1
00:00:00,506 --> 00:00:04,886
[Music]

2
00:00:05,386 --> 00:00:07,816
>> Extravehicular
activity, or EVA.

3
00:00:09,336 --> 00:00:10,946
There may be no greater image

4
00:00:10,946 --> 00:00:13,726
that represents human
exploration then

5
00:00:13,726 --> 00:00:16,126
that of an astronaut
in a spacesuit.

6
00:00:16,276 --> 00:00:20,316
A spaceship for one that
allows them to survive and work

7
00:00:20,516 --> 00:00:21,916
in the harshest of environments.

8
00:00:23,566 --> 00:00:26,916
Throughout the history of
space flight, EVA has time

9
00:00:26,976 --> 00:00:28,646
and again proven its value

10
00:00:29,086 --> 00:00:31,766
and has become essential
to space exploration.

11
00:00:32,516 --> 00:00:35,606
[Music]

12
00:00:36,106 --> 00:00:38,566
Behind every EVA is a team
of professionals who tend

13
00:00:38,646 --> 00:00:42,696
to every detail of the space
walk, ensuring mission success.

14
00:00:43,916 --> 00:00:46,596
Their experiences have
taught them valuable lessons

15
00:00:47,176 --> 00:00:51,026
to pass on, as humankind
continues its journey toward

16
00:00:51,406 --> 00:00:51,976
new discoveries.

17
00:00:52,516 --> 00:00:59,696
[Music]

18
00:01:00,196 --> 00:01:02,446
>> I just have this personal
opinion about lessons learned.

19
00:01:02,446 --> 00:01:09,426
I feel like that anything we do
today, any way you look at it,

20
00:01:09,426 --> 00:01:14,636
is probably affected by a lesson
learned from a previous attempt.

21
00:01:14,636 --> 00:01:20,326
In the Apollo years, the helmet
that was processed for the IVA,

22
00:01:20,326 --> 00:01:23,616

which is intra-vehicular
activities, was just a bubble,

23
00:01:23,666 --> 00:01:28,506
and when they were worked on
the bubble in the lab on a table

24
00:01:28,626 --> 00:01:31,496
by those same procedures
I tell you about,

25
00:01:32,016 --> 00:01:34,106
it had you place the
helmet bubble in this,

26
00:01:34,106 --> 00:01:35,206
what we call the donut.

27
00:01:35,206 --> 00:01:36,566
It was just a ring
that was padded.

28
00:01:36,666 --> 00:01:38,956
You set the bubble on it
and you did your work.

29
00:01:39,506 --> 00:01:43,466
Okay. Well those donuts and
those bubbles transitioned

30
00:01:43,666 --> 00:01:45,496
to the shuttle program.

31
00:01:45,496 --> 00:01:48,686
The shuttle helmet used
the Apollo design bubble,

32
00:01:48,686 --> 00:01:52,186
only it had a shell on it
that was significantly bigger

33
00:01:52,216 --> 00:01:56,766
than the bubble, and so when
you took this bigger shape

34
00:01:56,766 --> 00:01:58,316
and put it in that little donut,

35
00:01:58,316 --> 00:02:01,686
the center of gravity
was off a little bit,

36
00:02:01,686 --> 00:02:02,396
so you had to be careful.

37
00:02:02,666 --> 00:02:06,006
So a technician one night
working on this helmet,

38
00:02:07,216 --> 00:02:11,586
called me in despair that
the helmet had rolled off

39
00:02:12,146 --> 00:02:13,316
of this donut onto the floor.

40
00:02:14,276 --> 00:02:19,796
This was one of four shuttle
helmets that we had at the time.

41
00:02:19,796 --> 00:02:21,346
This could happen to
another technician

42
00:02:21,346 --> 00:02:23,606
if we didn't change the process.

43
00:02:23,606 --> 00:02:25,906
Well as soon as it happened,

44
00:02:25,906 --> 00:02:27,866
he realized what happened
and how to fix it.

45
00:02:28,066 --> 00:02:30,706
And so that was one of the first
things he told me is this would

46
00:02:30,826 --> 00:02:33,166
never have happened if
I had a bigger donut.

47
00:02:33,726 --> 00:02:35,726
It was a matter of
within the next day

48
00:02:35,726 --> 00:02:37,016
or two we had the bigger donuts

49
00:02:37,106 --> 00:02:38,696
and we had the procedure
in place.

50
00:02:38,696 --> 00:02:41,316
I don't care what lab, you
find a lab, you find a process,

51
00:02:41,316 --> 00:02:43,096
you find a technician
working on the hardware,

52
00:02:43,096 --> 00:02:46,006
and I will show you a procedure
that's been changed by lessons

53
00:02:46,296 --> 00:02:49,896
like that, that were learned in
corporate and to the procedures.

54
00:02:50,286 --> 00:02:53,656
I'll bet you could find
one in so many people

55
00:02:53,656 --> 00:02:58,396
that would tell you that they
can remember this one thing

56
00:02:58,396 --> 00:03:00,036
happening, and happening again,

57
00:03:01,046 --> 00:03:03,296
because the lesson
learned wasn't applied.

58
00:03:04,656 --> 00:03:07,356
And that, to me in
this business,

59
00:03:07,356 --> 00:03:08,976
is kind of unacceptable really.

60
00:03:09,516 --> 00:03:11,656
[Music]

61
00:03:12,156 --> 00:03:13,636
>> It is the early 1980s,

62
00:03:13,926 --> 00:03:16,846
and NASA has a new spacecraft
called the space shuttle,

63
00:03:17,186 --> 00:03:19,516
which is getting ready
for its maiden voyage.

64
00:03:20,796 --> 00:03:24,576
A new program gets a new suit
and technicians eagerly ready

65
00:03:24,576 --> 00:03:26,636
to shuttle space suit
for human testing.

66
00:03:27,246 --> 00:03:29,856
They are about to
discover that for EVA,

67
00:03:29,976 --> 00:03:34,056
lessons learned can begin long
before a mission ever launches.

