
Robert Braun

1
00:00:05,269 --> 00:00:03,110
i think what i will do is uh oh then the

2
00:00:07,190 --> 00:00:05,279
other thing is at the end of the hour

3
00:00:08,549 --> 00:00:07,200
we are going to move a couple hundred

4
00:00:11,430 --> 00:00:08,559
yards from here

5
00:00:13,270 --> 00:00:11,440
uh and reassemble with the other groups

6
00:00:15,190 --> 00:00:13,280
which time

7
00:00:17,990 --> 00:00:15,200
i'm going to have the privilege

8
00:00:20,230 --> 00:00:18,000
of summarizing all the

9
00:00:23,429 --> 00:00:20,240
wise and succinct remarks that are made

10
00:00:25,429 --> 00:00:23,439
here so don't let me down

11
00:00:27,910 --> 00:00:25,439
the uh i'd like to introduce our

12
00:00:29,589 --> 00:00:27,920
panelists first i'll do that

13
00:00:31,589 --> 00:00:29,599

and i'll do it very briefly i don't do

14
00:00:32,870 --> 00:00:31,599
justice to them and then we're going to

15
00:00:35,190 --> 00:00:32,880
start at the other end of the table and

16
00:00:37,430 --> 00:00:35,200
just work this way and when that's over

17
00:00:38,869 --> 00:00:37,440
then we'll turn uh to those of you in

18
00:00:41,590 --> 00:00:38,879
the audience

19
00:00:43,990 --> 00:00:41,600
uh first of course is ed lew who

20
00:00:45,350 --> 00:00:44,000
has a bachelor of science in engineering

21
00:00:47,910 --> 00:00:45,360
from cornell

22
00:00:49,750 --> 00:00:47,920
he has a phd in applied physics from

23
00:00:52,549 --> 00:00:49,760
stanford

24
00:00:54,549 --> 00:00:52,559
he was a nasa astronaut for 12 years

25
00:00:56,790 --> 00:00:54,559
flew the space shuttle twice

26
00:00:58,869 --> 00:00:56,800
and i believe he was the first flight

27
00:01:01,750 --> 00:00:58,879
engineer on the first american flight

28
00:01:05,109 --> 00:01:01,760
engineer on the russian soyuz

29
00:01:05,910 --> 00:01:05,119
he spent six months on the iss

30
00:01:07,510 --> 00:01:05,920
and

31
00:01:09,510 --> 00:01:07,520
is now program managed for advanced

32
00:01:11,510 --> 00:01:09,520
projects at google

33
00:01:15,030 --> 00:01:11,520
so it's an interesting job transition

34
00:01:16,630 --> 00:01:15,040
and a great perspective for us

35
00:01:17,990 --> 00:01:16,640
second we'll hear from bobby braun who

36
00:01:20,390 --> 00:01:18,000
has a phd in aeronautics and

37
00:01:22,789 --> 00:01:20,400
astronautics from stanford

38
00:01:25,350 --> 00:01:22,799

some 20 years experience in

39
00:01:26,469 --> 00:01:25,360
doing design and analysis of planetary

40
00:01:28,870 --> 00:01:26,479
systems

41
00:01:31,830 --> 00:01:28,880
and that includes the

42
00:01:35,350 --> 00:01:31,840
mars pathfinder missions

43
00:01:37,830 --> 00:01:35,360
he was co-chair of the nrc review of the

44
00:01:40,069 --> 00:01:37,840
nasa institute for advanced concepts

45
00:01:41,910 --> 00:01:40,079
and he's currently nasa's chief

46
00:01:43,990 --> 00:01:41,920
technologist

47
00:01:46,149 --> 00:01:44,000
and then lastly will be doug cook who is

48
00:01:47,749 --> 00:01:46,159
a texas aggie

49
00:01:50,550 --> 00:01:47,759
with a bachelor of science degree in

50
00:01:52,630 --> 00:01:50,560
aerospace engineering he has over 35

51
00:01:54,469 --> 00:01:52,640
years of experience

52
00:01:56,709 --> 00:01:54,479
pretty much covering the main human

53
00:01:59,350 --> 00:01:56,719
space flight programs the space shuttle

54
00:02:00,469 --> 00:01:59,360
the space station and now exploration

55
00:02:02,230 --> 00:02:00,479
programs

56
00:02:04,630 --> 00:02:02,240
he's been assigned

57
00:02:06,149 --> 00:02:04,640
important responsibilities to carry out

58
00:02:09,430 --> 00:02:06,159
the program that

59
00:02:12,229 --> 00:02:09,440
we've heard about

60
00:02:14,309 --> 00:02:12,239
in march of 1993 when nasa undertook the

61
00:02:15,190 --> 00:02:14,319
redesign of the

62
00:02:17,350 --> 00:02:15,200
of

63
00:02:19,190 --> 00:02:17,360

the iss

64
00:02:21,270 --> 00:02:19,200
he led the engineering and technical

65
00:02:23,110 --> 00:02:21,280
aspects of that redesign

66
00:02:26,309 --> 00:02:23,120
he was a nasa technical advisor to the

67
00:02:28,869 --> 00:02:26,319
columbia accident investigation board

68
00:02:31,509 --> 00:02:28,879
and he currently is the associate

69
00:02:33,350 --> 00:02:31,519
administrator for exploration systems

70
00:02:36,229 --> 00:02:33,360
mission

71
00:02:39,990 --> 00:02:36,239
so

72
00:02:41,509 --> 00:02:40,000
thank you all three of you for appearing

73
00:02:45,670 --> 00:02:41,519
and uh

74
00:02:50,710 --> 00:02:48,309
okay i first wanted to uh make the point

75
00:02:52,309 --> 00:02:50,720
that

76
00:02:54,949 --> 00:02:52,319
this is all about innovation in some

77
00:02:55,670 --> 00:02:54,959
sense because i think what

78
00:02:59,750 --> 00:02:55,680
the

79
00:03:01,509 --> 00:02:59,760
states taxpayer really wants out of nasa

80
00:03:03,430 --> 00:03:01,519
is for them to do innovative things that

81
00:03:04,949 --> 00:03:03,440
amaze them right they want them to do

82
00:03:07,509 --> 00:03:04,959
they want to see value for their money

83
00:03:08,470 --> 00:03:07,519
they want to see nasa doing things right

84
00:03:09,910 --> 00:03:08,480
and and

85
00:03:11,270 --> 00:03:09,920
you hear people talking about it i think

86
00:03:12,790 --> 00:03:11,280
the president probably used this word

87
00:03:14,070 --> 00:03:12,800
four or five times in a speech probably

88
00:03:17,190 --> 00:03:14,080

use the word innovation four or five

89
00:03:18,630 --> 00:03:17,200
times and you hear it everywhere and the

90
00:03:21,270 --> 00:03:18,640
question is

91
00:03:23,830 --> 00:03:21,280
how do you drive innovation how do you

92
00:03:25,270 --> 00:03:23,840
get a group you know as large as nasa to

93
00:03:26,710 --> 00:03:25,280
be innovative

94
00:03:28,949 --> 00:03:26,720
and over the years i've come to the

95
00:03:30,949 --> 00:03:28,959
conclusion that

96
00:03:32,550 --> 00:03:30,959
there isn't a

97
00:03:34,710 --> 00:03:32,560
special formula for it but there are

98
00:03:37,589 --> 00:03:34,720
certain things that you can do that make

99
00:03:38,949 --> 00:03:37,599
an innovative environment possible

100
00:03:41,509 --> 00:03:38,959
and

101
00:03:43,830 --> 00:03:41,519
to a large extent i think that is the

102
00:03:46,949 --> 00:03:43,840
ability to move quickly i think

103
00:03:49,190 --> 00:03:46,959
innovation really is speed in a lot of

104
00:03:50,869 --> 00:03:49,200
respects what that means is the ability

105
00:03:53,750 --> 00:03:50,879
to do

106
00:03:56,550 --> 00:03:53,760
tests of things to try new ideas

107
00:03:58,630 --> 00:03:56,560
see what works to iterate

108
00:04:01,350 --> 00:03:58,640
to try things over again and that means

109
00:04:03,110 --> 00:04:01,360
a high pace of operations

110
00:04:04,550 --> 00:04:03,120
at google we use the phrase launch early

111
00:04:07,910 --> 00:04:04,560
launch often

112
00:04:09,350 --> 00:04:07,920
and we use it we apply it to

113
00:04:10,949 --> 00:04:09,360

um

114
00:04:13,190 --> 00:04:10,959
projects that are launching when people

115
00:04:16,550 --> 00:04:13,200
have new ideas you know you can try them

116
00:04:18,069 --> 00:04:16,560
out when you want to modify

117
00:04:33,430 --> 00:04:18,079
a

118
00:04:35,030 --> 00:04:33,440
of effort on

119
00:04:37,350 --> 00:04:35,040
building

120
00:04:40,310 --> 00:04:37,360
the the system such that the launch

121
00:04:43,030 --> 00:04:40,320
process launching a new product

122
00:04:44,710 --> 00:04:43,040
is relatively easy

123
00:04:46,070 --> 00:04:44,720
and

124
00:04:47,670 --> 00:04:46,080
not to say that

125
00:04:49,990 --> 00:04:47,680
the work that's done at nasa is like

126
00:04:52,629 --> 00:04:50,000
software it is completely not

127
00:04:54,230 --> 00:04:52,639
but the concept of building your

128
00:04:58,390 --> 00:04:54,240
infrastructure such that you can do

129
00:05:00,310 --> 00:04:58,400
tests easily and do try ideas easily and

130
00:05:01,909 --> 00:05:00,320
bring them to fruition in you know not

131
00:05:04,390 --> 00:05:01,919
in decades but in

132
00:05:05,590 --> 00:05:04,400
years and see what works and then and

133
00:05:08,310 --> 00:05:05,600
change it

134
00:05:11,189 --> 00:05:08,320
i do think does hold over

135
00:05:14,310 --> 00:05:11,199
in my years at nasa i remember

136
00:05:16,070 --> 00:05:14,320
how often we were in a situation where

137
00:05:17,270 --> 00:05:16,080
we would have a good idea

138
00:05:18,790 --> 00:05:17,280

and and

139
00:05:20,230 --> 00:05:18,800
there would be no way to try it there

140
00:05:21,830 --> 00:05:20,240
would be you know if you could only get

141
00:05:23,350 --> 00:05:21,840
some flight test information we would

142
00:05:25,270 --> 00:05:23,360
have been you know we would have saved

143
00:05:27,189 --> 00:05:25,280
ourselves years of arguing but instead

144
00:05:29,430 --> 00:05:27,199
we may argue about it for years because

145
00:05:30,390 --> 00:05:29,440
there was no flight opportunity

146
00:05:33,830 --> 00:05:30,400
so

147
00:05:36,870 --> 00:05:33,840
i think is really

148
00:05:39,990 --> 00:05:36,880
get yourself to the level of

149
00:05:41,510 --> 00:05:40,000
a you know a rapid development program

150
00:05:43,830 --> 00:05:41,520
and think like a rapid development

151
00:05:45,350 --> 00:05:43,840
program where your time scales are short

152
00:05:47,270 --> 00:05:45,360
you're not necessarily trying to bite

153
00:05:49,350 --> 00:05:47,280
off gigantic chunks but you're trying to

154
00:05:52,150 --> 00:05:49,360
buy lots and lots and lots of small

155
00:05:54,150 --> 00:05:52,160
chunks and build a program around lots

156
00:05:56,469 --> 00:05:54,160
and lots of small chunks

157
00:05:58,870 --> 00:05:56,479
and i think that that is the kind of

158
00:06:00,629 --> 00:05:58,880
mindset that you need to be in to drive

159
00:06:02,550 --> 00:06:00,639
new ideas that's what gets people

160
00:06:04,550 --> 00:06:02,560
thinking that's what gets people excited

161
00:06:06,950 --> 00:06:04,560
when you have this opportunity

162
00:06:07,909 --> 00:06:06,960
to get lots of small victories

163
00:06:09,430 --> 00:06:07,919

and

164
00:06:11,029 --> 00:06:09,440
when you translate that over to nasa

165
00:06:12,469 --> 00:06:11,039
what does that mean

166
00:06:14,629 --> 00:06:12,479
i think the

167
00:06:16,710 --> 00:06:14,639
uh equivalent of what we call launch

168
00:06:18,070 --> 00:06:16,720
infrastructure at google which is you

169
00:06:20,309 --> 00:06:18,080
know the ability to push new code

170
00:06:23,029 --> 00:06:20,319
quickly try tests quickly and so on the

171
00:06:24,710 --> 00:06:23,039
launch infrastructure is really our

172
00:06:26,550 --> 00:06:24,720
at nasa which is real launch

173
00:06:28,070 --> 00:06:26,560
infrastructure which is you know the

174
00:06:29,110 --> 00:06:28,080
launch systems

175
00:06:31,590 --> 00:06:29,120
and

176
00:06:35,430 --> 00:06:31,600
so i would argue that

177
00:06:37,590 --> 00:06:35,440
moving to a an architecture that has

178
00:06:39,670 --> 00:06:37,600
more rapid launches lots of rapid

179
00:06:40,629 --> 00:06:39,680
launches even if they're smaller is

180
00:06:41,830 --> 00:06:40,639
worth

181
00:06:44,469 --> 00:06:41,840
the

182
00:06:46,150 --> 00:06:44,479
payload penalty you take

183
00:06:47,670 --> 00:06:46,160
as you all know the larger the rocket in

184
00:06:48,950 --> 00:06:47,680
general the larger the payload fraction

185
00:06:50,870 --> 00:06:48,960
but you're going to take a payload

186
00:06:54,309 --> 00:06:50,880
penalty from doing this but i think you

187
00:06:56,469 --> 00:06:54,319
jane in an innovation uh bonus

188
00:06:58,870 --> 00:06:56,479

in that you now have engineers have the

189
00:07:00,790 --> 00:06:58,880
ability to try things

190
00:07:02,390 --> 00:07:00,800
much more easily much more rapidly and

191
00:07:04,309 --> 00:07:02,400
without as much

192
00:07:06,870 --> 00:07:04,319
sort of risk of failure

193
00:07:08,629 --> 00:07:06,880
if you if you set up your mission such

194
00:07:10,309 --> 00:07:08,639
that you know maybe you've got a mission

195
00:07:11,749 --> 00:07:10,319
every six months or one year when you're

196
00:07:13,990 --> 00:07:11,759
or maybe every two years you've got a

197
00:07:14,950 --> 00:07:14,000
test opportunity for your team boy

198
00:07:16,390 --> 00:07:14,960
you're not going to try anything

199
00:07:17,909 --> 00:07:16,400
terribly exciting

200
00:07:19,589 --> 00:07:17,919
because if you only get a test

201
00:07:20,469 --> 00:07:19,599
opportunity every couple of years you

202
00:07:22,629 --> 00:07:20,479
know

203
00:07:24,070 --> 00:07:22,639
you you better make sure that you don't

204
00:07:25,589 --> 00:07:24,080
try to you know you don't do something

205
00:07:26,710 --> 00:07:25,599
too outlandish because your next

206
00:07:28,629 --> 00:07:26,720
opportunity doesn't come up for a few

207
00:07:31,830 --> 00:07:28,639
more years and i've seen that mentality

208
00:07:33,749 --> 00:07:31,840
at nasa and

209
00:07:35,110 --> 00:07:33,759
i think that that

210
00:07:37,350 --> 00:07:35,120
the way to change that is through a

211
00:07:40,150 --> 00:07:37,360
structural change

212
00:07:42,150 --> 00:07:40,160
i would i think that

213
00:07:45,110 --> 00:07:42,160

to translate that back to launchers

214
00:07:47,110 --> 00:07:45,120
perhaps a medium-scale launcher

215
00:07:49,350 --> 00:07:47,120
you know perhaps a little bit larger

216
00:07:51,430 --> 00:07:49,360
than a soyuz uh or perhaps you know up

217
00:07:54,230 --> 00:07:51,440
to double the size of soyuz

218
00:07:55,830 --> 00:07:54,240
that sort of class launcher but

219
00:07:58,469 --> 00:07:55,840
where the requirement was placed on it

220
00:08:01,029 --> 00:07:58,479
that it could launch very very rapidly

221
00:08:02,070 --> 00:08:01,039
without using up all of nasa's resources

222
00:08:04,150 --> 00:08:02,080
and you know you get a lot of

223
00:08:06,390 --> 00:08:04,160
operational scale

224
00:08:09,270 --> 00:08:06,400
from doing that the other advantage to

225
00:08:10,629 --> 00:08:09,280
this is not just in the development side

226
00:08:12,309 --> 00:08:10,639
of things the development side of

227
00:08:13,670 --> 00:08:12,319
payloads and things in deep space which

228
00:08:14,950 --> 00:08:13,680
is really what nasa should be doing and

229
00:08:16,629 --> 00:08:14,960
we heard today

230
00:08:17,430 --> 00:08:16,639
but from the pure operational side of

231
00:08:19,510 --> 00:08:17,440
things

232
00:08:21,189 --> 00:08:19,520
the faster you get the better you get at

233
00:08:23,189 --> 00:08:21,199
being faster

234
00:08:25,110 --> 00:08:23,199
you know that and we see that here at

235
00:08:27,350 --> 00:08:25,120
right here at kennedy space center when

236
00:08:28,469 --> 00:08:27,360
our launch rate was low things became

237
00:08:32,630 --> 00:08:28,479
difficult

238
00:08:34,230 --> 00:08:32,640

launch teams the launch prep teams

239
00:08:35,350 --> 00:08:34,240
everything became more difficult because

240
