44.882
fact that this is not regulatory,

437
00:25:46.102 --> 00:25:49.702
no regulations, just recommended practices.

438
00:25:51.902 --> 00:25:55.862
Given the roles that FTE plays in flight test and

439
00:25:55.902 --> 00:25:56.462
how critical

440
00:25:57.342 --> 00:25:57.882
we think it is,

441
00:25:59.522 --> 00:26:03.422
and just like you said, there are levels to it from novice to
practitioner to

442
00:26:03.502 --> 00:26:04.482
leader to mentor.

443
00:26:06.142 --> 00:26:07.342

What is your view on

444
00:26:08.782 --> 00:26:11.862
actually including regulatory

445
00:26:12.402 --> 00:26:16.302
organization in that? And just like we treat pilots and doctors and

446
00:26:16.322 --> 00:26:19.632
nurses and everybody else, FTE can have that status as

447
00:26:20.442 --> 00:26:23.682
with a certificate or some other way.

448
00:26:23.962 --> 00:26:24.982
What do you think of that?

449
00:26:26.122 --> 00:26:26.302
So,

450
00:26:27.162 --> 00:26:29.142
at the Trieste

451
00:26:30.102 --> 00:26:33.562
in Italy, the conference, we talked about how we came up with calling it

452
00:26:33.822 --> 00:26:36.162
best practices instead of regulation.

453
00:26:36.222 --> 00:26:39.802
We looked at EASA that does regulate its flight test

454
00:26:39.822 --> 00:26:42.852
engineers. We looked at the Royal Aeronautical Society,

455
00:26:43.782 --> 00:26:47.602
and there's two reasons we didn't go that way.

456
00:26:47.622 --> 00:26:48.622
First and foremost,

457
00:26:49.442 --> 00:26:52.322
the experience of EASA is that it's inflexible.

458
00:26:52.362 --> 00:26:53.082
It doesn't really

459
00:26:55.182 --> 00:26:58.502
make sure that flight test engineers are fully qualified.

460
00:26:58.522 --> 00:27:02.502
It doesn't always meet what is necessary to be

461
00:27:02.562 --> 00:27:06.282
a competent, capable professional, and it's inflexible.

462
00:27:06.962 --> 00:27:10.542
The Royal Aeronautical Society has a comprehensive

463
00:27:10.582 --> 00:27:11.122
program,

464
00:27:12.002 --> 00:27:15.522
but SFT, at its current level, doesn't have the

465
00:27:16.942 --> 00:27:20.062
bandwidth to make it regulatory. So

466
00:27:21.402 --> 00:27:25.002
I think our approach was a pragmatic one, that we

467
00:27:25.082 --> 00:27:28.502
want a grassroots effort from everyone

468
00:27:28.562 --> 00:27:32.482
here to start the process. If we get enough critical

469
00:27:32.582 --> 00:27:35.922
mass, if we get help from the MOD in the UK,

470
00:27:36.662 --> 00:27:40.642

and the FAA just saying, "This is a good idea," maybe someday there

471
00:27:40.682 --> 00:27:44.482
will be one. But we don't want to take away

472
00:27:44.602 --> 00:27:48.462
the flexibility for companies who have very different

473
00:27:48.522 --> 00:27:51.562
vehicles and processes. Does that answer your question?

474
00:27:52.002 --> 00:27:52.702
Yes, sir. Thank you.

475
00:27:52.742 --> 00:27:52.942
Okay.

476
00:27:55.322 --> 00:27:55.332
Yeah.

477
00:27:57.582 --> 00:27:58.062
Another one.

478
00:28:02.302 --> 00:28:06.282
I was thinking about it. It relates to the

479
00:28:06.322 --> 00:28:10.002
first part of your presentation when you were mentioning a

480
00:28:10.142 --> 00:28:12.582
complex system, which is actually

481
00:28:14.122 --> 00:28:15.762
more and more where we are operating.

482
00:28:16.562 --> 00:28:16.782
How

483
00:28:18.562 --> 00:28:20.242
can we make sure that

484
00:28:22.682 --> 00:28:26.332
our testing is sufficient in the case of

485
00:28:26.442 --> 00:28:30.402
complex system? I have sometimes the feeling that we are making some

486
00:28:30.522 --> 00:28:33.962
samples testing, and how can we make sure that at the end

487
00:28:34.602 --> 00:28:37.241
it's been really proven by testing?

488
00:28:38.142 --> 00:28:38.342
All right.

489
00:28:39.282 --> 00:28:43.162
The question is, how can we ensure that in a complex system,

490
00:28:43.222 --> 00:28:44.362
the testing is adequate?

491
00:28:45.262 --> 00:28:48.382
So the short answer is, I don't have an answer.

492
00:28:48.402 --> 00:28:52.192
But I also will say that these

493
00:28:52.242 --> 00:28:55.972
new tools we're talking about that deal with non-deterministic complex

494
00:28:56.062 --> 00:28:59.482
systems, like STPA is one,

495
00:29:00.262 --> 00:29:03.652
it will go out and maybe find some things that we might not have thought

496
00:29:03.742 --> 00:29:04.702
about.

497
00:29:05.922 --> 00:29:06.662

But it's hard.

498
00:29:09.222 --> 00:29:13.082
General Beeker Wickerd put out his Becoming Bayesian

499
00:29:13.102 --> 00:29:16.082
paper. How many people read that? It came out last September.