68
00:03:34,246 --> 00:03:37,686
>> It is in the early'80s,
and the program was still kind

69
00:03:37,686 --> 00:03:38,986
of in the development phase.

70
00:03:38,986 --> 00:03:40,896
We had not gone through
certification yet.

71
00:03:40,896 --> 00:03:43,006
We hadn't flied in the
first shuttle flight yet.

72
00:03:43,746 --> 00:03:46,916
So we were still
building and learning

73
00:03:47,196 --> 00:03:50,236
about this spacecraft
called the EMU.

74
00:03:50,346 --> 00:03:52,906
One day we were testing
the spacesuit.

75
00:03:52,906 --> 00:03:54,756
The first time with oxygen.

76
00:03:55,056 --> 00:03:57,366
Was getting ready for a
human test later in the week.

77
00:03:58,016 --> 00:04:01,396
>> This test was
to turn on the SOP,

78
00:04:01,426 --> 00:04:04,366
which is the secondary
oxygen bottles.

79
00:04:04,526 --> 00:04:09,036
As we got to the point to throw
the manual switch to the SOP,

80
00:04:09,036 --> 00:04:12,566
or the EVA positions is what
they call it, at that time,

81
00:04:13,196 --> 00:04:14,836
the technician was
over the top of it.

82
00:04:14,976 --> 00:04:16,246
He moved the switch.

83
00:04:17,516 --> 00:04:19,546
[Explosion]

84
00:04:20,046 --> 00:04:22,076
[Music]

85
00:04:22,576 --> 00:04:24,936
>> We had a flash fire,
and it consumed the suit,

86
00:04:25,466 --> 00:04:27,456
severely injured one
of the technicians

87
00:04:27,456 --> 00:04:28,646
who was right next to the suit.

88
00:04:29,836 --> 00:04:33,336
>> One of our lessons learned
is that where we had to test

89
00:04:33,336 --> 00:04:37,486
and situated, it didn't
allow for a good egress,

90
00:04:37,816 --> 00:04:40,306
so everyone ran to the
back side of the testing.

91
00:04:40,306 --> 00:04:42,316
Myself, I happened to
be on the opposite side,

92
00:04:42,316 --> 00:04:47,116
so I had good egress to the
door and I made it to the door

93
00:04:47,116 --> 00:04:49,336
and got out, got a
fire extinguisher,

94
00:04:49,336 --> 00:04:52,196
and by then other people
were coming, and we started

95
00:04:52,196 --> 00:04:56,136
to put the fire out, and then
get the rest of our people out.

96
00:04:56,136 --> 00:05:00,626
>> And it was determined that
a very small piece of metal

97
00:05:00,776 --> 00:05:05,156
about the size 8/1000 of an
inch when it's accelerated

98
00:05:05,156 --> 00:05:08,796
in the oxygen flow stream could
create this kind of event.

99
00:05:08,796 --> 00:05:13,316
And so that made a big
impression on me and a lot

100
00:05:13,316 --> 00:05:16,666
of the younger guys in the
insuring ranks at the time

101
00:05:16,666 --> 00:05:19,496
that something that small
can't be overlooked.

102
00:05:19,816 --> 00:05:24,636
And so that framed a lot of our
decision making going forward.

103
00:05:25,256 --> 00:05:27,946
>> The investigation brought
a lot of good things up.

104
00:05:27,946 --> 00:05:32,436
Nowadays we have processes
where we buy off a block,

105
00:05:32,436 --> 00:05:34,946
or the quality person
will buy off a step

106
00:05:34,996 --> 00:05:36,676
so you have this
check and balances.

107
00:05:37,156 --> 00:05:40,176
Those are really good processes
that have been put in place.

108
00:05:40,466 --> 00:05:44,906
Bring in that outside set of
eyes to look at your hardware.

109
00:05:45,306 --> 00:05:47,396
Get that second opinion
of something.

110
00:05:48,226 --> 00:05:51,166
>> If we don't do this
right, the end user,

111
00:05:51,436 --> 00:05:55,206
who a lot of times are sitting
in meetings with us, or friends,

112
00:05:55,206 --> 00:05:57,226
or we see them at
the grocery store,

113
00:05:58,486 --> 00:05:59,946
might pay that ultimate price.

114
00:06:00,696 --> 00:06:03,806
>> When you go in and looking
at your project, who you're task

115
00:06:03,806 --> 00:06:08,966
at hand, look at the hardware
and look at the people.

116

00:06:09,186 --> 00:06:14,116
We all want to go home at the
end of the day healthy and safe.

117
00:06:14,636 --> 00:06:16,956
And that's our priority here.

118
00:06:18,056 --> 00:06:21,776
Yeah, I do have a
quote that I would

119
00:06:21,776 --> 00:06:23,376
like to pass on to everybody.

120
00:06:23,376 --> 00:06:26,166
This is by Winston
Churchill, and it says,

121
00:06:26,166 --> 00:06:29,916
all men make mistakes,
but only wise men learn

122
00:06:29,916 --> 00:06:30,896
from their mistakes.

123
00:06:31,236 --> 00:06:32,976
I think those are some good
words to go forward with.

124
00:06:33,516 --> 00:06:36,716
[Music]

125
00:06:37,216 --> 00:06:39,216
>> While there were
important lessons learned

126
00:06:39,216 --> 00:06:41,336
with the spacesuit development,

127

00:06:41,336 --> 00:06:44,816
the value of EVA itself
was not fully realized

128
00:06:44,816 --> 00:06:46,146
in the early shuttle years.

129
00:06:46,146 --> 00:06:51,576
>> When I came to the
government in the early '80s,

130
00:06:51,576 --> 00:06:55,136
and even before I got
here, the shuttle program,

131
00:06:55,136 --> 00:06:58,156
when they started EVA wasn't
even a part of the program.

132
00:06:58,156 --> 00:07:00,876
The only reason it came in
was for some contingencies.

133
00:07:01,516 --> 00:07:03,926
>> Extravehicular
activity would be necessary

134
00:07:03,926 --> 00:07:06,706
for a manual payload bay
door closing operation.