00:08:37,589 --> 00:08:35,360
they weren't

241
00:08:38,630 --> 00:08:37,599
in a an operational

242
00:08:40,310 --> 00:08:38,640
tempo

243
00:08:41,990 --> 00:08:40,320
actually the faster things got up to

244
00:08:44,230 --> 00:08:42,000
some limit

245
00:08:45,509 --> 00:08:44,240
uh things get better of course there's

246
00:08:47,269 --> 00:08:45,519
there's something there you can go too

247
00:08:49,670 --> 00:08:47,279
fast for any given system

248
00:08:51,509 --> 00:08:49,680
and and shuttle did run up against that

249
00:08:53,590 --> 00:08:51,519
some years ago shuttle's limit is

250
00:08:54,550 --> 00:08:53,600
perhaps about seven or so flights per

251
00:08:56,230 --> 00:08:54,560
year

252
00:08:59,190 --> 00:08:56,240
for that particular system but what that

253
00:09:01,430 --> 00:08:59,200
means is that you should place the

254
00:09:03,750 --> 00:09:01,440
design requirement on your systems such

255
00:09:05,910 --> 00:09:03,760
that you can reach a high

256
00:09:08,310 --> 00:09:05,920
operational piece i think that we should

257
00:09:10,230 --> 00:09:08,320
be shooting for something like you know

258
00:09:12,310 --> 00:09:10,240
once every week once every two weeks

259
00:09:14,949 --> 00:09:12,320
that sort of type of tempo

260
00:09:16,870 --> 00:09:14,959
with our requirements and for real i

261
00:09:18,870 --> 00:09:16,880
know they talked about that for shuttle

262
00:09:20,310 --> 00:09:18,880
back then uh back

263
00:09:22,470 --> 00:09:20,320

30 years ago

264
00:09:24,470 --> 00:09:22,480
and i think that there was some

265
00:09:26,470 --> 00:09:24,480
uh fudging of numbers when they people

266
00:09:28,630 --> 00:09:26,480
said that the shuttle would launch was

267
00:09:30,550 --> 00:09:28,640
capable of launching that that

268
00:09:31,269 --> 00:09:30,560
frequently because it really wasn't

269
00:09:33,750 --> 00:09:31,279
but

270
00:09:35,110 --> 00:09:33,760
if you go to a simplified system a soyuz

271
00:09:37,030 --> 00:09:35,120
type system but you know an

272
00:09:38,630 --> 00:09:37,040
american-made soyuz system i think we

273
00:09:42,550 --> 00:09:38,640
could do wonderful things with that so

274
00:09:46,949 --> 00:09:45,910
very good thank you very much bye

275
00:09:48,790 --> 00:09:46,959
great

276
00:09:50,389 --> 00:09:48,800
i'll see so

277
00:09:51,509 --> 00:09:50,399
first of all good afternoon

278
00:09:53,350 --> 00:09:51,519
um

279
00:09:55,590 --> 00:09:53,360
so i'm at nasa now and so i had to make

280
00:09:57,030 --> 00:09:55,600
some slides

281
00:09:59,190 --> 00:09:57,040
so uh

282
00:10:00,870 --> 00:09:59,200
is there a way we can project them or

283
00:10:03,350 --> 00:10:00,880
would you rather i just talk oh great

284
00:10:04,710 --> 00:10:03,360
and why don't we go to the next one

285
00:10:07,829 --> 00:10:04,720
it's one of the things i learned that we

286
00:10:09,509 --> 00:10:07,839
do in the government we make good slides

287
00:10:11,750 --> 00:10:09,519
next slide please

288
00:10:13,829 --> 00:10:11,760

yeah so i've been thinking a lot about

289
00:10:15,430 --> 00:10:13,839
uh technology in these last few months

290
00:10:18,230 --> 00:10:15,440
i've been thinking a lot

291
00:10:20,150 --> 00:10:18,240
in particular about nasa's technology

292
00:10:22,949 --> 00:10:20,160
programs

293
00:10:23,829 --> 00:10:22,959
and i wanted to start by

294
00:10:25,430 --> 00:10:23,839
putting

295
00:10:28,550 --> 00:10:25,440
some of these technology discussions

296
00:10:30,630 --> 00:10:28,560
perhaps into a larger context

297
00:10:33,030 --> 00:10:30,640
what is on this slide

298
00:10:35,829 --> 00:10:33,040
are the recommendations from a number of

299
00:10:37,590 --> 00:10:35,839
uh reports or guidance uh recent

300
00:10:39,829 --> 00:10:37,600
guidance from congress

301
00:10:41,430 --> 00:10:39,839
uh and what i've been doing in my job as

302
00:10:42,710 --> 00:10:41,440
many of you know i've started just a few

303
00:10:45,829 --> 00:10:42,720
months ago

304
00:10:47,670 --> 00:10:45,839
what i've been doing is reading

305
00:10:50,150 --> 00:10:47,680
technology and about how nasa did

306
00:10:52,069 --> 00:10:50,160
technology in the past and how nasa has

307
00:10:53,829 --> 00:10:52,079
a possibility of doing innovation and

308
00:10:55,269 --> 00:10:53,839
technology in the future

309
00:10:57,030 --> 00:10:55,279
and a couple things have jumped out at

310
00:10:58,829 --> 00:10:57,040
me uh the first is illustrated on this

311
00:11:01,350 --> 00:10:58,839
slide there's been a very

312
00:11:03,269 --> 00:11:01,360
consistent set of external

313
00:11:05,430 --> 00:11:03,279

recommendations

314
00:11:06,550 --> 00:11:05,440
coming from a number of reports

315
00:11:08,230 --> 00:11:06,560
including

316
00:11:10,069 --> 00:11:08,240
norm's report most recently on the

317
00:11:13,190 --> 00:11:10,079
bottom of this slide

318
00:11:14,790 --> 00:11:13,200
a couple of nrc reports

319
00:11:16,389 --> 00:11:14,800
actually prior to the two that are on

320
00:11:18,389 --> 00:11:16,399
this that are listed here on this slide

321
00:11:20,470 --> 00:11:18,399
there was an nrc report done about a

322
00:11:21,430 --> 00:11:20,480
year earlier that pointed out how

323
00:11:22,949 --> 00:11:21,440
limited

324
00:11:25,430 --> 00:11:22,959
uh and how

325
00:11:27,910 --> 00:11:25,440
lacking nasa's technology investments

326
00:11:31,350 --> 00:11:27,920
were these two nrc reports with which

327
00:11:33,350 --> 00:11:31,360
both came out in uh 2009 uh one is

328
00:11:35,430 --> 00:11:33,360
called america's future in space and the

329
00:11:37,110 --> 00:11:35,440
other is a review of the nasa institut

330
00:11:39,750 --> 00:11:37,120
of advanced concepts

331
00:11:42,470 --> 00:11:39,760
both pointed out the importance of

332
00:11:44,550 --> 00:11:42,480
technology and innovation for nasa and

333
00:11:47,110 --> 00:11:44,560
in fact for the age for the nation

334
00:11:49,190 --> 00:11:47,120
through nasa uh in fact both both of

335
00:11:51,430 --> 00:11:49,200
these committees pointed out that nasa

336
00:11:54,150 --> 00:11:51,440
over the past decade had been

337
00:11:57,110 --> 00:11:54,160
effectively eating its seed corn uh

338
00:11:59,990 --> 00:11:57,120

eating its uh its investments in the

339
00:12:01,110 --> 00:12:00,000
future uh by being perhaps too mission

340
00:12:03,030 --> 00:12:01,120
focused

341
00:12:05,190 --> 00:12:03,040
uh at the top of this slide i also have

342
00:12:07,990 --> 00:12:05,200
listed the nasa authorization act of

343
00:12:09,509 --> 00:12:08,000
2008 where congress actually came to

344
00:12:10,790 --> 00:12:09,519
this conclusion

345
00:12:12,470 --> 00:12:10,800
and spoke

346
00:12:14,870 --> 00:12:12,480
very clearly about the importance of

347
00:12:17,350 --> 00:12:14,880
technology investment in nasa can we go

348
00:12:18,629 --> 00:12:17,360
to the next slide please

349
00:12:21,350 --> 00:12:18,639
the reading that i've been doing has

350
00:12:23,990 --> 00:12:21,360
also been fascinating this slide here

351
00:12:26,470 --> 00:12:24,000
illustrates a number of reports very

352
00:12:29,269 --> 00:12:26,480
high level very a number of presidential

353
00:12:31,350 --> 00:12:29,279
commissions uh several internal nasa

354
00:12:32,629 --> 00:12:31,360
studies dating all the way back if you

355
00:12:34,310 --> 00:12:32,639
look on the right

356
00:12:36,790 --> 00:12:34,320
uh to the apollo

357
00:12:40,150 --> 00:12:36,800
to the post apollo uh space task group

358
00:12:42,310 --> 00:12:40,160
in 1969 and then jumping into the 80s

359
00:12:44,470 --> 00:12:42,320
with a number of reports like pioneering

360
00:12:48,069 --> 00:12:44,480
the space frontier

361
00:12:50,470 --> 00:12:48,079
the sally ride report on leadership

362
00:12:52,710 --> 00:12:50,480
norm augustine's first report

363
00:12:54,629 --> 00:12:52,720

and then most recently as you move to

364
00:12:57,190 --> 00:12:54,639
the left uh some of the more recent

365
00:12:58,069 --> 00:12:57,200
reports including the latest augustine

366
00:13:00,150 --> 00:12:58,079
report

367
00:13:01,030 --> 00:13:00,160
uh what's fascinating to me are a couple

368
00:13:03,590 --> 00:13:01,040
points

369
00:13:05,990 --> 00:13:03,600
what i've done here is uh listed the

370
00:13:08,310 --> 00:13:06,000
technologies or the capabilities that

371
00:13:09,590 --> 00:13:08,320
are called out in these reports each of

372
00:13:11,670 --> 00:13:09,600
these reports goes through and

373
00:13:13,430 --> 00:13:11,680
identifies in great detail the

374
00:13:15,910 --> 00:13:13,440
capabilities that are lacking and the

375
00:13:17,990 --> 00:13:15,920
capabilities that need to be invested in

376
00:13:19,350 --> 00:13:18,000
for nasa to advance beyond low earth

377
00:13:21,590 --> 00:13:19,360
orbit

378
00:13:24,230 --> 00:13:21,600
they identify the capabilities and the

379
00:13:26,069 --> 00:13:24,240
technology investments needed for nasa

380
00:13:28,310 --> 00:13:26,079
to go to all the places that you heard

381
00:13:30,949 --> 00:13:28,320
the president speak about today and all

382
00:13:33,350 --> 00:13:30,959
the places that we in this room and as

383
00:13:35,030 --> 00:13:33,360
aerospace engineers or folks interested

384
00:13:36,550 --> 00:13:35,040
in our spacecraft program have been

385
00:13:38,870 --> 00:13:36,560
talking about

386
00:13:41,829 --> 00:13:38,880
really for decades and what you see here

387
00:13:43,670 --> 00:13:41,839
is a marvelous uh consistency among

388
00:13:45,829 --> 00:13:43,680

these reports

389
00:13:47,110 --> 00:13:45,839
that speaks to a couple of things to me

390
00:13:49,910 --> 00:13:47,120
first of all

391
00:13:52,470 --> 00:13:49,920
there are clearly some very well defined

392
00:13:54,069 --> 00:13:52,480
capability areas that nasa does need to

393
00:13:56,230 --> 00:13:54,079
invest in if we're going to go beyond

394
00:13:57,829 --> 00:13:56,240
low earth orbit a number of independent

395
00:13:59,110 --> 00:13:57,839
panels have all come to that same

396
00:14:00,949 --> 00:13:59,120
conclusion

397
00:14:03,110 --> 00:14:00,959
second of all and this is perhaps the

398
00:14:05,110 --> 00:14:03,120
disappointing part for me

399
00:14:06,949 --> 00:14:05,120
the technologies and capabilities that

400
00:14:10,710 --> 00:14:06,959
are called for in a report like

401
00:14:12,550 --> 00:14:10,720
pioneering the space frontier from 1986

402
00:14:14,629 --> 00:14:12,560
are actually quite similar to the

403
00:14:16,470 --> 00:14:14,639
technologies and capabilities called for

404
00:14:18,949 --> 00:14:16,480
in the augustine report of just this

405
00:14:21,990 --> 00:14:18,959
past year and that to me speaks to the

406
00:14:23,430 --> 00:14:22,000
lack of progress that we've made

407
00:14:26,550 --> 00:14:23,440
of these reports

408
00:14:28,230 --> 00:14:26,560
my favorite is actually uh sorry norm

409
00:14:31,670 --> 00:14:28,240
my favorite is actually pioneering the

410
00:14:34,870 --> 00:14:31,680
space frontier from 1986

411
00:14:36,710 --> 00:14:34,880
i would encourage any of you that are

412
00:14:38,949 --> 00:14:36,720
you know in college in high school that

413
00:14:40,870 --> 00:14:38,959

are maybe listening today

414
00:14:43,590 --> 00:14:40,880
or watching this to get a hold of that

415
00:14:45,670 --> 00:14:43,600
report it's really remarkable

416
00:14:48,629 --> 00:14:45,680
the way that report starts out

417
00:14:50,949 --> 00:14:48,639
is with technology the very first page

418
00:14:52,790 --> 00:14:50,959
talks about the importance of technology

419
00:14:54,949 --> 00:14:52,800
in fact what they do in that report is

420
00:14:57,670 --> 00:14:54,959
they start by talking about the way it

421
00:15:00,069 --> 00:14:57,680
was in this country in 1935

422
00:15:02,870 --> 00:15:00,079
1935 we were just beginning

423
00:15:04,790 --> 00:15:02,880
transcontinental air travel

424
00:15:07,189 --> 00:15:04,800
we were still actually delivering some

425
00:15:08,389 --> 00:15:07,199
mail not very much but some mail by pony

426
00:15:10,310 --> 00:15:08,399
express

427
00:15:12,150 --> 00:15:10,320
and it jumps forward 50 years into the

428
00:15:15,750 --> 00:15:12,160
future to the time that that report was

429
00:15:17,590 --> 00:15:15,760
written in 1985 and it talks about

430
00:15:19,430 --> 00:15:17,600
all the technologies many that have come

431
00:15:22,230 --> 00:15:19,440
about through our space program

432
00:15:24,870 --> 00:15:22,240
navigation technologies uh prediction of

433
00:15:27,509 --> 00:15:24,880
weather technologies uh and many other

434
00:15:29,749 --> 00:15:27,519
technologies that you know nobody in

435
00:15:31,110 --> 00:15:29,759
1935 would have been able to predict

436
00:15:33,509 --> 00:15:31,120
these are largely what i would call

437
00:15:35,430 --> 00:15:33,519
disruptive technologies some of them had

438
00:15:37,350 --> 00:15:35,440

plans and had road maps and were you

439
00:15:39,749 --> 00:15:37,360
know well funded others were things that

440
00:15:40,870 --> 00:15:39,759
just came about through largely through

441
00:15:42,710 --> 00:15:40,880
innovation

442
00:15:44,550 --> 00:15:42,720
the report then talks about the year

443
00:15:46,550 --> 00:15:44,560
2035

444
00:15:48,069 --> 00:15:46,560
and it says what are the technologies

445
00:15:51,670 --> 00:15:48,079
and what are the missions that will be

446
00:15:54,629 --> 00:15:51,680
available that will be possible in 2035

447
00:15:56,710 --> 00:15:54,639
and i think in 1985 that panel had a

448
00:15:58,310 --> 00:15:56,720
hard time identifying that just you know

449
00:16:01,189 --> 00:15:58,320
just just like it would be hard for

450
00:16:05,749 --> 00:16:01,199
someone from 1935 to predict the future

451
00:16:08,389 --> 00:16:05,759
of 1985. it's hard in 1985 or even today

452
00:16:09,990 --> 00:16:08,399
to predict the future of 2035

453
00:16:12,710 --> 00:16:10,000
and one last thing i want to say about

454
00:16:15,350 --> 00:16:12,720
2035 which i get from that report and

455
00:16:17,829 --> 00:16:15,360
also from the president's remarks today

456
00:16:19,189 --> 00:16:17,839
it's important to realize that

457
00:16:20,550 --> 00:16:19,199
the students in our nation's

458
00:16:22,790 --> 00:16:20,560
universities

459
00:16:26,150 --> 00:16:22,800
will be two-thirds of the way through

460
00:16:27,749 --> 00:16:26,160
their professional career in 2035. none

461
00:16:30,150 --> 00:16:27,759
of us at this table will be sitting at a

462
00:16:31,670 --> 00:16:30,160
table like this right there'll be others

463
00:16:33,030 --> 00:16:31,680

and they're in universities today and

464
00:16:34,310 --> 00:16:33,040
they'll be two-thirds of the way through

465
00:16:36,710 --> 00:16:34,320
their career

466
00:16:38,870 --> 00:16:36,720
my son is in ninth grade my daughters

467
00:16:40,870 --> 00:16:38,880
are in middle school they'll be halfway

468
00:16:42,470 --> 00:16:40,880
through their professional careers in

469
00:16:44,710 --> 00:16:42,480
2035.