500
00:29:16.762 --> 00:29:20.702
That's a mind-meld paper. But he

501
00:29:20.742 --> 00:29:24.631
talks about he's dealing with uncertainty, and when's enough enough, and

502
00:29:24.682 --> 00:29:28.502
how to make the decision. So the question is

503
00:29:28.562 --> 00:29:32.362
really relevant. How do you test all these AI systems coming on

504
00:29:32.382 --> 00:29:36.142
board? What's enough? We have to do more research.

505
00:29:36.642 --> 00:29:39.522
I would recommend reading General Wickerd's paper.

506
00:29:39.922 --> 00:29:42.242
I would recommend investigating STPA,

507
00:29:43.322 --> 00:29:43.522
and

508
00:29:44.782 --> 00:29:48.442
maybe model-based test engineering, but we don't have a

509
00:29:48.502 --> 00:29:50.682
complete, adequate answer.

510
00:29:55.682 --> 00:29:55.862
Yep.

511
00:29:57.242 --> 00:29:58.622
You want to grab the mic?

512
00:30:00.782 --> 00:30:04.042
Sure. So back on your question about

513
00:30:06.302 --> 00:30:08.842
organizations volunteering as part of this

514
00:30:10.542 --> 00:30:14.442
training process or standard. For companies like

515
00:30:14.462 --> 00:30:17.982
Boeing or other companies that have a wide range of flight test

516
00:30:18.042 --> 00:30:20.442
engineers and a training program

517
00:30:20.482 --> 00:30:24.390
withinI could see myself proposing

518
00:30:24.450 --> 00:30:28.420
to my leadership, "Hey, there's this thing that SFTE is

519
00:30:28.450 --> 00:30:32.390
doing. I think it's cool." And I know the response is going to be, "Well,

520
00:30:32.430 --> 00:30:36.130
what's the business case? What's the business case for the company

521
00:30:36.190 --> 00:30:40.150
to spend the extra effort to get them to apply and get

522
00:30:40.190 --> 00:30:41.830
this standard?" So I guess,

523
00:30:42.710 --> 00:30:46.680
I'd love to hear your thoughts on what would you say is the business case
for a

524

00:30:47.190 --> 00:30:49.310
company to step forward, step up to this?

525
00:30:49.850 --> 00:30:53.650
It's a great question. I didn't have time to put it in here, but I have, what's the

526
00:30:53.690 --> 00:30:56.900
business case? When I went out to the 412 test wing,

527
00:30:57.690 --> 00:30:59.290
they said, "Jeff, we do all this stuff.

528
00:30:59.460 --> 00:31:01.570
We have your training processes we put in place.

529
00:31:01.630 --> 00:31:03.690
Why do we need to do this?" And I said, "Well,

530
00:31:04.610 --> 00:31:08.390
first of all, if you model it, maybe some of your

531
00:31:08.470 --> 00:31:12.350
DoD contractors, you may not make it contractual yet, but you

532
00:31:12.390 --> 00:31:16.370
can at least say you ought to adhere to it." The other thing you can say is, "We're

533
00:31:16.490 --> 00:31:18.490
a good place to work," and you can

534
00:31:18.550 --> 00:31:22.230
recruit and retain.

535
00:31:22.670 --> 00:31:26.270
And when we talked to Gulfstream, they said, "When we started telling

536
00:31:26.669 --> 00:31:30.460
our FTE applicants what we would do for

537

00:31:30.510 --> 00:31:33.620
them, we were able to recruit better." So the answer is

538
00:31:34.550 --> 00:31:37.770
recruitment and retention are two factors,

539
00:31:38.110 --> 00:31:41.870
especially if SFTE holds you up as

540
00:31:42.330 --> 00:31:43.190
an organization.

541
00:31:44.330 --> 00:31:47.790
You can also look and say, "And look,

542
00:31:48.250 --> 00:31:51.890
it makes sense. The regulatory agency

543
00:31:51.930 --> 00:31:54.290
recognizes it as a best practice." So it's there.

544
00:31:55.310 --> 00:31:56.410
Beyond that,

545
00:31:57.590 --> 00:32:00.950
it's going to take the same kind of advocacy that we've had to do for
other

546
00:32:01.010 --> 00:32:01.950
cultural events.

547
00:32:02.810 --> 00:32:04.460
While we're at it, at Boeing,

548
00:32:05.490 --> 00:32:09.030
recommended practices doesn't have to be the entire Boeing

549
00:32:09.110 --> 00:32:12.990
company. It can be an organization within Boeing that applies for

550
00:32:13.000 --> 00:32:16.850

it. The way we've structured is you can say, "This is the group we're applying for,

551
00:32:17.120 --> 00:32:20.950
this is the process we use," and if, for example,

552
00:32:21.330 --> 00:32:23.710
Boeing doesn't do that all over, that's okay.

553
00:32:24.670 --> 00:32:26.550
Thanks.

554
00:32:26.670 --> 00:32:26.890
Yeah.

555
00:32:27.450 --> 00:32:27.770
Thanks.

556
00:32:29.670 --> 00:32:30.129
All right.

557
00:32:31.270 --> 00:32:33.970
We're just right on time. Thanks again, Jeff.

558
00:32:34.010 --> 00:32:35.330
Yep. Thank you.