135
00:07:07,546 --> 00:07:09,696
Although there are
presently no plans

136
00:07:09,696 --> 00:07:12,456
for extravehicular activity
on the first flight.

137
00:07:13,146 --> 00:07:16,796

>> I think we were viewed
by the early leadership

138
00:07:16,796 --> 00:07:18,256
at the time as a risk.

139
00:07:18,836 --> 00:07:20,546
Anytime you go in space
flight, it's a risk,

140
00:07:20,936 --> 00:07:23,976
but then going outside the
vehicle is even a bigger risk.

141
00:07:23,976 --> 00:07:25,226
And so we were sort

142
00:07:25,226 --> 00:07:26,616
of a four-letter word
for a while there.

143
00:07:27,506 --> 00:07:30,246
In the early days, we did
a lot more demonstration

144
00:07:30,246 --> 00:07:32,526
to show you could do
something with EVA.

145
00:07:32,526 --> 00:07:34,616
>> Let it be a big one
small step [inaudible]

146
00:07:35,366 --> 00:07:38,966
but it's a heck of
a big leap for me.

147
00:07:39,826 --> 00:07:42,056
>> Copy that Bruce.

148
00:07:43,716 --> 00:07:44,216
Thank you.

149
00:07:44,216 --> 00:07:46,086
>> And then we were
able to demonstrate

150
00:07:46,166 --> 00:07:50,306
to the program leadership that
we brought to the table an asset

151
00:07:50,366 --> 00:07:52,416
that they really needed.

152
00:07:53,086 --> 00:07:57,176
We had several missions worth of
satellite rescue, where we'd go

153
00:07:57,176 --> 00:08:00,676
out and either repair
or go grab and put back

154
00:08:00,676 --> 00:08:02,836
on the payload data
refurbished on the ground.

155
00:08:03,606 --> 00:08:05,696
Satellites that had issues.

156
00:08:05,786 --> 00:08:09,186
So we have made our mark
in that regard as well.

157
00:08:09,496 --> 00:08:12,606
And so I think that really
helped us in the early days

158
00:08:12,666 --> 00:08:16,606
to go from something that

is to be avoided to an asset

159
00:08:16,666 --> 00:08:17,836
that would be utilized.

160
00:08:17,906 --> 00:08:21,896
>> The EVA's during the early
shuttle years would provide

161
00:08:21,896 --> 00:08:24,636
valuable experience,
as NASA began to plan

162
00:08:24,636 --> 00:08:27,486
for a new project
building a space station.

163
00:08:28,496 --> 00:08:31,036
The mission was to construct
a spacecraft the size

164
00:08:31,036 --> 00:08:34,176
of the football field, with
the worksite in earth orbit.

165
00:08:35,156 --> 00:08:37,406
While robots could move
the big parts together,

166
00:08:37,826 --> 00:08:39,676
the intricate work
of connecting cables

167
00:08:40,046 --> 00:08:44,296
and other fine tasks could
only be done by human hands.

168
00:08:45,146 --> 00:08:48,286
The spotlight was about
to turn once again to EVA,

169
00:08:48,666 --> 00:08:51,636
and prompt the formation
of an EVA office.

170
00:08:52,456 --> 00:08:55,866
>> In the early '90s was
when we had been developing

171
00:08:56,426 --> 00:08:57,266
station freedom.

172
00:08:57,816 --> 00:09:02,206
But what we began to understand
with the agency and center began

173
00:09:02,206 --> 00:09:08,086
to understand, was the
complexity of the problem

174
00:09:08,086 --> 00:09:12,006
or the challenge in assembling
what is now the International

175
00:09:12,006 --> 00:09:12,826
Space Station.

176
00:09:13,536 --> 00:09:16,726
And there was a study I
recall in the early '90s,

177
00:09:16,726 --> 00:09:19,916
the Fisher-Price study.

178
00:09:19,916 --> 00:09:21,066
>> Our reporters indicated

179
00:09:21,106 --> 00:09:22,956
that the requirements

are significant,

180
00:09:23,196 --> 00:09:25,156
but we believe not
insurmountable.

181
00:09:26,046 --> 00:09:29,006
In the final portion of our
report, we have listed a series

182
00:09:29,006 --> 00:09:31,266
of recommendations
that can be implemented

183
00:09:31,566 --> 00:09:33,176
with decreased the
total requirements

184
00:09:33,176 --> 00:09:35,846
for space station
maintenance, encourage the use

185
00:09:35,846 --> 00:09:38,706
of multiple systems, such
as suited astronauts.

186
00:09:39,146 --> 00:09:41,376
>> We were heading into this
era where we're going to go off

187
00:09:41,376 --> 00:09:43,516
and do a significant
amount of EVAs to go

188
00:09:43,516 --> 00:09:46,726
and build the space
station, and the number

189
00:09:46,726 --> 00:09:48,616
of EVAs kept growing

dramatically.

190
00:09:48,846 --> 00:09:51,426
>> It was, I guess
what I'd say, alarming.

191
00:09:52,776 --> 00:09:55,286
And so I think we begin to
understand that we needed

192
00:09:55,476 --> 00:09:58,316
to focus on EVA and
how were we going

193
00:09:58,466 --> 00:10:01,356
to do extravehicular
activity in the space walks,

194
00:10:01,356 --> 00:10:04,746
and how were we going to
organize our approach to that.

195
00:10:05,726 --> 00:10:09,516
>> This was going to take a
major step up in our ability

196
00:10:09,516 --> 00:10:13,786
to perform EVAs, and so because
of that, we started doing kind

197
00:10:13,786 --> 00:10:18,586
of sample type of practice EVAs
during the shuttle program,

198
00:10:18,846 --> 00:10:23,796
where we use some of the types
of hardware that we might see

199
00:10:23,796 --> 00:10:25,916
on space station,

to see if it works.

200
00:10:26,376 --> 00:10:27,636
>> We learned a lot in that era.

201
00:10:27,636 --> 00:10:30,396
We learned that it's hard.