470
00:16:46,389 --> 00:16:44,720
we need to invest in technologies not

471
00:16:48,550 --> 00:16:46,399
just for what it will bring to our space

472
00:16:50,949 --> 00:16:48,560
program today but we need to invest in

473
00:16:53,189 --> 00:16:50,959
technologies for the capabilities that

474
00:16:54,790 --> 00:16:53,199
it will give that generation to do the

475
00:16:56,470 --> 00:16:54,800
things that we would like to do and that

476
00:16:59,350 --> 00:16:56,480
are talked about in many of these

477
00:17:02,150 --> 00:16:59,360
reports next slide please

478
00:17:04,789 --> 00:17:02,160
uh this is one of my favorite slides

479
00:17:07,189 --> 00:17:04,799
it actually originated uh at the johnson

480
00:17:10,150 --> 00:17:07,199
space center many years ago uh and it

481
00:17:11,990 --> 00:17:10,160
shows in my view the value of technology

482
00:17:14,230 --> 00:17:12,000
which this is a slide which shows the

483
00:17:15,990 --> 00:17:14,240
mass requirements for a human mars

484
00:17:18,069 --> 00:17:16,000
mission which we heard a little bit

485
00:17:20,549 --> 00:17:18,079
about today and which we all know is

486
00:17:22,230 --> 00:17:20,559
perhaps the grand challenge for human

487
00:17:24,470 --> 00:17:22,240
exploration it's not something we're

488
00:17:25,990 --> 00:17:24,480

going to do soon but it is something we

489
00:17:28,309 --> 00:17:26,000
all want to do

490
00:17:30,870 --> 00:17:28,319
and what's plotted there is the mass

491
00:17:32,870 --> 00:17:30,880
required not on the surface of the earth

492
00:17:35,110 --> 00:17:32,880
to start that mission but the mass

493
00:17:37,190 --> 00:17:35,120
required in low earth orbit just to

494
00:17:39,270 --> 00:17:37,200
begin to send humans to mars and have

495
00:17:42,070 --> 00:17:39,280
the capability to return them home

496
00:17:45,270 --> 00:17:42,080
safely and what i think is so striking

497
00:17:47,510 --> 00:17:45,280
is the y-axis right it's plotted in

498
00:17:50,310 --> 00:17:47,520
units of international space station

499
00:17:53,110 --> 00:17:50,320
mass at core complete we're almost there

500
00:17:54,710 --> 00:17:53,120
we're almost at one today

501
00:17:57,029 --> 00:17:54,720
and what you see here is that without an

502
00:17:59,190 --> 00:17:57,039
investment in technology this mission

503
00:18:01,750 --> 00:17:59,200
would require something on the order of

504
00:18:04,070 --> 00:18:01,760
12 international space stations in low

505
00:18:05,830 --> 00:18:04,080
earth orbit

506
00:18:07,029 --> 00:18:05,840
to be honest that i don't believe that's

507
00:18:09,110 --> 00:18:07,039
feasible

508
00:18:11,430 --> 00:18:09,120
uh and in fact that's that's quite a

509
00:18:12,470 --> 00:18:11,440
hard sell in in washington i'm finding

510
00:18:15,110 --> 00:18:12,480
out

511
00:18:17,029 --> 00:18:15,120
but through technology investment and a

512
00:18:19,110 --> 00:18:17,039
number of the technologies required are

513
00:18:20,950 --> 00:18:19,120

listed on this slide you can see that we

514
00:18:23,750 --> 00:18:20,960
could bring those mass requirements down

515
00:18:25,830 --> 00:18:23,760
from 12 to something like two

516
00:18:27,190 --> 00:18:25,840
international space station masses now

517
00:18:28,470 --> 00:18:27,200
let me tell you that's still quite a

518
00:18:30,470 --> 00:18:28,480
challenge right that's not something

519
00:18:32,950 --> 00:18:30,480
that we can just snap our fingers and

520
00:18:34,070 --> 00:18:32,960
say well that's a done deal right it's

521
00:18:35,990 --> 00:18:34,080
taken us

522
00:18:38,549 --> 00:18:36,000
close to a decade to get to one

523
00:18:41,029 --> 00:18:38,559
international space station mass so two

524
00:18:42,710 --> 00:18:41,039
is still a grand challenge but it's in

525
00:18:44,630 --> 00:18:42,720
the realm of feasibility that we can

526
00:18:47,350 --> 00:18:44,640
actually talk about it

527
00:18:49,510 --> 00:18:47,360
and it's uh i think a very clear example

528
00:18:51,190 --> 00:18:49,520
of the kind of capabilities that would

529
00:18:53,830 --> 00:18:51,200
be enabled through an advanced

530
00:18:55,909 --> 00:18:53,840
technology program like the one that i

531
00:18:57,750 --> 00:18:55,919
and doug are going to talk about today

532
00:19:00,150 --> 00:18:57,760
next slide

533
00:19:01,990 --> 00:19:00,160
this is a summary of all of the nasa

534
00:19:04,549 --> 00:19:02,000
technology programs that we've been

535
00:19:06,230 --> 00:19:04,559
putting together it's an integra in that

536
00:19:08,150 --> 00:19:06,240
relate to human space flight i should

537
00:19:09,750 --> 00:19:08,160
say not those pertaining perhaps to

538
00:19:11,510 --> 00:19:09,760

aeronautics or the science mission

539
00:19:13,190 --> 00:19:11,520
directorate

540
00:19:15,350 --> 00:19:13,200
this is a summary of the technology

541
00:19:17,510 --> 00:19:15,360
programs both within the office of the

542
00:19:19,590 --> 00:19:17,520
chief technologist that i've been

543
00:19:21,430 --> 00:19:19,600
organizing and those that doug has been

544
00:19:22,789 --> 00:19:21,440
organizing in the exploration systems

545
00:19:24,230 --> 00:19:22,799
mission directorate

546
00:19:26,710 --> 00:19:24,240
and what i want to point out here is

547
00:19:29,430 --> 00:19:26,720
we're investing in a broad portfolio of

548
00:19:32,150 --> 00:19:29,440
technologies through a range of

549
00:19:35,029 --> 00:19:32,160
technology programs we actually need a

550
00:19:36,950 --> 00:19:35,039
diverse set of technology programs we

551
00:19:38,789 --> 00:19:36,960
need technologies that span if you look

552
00:19:40,549 --> 00:19:38,799
at the bar on the bottom

553
00:19:43,190 --> 00:19:40,559
we need technologies that span the

554
00:19:45,110 --> 00:19:43,200
entire technology readiness level all

555
00:19:47,350 --> 00:19:45,120
the way from paper studies of advanced

556
00:19:50,470 --> 00:19:47,360
visionary concepts

557
00:19:52,230 --> 00:19:50,480
through flight and flight testing of

558
00:19:54,549 --> 00:19:52,240
important technologies that will that

559
00:19:56,710 --> 00:19:54,559
will end up one day on missions

560
00:19:59,029 --> 00:19:56,720
we need technologies that are planned

561
00:20:00,950 --> 00:19:59,039
from the top down where we set high

562
00:20:03,190 --> 00:20:00,960
level goals for our human exploration

563
00:20:05,350 --> 00:20:03,200

enterprise we translate that goals into

564
00:20:07,750 --> 00:20:05,360
architectures and missions from missions

565
00:20:09,830 --> 00:20:07,760
to spacecraft and technologies and then

566
00:20:11,830 --> 00:20:09,840
we have a nice flow down that we can

567
00:20:14,630 --> 00:20:11,840
plan certain technologies and best

568
00:20:17,190 --> 00:20:14,640
investments but we also need disruptive

569
00:20:19,590 --> 00:20:17,200
technologies we need to invest in

570
00:20:22,390 --> 00:20:19,600
research and technology in a broad

571
00:20:23,350 --> 00:20:22,400
portfolio approach because we don't know

572
00:20:25,590 --> 00:20:23,360
every

573
00:20:27,909 --> 00:20:25,600
advance that's going to be made over the

574
00:20:30,710 --> 00:20:27,919
next couple decades just like the folks

575
00:20:32,870 --> 00:20:30,720
doing looking back at 1935 certainly

576
00:20:35,990 --> 00:20:32,880
couldn't predict every technology

577
00:20:39,190 --> 00:20:36,000
advance in particular you know this one

578
00:20:40,789 --> 00:20:39,200
uh the communicator from star trek right

579
00:20:42,789 --> 00:20:40,799
um you know that was a hard one to

580
00:20:45,270 --> 00:20:42,799
predict that would come to fruition the

581
00:20:46,710 --> 00:20:45,280
internet would be another great example

582
00:20:48,870 --> 00:20:46,720
for ed

583
00:20:51,990 --> 00:20:48,880
i didn't do it i know you didn't do it

584
00:20:54,470 --> 00:20:52,000
but still i use it yes we all use it so

585
00:20:56,390 --> 00:20:54,480
what we actually need in nasa is a range

586
00:20:58,710 --> 00:20:56,400
of programs that span

587
00:21:00,390 --> 00:20:58,720
all the way from concept to flight and

588
00:21:01,669 --> 00:21:00,400

through these programs that's what we're

589
00:21:02,870 --> 00:21:01,679
going to do we're going to take a number

590
00:21:04,070 --> 00:21:02,880
of the technologies that have been

591
00:21:06,390 --> 00:21:04,080
studied

592
00:21:08,950 --> 00:21:06,400
frankly for decades now and that have

593
00:21:09,909 --> 00:21:08,960
remained in the realm of paper study and

594
00:21:11,669 --> 00:21:09,919
we're going to take them into

595
00:21:13,990 --> 00:21:11,679
laboratories we're going to prove them

596
00:21:16,070 --> 00:21:14,000
out the prove the fundamental physics

597
00:21:18,230 --> 00:21:16,080
that are holding those technologies back

598
00:21:20,470 --> 00:21:18,240
take them into flight in a relevant

599
00:21:22,950 --> 00:21:20,480
environment and make them real so that

600
00:21:25,190 --> 00:21:22,960
they can be adopted by our missions next

601
00:21:29,350 --> 00:21:25,200
slide

602
00:21:31,590 --> 00:21:29,360
to bother you with all the details but

603
00:21:32,789 --> 00:21:31,600
there is uh there is one point that i do

604
00:21:35,669 --> 00:21:32,799
want to make here

605
00:21:37,029 --> 00:21:35,679
uh and the point really is is that

606
00:21:39,110 --> 00:21:37,039
in my view

607
00:21:40,710 --> 00:21:39,120
what the president's budget request

608
00:21:42,310 --> 00:21:40,720
really represents

609
00:21:45,430 --> 00:21:42,320
is a balancing

610
00:21:47,990 --> 00:21:45,440
of nasa's three core competencies these

611
00:21:51,270 --> 00:21:48,000
are long-standing competencies that nasa

612
00:21:53,430 --> 00:21:51,280
has had since its uh since its creation

613
00:21:55,270 --> 00:21:53,440

in 1958.

614
00:21:57,750 --> 00:21:55,280
these are the technologies one of

615
00:22:00,310 --> 00:21:57,760
research and technology which has long

616
00:22:03,430 --> 00:22:00,320
been an underpinning of nasa

617
00:22:05,830 --> 00:22:03,440
of space flight hardware development

618
00:22:07,190 --> 00:22:05,840
and of mission operations and when i

619
00:22:09,110 --> 00:22:07,200
look at what the president's putting

620
00:22:11,430 --> 00:22:09,120
forward and i hear the president speak

621
00:22:14,070 --> 00:22:11,440
about technology and innovation what i

622
00:22:16,549 --> 00:22:14,080
see is really a balancing of that where

623
00:22:19,350 --> 00:22:16,559
research and technology

624
00:22:21,750 --> 00:22:19,360
is brought back up into perhaps in my

625
00:22:23,270 --> 00:22:21,760
view at least the proper balance with

626
00:22:27,270 --> 00:22:23,280
those other two very important

627
00:22:29,029 --> 00:22:27,280
competencies of nasa

628
00:22:31,190 --> 00:22:29,039
by in doing so

629
00:22:34,390 --> 00:22:31,200
what what that will enable

630
00:22:36,549 --> 00:22:34,400
is uh new approaches to net to nasa's

631
00:22:39,029 --> 00:22:36,559
current mission set or entirely new

632
00:22:42,070 --> 00:22:39,039
missions altogether it will allow nasa

633
00:22:44,390 --> 00:22:42,080
to be part of the innovation engine uh

634
00:22:46,710 --> 00:22:44,400
within our within this country for nasa

635
00:22:49,029 --> 00:22:46,720
to sit if you will at par at the at the

636
00:22:51,510 --> 00:22:49,039
grown-ups table with the other research

637
00:22:54,149 --> 00:22:51,520
and development organizations uh that

638
00:22:56,870 --> 00:22:54,159

make a part of our federal government

639
00:22:58,710 --> 00:22:56,880
and it's for those reasons that i think

640
00:23:01,830 --> 00:22:58,720
frankly that it's the right approach can

641
00:23:05,350 --> 00:23:03,750
i want to take just a minute and talk

642
00:23:06,630 --> 00:23:05,360
about the space technology program

643
00:23:08,870 --> 00:23:06,640
because doug is going to go into much

644
00:23:11,270 --> 00:23:08,880
more detail into the exploration system

645
00:23:14,310 --> 00:23:11,280
mission directorate technology programs

646
00:23:16,149 --> 00:23:14,320
the space technology program was set up

647
00:23:19,430 --> 00:23:16,159
principally to be what i call a

648
00:23:21,110 --> 00:23:19,440
technology push program all right it's

649
00:23:23,510 --> 00:23:21,120
not a program where we're going to be

650
00:23:25,510 --> 00:23:23,520
investing in technologies for the next

651
00:23:27,750 --> 00:23:25,520
mission in fact if if there is a

652
00:23:30,149 --> 00:23:27,760
technology for the very next mission in

653
00:23:32,070 --> 00:23:30,159
my view that should be uh

654
00:23:34,070 --> 00:23:32,080
sponsored by one of the nasa mission

655
00:23:36,549 --> 00:23:34,080
directorates the space technology

656
00:23:38,789 --> 00:23:36,559
program is set up to be outside

657
00:23:41,710 --> 00:23:38,799
the mission directorates and to look at

658
00:23:44,149 --> 00:23:41,720
what i might call broadly applicable or

659
00:23:45,909 --> 00:23:44,159
non-mission-focused technologies

660
00:23:48,070 --> 00:23:45,919
these are technologies that could impact

661
00:23:51,269 --> 00:23:48,080
a wide variety of customers and could

662
00:23:53,669 --> 00:23:51,279
affect a large number of nasa missions

663
00:23:55,830 --> 00:23:53,679

missions of other government agencies

664
00:23:58,310 --> 00:23:55,840
and industry missions now the space

665
00:24:00,630 --> 00:23:58,320
technology program is set up with three

666
00:24:02,630 --> 00:24:00,640
major divisions we have an early stage

667
00:24:05,110 --> 00:24:02,640
innovation component and this is a

668
00:24:07,830 --> 00:24:05,120
component that has been lacking

669
00:24:09,510 --> 00:24:07,840
for a number of years in nasa

670
00:24:12,230 --> 00:24:09,520
and this component is going to go out

671
00:24:15,190 --> 00:24:12,240
and seek the best ideas wherever those

672
00:24:16,149 --> 00:24:15,200
ideas may be visionary concepts of our

673
00:24:18,789 --> 00:24:16,159
future

674
00:24:21,110 --> 00:24:18,799
the game changing technology program is

675
00:24:23,029 --> 00:24:21,120
going to take the some of those concepts

676
00:24:25,190 --> 00:24:23,039
and the and take that little bit of

677
00:24:27,110 --> 00:24:25,200
physics that's holding that concept back

678
00:24:28,789 --> 00:24:27,120
and prove it in flight

679
00:24:31,110 --> 00:24:28,799
and the final piece the cross-cutting

680
00:24:32,870 --> 00:24:31,120
capabilities program is going to take

681
00:24:35,430 --> 00:24:32,880
some of those technologies that we prove

682
00:24:37,510 --> 00:24:35,440
in the lab and prove them uh take them

683
00:24:39,830 --> 00:24:37,520
into flight in the relevant environment

684
00:24:44,070 --> 00:24:39,840
next slide please

685
00:24:46,710 --> 00:24:44,080
um it's this program is set up uh to

686
00:24:49,190 --> 00:24:46,720
to work in a competitive manner

687
00:24:50,789 --> 00:24:49,200
all of the almost all of the awards are

688
00:24:52,390 --> 00:24:50,799

going to be made competitively it's

689
00:24:56,310 --> 00:24:52,400
going to be an open process that

690
00:24:58,549 --> 00:24:56,320
involves industry academia nasa centers

691
00:25:00,149 --> 00:24:58,559
the other government labs

692
00:25:01,909 --> 00:25:00,159
as i mentioned it's a program that's

693
00:25:03,750 --> 00:25:01,919
looking for what you might call broadly

694
00:25:05,990 --> 00:25:03,760
applicable or non-mission focused

695
00:25:08,310 --> 00:25:06,000
technologies and i've listed a couple of

696
00:25:10,149 --> 00:25:08,320
those technologies on this slide now

697
00:25:13,029 --> 00:25:10,159
these by the way that list is is

698
00:25:15,269 --> 00:25:13,039
certainly not meant to be inclusive

699
00:25:16,950 --> 00:25:15,279
because the call many of the calls for

700
00:25:19,110 --> 00:25:16,960
this program are going to be wide open

701
00:25:21,269 --> 00:25:19,120
we're going to be looking for ideas uh

702
00:25:23,830 --> 00:25:21,279
from the community and we will find we

703
00:25:26,789 --> 00:25:23,840
will sponsor and fund those ideas really

704
00:25:29,029 --> 00:25:26,799
based entirely on the the merit of the

705
00:25:31,430 --> 00:25:29,039
research that's proposed

706
00:25:33,750 --> 00:25:31,440
next slide please

707
00:25:35,510 --> 00:25:33,760
so i'd like to close with just a couple

708
00:25:37,350 --> 00:25:35,520
of of thoughts and they're listed on

709
00:25:38,149 --> 00:25:37,360
this summary slide

710
00:25:39,909 --> 00:25:38,159
one

711
00:25:42,710 --> 00:25:39,919
there have been a consistent set of

712
00:25:44,789 --> 00:25:42,720
recommendations made both by congress

713
00:25:47,269 --> 00:25:44,799

and a number of external panels that

714
00:25:48,789 --> 00:25:47,279
have driven nasa to the development of

715
00:25:51,269 --> 00:25:48,799
the technology approach that we're

716
00:25:53,750 --> 00:25:51,279
putting forward today

717
00:25:56,230 --> 00:25:53,760
two our planning process is really

718
00:25:57,190 --> 00:25:56,240
moving rapidly and actually it's in my

719
00:25:59,350 --> 00:25:57,200
view

720
00:26:01,350 --> 00:25:59,360
it's going fairly well we're putting a

721
00:26:02,630 --> 00:26:01,360
lot of detail into these technology

722
00:26:04,470 --> 00:26:02,640
programs and we're going to be ready to

723
00:26:06,310 --> 00:26:04,480
roll those out at the beginning of the

724
00:26:08,230 --> 00:26:06,320
fiscal year

725
00:26:10,149 --> 00:26:08,240
three through these programs both the

726
00:26:12,149 --> 00:26:10,159
space technology program and the ones

727
00:26:13,990 --> 00:26:12,159
that doug will describe in a moment

728
00:26:15,909 --> 00:26:14,000
we're going to develop new technologies

729
00:26:18,310 --> 00:26:15,919
new capabilities that are going to allow

730
00:26:19,830 --> 00:26:18,320
nasa to do an entirely set of missions

731
00:26:21,830 --> 00:26:19,840
we're going to use these capabilities to

732
00:26:23,750 --> 00:26:21,840
get humans into deep space we're going

733
00:26:25,750 --> 00:26:23,760
to use these capabilities to improve our

734
00:26:27,830 --> 00:26:25,760
robotic explorers we're going to use

735
00:26:31,510 --> 00:26:27,840
these capabilities to improve our

736
00:26:33,510 --> 00:26:31,520
knowledge and understanding of the earth

737
00:26:36,310 --> 00:26:33,520
and then finally here

738
00:26:38,470 --> 00:26:36,320

i want to definitely point out that nasa

739
00:26:40,950 --> 00:26:38,480
focused on innovation and technology is

740
00:26:43,190 --> 00:26:40,960
important for the agency but it's also

741
00:26:45,830 --> 00:26:43,200
important for the nation

742
00:26:48,310 --> 00:26:45,840
nasa serves perhaps a unique role

743
00:26:51,029 --> 00:26:48,320
to inspire and motivate

744
00:26:53,750 --> 00:26:51,039
our young people into

745
00:26:56,470 --> 00:26:53,760
educational and career paths in science

746
00:26:58,950 --> 00:26:56,480
technology engineering and mathematics i

747
00:27:01,510 --> 00:26:58,960
know that firsthand i'm a product of

748
00:27:04,470 --> 00:27:01,520
nasa's educational programs

749
00:27:06,950 --> 00:27:04,480
nasa got me hooked at a young age

750
00:27:09,190 --> 00:27:06,960
through a summer program at the langley

751
00:27:11,029 --> 00:27:09,200
research center and they actually kept

752
00:27:12,630 --> 00:27:11,039
me involved in graduate school through

753
00:27:14,630 --> 00:27:12,640
the office of education and some of

754
00:27:16,549 --> 00:27:14,640
their programs these are very these

755
00:27:18,230 --> 00:27:16,559
programs are very important to me

756
00:27:20,230 --> 00:27:18,240
you know they're also very important to

757
00:27:21,909 --> 00:27:20,240
our administrator charlie bolden and

758
00:27:23,750 --> 00:27:21,919
they're also very important to this

759
00:27:27,190 --> 00:27:23,760
nation it is a unique

760
00:27:28,950 --> 00:27:27,200
uh capability that nasa can provide

761
00:27:29,990 --> 00:27:28,960
in addition i also want to point out

762
00:27:32,310 --> 00:27:30,000
that

763
00:27:34,549 --> 00:27:32,320

the nasa centers are full of

764
00:27:36,470 --> 00:27:34,559
intellectual capital and that

765
00:27:38,389 --> 00:27:36,480
intellectual capital while it's working

766
00:27:40,389 --> 00:27:38,399
on some of the greatest challenges in

767
00:27:43,029 --> 00:27:40,399
human space flight or in exploring our

768
00:27:44,789 --> 00:27:43,039
solar system that same capital can also

769
00:27:47,590 --> 00:27:44,799
be applied to

770
00:27:50,630 --> 00:27:47,600
major national needs here on the earth

771
00:27:53,990 --> 00:27:50,640
major societal challenges like energy

772
00:27:56,149 --> 00:27:54,000
prediction of disasters weather

773
00:27:58,389 --> 00:27:56,159
national security these are all things

774
00:28:00,230 --> 00:27:58,399
that integrate and cross right into our

775
00:28:02,149 --> 00:28:00,240
space program and so that is certainly

776
00:28:03,269 --> 00:28:02,159
another area that these programs can

777
00:28:06,389 --> 00:28:03,279
contribute

778
00:28:13,029 --> 00:28:08,950
bobby thank you very much doug your turn

779
00:28:15,510 --> 00:28:13,039
yes sir while my church is coming up

780
00:28:17,430 --> 00:28:15,520
i just outline

781
00:28:20,389 --> 00:28:17,440
our organization has a current

782
00:28:21,669 --> 00:28:20,399
constellation program as well as uh in

783
00:28:24,549 --> 00:28:21,679
the new budget

784
00:28:27,590 --> 00:28:24,559
request we have the commercial crew

785
00:28:29,990 --> 00:28:27,600
efforts uh and program that that will be

786
00:28:34,230 --> 00:28:30,000
getting started so i wanted to mention

787
00:28:36,950 --> 00:28:34,240
that we also have a very robust

788
00:28:39,350 --> 00:28:36,960

technology portfolio and demonstration

789
00:28:41,669 --> 00:28:39,360
effort and research

790
00:28:43,750 --> 00:28:41,679
effort that we'll be going forward with

791
00:28:44,710 --> 00:28:43,760
i'm going to concentrate today and focus

792
00:28:47,269 --> 00:28:44,720
on

793
00:28:50,630 --> 00:28:47,279
what we're doing in in the area of

794
00:28:53,269 --> 00:28:50,640
research and technology and i think

795
00:28:55,510 --> 00:28:53,279
the things that bobby has talked about

796
00:28:57,269 --> 00:28:55,520
are are

797
00:28:59,350 --> 00:28:57,279
overarching and

798
00:29:01,190 --> 00:28:59,360
directly apply to to the things i'll

799
00:29:02,950 --> 00:29:01,200
talk with you about

800
00:29:05,350 --> 00:29:02,960
actually we will be working closely

801
00:29:07,510 --> 00:29:05,360
together to make sure we coordinate the

802
00:29:09,430 --> 00:29:07,520
the overarching aspects of his

803
00:29:11,590 --> 00:29:09,440
particular responsibilities as well as

804
00:29:14,549 --> 00:29:11,600
the more focused efforts that we'll have

805
00:29:16,870 --> 00:29:14,559
in exploration technologies a number of

806
00:29:19,669 --> 00:29:16,880
the of the emerging technologies that

807
00:29:23,110 --> 00:29:19,679
he'll he will be uh working to develop

808
00:29:24,549 --> 00:29:23,120
will find on wraps um into our programs

809
00:29:27,350 --> 00:29:24,559
in technology so that will be an

810
00:29:28,870 --> 00:29:27,360
important facet of our relationship at

811
00:29:31,669 --> 00:29:28,880
nasa in the future

812
00:29:33,029 --> 00:29:31,679
um let's see where we are okay so if we

813
00:29:35,990 --> 00:29:33,039

go to chart two

814
00:29:38,549 --> 00:29:36,000
um what i wanted to do is is pull all of

815
00:29:40,870 --> 00:29:38,559
this together in a way to visualize uh

816
00:29:43,430 --> 00:29:40,880
what we're talking about uh if we look

817
00:29:45,430 --> 00:29:43,440
at if we if we look at uh the

818
00:29:47,350 --> 00:29:45,440
destinations that are possible for human

819
00:29:48,389 --> 00:29:47,360
space flight

820
00:29:50,789 --> 00:29:48,399
there there are a number of

821
00:29:54,070 --> 00:29:50,799
possibilities with with our grandest

822
00:29:55,350 --> 00:29:54,080
vision ultimately sending people to mars

823
00:29:56,149 --> 00:29:55,360
and

824
00:29:57,990 --> 00:29:56,159
we

825
00:30:00,710 --> 00:29:58,000
you've heard about the various

826
00:30:03,029 --> 00:30:00,720
destinations in in the discussions

827
00:30:05,510 --> 00:30:03,039
i do want to say that it is important to

828
00:30:06,470 --> 00:30:05,520
understand what it takes to go do these

829
00:30:09,269 --> 00:30:06,480
missions

830
00:30:12,070 --> 00:30:09,279