202
00:10:30,496 --> 00:10:33,766
I mean, assembling things in
the vacuum of space is hard,

203
00:10:33,766 --> 00:10:35,886
and you have to develop
a lot of tools.

204
00:10:35,886 --> 00:10:38,776
You have to get worksite
stabilization.

205
00:10:38,776 --> 00:10:39,776
All those kind of things.

206
00:10:39,976 --> 00:10:43,466
It think that precipitated
the formation of an office

207
00:10:43,466 --> 00:10:46,926
from headquarters to say, okay,
this is going to be so important

208
00:10:47,026 --> 00:10:49,956
that we need to go ahead and
stand up a specific office

209
00:10:50,386 --> 00:10:54,716
to really focus on what it's
going to take as a discipline

210

00:10:54,846 --> 00:10:58,596
to make sure that these
EVAs are successful.

211
00:10:59,226 --> 00:11:03,176
>> They took that segment
out of space shuttle,

212
00:11:03,826 --> 00:11:05,386
stood at the project office,

213
00:11:05,386 --> 00:11:08,486
and then all the work may have
still be working engineering

214
00:11:08,486 --> 00:11:10,746
and space live sciences,
the authority went

215
00:11:10,746 --> 00:11:12,246
through the EVA project office.

216
00:11:12,346 --> 00:11:17,896
>> I think what happened was is
basically the management took

217
00:11:18,016 --> 00:11:22,756
ownership of EVA, and we kind
of forced it upon both shuttle

218
00:11:22,756 --> 00:11:24,206
and station who were
are customers

219
00:11:24,206 --> 00:11:26,816
at the time, to do trades.

220
00:11:27,126 --> 00:11:30,926
To go off and acknowledge
the risk associated with EVA

221
00:11:30,926 --> 00:11:36,716
and compare that to the required
design changes for all aspects

222
00:11:36,716 --> 00:11:38,806
of the development
of the space station.

223
00:11:38,806 --> 00:11:42,996
Do you want to go and
develop in the design change,

224
00:11:42,996 --> 00:11:44,936
or do you want to have to go and
do two or three additional EVAs

225
00:11:44,936 --> 00:11:47,376
with the risk associated
with doing those EVAs.

226
00:11:47,376 --> 00:11:49,326
>> Not just thinking about,
okay, I've got to build a piece

227
00:11:49,326 --> 00:11:51,926
of hardware, but how is that
piece of hardware, that tool,

228
00:11:51,926 --> 00:11:54,696
going to interface with the
piece of station hardware?

229
00:11:55,246 --> 00:11:58,116
Not only that interface,
but that task.

230
00:11:58,116 --> 00:11:59,316
How long is that going to take?

231
00:11:59,736 --> 00:12:03,116
How does that interact and play
with the capability of tools,

232
00:12:03,116 --> 00:12:06,986
and suit, and what impacts does
it have on the station program.

233
00:12:07,026 --> 00:12:08,126
What do they need
to account for?

234
00:12:08,846 --> 00:12:10,366
What changes, perhaps,
do they need to make

235
00:12:10,416 --> 00:12:11,496
in their hardware design?

236
00:12:12,306 --> 00:12:15,366
All that now centralized and
focused on one organization.

237
00:12:15,396 --> 00:12:18,856
I think it, yeah, I think I
helped with the communication

238
00:12:18,856 --> 00:12:20,906
and with the planning
in the inner duration.

239
00:12:21,496 --> 00:12:23,656
>> The design of the
space station evolved

240
00:12:23,746 --> 00:12:25,996
into the international
space station.

241

00:12:26,706 --> 00:12:28,576
But one concept remained
the same.

242
00:12:29,136 --> 00:12:31,246
Station assembly was
going to rely heavily

243
00:12:31,286 --> 00:12:32,806
on spacewalking astronauts.

244
00:12:33,806 --> 00:12:35,706
The Spike [phonetic],
an EVA activity,

245
00:12:36,116 --> 00:12:38,956
became known as the Wall of EVA.

246
00:12:39,936 --> 00:12:43,046
One of the first questions the
EVA office would address was

247
00:12:43,206 --> 00:12:46,556
what those astronauts would be
wearing for the assembly tasks.

248
00:12:47,346 --> 00:12:48,646
>> The start of a
space station freedom,

249
00:12:49,096 --> 00:12:50,896
and then larger be an
international space station,

250
00:12:50,996 --> 00:12:53,396
the thought was, just like
for Apollo, just like we did

251
00:12:53,396 --> 00:12:54,756
for shuttle, just

like for Gemini,

252
00:12:54,756 --> 00:12:55,826
they each had their
own spacesuit.

253
00:12:56,416 --> 00:12:57,426
And so the thought was, hey,

254
00:12:57,426 --> 00:13:00,456
let's go build a new
spacesuit and, obviously,

255
00:13:00,526 --> 00:13:05,016
budget cuts began to happen
and so for whatever reason,

256
00:13:05,106 --> 00:13:07,136
the decision was made that
EMU will be good enough.

257
00:13:08,376 --> 00:13:13,716
>> So a station came into focus,
the EMU system was getting close

258
00:13:13,716 --> 00:13:16,776
to its design limits; 15 years.

259
00:13:17,516 --> 00:13:23,256
>> And when you got to those
years in '92, '93, '94 and '95,

260
00:13:23,256 --> 00:13:25,466
and you began to look at the
systems, well they weren't used

261
00:13:25,466 --> 00:13:26,576
as much as they expected.

262

00:13:26,706 --> 00:13:29,416
And the reality was,
at the end of 15 years,

263
00:13:29,416 --> 00:13:31,386
metal doesn't just
suddenly turn to dust.

264
00:13:32,446 --> 00:13:37,616
And so we set about a program
called Surety EMU Availability.

265
00:13:38,256 --> 00:13:41,496
How are we going to assure
that the EMUs are available now

266
00:13:41,616 --> 00:13:44,276
for station to complete
station assembly?

267
00:13:44,786 --> 00:13:47,086
>> We did not go out and
build a new spacesuit.