just yesterday we kicked off

831
00:30:13,110 --> 00:30:12,080
the human exploration framework

832
00:30:18,230 --> 00:30:13,120
team

833
00:30:20,710 --> 00:30:18,240
develop the the design reference

834
00:30:22,950 --> 00:30:20,720
missions if you will for going to these

835
00:30:24,789 --> 00:30:22,960
various destinations so that we can we

836
00:30:25,510 --> 00:30:24,799
can work into them

837
00:30:28,070 --> 00:30:25,520
the

838
00:30:30,310 --> 00:30:28,080

impacts or leverage that you get from

839
00:30:31,669 --> 00:30:30,320
various technologies as you go look at

840
00:30:35,669 --> 00:30:31,679
these

841
00:30:37,750 --> 00:30:35,679
learn that there are certain

842
00:30:39,590 --> 00:30:37,760
capabilities that it takes to send

843
00:30:42,070 --> 00:30:39,600
people there and and many of them are

844
00:30:43,990 --> 00:30:42,080
common between the various destinations

845
00:30:46,789 --> 00:30:44,000
so it's important to understand that so

846
00:30:49,669 --> 00:30:46,799
that we in the future plan our programs

847
00:30:52,070 --> 00:30:49,679
in a way that that

848
00:30:55,590 --> 00:30:52,080
get us the most uh

849
00:30:56,630 --> 00:30:55,600
capability and versatility in in

850
00:31:00,950 --> 00:30:56,640
in our

851
00:31:03,190 --> 00:31:00,960
infrastructure

852
00:31:05,509 --> 00:31:03,200
all of these lead lead you to

853
00:31:07,590 --> 00:31:05,519
a set of capabilities and

854
00:31:09,669 --> 00:31:07,600
and technology and research that it

855
00:31:12,789 --> 00:31:09,679
takes to go do these missions and you

856
00:31:14,870 --> 00:31:12,799
find that uh and and bobby had the

857
00:31:17,029 --> 00:31:14,880
perfect chart which is one that we

858
00:31:19,110 --> 00:31:17,039
originally did a long time ago but shows

859
00:31:21,669 --> 00:31:19,120
the leverage of the various technologies

860
00:31:23,909 --> 00:31:21,679
that it takes to go to mars and you

861
00:31:25,909 --> 00:31:23,919
absolutely probably cannot do it unless

862
00:31:27,990 --> 00:31:25,919
we go invest in these technologies

863
00:31:29,909 --> 00:31:28,000

they're absolutely essential

864
00:31:31,590 --> 00:31:29,919
there's a list of them they've been

865
00:31:35,190 --> 00:31:31,600
repeated in reports actually i've been

866
00:31:37,350 --> 00:31:35,200
on a couple of those reports myself

867
00:31:38,230 --> 00:31:37,360
20 over the last 20 years

868
00:31:42,389 --> 00:31:38,240
and

869
00:31:43,990 --> 00:31:42,399
there are areas that we have to invest

870
00:31:46,149 --> 00:31:44,000
in if we're going to go beyond places

871
00:31:47,750 --> 00:31:46,159
we've been before

872
00:31:49,269 --> 00:31:47,760
in terms of

873
00:31:50,789 --> 00:31:49,279
the little green boxes at the bottom of

874
00:31:52,070 --> 00:31:50,799
the chart talk about breakthrough

875
00:31:54,230 --> 00:31:52,080
technologies these are the kind of

876
00:31:56,549 --> 00:31:54,240
things that will come out of

877
00:31:58,389 --> 00:31:56,559
what the work that bobby does that leads

878
00:32:02,149 --> 00:31:58,399
into

879
00:32:03,990 --> 00:32:02,159
new possibilities and on-ramps to to uh

880
00:32:06,389 --> 00:32:04,000
for certain technologies that will be

881
00:32:08,789 --> 00:32:06,399
critical to us as well and we'll find

882
00:32:11,750 --> 00:32:08,799
leverage in in making these destinations

883
00:32:14,389 --> 00:32:11,760
so this i think kind of pulls together

884
00:32:16,549 --> 00:32:14,399
um the thinking that it takes to to

885
00:32:18,149 --> 00:32:16,559
understand um what the critical

886
00:32:21,669 --> 00:32:18,159
technologies are

887
00:32:24,070 --> 00:32:21,679
if we can go to um slide three

888
00:32:25,909 --> 00:32:24,080

uh this this chart lays out the various

889
00:32:27,269 --> 00:32:25,919
technology areas that are that are in

890
00:32:29,350 --> 00:32:27,279
the in

891
00:32:31,509 --> 00:32:29,360
the exploration

892
00:32:33,029 --> 00:32:31,519
president's budget request it starts

893
00:32:35,830 --> 00:32:33,039
with exploration technology and

894
00:32:38,389 --> 00:32:35,840
demonstrations which includes flagship

895
00:32:40,710 --> 00:32:38,399
technology demonstration program it

896
00:32:43,990 --> 00:32:40,720
includes enabling technology

897
00:32:45,110 --> 00:32:44,000
development and demonstration program

898
00:32:46,549 --> 00:32:45,120
these are

899
00:32:48,549 --> 00:32:46,559
two different areas that i'll talk more

900
00:32:49,669 --> 00:32:48,559
about it also includes heavy lift

901
00:32:52,549 --> 00:32:49,679
propulsion

902
00:32:54,549 --> 00:32:52,559
technology including first stage engine

903
00:32:56,710 --> 00:32:54,559
development it includes

904
00:32:58,710 --> 00:32:56,720
upper stage or in space engine

905
00:33:00,789 --> 00:32:58,720
demonstration and it includes

906
00:33:03,990 --> 00:33:00,799
foundational propulsion research these

907
00:33:06,789 --> 00:33:04,000
are areas where there are

908
00:33:09,990 --> 00:33:06,799
in very enhancing technologies that need

909
00:33:11,830 --> 00:33:10,000
to be developed in order to make our our

910
00:33:14,950 --> 00:33:11,840
launch vehicles more efficient and

911
00:33:17,190 --> 00:33:15,830
and

912
00:33:21,269 --> 00:33:17,200
so

913
00:33:22,630 --> 00:33:21,279

robotic missions i won't be talking

914
00:33:24,870 --> 00:33:22,640
about that because it's been talked in

915
00:33:26,950 --> 00:33:24,880
another session but it does factor into

916
00:33:28,710 --> 00:33:26,960
this whole approach in that

917
00:33:31,110 --> 00:33:28,720
these robotic missions that we'll be

918
00:33:32,549 --> 00:33:31,120
planning in in our programs

919
00:33:34,710 --> 00:33:32,559
will be

920
00:33:36,470 --> 00:33:34,720
the the opportunity to go learn about

921
00:33:38,870 --> 00:33:36,480
the destinations that we'll send people

922
00:33:39,830 --> 00:33:38,880
to but it will be also be able we'll be

923
00:33:42,950 --> 00:33:39,840
able to

924
00:33:45,990 --> 00:33:42,960
demonstrate the technologies that

925
00:33:48,230 --> 00:33:46,000
are essential uh for human spaceflight

926
00:33:50,310 --> 00:33:48,240
to to the destinations and we'll be

927
00:33:52,549 --> 00:33:50,320
testing in the relevant environment so

928
00:33:53,669 --> 00:33:52,559
these will be focused on that that kind

929
00:33:56,630 --> 00:33:53,679
of knowledge

930
00:33:59,269 --> 00:33:56,640
we also have the human research program

931
00:34:01,830 --> 00:33:59,279
which has increased funding all of these

932
00:34:04,950 --> 00:34:01,840
will be robust areas where we will be

933
00:34:07,669 --> 00:34:04,960
investing in the in research

934
00:34:10,310 --> 00:34:07,679
that it takes to send people into space

935
00:34:12,310 --> 00:34:10,320
if we go to uh the next chart

936
00:34:14,869 --> 00:34:12,320
we get into more of the exploration

937
00:34:17,030 --> 00:34:14,879
technology development demonstration

938
00:34:19,510 --> 00:34:17,040

these are many of the of the same

939
00:34:21,829 --> 00:34:19,520
technologies that are listed

940
00:34:24,629 --> 00:34:21,839
in on the charts that bobby showed that

941
00:34:26,710 --> 00:34:24,639
have been identified over a period of

942
00:34:28,869 --> 00:34:26,720
time that are that are incredibly

943
00:34:31,109 --> 00:34:28,879
important to us and have high leverage

944
00:34:32,550 --> 00:34:31,119
and actually are essential in terms of

945
00:34:34,869 --> 00:34:32,560
going beyond

946
00:34:37,829 --> 00:34:34,879
the places we've been before

947
00:34:40,230 --> 00:34:37,839
um advanced in-space propulsion is a big

948
00:34:42,790 --> 00:34:40,240
driver uh getting to high-efficiency

949
00:34:44,950 --> 00:34:42,800
in-space engines is critical in getting

950
00:34:47,109 --> 00:34:44,960
the mass down in low-earth orbit so that

951
00:34:49,909 --> 00:34:47,119
in terms of fuel that it takes to get to

952
00:34:50,869 --> 00:34:49,919
these uh destinations particularly the

953
00:34:53,510 --> 00:34:50,879
long

954
00:34:55,750 --> 00:34:53,520
duration flights to places like mars

955
00:34:57,430 --> 00:34:55,760
autonomous systems and avian avionics

956
00:34:59,030 --> 00:34:57,440
will help us to operate more efficiently

957
00:35:00,710 --> 00:34:59,040
in space

958
00:35:04,069 --> 00:35:00,720
cryogenic propellant storage and

959
00:35:07,829 --> 00:35:04,079
transfer is one that we will need

960
00:35:09,510 --> 00:35:07,839
as we as as we work in in space with

961
00:35:10,870 --> 00:35:09,520
large amounts of fuel to go to long

962
00:35:13,430 --> 00:35:10,880
death

963
00:35:16,069 --> 00:35:13,440

destinations far from here uh and not

964
00:35:17,670 --> 00:35:16,079
have the boil off that occurs in in some

965
00:35:19,750 --> 00:35:17,680
of our propellants

966
00:35:21,430 --> 00:35:19,760
entry descent and landing is a critical

967
00:35:24,950 --> 00:35:21,440
technology especially with the large

968
00:35:28,870 --> 00:35:24,960
masses that it takes to send people to

969
00:35:33,349 --> 00:35:31,589
developing um precision landing and

970
00:35:36,470 --> 00:35:33,359
hazard avoidance so that we can enter

971
00:35:38,550 --> 00:35:36,480
land in very interesting locations in on

972
00:35:41,990 --> 00:35:38,560
on other planetary bodies is is

973
00:35:44,390 --> 00:35:42,000
important to us as well as the the um

974
00:35:45,750 --> 00:35:44,400
the aerodynamic

975
00:35:48,870 --> 00:35:45,760
braking

976
00:35:50,230 --> 00:35:48,880
technologies that we'll need to to enter

977
00:35:52,310 --> 00:35:50,240
atmospheres

978
00:35:53,670 --> 00:35:52,320
eva technology will be important because

979
00:35:55,270 --> 00:35:53,680
our suits have to get lighter if we're

980
00:35:57,270 --> 00:35:55,280
going to other planets

981
00:35:59,349 --> 00:35:57,280
surface suits can't be as heavy as our

982
00:36:01,349 --> 00:35:59,359
current spacesuits are

983
00:36:02,950 --> 00:36:01,359
high efficiency power systems are also

984
00:36:05,349 --> 00:36:02,960
important in order to get down mass in

985
00:36:07,750 --> 00:36:05,359
order to be able to actually have enough

986
00:36:10,310 --> 00:36:07,760
power in a place like mars with reduced

987
00:36:14,230 --> 00:36:10,320
sunlight since it's farther out

988
00:36:18,550 --> 00:36:17,030

human robotic systems robots and humans

989
00:36:21,030 --> 00:36:18,560
working together

990
00:36:24,870 --> 00:36:21,040
expand our capabilities when we send

991
00:36:27,030 --> 00:36:24,880
people to achieve the science the goals

992
00:36:29,030 --> 00:36:27,040
and exploration goals that we'll have so

993
00:36:31,589 --> 00:36:29,040
that we make people more productive when

994
00:36:34,790 --> 00:36:31,599
they get to these locations and so in

995
00:36:36,230 --> 00:36:34,800
situ resource utilization is the use of

996
00:36:37,670 --> 00:36:36,240
indigenous

997
00:36:41,190 --> 00:36:37,680
chemicals or

998
00:36:43,349 --> 00:36:41,200
or minerals at a location like mars

999
00:36:44,630 --> 00:36:43,359
to develop your own fuel to make the

1000
00:36:46,470 --> 00:36:44,640
trip back so that you don't have to

1001
00:36:48,230 --> 00:36:46,480
carry all that fuel with you life

1002
00:36:49,990 --> 00:36:48,240
support and habitation systems it's

1003
00:36:51,750 --> 00:36:50,000
important to get to closed-loop life

1004
00:36:54,710 --> 00:36:51,760
support so that we don't have to carry

1005
00:36:57,589 --> 00:36:54,720
all the logistics and and resupply in in

1006
00:37:00,150 --> 00:36:57,599
terms of of water and air

1007
00:37:02,470 --> 00:37:00,160
light lightweight spacecraft materials

1008
00:37:04,710 --> 00:37:02,480
and structures are are incredibly

1009
00:37:05,990 --> 00:37:04,720
important to us in terms of getting mass

1010
00:37:08,230 --> 00:37:06,000
down

1011
00:37:12,150 --> 00:37:08,240
all of these we plan to have

1012
00:37:13,990 --> 00:37:12,160
demonstrations for over time where uh we

1013
00:37:16,069 --> 00:37:14,000

will have different demos on different

1014
00:37:17,829 --> 00:37:16,079
capabilities whether they're in in this

1015
00:37:18,790 --> 00:37:17,839
arena or in the flagship missions in

1016
00:37:21,510 --> 00:37:18,800
order to

1017
00:37:23,589 --> 00:37:21,520
uh demonstrate that and and reach the

1018
00:37:26,069 --> 00:37:23,599
higher readiness levels that we need to

1019
00:37:28,150 --> 00:37:26,079
go into development on systems

1020
00:37:31,510 --> 00:37:28,160
we go to the next chart uh this

1021
00:37:33,910 --> 00:37:31,520
addresses the human research program uh

1022
00:37:35,990 --> 00:37:33,920
i hope

1023
00:37:37,270 --> 00:37:36,000
not being able to see it as a as a

1024
00:37:38,550 --> 00:37:37,280
little challenge

1025
00:37:40,230 --> 00:37:38,560
biomedical

1026
00:37:44,069 --> 00:37:40,240
technologies are important we need to

1027
00:37:45,750 --> 00:37:44,079
keep our astronauts safe as we as we

1028
00:37:47,190 --> 00:37:45,760
get into

1029
00:37:48,950 --> 00:37:47,200
these various missions there are

1030
00:37:50,390 --> 00:37:48,960
different hazards that they have to deal

1031
00:37:52,950 --> 00:37:50,400
with and we have to keep them safe in

1032
00:37:55,589 --> 00:37:52,960
order to achieve the missions

1033
00:37:58,069 --> 00:37:55,599
we will be doing a a fair amount of this

1034
00:38:00,550 --> 00:37:58,079
on space station it is it is

1035
00:38:03,510 --> 00:38:00,560
a critical resource for long-duration

1036
00:38:05,990 --> 00:38:03,520
missions in microgravity space radiation

1037
00:38:07,430 --> 00:38:06,000
research is is incredibly important to

1038
00:38:09,670 --> 00:38:07,440

us as we

1039
00:38:11,589 --> 00:38:09,680
uh we'll be testing uh

1040
00:38:14,630 --> 00:38:11,599
understanding the effects on human cells

1041
00:38:15,750 --> 00:38:14,640
of inter inter uh intergalactic cosmic

1042
00:38:21,349 --> 00:38:15,760
radiation

1043
00:38:23,030 --> 00:38:21,359
beyond our uh that that affects our

1044
00:38:25,510 --> 00:38:23,040
astronauts once they get outside the

1045
00:38:28,069 --> 00:38:25,520
earth's magnetic field it's not as

1046
00:38:29,589 --> 00:38:28,079
much a danger in space station but once

1047
00:38:31,990 --> 00:38:29,599
we go on these long missions we'll be

1048
00:38:34,390 --> 00:38:32,000
out in it and we don't yet understand

1049
00:38:36,150 --> 00:38:34,400
that totally what the effects are of

1050
00:38:38,550 --> 00:38:36,160
that radiation so that could be a long

1051
00:38:41,109 --> 00:38:38,560
pole for us for long duration missions

1052
00:38:44,069 --> 00:38:41,119
behavioral health research is important

1053
00:38:45,990 --> 00:38:44,079