268
00:13:47,086 --> 00:13:48,896
And I think a lot of people
probably don't recognize

269
00:13:48,926 --> 00:13:51,826
that this is essentially the
suit we use today is the same

270
00:13:51,826 --> 00:13:54,096
suit that was designed in 1979.

271
00:13:54,486 --> 00:13:56,956
We've made some enhancements,
but for the most part,

272
00:13:56,956 --> 00:13:58,026

it's the exact same suit.

273
00:13:58,846 --> 00:14:00,616
And so there were a lot of
things that we've done trying

274
00:14:00,716 --> 00:14:02,586
to make it a little bit better.

275
00:14:02,956 --> 00:14:05,506
The current configuration
suit is almost 30 years old.

276
00:14:05,736 --> 00:14:06,486
The way it looks.

277
00:14:07,286 --> 00:14:10,156
But underneath the covering,
from all of the lessons learned,

278
00:14:10,156 --> 00:14:11,646
there's a lot of differences.

279
00:14:11,706 --> 00:14:14,416
>> We changed out some of
the components from aluminum

280
00:14:14,416 --> 00:14:18,856
to stainless steel, which lasts
a lot longer, and much more easy

281
00:14:18,856 --> 00:14:20,466
to refurbish on the ground.

282
00:14:21,046 --> 00:14:24,536
We added some components
where things were needed.

283
00:14:24,726 --> 00:14:27,796

Upgraded the technology and the
electronics world especially.

284
00:14:28,406 --> 00:14:31,096
Nobody has a computer that's
40 years old on the desktop.

285
00:14:31,226 --> 00:14:35,076
>> And so we went through
a series of redesigns

286
00:14:35,076 --> 00:14:37,686
with the gloves, trying
to make them more mobile.

287
00:14:37,766 --> 00:14:40,196
They give you better dexterity.

288
00:14:40,826 --> 00:14:44,646
Ease, the physical burden on
the astronaut and being able

289
00:14:44,746 --> 00:14:48,256
to manipulate his
indices of his hand.

290
00:14:49,046 --> 00:14:52,836
And adding something to protect
against the thermal extremes.

291
00:14:52,836 --> 00:14:54,776
And so we added some heaters
in the gloves as well.

292
00:14:55,826 --> 00:14:58,376
>> Yeah. A lot of credit
goes to the early designers

293
00:14:58,376 --> 00:15:02,476
and developers of that '70s

era of technology spacesuit.

294
00:15:03,216 --> 00:15:05,506
They built into it
a lot of margin

295
00:15:05,506 --> 00:15:06,866
that we are living on today.

296
00:15:06,996 --> 00:15:11,246
You never know when you build a
piece of hardware, the guys back

297
00:15:11,246 --> 00:15:14,466
in the '70s, and gals,
that built the design

298
00:15:14,466 --> 00:15:17,496
and tested the original
in use, you never know

299
00:15:17,496 --> 00:15:18,596
where that hardware's
going to end up.

300
00:15:18,596 --> 00:15:20,526
And you never know how
it's going to be used.

301
00:15:21,586 --> 00:15:23,306
So when you're at
your requirements,

302
00:15:23,346 --> 00:15:27,466
and you design your hardware,
remember it may be used

303
00:15:27,616 --> 00:15:33,216
in an environment you never
anticipated it being used in.

304
00:15:33,216 --> 00:15:36,396
>> While the suit was upgraded,
the EVA office prepared

305
00:15:36,396 --> 00:15:38,326
for station assembly
in other ways.

306
00:15:38,576 --> 00:15:43,476
One key to mission success was
to be involved with the design

307
00:15:43,476 --> 00:15:46,616
of the station hardware the
astronauts would be handling.

308
00:15:47,426 --> 00:15:49,656
>> I think space station
is an excellent example

309
00:15:49,656 --> 00:15:53,096
of how EVA was involved
early in Austin

310
00:15:53,166 --> 00:15:54,496
in the design of the vehicle.

311
00:15:54,766 --> 00:15:58,756
We, NASA, understood going
into the space station program

312
00:15:59,116 --> 00:16:01,156
that there was going to
be this wall of EVAs.

313
00:16:01,156 --> 00:16:04,396
We were going to need hours
of EVA crew member time

314
00:16:04,526 --> 00:16:05,936
to build the space station.

315
00:16:06,686 --> 00:16:09,826
Because we knew that going
in, the vehicle was designed

316
00:16:10,626 --> 00:16:13,606
for that work to occur
safely and successfully.

317
00:16:13,966 --> 00:16:16,356
There are translation
paths to the worksites.

318
00:16:16,946 --> 00:16:19,796
The connectors and the cables
that the EVA crew members had

319
00:16:19,876 --> 00:16:22,126
to plug in from element
to element,

320
00:16:22,126 --> 00:16:23,606
as each of them were attached.

321
00:16:24,306 --> 00:16:26,396
Those connectors were
designed to be handled

322
00:16:26,396 --> 00:16:27,756
and operated by crew members.

323
00:16:28,406 --> 00:16:29,096
We tested it.

324
00:16:29,226 --> 00:16:34,156
We found some of the hiccups in
the design, and then built tools

325
00:16:34,156 --> 00:16:37,116
to help the EVA crew
members actually whatever

326
00:16:37,116 --> 00:16:39,496
that mechanism was
that wasn't as easy

327
00:16:39,656 --> 00:16:41,366
as had originally
been conceived.

328
00:16:41,946 --> 00:16:46,626
So space station benefitted
because they planned for EVA

329
00:16:46,626 --> 00:16:48,886
to be a critical
part of the assembly.

330
00:16:49,516 --> 00:16:53,546
[Music]

331
00:16:54,046 --> 00:16:56,946
>> Station assembly was
underway, with EVA taking

332
00:16:57,016 --> 00:16:59,276
on their tasks, mission
by mission.

333
00:17:00,156 --> 00:17:02,946
The most complex engineering
feat conducted in space,

334
00:17:03,266 --> 00:17:04,706
the construction of the station,

335

00:17:04,706 --> 00:17:06,536
was bound to have
its challenges.

336
00:17:07,546 --> 00:17:11,206
To overcome problems, the
EVA office worked together

337
00:17:11,326 --> 00:17:13,496
with other teams.

338
00:17:13,536 --> 00:17:14,936
>> A lot of EVA who
[inaudible] situation,

339
00:17:15,006 --> 00:17:19,486
sometimes it just takes a
little more effort on the part

340
00:17:19,486 --> 00:17:21,506
of the crew member, and
the ground to overcome it,

341
00:17:21,506 --> 00:17:22,656
and sometimes we stop.

342
00:17:22,656 --> 00:17:24,846
We come inside, and
we think about it,

343
00:17:24,846 --> 00:17:27,906
then we go out another EVA
and we'd tackle it again.

344
00:17:27,906 --> 00:17:32,556
>> On STS-97, which was the
Station Assembly 4A flight,

345
00:17:32,556 --> 00:17:35,406
there was a problem with the

deployment of the solar rays,

346
00:17:35,886 --> 00:17:40,156
and so they put a small team of
us, and it consisted of people

347
00:17:40,226 --> 00:17:43,686
from EVA office, from
MOD, from the crew office,

348
00:17:43,686 --> 00:17:45,366
from engineering, from safety,

349
00:17:45,836 --> 00:17:48,406
and a [inaudible]
representative.

350
00:17:48,406 --> 00:17:51,236
Nobody was worried about
what organization each other

351
00:17:51,236 --> 00:17:51,636
was from.

352
00:17:51,636 --> 00:17:54,386
Nobody was worried about
what badge we were wearing.

353
00:17:54,456 --> 00:17:56,206
And that's not the
only time it happens.

354
00:17:56,206 --> 00:17:59,636
It happens countless times
over the ISS assembly.

355
00:17:59,706 --> 00:18:01,766
>> We try to always think
about what can go wrong,

356
00:18:01,766 --> 00:18:03,746
but there's probably
infinite number

357
00:18:03,746 --> 00:18:05,116
of things that can go wrong.

358
00:18:05,116 --> 00:18:06,736
But when these things
do go wrong,

359
00:18:06,736 --> 00:18:08,986
we pull in these
teams in real time.

360
00:18:09,056 --> 00:18:11,676
>> If you think back to,
kind of the Apollo 13 movie.

361
00:18:11,676 --> 00:18:15,076
You know, throw in everything
on the table that's available

362
00:18:15,126 --> 00:18:18,526
for them to use, and that
kind of stuff really happens,

363
00:18:18,526 --> 00:18:20,236
and so you have all
these different people

364
00:18:20,346 --> 00:18:23,256
with a common goal, but
totally different perspectives

365
00:18:23,856 --> 00:18:24,856
coming together.

366
00:18:25,566 --> 00:18:27,496

>> Back, I believe
it was STS-120,

367
00:18:27,896 --> 00:18:30,586
while they re-opened one solar
array, the array became stuck.

368
00:18:30,856 --> 00:18:31,996
It tore part of the array

369
00:18:33,126 --> 00:18:35,826
and we never thought we would
go do EVAs on the solar rays.

370
00:18:36,036 --> 00:18:39,326
It's an area that has a lot
of electrical conductivity.

371
00:18:40,106 --> 00:18:41,146
It's a hazardous.

372
00:18:41,146 --> 00:18:42,776
It's a shock hazard
for the crew member.

373
00:18:43,626 --> 00:18:46,406
We never thought we would do it
in a very short period of time,

374
00:18:46,606 --> 00:18:50,986
we sent him up on the
isle, on the boom,

375
00:18:50,986 --> 00:18:56,856
with tools that had been kept
on, taped over, and we went

376
00:18:56,856 --> 00:18:58,166
and repaired the array.

377
00:18:58,166 --> 00:18:59,086
And we did that pretty quick.

378
00:18:59,696 --> 00:19:03,216
>> We've had, on the
order of over 100 EVAs

379
00:19:03,216 --> 00:19:07,226
to assemble a space station,
and some years 20 or more EVAs,

380
00:19:07,926 --> 00:19:10,706
and there's no way
we could have done

381
00:19:10,766 --> 00:19:13,716
that without all these
organizations working together

382
00:19:13,716 --> 00:19:15,936
as well as they did.

383
00:19:16,156 --> 00:19:18,706
>> That's really the
fun part of the job.

384
00:19:18,796 --> 00:19:22,936
That's the fun part of the
job is when you line space

385
00:19:23,316 --> 00:19:25,166
and things don't work like
you thought they should,

386
00:19:26,636 --> 00:19:28,586
and then you've got a
very quickly, as a team,

387
00:19:28,866 --> 00:19:30,916

come together and
solve the problem.

388
00:19:31,516 --> 00:19:39,656
[Music]

389
00:19:40,156 --> 00:19:43,226
>> Station assembly and the
wall of EVA taught many lessons

390
00:19:43,356 --> 00:19:45,976
to NASA, but even as
this work was underway,

391
00:19:45,976 --> 00:19:49,526
a new set of tasks had to be
addressed by the EVA office.

392
00:19:49,896 --> 00:19:52,156
How to maintain the
space station.

393
00:19:53,046 --> 00:19:55,246
>> Well the station was
a very good test bed

394
00:19:55,326 --> 00:19:56,566
because in the shuttle era,

395
00:19:57,146 --> 00:20:01,666
shuttle flights were relatively
short, 7, 10, 14 days,

396
00:20:01,666 --> 00:20:04,866
and so if something went wrong,
you always had the option

397
00:20:04,866 --> 00:20:07,166
to come home, and then you
always had the option that,

398
00:20:07,166 --> 00:20:08,486
well, we'll just wait and fix

399
00:20:08,486 --> 00:20:09,916
that when the shuttle
comes back and lands.