from the standpoint of understanding

1054
00:38:47,990 --> 00:38:46,000
crew interactions over long periods of

1055
00:38:49,349 --> 00:38:48,000
times on these long trips

1056
00:38:51,109 --> 00:38:49,359
um

1057
00:38:53,510 --> 00:38:51,119
space station utilization as i mentioned

1058
00:38:54,950 --> 00:38:53,520
will be critical and and our investment

1059
00:38:57,430 --> 00:38:54,960
will be increased there over what we

1060
00:38:59,109 --> 00:38:57,440
have been planning um

1061
00:39:01,910 --> 00:38:59,119
we will we'll be learning more about the

1062
00:39:03,030 --> 00:39:01,920
human risk associated with microgravity

1063
00:39:05,670 --> 00:39:03,040

that will

1064
00:39:07,190 --> 00:39:05,680
they will experience both in orbit

1065
00:39:09,349 --> 00:39:07,200
around the earth but also on long

1066
00:39:10,390 --> 00:39:09,359
duration missions we'll be adding new

1067
00:39:13,430 --> 00:39:10,400
content

1068
00:39:16,310 --> 00:39:13,440
to that research through a research

1069
00:39:18,470 --> 00:39:16,320
announcements that will add to

1070
00:39:20,470 --> 00:39:18,480
the things that we'll learn there

1071
00:39:23,109 --> 00:39:20,480
if we go to the next chart

1072
00:39:25,589 --> 00:39:23,119
next i'll move into an area

1073
00:39:27,829 --> 00:39:25,599
that is is

1074
00:39:29,910 --> 00:39:27,839
very very exciting for us which is the

1075
00:39:33,750 --> 00:39:29,920
flagship technology mission

1076
00:39:35,829 --> 00:39:33,760
uh area where we will be testing uh at

1077
00:39:38,230 --> 00:39:35,839
larger scales and gradually larger

1078
00:39:40,069 --> 00:39:38,240
scales different capabilities that are

1079
00:39:43,430 --> 00:39:40,079
essential to us

1080
00:39:46,069 --> 00:39:43,440
some of what our teams have mapped out

1081
00:39:47,589 --> 00:39:46,079
in the last few weeks are are listed

1082
00:39:49,589 --> 00:39:47,599
across

1083
00:39:51,190 --> 00:39:49,599
on the left-hand column which are

1084
00:39:53,910 --> 00:39:51,200
propellant transfer and storage

1085
00:39:56,230 --> 00:39:53,920
lightweight inflatable modules

1086
00:39:58,790 --> 00:39:56,240
automated rendezvous and docking

1087
00:40:00,630 --> 00:39:58,800
closed-loop life support aero capture

1088
00:40:02,550 --> 00:40:00,640

and entry descent and landing

1089
00:40:04,630 --> 00:40:02,560
advanced space propulsion

1090
00:40:06,390 --> 00:40:04,640
and we have a number of missions across

1091
00:40:07,910 --> 00:40:06,400
the top which are candidate missions at

1092
00:40:09,750 --> 00:40:07,920
this point but we have we've put

1093
00:40:11,990 --> 00:40:09,760
together some ideas to to get the

1094
00:40:14,230 --> 00:40:12,000
existence proof what what is it

1095
00:40:17,670 --> 00:40:14,240
that we can accomplish within the in the

1096
00:40:20,870 --> 00:40:17,680
fy 11 budget request and so you see x is

1097
00:40:23,349 --> 00:40:20,880
on uh for multiple x's on certain of

1098
00:40:26,470 --> 00:40:23,359
these missions where we can accomplish

1099
00:40:29,430 --> 00:40:26,480
uh objectives for uh some of these

1100
00:40:30,710 --> 00:40:29,440
technology areas on on in in a single

1101
00:40:32,630 --> 00:40:30,720
mission

1102
00:40:34,790 --> 00:40:32,640
if we go to the next chart uh this is an

1103
00:40:38,950 --> 00:40:34,800
example uh as we

1104
00:40:42,230 --> 00:40:38,960
as we put together um our advanced space

1105
00:40:44,630 --> 00:40:42,240
propulsion we can we can start with

1106
00:40:46,790 --> 00:40:44,640
existing capabilities the kind of

1107
00:40:48,790 --> 00:40:46,800
capabilities that have been developed in

1108
00:40:51,430 --> 00:40:48,800
ion engines for

1109
00:40:53,750 --> 00:40:51,440
missions like deep space 1 and dawn

1110
00:40:56,790 --> 00:40:53,760
and begin to do some of our

1111
00:40:57,910 --> 00:40:56,800
begin with a bus basically that can do

1112
00:40:59,750 --> 00:40:57,920
multiple

1113
00:41:02,390 --> 00:40:59,760

missions

1114
00:41:04,790 --> 00:41:02,400
for us in in these technology areas that

1115
00:41:07,270 --> 00:41:04,800
will gradually increase in capability uh

1116
00:41:11,910 --> 00:41:07,280
building to higher megawatt or higher

1117
00:41:16,069 --> 00:41:13,829
in space power capabilities whether it's

1118
00:41:18,710 --> 00:41:16,079
solar power or phishing power

1119
00:41:20,550 --> 00:41:18,720
as we get to ultimately

1120
00:41:23,270 --> 00:41:20,560
the high efficiency propulsion

1121
00:41:26,790 --> 00:41:23,280
capabilities whether it's plasma engines

1122
00:41:29,109 --> 00:41:26,800
or nuclear thermal propulsion

1123
00:41:31,589 --> 00:41:29,119
in the next chart please this one talks

1124
00:41:32,950 --> 00:41:31,599
about in-space propellant storage and

1125
00:41:35,349 --> 00:41:32,960
transfer

1126
00:41:37,990 --> 00:41:35,359
these are some ideas on on how we might

1127
00:41:41,190 --> 00:41:38,000
start that with with one of these buses

1128
00:41:45,109 --> 00:41:41,200
that i mentioned earlier uh having a six

1129
00:41:49,270 --> 00:41:45,119
month stay with cryo storage

1130
00:41:51,910 --> 00:41:49,280
working through and and employing

1131
00:41:55,670 --> 00:41:51,920
the technology to to

1132
00:41:57,349 --> 00:41:55,680
to in cryo cooling and and maintaining

1133
00:41:59,829 --> 00:41:57,359
the cryo

1134
00:42:01,670 --> 00:41:59,839
fuels in space also

1135
00:42:03,910 --> 00:42:01,680
the first step would probably be to

1136
00:42:07,109 --> 00:42:03,920
transfer some of this fuel on on board a

1137
00:42:08,309 --> 00:42:07,119
single spacecraft the step beyond that

1138
00:42:10,870 --> 00:42:08,319

could be

1139
00:42:13,270 --> 00:42:10,880
multiple spacecraft where we're testing

1140
00:42:15,030 --> 00:42:13,280
out connectors

1141
00:42:17,190 --> 00:42:15,040
and and flow through between one

1142
00:42:19,430 --> 00:42:17,200
spacecraft another in in that type of

1143
00:42:21,510 --> 00:42:19,440
scenario we'd also be checking out

1144
00:42:23,990 --> 00:42:21,520
automated rendezvous and docking

1145
00:42:26,069 --> 00:42:24,000
so as we move through these steps we

1146
00:42:28,550 --> 00:42:26,079
gradually increase our capabilities we

1147
00:42:30,550 --> 00:42:28,560
we understand the technologies engaging

1148
00:42:31,829 --> 00:42:30,560
understanding how much fuel that you you

1149
00:42:33,030 --> 00:42:31,839
have in a tank how much you've

1150
00:42:35,430 --> 00:42:33,040
transferred

1151
00:42:37,750 --> 00:42:35,440
which is not simple either

1152
00:42:39,990 --> 00:42:37,760
as we work through understanding these

1153
00:42:41,349 --> 00:42:40,000
types of technologies

1154
00:42:43,270 --> 00:42:41,359
the next chart

1155
00:42:45,349 --> 00:42:43,280
talks to inflatable

1156
00:42:48,710 --> 00:42:45,359
technology we here we would start with

1157
00:42:51,109 --> 00:42:48,720
small inflatables on on station to test

1158
00:42:52,710 --> 00:42:51,119
out that technology we would grow over

1159
00:42:55,589 --> 00:42:52,720
time to

1160
00:43:01,430 --> 00:42:58,069
modules that are inflatable where we

1161
00:43:04,069 --> 00:43:01,440
could scar for life support systems and

1162
00:43:05,990 --> 00:43:04,079
and a capability that we've worked out

1163
00:43:08,230 --> 00:43:06,000

in the last few years called suit ports

1164
00:43:09,990 --> 00:43:08,240
we actually get past the idea of

1165
00:43:12,230 --> 00:43:10,000
airlocks and you can actually transfer

1166
00:43:14,470 --> 00:43:12,240
directly into suits from your from your

1167
00:43:16,630 --> 00:43:14,480
spacecraft

1168
00:43:18,470 --> 00:43:16,640
obviously space station is location

1169
00:43:21,430 --> 00:43:18,480
where you can also test out

1170
00:43:23,030 --> 00:43:21,440
new space suit technology

1171
00:43:24,309 --> 00:43:23,040
next chart

1172
00:43:26,710 --> 00:43:24,319
we also

1173
00:43:28,790 --> 00:43:26,720
are looking at a road map and we'll be

1174
00:43:31,430 --> 00:43:28,800
working closely with bobby on this one

1175
00:43:33,510 --> 00:43:31,440
as we bring in the emerging technology

1176
00:43:36,710 --> 00:43:33,520
inflatable heat and inflatable heat

1177
00:43:38,950 --> 00:43:36,720
shields where it combines new technology

1178
00:43:40,390 --> 00:43:38,960
in both arrow and arrow heating with

1179
00:43:42,150 --> 00:43:40,400
inflatable shapes

1180
00:43:44,470 --> 00:43:42,160
and this just shows a progression

1181
00:43:46,150 --> 00:43:44,480
through the types of

1182
00:43:48,390 --> 00:43:46,160
demonstrations that we would do in the

1183
00:43:52,630 --> 00:43:48,400
flagship mission

1184
00:43:55,750 --> 00:43:52,640
to to demonstrate these types of

1185
00:43:58,230 --> 00:43:55,760
entry vehicles we would also look at

1186
00:44:00,150 --> 00:43:58,240
not just blunt shapes but middle and mid

1187
00:44:02,150 --> 00:44:00,160
all over d shapes

1188
00:44:03,510 --> 00:44:02,160

lifted drag shapes that would be able to

1189
00:44:06,470 --> 00:44:03,520
maneuver

1190
00:44:09,109 --> 00:44:06,480
a little more in a in a mars environment

1191
00:44:11,190 --> 00:44:09,119
mars is going to be a unique um

1192
00:44:13,589 --> 00:44:11,200
concern in terms of entry descent and

1193
00:44:15,829 --> 00:44:13,599
landing because you can't just use a

1194
00:44:17,270 --> 00:44:15,839
heat shield and put the chutes out

1195
00:44:19,349 --> 00:44:17,280
and land

1196
00:44:21,349 --> 00:44:19,359
with the large vehicle that it takes to

1197
00:44:23,910 --> 00:44:21,359
send people so that will be a unique

1198
00:44:27,430 --> 00:44:23,920
case that we'll have to develop

1199
00:44:28,630 --> 00:44:27,440
with a lot of propulsion during decent

1200
00:44:29,589 --> 00:44:28,640
potentially

1201
00:44:32,309 --> 00:44:29,599
early

1202
00:44:34,470 --> 00:44:32,319
use of of the the hypersonic inflatable

1203
00:44:37,030 --> 00:44:34,480
shapes to slow it down

1204
00:44:39,270 --> 00:44:37,040
and then then the precision landing and

1205
00:44:42,790 --> 00:44:41,190
hazard avoidance once you get near the

1206
00:44:45,990 --> 00:44:42,800
ground

1207
00:44:46,870 --> 00:44:46,000
next chart which is the final chart um

1208
00:44:48,790 --> 00:44:46,880
so

1209
00:44:51,589 --> 00:44:48,800
i think when you pull these together all

1210
00:44:53,270 --> 00:44:51,599
these ideas together you see that that

1211
00:44:55,589 --> 00:44:53,280
this program

1212
00:44:57,430 --> 00:44:55,599
does seek to extend human presence

1213
00:45:00,309 --> 00:44:57,440

throughout the solar system

1214
00:45:01,990 --> 00:45:00,319
our budget request this year the fy 11

1215
00:45:04,309 --> 00:45:02,000
budget request the president talked

1216
00:45:06,309 --> 00:45:04,319
about today

1217
00:45:09,510 --> 00:45:06,319
we'll focus on these capabilities that

1218
00:45:12,470 --> 00:45:09,520
i've outlined in in terms of uh getting

1219
00:45:15,750 --> 00:45:12,480
us to potential destinations

1220
00:45:17,589 --> 00:45:15,760
moving out beyond earth orbit to places

1221
00:45:19,349 --> 00:45:17,599
we have not been before and staying for

1222
00:45:21,030 --> 00:45:19,359
lengths of time in those places that we

1223
00:45:24,309 --> 00:45:21,040
have not done

1224
00:45:26,630 --> 00:45:24,319
this this investment will focus on

1225
00:45:28,470 --> 00:45:26,640
learning

1226
00:45:30,710 --> 00:45:28,480
getting information and knowledge about

1227
00:45:32,950 --> 00:45:30,720
the locations that we go to that we'll

1228
00:45:34,950 --> 00:45:32,960
send people to as well as developing the

1229
00:45:35,750 --> 00:45:34,960
capabilities to get there

1230
00:45:37,910 --> 00:45:35,760
so

1231
00:45:39,750 --> 00:45:37,920
the approach expands the alternatives

1232
00:45:40,710 --> 00:45:39,760
and the unique capabilities that are

1233
00:45:43,109 --> 00:45:40,720
needed

1234
00:45:46,069 --> 00:45:43,119
that that are through strategic

1235
00:45:49,109 --> 00:45:46,079
investments that are very much needed in

1236
00:45:52,309 --> 00:45:49,119
order to be able to conceive of going to

1237
00:45:54,950 --> 00:45:52,319
some of these uh distant locations and

1238
00:45:57,109 --> 00:45:54,960

with that i'll turn it back to norm okay

1239
00:45:58,710 --> 00:45:57,119
doug thank you very much and thank each

1240
00:46:00,790 --> 00:45:58,720
of our panelists

1241
00:46:02,950 --> 00:46:00,800
uh we now at the point of the session

1242
00:46:04,230 --> 00:46:02,960
where we turn to those of you in the in

1243
00:46:07,430 --> 00:46:04,240
the audience

1244
00:46:10,950 --> 00:46:07,440
to uh make comments ask questions uh

1245
00:46:11,670 --> 00:46:10,960
offer suggestions uh propose new ideas

1246
00:46:13,670 --> 00:46:11,680
that

1247
00:46:14,710 --> 00:46:13,680
we should have thought of

1248
00:46:18,069 --> 00:46:14,720
so

1249
00:46:22,230 --> 00:46:19,349
please

1250
00:46:28,230 --> 00:46:26,470
ed talked initially about the need for

1251
00:46:29,910 --> 00:46:28,240
organizations to be agile in their

1252
00:46:31,990 --> 00:46:29,920
approach to these activities in order to

1253
00:46:35,270 --> 00:46:32,000
be successful

1254
00:46:37,750 --> 00:46:35,280
at jsc and at nasa we have

1255
00:46:39,270 --> 00:46:37,760
complex system engineering processes in

1256
00:46:41,190 --> 00:46:39,280
place which

1257
00:46:42,790 --> 00:46:41,200
have been codified and institutionalized

1258
00:46:44,230 --> 00:46:42,800
into the organization

1259
00:46:46,150 --> 00:46:44,240
and while they're very thorough in what

1260
00:46:47,990 --> 00:46:46,160
they do they're not really what you

1261
00:46:49,109 --> 00:46:48,000
would call agile

1262
00:46:50,950 --> 00:46:49,119
how can we

1263
00:46:52,950 --> 00:46:50,960

create that kind of agile environment

1264
00:46:56,230 --> 00:46:52,960
that we need in order to take on these

1265
00:46:58,150 --> 00:46:56,240
challenges that have been described

1266
00:46:59,829 --> 00:46:58,160
well that's a great question ed i think

1267
00:47:02,309 --> 00:46:59,839
we'll start with you and then let's let

1268
00:47:04,150 --> 00:47:02,319
uh either bobby or doug follow up if

1269
00:47:06,069 --> 00:47:04,160
they wish okay i think that's a great

1270
00:47:09,829 --> 00:47:06,079
point andy uh and i actually wanted to

1271
00:47:11,190 --> 00:47:09,839
ask a question of doug first or maybe a

1272
00:47:12,470 --> 00:47:11,200
comment

1273
00:47:14,870 --> 00:47:12,480
my thought was that there's so many

1274
00:47:17,829 --> 00:47:14,880
things that you want to test out there

1275
00:47:19,910 --> 00:47:17,839
my actual feeling is that unless nasa

1276
00:47:21,750 --> 00:47:19,920
changes the way it does business as andy

1277
00:47:22,870 --> 00:47:21,760
alluded to

1278
00:47:24,790 --> 00:47:22,880
none of that

1279
00:47:27,349 --> 00:47:24,800
is going to happen meaning

1280
00:47:29,750 --> 00:47:27,359
not at a pace that will

1281
00:47:31,030 --> 00:47:29,760
really lead to what the president asked

1282
00:47:36,549 --> 00:47:31,040
for

1283
00:47:38,309 --> 00:47:36,559
the way nasa does things and

1284
00:47:41,030 --> 00:47:38,319
i think there is a sort of form follows

1285
00:47:43,109 --> 00:47:41,040
function thing in that you need to set

1286
00:47:43,990 --> 00:47:43,119
things up such that

1287
00:47:46,150 --> 00:47:44,000
uh

1288
00:47:47,750 --> 00:47:46,160

it is easy to do a flight test because

1289
00:47:49,510 --> 00:47:47,760
there are so many flight tests required

1290
00:47:51,670 --> 00:47:49,520
to do all those things you mentioned

1291
00:47:53,349 --> 00:47:51,680
there must have been 50 up there or more

1292
00:47:55,829 --> 00:47:53,359
50 or 100 different flight tests

1293
00:47:57,829 --> 00:47:55,839
required to just initially test all the

1294
00:47:59,510 --> 00:47:57,839
technologies you list up there and if

1295
00:48:01,190 --> 00:47:59,520
you're testing one of these every six

1296
00:48:02,390 --> 00:48:01,200
months then you can count the number of

1297
00:48:04,309 --> 00:48:02,400
years and you can see that that's never

1298
00:48:07,910 --> 00:48:04,319
going to happen

1299
00:48:09,670 --> 00:48:07,920
so i think again to to make the system

1300
00:48:11,589 --> 00:48:09,680
operate fast we need to build a system

1301
00:48:14,870 --> 00:48:11,599
that's capable of moving quickly and

1302
00:48:17,349 --> 00:48:14,880
that means very rapid turnaround

1303
00:48:20,549 --> 00:48:17,359
yes and i i think uh with what by the

1304
00:48:22,230 --> 00:48:20,559
name of the nature of this

1305
00:48:23,589 --> 00:48:22,240
program these sets of programs that have

1306
00:48:25,510 --> 00:48:23,599
been laid out

1307
00:48:27,109 --> 00:48:25,520
we will be

1308
00:48:30,790 --> 00:48:27,119
we'll be putting

1309
00:48:34,309 --> 00:48:32,230
these demonstration flagship

1310
00:48:36,150 --> 00:48:34,319
demonstration missions the the robotic

1311
00:48:38,630 --> 00:48:36,160
missions we'll be combining some of

1312
00:48:40,950 --> 00:48:38,640
these technologies of course with uh on

1313
00:48:42,309 --> 00:48:40,960

on some of these missions we're planning

1314
00:48:45,510 --> 00:48:42,319
to to start

1315
00:48:47,829 --> 00:48:45,520
four flagship technology uh

1316
00:48:50,309 --> 00:48:47,839
demonstrations in fy 11 with more to

1317
00:48:53,349 --> 00:48:50,319
follow thereafter and we'll be working

1318
00:48:55,990 --> 00:48:53,359
on uh the first few

1319
00:48:57,990 --> 00:48:56,000
robotic missions as well

1320
00:48:59,589 --> 00:48:58,000
we also have which i didn't mention i

1321
00:49:01,990 --> 00:48:59,599
meant to uh

1322
00:49:03,190 --> 00:49:02,000
scout mission capability which will be

1323
00:49:08,230 --> 00:49:03,200
very small

1324
00:49:11,030 --> 00:49:08,240
uh spacecraft possibly grouped on on

1325
00:49:12,069 --> 00:49:11,040
on a single launch vehicle that that can

1326
00:49:15,910 --> 00:49:12,079
that can

1327
00:49:19,270 --> 00:49:15,920
demonstrate or or provide information on

1328
00:49:21,109 --> 00:49:19,280
mult for multiple purposes so i i think

1329
00:49:22,150 --> 00:49:21,119
you're right i think in order to get

1330
00:49:24,470 --> 00:49:22,160
through this

1331
00:49:26,790 --> 00:49:24,480
uh we'll have to be agile

1332
00:49:29,430 --> 00:49:26,800
i think by biting them biting some of

1333
00:49:31,829 --> 00:49:29,440
these off in in the chunks that that are

1334
00:49:35,990 --> 00:49:31,839
that are

1335
00:49:37,510 --> 00:49:36,000
shorter term and more often will get to

1336
00:49:40,870 --> 00:49:37,520
that point

1337
00:49:42,630 --> 00:49:40,880
we've got a lot of folks stand in line

1338
00:49:44,549 --> 00:49:42,640

with questions and so what i'm going to

1339
00:49:46,470 --> 00:49:44,559
ask is that we'll probably just have one

1340
00:49:48,150 --> 00:49:46,480
panelist address each question and ask

1341
00:49:49,990 --> 00:49:48,160
you to be relatively brief

1342
00:49:51,670 --> 00:49:50,000
please

1343
00:49:54,470 --> 00:49:51,680
excuse me mj swallow the university of

1344
00:49:58,870 --> 00:49:57,349
the comments about the predictions 1939

1345
00:50:00,390 --> 00:49:58,880
i think after the second world war we

1346
00:50:01,829 --> 00:50:00,400
gathered all the nobel prize winners

1347
00:50:03,349 --> 00:50:01,839
together to say what's going to happen

1348
00:50:05,270 --> 00:50:03,359
in the next 50 years and they missed

1349
00:50:07,270 --> 00:50:05,280
almost everything

1350
00:50:08,390 --> 00:50:07,280
with that comment in mind and thinking

1351
00:50:14,710 --> 00:50:08,400
about

1352
00:50:17,270 --> 00:50:14,720
architecture for the research that

1353
00:50:18,710 --> 00:50:17,280
involves uh by way of analogy some of

1354
00:50:20,390 --> 00:50:18,720
the things that have been done with with

1355
00:50:21,990 --> 00:50:20,400
pcs to

1356
00:50:24,150 --> 00:50:22,000
string them all together to make one

1357
00:50:26,230 --> 00:50:24,160
supercomputer but instead of that human

1358
00:50:27,750 --> 00:50:26,240
capital we have lots of chaos at

1359
00:50:30,230 --> 00:50:27,760
universities every year we get a whole

1360
00:50:32,870 --> 00:50:30,240
new class of chaos at universities

1361
00:50:34,630 --> 00:50:32,880
what about putting some emphasis on

1362
00:50:36,309 --> 00:50:34,640
subaru flights

1363
00:50:38,390 --> 00:50:36,319

there's lots of experiments that can be

1364
00:50:39,670 --> 00:50:38,400
done in subaru flights zero gravity

1365
00:50:42,230 --> 00:50:39,680
experiments structural experiments

1366
00:50:44,309 --> 00:50:42,240
propulsion experiments etc on very small

1367
00:50:46,069 --> 00:50:44,319
scale very rapid turnaround that would

1368
00:50:48,069 --> 00:50:46,079
involve lots of people i think the

1369
00:50:49,430 --> 00:50:48,079
problem now with nasa missions

1370
00:50:51,430 --> 00:50:49,440
from a university standpoint it

1371
00:50:53,430 --> 00:50:51,440
sometimes costs us millions of dollars

1372
00:50:55,109 --> 00:50:53,440
even to compete for one and there are

1373
00:50:57,910 --> 00:50:55,119
years and years and only a few people

1374
00:50:59,349 --> 00:50:57,920
play so if we can engage a broader

1375
00:51:01,109 --> 00:50:59,359
spectrum of the intellect that's out

1376
00:51:03,430 --> 00:51:01,119
there that's interested hungry

1377
00:51:04,950 --> 00:51:03,440
enthusiastic young don't know what can't

1378
00:51:07,109 --> 00:51:04,960
be done etcetera

1379
00:51:09,670 --> 00:51:07,119
i propose that perhaps an architecture

1380
00:51:11,750 --> 00:51:09,680
using distributed kind of uh research

1381
00:51:13,109 --> 00:51:11,760
with using separate orbital flights to

1382
00:51:15,190 --> 00:51:13,119
address many of the things that were on

1383
00:51:18,069 --> 00:51:15,200
your list might be useful thank you

1384
00:51:19,589 --> 00:51:18,079
bobby yeah so

1385
00:51:20,870 --> 00:51:19,599
it might not

1386
00:51:22,549 --> 00:51:20,880
so as a

1387
00:51:23,910 --> 00:51:22,559
former university professor it probably

1388
00:51:25,349 --> 00:51:23,920

doesn't surprise you that i would agree

1389
00:51:26,630 --> 00:51:25,359
with your statement

1390
00:51:28,470 --> 00:51:26,640
and one of the things that we're working

1391
00:51:30,710 --> 00:51:28,480
on is to uh

1392
00:51:33,030 --> 00:51:30,720
capitalize if you will on all possible

1393
00:51:35,670 --> 00:51:33,040
platforms right when i talk about

1394
00:51:37,430 --> 00:51:35,680
relevant flight environments right each

1395
00:51:39,190 --> 00:51:37,440
technology has a relevant flight

1396
00:51:41,750 --> 00:51:39,200
environment and it's important that we

1397
00:51:43,990 --> 00:51:41,760
choose the lowest cost or the most

1398
00:51:45,990 --> 00:51:44,000
accessible test bed so that we can do

1399
00:51:47,670 --> 00:51:46,000
many tests of that technology in the

1400
00:51:49,670 --> 00:51:47,680
relevant flight environment if something

1401
00:51:51,510 --> 00:51:49,680
can be proven on the ground then great

1402
00:51:53,109 --> 00:51:51,520
let's do it on the ground if it requires

1403
00:51:55,030 --> 00:51:53,119
a high altitude balloon or a sounding

1404
00:51:56,870 --> 00:51:55,040
rocket flight let's do that not

1405
00:51:59,030 --> 00:51:56,880
everything has to be its own low earth

1406
00:52:01,030 --> 00:51:59,040
orbit flight test or you know we don't

1407
00:52:02,950 --> 00:52:01,040
need necessarily to go out to mars for

1408
00:52:04,710 --> 00:52:02,960
example to prove every technology just

1409
00:52:06,549 --> 00:52:04,720
to prove it in the space

1410
00:52:08,470 --> 00:52:06,559
in the space environment

1411
00:52:10,150 --> 00:52:08,480
and i so i take your point very

1412
00:52:12,390 --> 00:52:10,160
seriously and in addition

1413
00:52:13,750 --> 00:52:12,400

i do want to say that through these

1414
00:52:16,710 --> 00:52:13,760
programs where we're going to have a

1415
00:52:18,710 --> 00:52:16,720
steady cadence of flight testing where

1416
00:52:20,710 --> 00:52:18,720
we're going to have a steady cadence of

1417
00:52:23,030 --> 00:52:20,720
demonstrations and test programs not

1418
00:52:24,630 --> 00:52:23,040
just paper studies we do intend to

1419
00:52:26,870 --> 00:52:24,640
involve a broader community in

1420
00:52:28,710 --> 00:52:26,880
particular uh the university research

1421
00:52:29,910 --> 00:52:28,720
community and industry

1422
00:52:33,270 --> 00:52:29,920
okay uh

1423
00:52:35,030 --> 00:52:33,280
we've got a light there bo is that you

1424
00:52:40,069 --> 00:52:35,040
go

1425
00:52:42,390 --> 00:52:40,079
is to uh to add lou

1426
00:52:44,230 --> 00:52:42,400
you said that uh and by the way i think

1427
00:52:46,870 --> 00:52:44,240
if somebody comes from google used to be

1428
00:52:48,390 --> 00:52:46,880
like a pinnacle innovate of innovation

1429
00:52:50,309 --> 00:52:48,400
but you said something interesting you

1430
00:52:52,710 --> 00:52:50,319
said you know we haven't found the

1431
00:52:55,349 --> 00:52:52,720
formula with that that would single

1432
00:52:57,190 --> 00:52:55,359
formula to foster or

1433
00:53:00,390 --> 00:52:57,200
bring about innovation but i was

1434
00:53:03,030 --> 00:53:00,400
wondering have you found things by

1435
00:53:04,390 --> 00:53:03,040
contrast from your experience from nasa

1436
00:53:06,790 --> 00:53:04,400
and google

1437
00:53:08,870 --> 00:53:06,800
things that not that that inhibit

1438
00:53:10,549 --> 00:53:08,880

innovation

1439
00:53:12,630 --> 00:53:10,559
because i have seen some and i wonder

1440
00:53:14,630 --> 00:53:12,640
what you have what do you think

1441
00:53:15,990 --> 00:53:14,640
when you look at two organizations nasa

1442
00:53:18,630 --> 00:53:16,000
and google

1443
00:53:20,230 --> 00:53:18,640
uh absolutely i think that

1444
00:53:21,030 --> 00:53:20,240
the

1445
00:53:23,109 --> 00:53:21,040
uh

1446
00:53:24,150 --> 00:53:23,119
when things are difficult to try new

1447
00:53:26,309 --> 00:53:24,160
ideas

1448
00:53:29,829 --> 00:53:26,319
and when your opportunities are

1449
00:53:32,150 --> 00:53:29,839
infrequent to try new ideas that clearly

1450
00:53:33,990 --> 00:53:32,160
uh quashes innovation

1451
00:53:36,710 --> 00:53:34,000
and unfortunately i think we're sort of

1452
00:53:39,349 --> 00:53:36,720
in that state right now with nasa

1453
00:53:40,630 --> 00:53:39,359
if you if you have some new idea and

1454
00:53:41,990 --> 00:53:40,640
you're looking for the next available

1455
00:53:43,270 --> 00:53:42,000
flight opportunity it might be five to

1456
00:53:46,069 --> 00:53:43,280
ten years out

1457
00:53:47,430 --> 00:53:46,079
what are your chances of trying that uh

1458
00:53:49,190 --> 00:53:47,440
it better be pretty fairly developed

1459
00:53:50,710 --> 00:53:49,200
before you you really get a chance to do

1460
00:53:52,630 --> 00:53:50,720
it depends upon the size of it of course

1461
00:53:54,790 --> 00:53:52,640
there are some small scale experiments

1462
00:53:57,190 --> 00:53:54,800
but they're not a lot and if what you're

1463
00:53:58,950 --> 00:53:57,200

like would like to try isn't it has any

1464
00:54:01,190 --> 00:53:58,960
significant mass to it you are looking

1465
00:54:03,750 --> 00:54:01,200
at five to ten years out

1466
00:54:05,270 --> 00:54:03,760
yeah one thing you notice and doug maybe

1467
00:54:07,510 --> 00:54:05,280
you probably can relate to that i

1468
00:54:11,270 --> 00:54:07,520
noticed that during constellation

1469
00:54:13,829 --> 00:54:11,280
development nasa has put very firm

1470
00:54:16,069 --> 00:54:13,839
rigid processes in place

1471
00:54:17,670 --> 00:54:16,079
during development and i always felt

1472
00:54:19,790 --> 00:54:17,680
like you know during development

1473
00:54:22,870 --> 00:54:19,800
especially early development you need

1474
00:54:24,549 --> 00:54:22,880
flexibility to foster innovation give

1475
00:54:28,150 --> 00:54:24,559
people a chance to think a little more

1476
00:54:29,990 --> 00:54:28,160
independently and as you approach toward

1477
00:54:31,910 --> 00:54:30,000
firming you what you want to build and

1478
00:54:34,470 --> 00:54:31,920
building it then you need to tighten up

1479
00:54:37,990 --> 00:54:34,480
that discipline and processes and i felt

1480
00:54:41,109 --> 00:54:38,000
like nasa perhaps started too early with

1481
00:54:42,150 --> 00:54:41,119
governance and and processes and i think

1482
00:54:44,150 --> 00:54:42,160
those

1483
00:54:45,030 --> 00:54:44,160
slowed down decision-making process and

1484
00:54:47,589 --> 00:54:45,040
also

1485
00:54:49,270 --> 00:54:47,599
stifled innovation

1486
00:54:50,549 --> 00:54:49,280
but i don't know do you agree with that

1487
00:54:53,109 --> 00:54:50,559
dog or

1488
00:54:53,990 --> 00:54:53,119

sir

1489
00:54:55,750 --> 00:54:54,000
certainly

1490
00:54:57,910 --> 00:54:55,760
um

1491
00:55:00,230 --> 00:54:57,920
absolutely we we have to work to

1492
00:55:03,510 --> 00:55:00,240
streamline our process processes that's

1493
00:55:04,870 --> 00:55:03,520
what ed is alluding to and and um we're

1494
00:55:07,349 --> 00:55:04,880
we are

1495
00:55:09,510 --> 00:55:07,359
have started uh looking at that already

1496
00:55:12,950 --> 00:55:09,520
and and and

1497
00:55:14,630 --> 00:55:12,960
we we have to be more agile uh actually

1498
00:55:17,270 --> 00:55:14,640
this approach to developing the

1499