400
00:20:10,706 --> 00:20:14,926
Well, ISS doesn't land,
and so if something breaks,

401
00:20:14,926 --> 00:20:18,636
you need to fix it up there in
space, so the EVA role again,

402
00:20:18,636 --> 00:20:21,046
it becomes much more important.

403
00:20:21,166 --> 00:20:24,196
>> Some of the hardware that's
just been launched is just

404
00:20:24,196 --> 00:20:28,026
starting its life, where some
of its already been 12 years

405
00:20:28,026 --> 00:20:31,996
on orbit, and is now getting
to that critical juncture

406
00:20:31,996 --> 00:20:34,946
where from a certification
standpoint,

407
00:20:34,946 --> 00:20:37,216
it might be at the
end of the life.

408

00:20:37,216 --> 00:20:41,006
>> Some of the hardware on
the station is critical enough

409
00:20:41,006 --> 00:20:44,536
that should it fail, the station
would have to be abandoned.

410
00:20:44,926 --> 00:20:46,236
To avoid this scenario,

411
00:20:46,236 --> 00:20:50,746
NASA identified critical
contingency EVA spacewalks

412
00:20:50,816 --> 00:20:52,516
which could be conducted
in short order

413
00:20:52,816 --> 00:20:55,346
to fix any failed hardware.

414
00:20:55,406 --> 00:20:58,566
Any crew at any time
would have to be prepared

415
00:20:58,566 --> 00:21:01,056
to conduct these emergency EVAs.

416
00:21:01,606 --> 00:21:05,726
>> What we did was we went
through step-by-step each

417
00:21:05,726 --> 00:21:09,486
of those failures, and kind of
came up with a little packet

418
00:21:09,666 --> 00:21:12,716
of a straw man of what's
your procedures would be,

419
00:21:12,946 --> 00:21:14,516
or what your tools
were going to be.

420
00:21:14,686 --> 00:21:18,746
And by going through that
process, we had a situation

421
00:21:18,746 --> 00:21:22,966
where one of those items
did fail, and we were able

422
00:21:23,106 --> 00:21:26,486
to quickly get out
the door and go ahead

423
00:21:26,486 --> 00:21:28,676
and successfully take
care of that problem.

424
00:21:28,916 --> 00:21:31,406
>> And so EVA becomes
an integral part

425
00:21:31,856 --> 00:21:34,776
of station operations and
station maintenance and repair,

426
00:21:35,036 --> 00:21:39,356
and then going to our further
exploration destinations,

427
00:21:39,356 --> 00:21:42,286
it's even more important
because we're going to Mars.

428
00:21:43,046 --> 00:21:46,166
Again, EVA is going to
have to play a role in that

429
00:21:46,206 --> 00:21:48,426
because the ship on its halfway

430
00:21:48,426 --> 00:21:50,326
to Mars can't come
home for repairs.

431
00:21:50,326 --> 00:21:52,476
We're going to have
to keep it going,

432
00:21:52,476 --> 00:21:55,926
and then do what we can while
it's out there in space.

433
00:21:55,926 --> 00:21:58,446
>> To conduct maintenance
EVAs on the station,

434
00:21:58,446 --> 00:22:02,636
one assumed the astronauts have
a perfectly working spacesuit.

435
00:22:02,636 --> 00:22:05,806
A new challenge to overcome in
an era of long-term exploration.

436
00:22:05,806 --> 00:22:08,346
How to fix this spacesuit
in space.

437
00:22:08,346 --> 00:22:10,356
>> The guys are all suited up.

438
00:22:10,356 --> 00:22:15,016
We have a little leak
problem with Steve's suit

439

00:22:15,566 --> 00:22:18,726
and enough being traced
to an O-ring on one

440
00:22:19,996 --> 00:22:23,576
of the lithium hydroxide
canisters we use

441
00:22:24,286 --> 00:22:26,916
to scrub the CO-2 in that.

442
00:22:26,916 --> 00:22:29,976
>> Yeah. Bars not
really working to stay

443
00:22:30,026 --> 00:22:30,706
out of there, but [crosstalk].

444
00:22:30,826 --> 00:22:33,286
>> That is our smoking
gun for a leaky suit.

445
00:22:33,286 --> 00:22:35,286
>> Hopefully that'll
get out of the way too.

446
00:22:35,456 --> 00:22:41,196
>> I can tell you something that
really fascinates me is just

447
00:22:41,196 --> 00:22:45,436
when we do have a failure
of any kind on the EMU,

448
00:22:45,436 --> 00:22:48,436
it's kind of like watching a
piece of food drop to the ground

449
00:22:48,436 --> 00:22:50,126
at a picnic and the ants

pssss [laughing] go get it.

450
00:22:50,226 --> 00:22:55,626
That's sort of what happens when
we have a failure of something

451
00:22:55,706 --> 00:22:58,576
like the EMU because
that's the crew's lifeline.

452
00:22:58,576 --> 00:22:59,396
That's what keeps them.

453
00:22:59,396 --> 00:23:02,066
It's really our little
mini spacecraft.

454
00:23:02,066 --> 00:23:05,846
And so that's one of the most
important things that we have

455
00:23:05,846 --> 00:23:08,446
in EVA, and so when
something does go wrong,

456
00:23:08,446 --> 00:23:13,456
you see this team come
together like those ants

457
00:23:13,456 --> 00:23:18,576
and just immediately
start working the problem.

458
00:23:18,576 --> 00:23:23,066
>> Every [inaudible] opportunity
and sometimes you're forced

459
00:23:23,146 --> 00:23:24,226
by necessity to do things

460
00:23:24,226 --> 00:23:27,226
that you never thought
that you would do.

461
00:23:27,226 --> 00:23:29,316
>> We had a situation
where shortly

462
00:23:29,316 --> 00:23:32,926
after the Columbia accident
and we then weren't' able

463
00:23:33,146 --> 00:23:39,196
to launch anything, we had
one of our suits go down.

464
00:23:39,286 --> 00:23:43,876
How are we going to go
address this failure?

465
00:23:43,876 --> 00:23:50,036
We can't just bring it down
now and launch up another one.