00:55:19,349 --> 00:55:17,280
technology and capability will will tend

1500
00:55:21,589 --> 00:55:19,359
to drive you to that um if you're on

1501
00:55:23,990 --> 00:55:21,599
short turnaround and developing a quick

1502
00:55:26,150 --> 00:55:24,000
turnaround demonstration i think i think

1503
00:55:27,910 --> 00:55:26,160
you'll have to get in that mode so maybe

1504
00:55:30,309 --> 00:55:27,920
this is a forcing function

1505
00:55:32,829 --> 00:55:30,319
both thank you very much uh could i add

1506
00:55:36,309 --> 00:55:32,839
one thing to that it's not just the

1507
00:55:37,750 --> 00:55:36,319
processes but actually having some

1508
00:55:39,430 --> 00:55:37,760
physical infrastructure that allows you

1509
00:55:41,109 --> 00:55:39,440
to do that for instance could you

1510
00:55:42,390 --> 00:55:41,119
imagine what we could do if we had an

1511
00:55:43,910 --> 00:55:42,400
american-built

1512
00:55:45,750 --> 00:55:43,920
soyuz cloud

1513
00:55:47,190 --> 00:55:45,760

launcher that was

1514
00:55:49,030 --> 00:55:47,200
i have no doubt in my mind that we could

1515
00:55:50,549 --> 00:55:49,040
do it better than the russians and i'm a

1516
00:55:52,789 --> 00:55:50,559
satisfied customer of having flown a

1517
00:55:54,789 --> 00:55:52,799
soyuz but can you imagine if we had

1518
00:55:55,670 --> 00:55:54,799
something that could put up say 10 to 15

1519
00:55:57,990 --> 00:55:55,680
tons

1520
00:56:00,150 --> 00:55:58,000
on that price point at which the soyuz

1521
00:56:01,829 --> 00:56:00,160
does it which i think we can do and you

1522
00:56:04,069 --> 00:56:01,839
could launch it every week like a soyuz

1523
00:56:05,829 --> 00:56:04,079
is capable of what would we do with that

1524
00:56:08,069 --> 00:56:05,839
oh yeah

1525
00:56:11,349 --> 00:56:08,079
both thank you we've got two more people

1526
00:56:13,109 --> 00:56:11,359
and so we'll do these quickly and uh

1527
00:56:15,750 --> 00:56:13,119
i uh

1528
00:56:17,910 --> 00:56:15,760
uh will you please go ahead uh steve

1529
00:56:19,750 --> 00:56:17,920
squires cornell university uh one of the

1530
00:56:22,630 --> 00:56:19,760
main things that i'm doing these days is

1531
00:56:24,309 --> 00:56:22,640
helping to run the nrc's uh planetary

1532
00:56:26,710 --> 00:56:24,319
decadal survey and one of the problems

1533
00:56:28,630 --> 00:56:26,720
that we have identified as a big big

1534
00:56:33,030 --> 00:56:28,640
issue is what we've referred to

1535
00:56:35,030 --> 00:56:33,040
informally as the trl valley of death

1536
00:56:37,910 --> 00:56:35,040
historically nasa's done a great job of

1537
00:56:40,549 --> 00:56:37,920
taking real low technology readiness

1538
00:56:43,030 --> 00:56:40,559

level ideas and moving them to sort of

1539
00:56:44,470 --> 00:56:43,040
mid-range technology readiness but

1540
00:56:46,390 --> 00:56:44,480
getting them to the point where they're

1541
00:56:48,630 --> 00:56:46,400
ready for flight

1542
00:56:51,109 --> 00:56:48,640
and where a project manager is ready to

1543
00:56:53,829 --> 00:56:51,119
accept the risk of using that technology

1544
00:56:56,150 --> 00:56:53,839
has been an area where we believe the

1545
00:56:57,670 --> 00:56:56,160
the agency has fallen short and so my

1546
00:56:59,670 --> 00:56:57,680
question for this group and i guess

1547
00:57:02,230 --> 00:56:59,680
particularly for doug and bobby is in

1548
00:57:04,230 --> 00:57:02,240
the president's plan for nasa going

1549
00:57:06,470 --> 00:57:04,240
forward what's going to change to make

1550
00:57:08,230 --> 00:57:06,480
that better

1551
00:57:10,230 --> 00:57:08,240
i can start with that

1552
00:57:12,710 --> 00:57:10,240
well so that's a great question steve

1553
00:57:14,309 --> 00:57:12,720
and i'm actually i'm very familiar with

1554
00:57:15,829 --> 00:57:14,319
the valley of death

1555
00:57:18,789 --> 00:57:15,839
having tried to get through it several

1556
00:57:21,109 --> 00:57:18,799
times in the past unsuccessfully

1557
00:57:22,870 --> 00:57:21,119
the the big change really is these is

1558
00:57:25,510 --> 00:57:22,880
the new program right the space

1559
00:57:27,510 --> 00:57:25,520
technology program in particular is set

1560
00:57:29,670 --> 00:57:27,520
up to get through that valley and to

1561
00:57:34,710 --> 00:57:29,680
deliver

1562
00:57:36,950 --> 00:57:34,720
beyond trl of six so beyond testing in a

1563
00:57:39,030 --> 00:57:36,960

relevant environment in addition that

1564
00:57:41,829 --> 00:57:39,040
cross-cutting capability demonstration

1565
00:57:44,069 --> 00:57:41,839
program that i mentioned quickly

1566
00:57:46,309 --> 00:57:44,079
will only sponsor technologies in which

1567
00:57:47,829 --> 00:57:46,319
a customer has already been identified

1568
00:57:49,990 --> 00:57:47,839
and when that when in which that

1569
00:57:52,230 --> 00:57:50,000
customer is actually providing a portion

1570
00:57:54,230 --> 00:57:52,240
of the funding for that demonstration to

1571
00:57:56,549 --> 00:57:54,240
prove their interest in flying that

1572
00:57:59,109 --> 00:57:56,559
technology in the future so we'll have a

1573
00:58:02,230 --> 00:57:59,119
handshake deal up front along with some

1574
00:58:04,390 --> 00:58:02,240
cash actually from that customer to fly

1575
00:58:06,390 --> 00:58:04,400
that technology on some future mission

1576
00:58:08,309 --> 00:58:06,400
and then through this new program which

1577
00:58:09,750 --> 00:58:08,319
i need to tell you didn't exist

1578
00:58:11,430 --> 00:58:09,760
previously

1579
00:58:13,750 --> 00:58:11,440
will have the capability to take these

1580
00:58:15,589 --> 00:58:13,760
technologies from concept all the way to

1581
00:58:17,670 --> 00:58:15,599
flight the tough part of course is

1582
00:58:19,430 --> 00:58:17,680
always protecting technology funds when

1583
00:58:20,630 --> 00:58:19,440
money gets tight and i wish you the best

1584
00:58:23,589 --> 00:58:20,640
of luck with that

1585
00:58:25,430 --> 00:58:23,599
thank you thank you

1586
00:58:27,270 --> 00:58:25,440
hi my name is jim fenton i'm at the

1587
00:58:28,710 --> 00:58:27,280
florida solar energy center just 15

1588
00:58:30,069 --> 00:58:28,720

minutes away

1589
00:58:32,470 --> 00:58:30,079
um

1590
00:58:33,910 --> 00:58:32,480
i agree this is about technology i've

1591
00:58:35,670 --> 00:58:33,920
heard innovation

1592
00:58:38,789 --> 00:58:35,680
i've heard agile

1593
00:58:41,030 --> 00:58:38,799
i did not hear inspiration

1594
00:58:43,030 --> 00:58:41,040
i heard motivation

1595
00:58:45,109 --> 00:58:43,040
motivation is to push people to do

1596
00:58:47,109 --> 00:58:45,119
things they don't want to do

1597
00:58:49,670 --> 00:58:47,119
nasa famously

1598
00:58:51,430 --> 00:58:49,680
inspired a generation of future

1599
00:58:54,390 --> 00:58:51,440
scientists and engineers

1600
00:58:56,309 --> 00:58:54,400
i want nasa to do that again

1601
00:58:59,349 --> 00:58:56,319
i want inspiration up there with the

1602
00:59:00,950 --> 00:58:59,359
words innovation and technology

1603
00:59:03,990 --> 00:59:00,960
thank you

1604
00:59:05,990 --> 00:59:04,000
our guest of honor we will make an

1605
00:59:07,670 --> 00:59:06,000
exception please

1606
00:59:09,750 --> 00:59:07,680
i'll never hear the end of this session

1607
00:59:11,589 --> 00:59:09,760
overrun so

1608
00:59:12,950 --> 00:59:11,599
norm thank you sure thank all the

1609
00:59:15,190 --> 00:59:12,960
panelists uh

1610
00:59:17,349 --> 00:59:15,200
i tried to

1611
00:59:19,270 --> 00:59:17,359
be in a number of uh

1612
00:59:20,390 --> 00:59:19,280
sessions my name is sheila jackson lee

1613
00:59:21,510 --> 00:59:20,400

and i come from

1614
00:59:24,230 --> 00:59:21,520
houston

1615
00:59:26,309 --> 00:59:24,240
uh near the johnson space center

1616
00:59:27,910 --> 00:59:26,319
first of all i i think we did have some

1617
00:59:30,549 --> 00:59:27,920
inspiration today and i think that's an

1618
00:59:33,750 --> 00:59:30,559
important point i keep trying to grow

1619
00:59:36,630 --> 00:59:33,760
uh physicists and a number of

1620
00:59:39,030 --> 00:59:36,640
body politic for science in america so

1621
00:59:40,870 --> 00:59:39,040
this is an important element

1622
00:59:42,789 --> 00:59:40,880
i also think uh

1623
00:59:44,630 --> 00:59:42,799
ed's point about the soyuz was an

1624
00:59:46,069 --> 00:59:44,640
interesting point uh the president's

1625
00:59:47,670 --> 00:59:46,079
points about orion is another

1626
00:59:50,470 --> 00:59:47,680
interesting point

1627
00:59:52,309 --> 00:59:50,480
my question is that we have uh

1628
00:59:54,069 --> 00:59:52,319
interrelated links between the centers

1629
00:59:56,549 --> 00:59:54,079
i'm obviously

1630
00:59:58,069 --> 00:59:56,559
hearing from constituents all the time

1631
01:00:01,030 --> 00:59:58,079
about

1632
01:00:02,630 --> 01:00:01,040
jobs the economy aspect of it

1633
01:00:04,230 --> 01:00:02,640
but preserving the science the

1634
01:00:05,510 --> 01:00:04,240
intelligence of it if you will the

1635
01:00:08,069 --> 01:00:05,520
knowledge

1636
01:00:10,390 --> 01:00:08,079
my question is in this period of time

1637
01:00:12,309 --> 01:00:10,400
when people were geared toward one

1638
01:00:14,870 --> 01:00:12,319

program and i thank the president for

1639
01:00:17,430 --> 01:00:14,880
his message and his inspiration

1640
01:00:19,109 --> 01:00:17,440
what are we doing with that body of

1641
01:00:21,589 --> 01:00:19,119
of uh human

1642
01:00:25,430 --> 01:00:21,599
resource right now you're talking about

1643
01:00:26,630 --> 01:00:25,440
new technology uh ed do we go to uh you

1644
01:00:27,510 --> 01:00:26,640
know if we just

1645
01:00:29,270 --> 01:00:27,520
put

1646
01:00:31,750 --> 01:00:29,280
the president's speech here and they say

1647
01:00:33,910 --> 01:00:31,760
let's go do it and build a soyuz what do

1648
01:00:36,150 --> 01:00:33,920
we do right now that's the fear that's

1649
01:00:38,069 --> 01:00:36,160
the apprehension for individuals who are

1650
01:00:40,470 --> 01:00:38,079
right in the midst of these sinners

1651
01:00:42,309 --> 01:00:40,480
right now in particular

1652
01:00:44,950 --> 01:00:42,319
where i am right now kennedy and then

1653
01:00:47,109 --> 01:00:44,960
johnson uh in particular

1654
01:00:48,870 --> 01:00:47,119
that's a great question to close on and

1655
01:00:51,910 --> 01:00:48,880
doug i think we'll let you take that one

1656
01:00:54,549 --> 01:00:51,920
on all right um certainly that that is

1657
01:00:57,990 --> 01:00:54,559
um that is an area that we are uh

1658
01:00:59,990 --> 01:00:58,000
working very hard on uh we uh when the

1659
01:01:01,750 --> 01:01:00,000
budget requests came out we put together

1660
01:01:04,309 --> 01:01:01,760
teams to go look at

1661
01:01:07,270 --> 01:01:04,319
at uh these not only these new

1662
01:01:08,309 --> 01:01:07,280
uh programs that that we've we've been

1663
01:01:10,470 --> 01:01:08,319

assigned

1664
01:01:12,950 --> 01:01:10,480
but but also uh we put together a

1665
01:01:14,390 --> 01:01:12,960
transition team to go look at the very

1666
01:01:17,030 --> 01:01:14,400
thing that you're you're talking about

1667
01:01:20,150 --> 01:01:17,040
how do we it is a shift it is a shift in

1668
01:01:22,230 --> 01:01:20,160
in in priorities and policy

1669
01:01:25,589 --> 01:01:22,240
in terms of of um

1670
01:01:27,270 --> 01:01:25,599
how we go about exploration and so it is

1671
01:01:30,470 --> 01:01:27,280
important that we work through that

1672
01:01:33,589 --> 01:01:30,480
carefully because we're we these are

1673
01:01:35,270 --> 01:01:33,599
we we these are our people too and

1674
01:01:37,510 --> 01:01:35,280
people that we've worked with for you

1675
01:01:40,390 --> 01:01:37,520
know for many years and me personally i

1676
01:01:41,910 --> 01:01:40,400
spent 32 years at johnson space center

1677
01:01:44,069 --> 01:01:41,920
before coming to

1678
01:01:47,430 --> 01:01:44,079
dc um

1679
01:01:49,750 --> 01:01:47,440
so it isn't it is it is a definitely

1680
01:01:53,030 --> 01:01:49,760
something that we we take very seriously

1681
01:01:54,950 --> 01:01:53,040
and are working on i think you annette a

1682
01:01:55,910 --> 01:01:54,960
lot of us will need to work with you yes

1683
01:01:57,910 --> 01:01:55,920
um

1684
01:02:00,390 --> 01:01:57,920
what i gleaned today is that you have

1685
01:02:01,829 --> 01:02:00,400
put forward somebody's heard me say this

1686
01:02:04,069 --> 01:02:01,839
many many times

1687
01:02:06,870 --> 01:02:04,079
today an onion and we need to peel the

1688
01:02:09,589 --> 01:02:06,880

layers and find out where we fit

1689
01:02:11,109 --> 01:02:09,599
onions sometimes sting but they are

1690
01:02:12,470 --> 01:02:11,119
pretty tasty

1691
01:02:14,789 --> 01:02:12,480
but i think it's important that we've

1692
01:02:17,190 --> 01:02:14,799
got to calm people and use the genius

1693
01:02:19,510 --> 01:02:17,200
that we have in all of these centers

1694
01:02:21,270 --> 01:02:19,520
and produce something for america that's

1695
01:02:22,230 --> 01:02:21,280
that's what i think is enormously

1696
01:02:24,549 --> 01:02:22,240
important

1697
01:02:26,710 --> 01:02:24,559
and i hope we can be around the table

1698
01:02:29,190 --> 01:02:26,720
really with our sleeves rolled up really

1699
01:02:30,710 --> 01:02:29,200
helping to produce and it's not done uh

1700
01:02:32,789 --> 01:02:30,720
as i know that you're not doing it but

1701
01:02:35,589 --> 01:02:32,799
not done in isolation there are so many

1702
01:02:37,910 --> 01:02:35,599
moving parts to this

1703
01:02:39,510 --> 01:02:37,920
that's a perfect wrap-up for us thank

1704
01:02:42,390 --> 01:02:39,520
you for doing that

1705
01:02:44,710 --> 01:02:42,400
uh let me a special thanks

1706
01:02:46,069 --> 01:02:44,720
to doug and bobby and ed for their

1707
01:02:46,950 --> 01:02:46,079
remarks

1708
01:02:49,270 --> 01:02:46,960
and

1709
01:02:51,589 --> 01:02:49,280
they've got a big challenge ahead uh

1710
01:02:53,190 --> 01:02:51,599
particularly uh our nasa folks here

1711
01:02:54,630 --> 01:02:53,200
current nasa folks

1712
01:02:57,349 --> 01:02:54,640
and uh thanks to each of you in the

1713
01:02:59,109 --> 01:02:57,359

audience for uh your questions

1714
01:03:01,349 --> 01:02:59,119
and to those uh

1715
01:03:02,549 --> 01:03:01,359
who are out in cyberspace we appreciate

1716
01:03:05,109 --> 01:03:02,559
your interest

1717
01:03:06,950 --> 01:03:05,119
i believe we're supposed to go back to a

1718
01:03:07,910 --> 01:03:06,960
broader session now

1719
01:03:09,270 --> 01:03:07,920
and

1720
01:03:11,190 --> 01:03:09,280
somebody will guide you if you go out