466
00:23:50,036 --> 00:23:53,926
>> The EVA office
confronted a first.

467
00:23:53,926 --> 00:23:57,136
The only way to have
the suit fixed was

468
00:23:57,136 --> 00:24:01,316
for the expedition crew
to crack open the suit

469
00:24:01,316 --> 00:24:09,586
and do the repairs themselves
in orbit, in microgravity,

470
00:24:09,706 --> 00:24:12,836
with only the tools
already on board.

471
00:24:12,946 --> 00:24:16,516
>> Because we were going to have
to do some things with the EMU

472
00:24:16,516 --> 00:24:20,766
that weren't really
designed to be done on orbit.

473
00:24:20,766 --> 00:24:23,546
They were designed to be
done in a lab by technicians,

474
00:24:23,546 --> 00:24:26,976
and we were going to have to
take pieces out of the EMU

475
00:24:26,976 --> 00:24:28,986
that weren't really
designed to be taken out.

476
00:24:28,986 --> 00:24:32,256
>> Yeah. But when we
built this thing in '79,

477
00:24:32,256 --> 00:24:32,956
you never would have thought

478
00:24:32,956 --> 00:24:39,016
of having a crew member break
it open and attempt to fix it.

479
00:24:39,016 --> 00:24:44,896
That was just not something that
they probably even conceived of.

480

00:24:44,896 --> 00:24:49,546
>> Ground crews got to
work figuring out how

481
00:24:49,546 --> 00:24:51,376
to best show the
astronauts the procedures

482
00:24:51,666 --> 00:24:53,186
for conducting the suit repairs.

483
00:24:53,436 --> 00:24:55,156
>> After we rung out
all the procedures

484
00:24:55,326 --> 00:25:00,026
and got all the steps
just the way we liked it,

485
00:25:00,026 --> 00:25:04,786
we videotaped it and we
shipped it up to the crew,

486
00:25:04,876 --> 00:25:10,206
and by having them watch
the procedure being done,

487
00:25:10,276 --> 00:25:11,206
it helped tremendously.

488
00:25:11,206 --> 00:25:14,166
>> In addition to learning how
to maintain the suit in orbit,

489
00:25:14,206 --> 00:25:17,416
the EVA office has also taken
great measures learning how

490
00:25:17,536 --> 00:25:18,626
to protect it.

491
00:25:18,626 --> 00:25:24,456
Working on the station can cause
wear and tear on suit gloves.

492
00:25:24,456 --> 00:25:27,716
>> If that vehicle has sharp
edges and pointy surfaces,

493
00:25:27,716 --> 00:25:30,506
and then the glove
is compromised,

494
00:25:30,506 --> 00:25:32,736
a cut glove could be a
catastrophic failure.

495
00:25:32,986 --> 00:25:34,646
At the very least,
it's a critical failure

496
00:25:34,676 --> 00:25:35,336
and you terminate your EVA

497
00:25:35,366 --> 00:25:36,986
and you did not accomplish the
objectives that caused you to go

498
00:25:37,016 --> 00:25:37,766
out the hatch in
the first place.

499
00:25:37,796 --> 00:25:38,906
>> Something we've been
doing since the shuttle days,

500
00:25:38,936 --> 00:25:40,256
but we have a team of folks
that work really closely

501
00:25:40,286 --> 00:25:41,726
with the crew, and they go in
and they look for sharp edges

502
00:25:41,756 --> 00:25:43,346
on any of the surfaces that
are going to be exposed to try

503
00:25:43,376 --> 00:25:44,246
to avoid getting
up on the station

504
00:25:44,276 --> 00:25:45,056
and accidently cutting a suit.

505
00:25:45,086 --> 00:25:46,106
>> We have fixed
hardware late in the flow.

506
00:25:46,136 --> 00:25:46,616
We file down sharps.

507
00:25:46,646 --> 00:25:48,146
We take threads of screws that
are protruding through structure

508
00:25:48,176 --> 00:25:49,196
and put a cap over
the exposed threads

509
00:25:49,226 --> 00:25:50,636
so that a crew member doesn't
reach behind the structure

510
00:25:50,666 --> 00:25:51,566
and cut their finger
on those threads.

511
00:25:51,596 --> 00:25:53,066

I think the lesson we've learned
is sharp edges are very real,

512
00:25:53,096 --> 00:25:53,996
and it's crucial
in the design phase

513
00:25:54,026 --> 00:25:55,076
and in the delivery
timeframe to verify

514
00:25:55,106 --> 00:25:55,976
that your sharp edges
don't exist.

515
00:25:56,516 --> 00:25:59,546
[Music]

516
00:26:00,046 --> 00:26:02,826
>> Not all sharp edges
are fixable on the ground.

517
00:26:03,986 --> 00:26:08,456
Some hazards are created, simply
by the station being exposed

518
00:26:08,456 --> 00:26:09,586
to the harshness of space.

519
00:26:10,496 --> 00:26:12,186
>> EVA because you're
putting a person

520
00:26:12,186 --> 00:26:15,116
into a pressure suit
that's pure oxygen.

521
00:26:16,036 --> 00:26:18,056
That comes with its
own unique hazards.

522
00:26:18,176 --> 00:26:22,096
And then you put them out into
a vacuum, with the space station

523
00:26:22,426 --> 00:26:25,576
that is supposed to be designed
to not have sharp edges,

524
00:26:25,656 --> 00:26:29,906
but it's now been out there
for, some parts of it,

525
00:26:29,976 --> 00:26:34,906
for almost 15 years,
and has been paltered

526
00:26:34,906 --> 00:26:37,016
by micrometeoroids, and
we're finding sharp edges

527
00:26:37,016 --> 00:26:38,586
on the outside of the station.

528
00:26:38,586 --> 00:26:41,556
Hand rails and translation pads
we found these little nicks.

529
00:26:42,396 --> 00:26:45,236
So that is one area that
we have to be concerned

530
00:26:45,236 --> 00:26:49,216
about for the future
station is the environment

531
00:26:49,296 --> 00:26:50,676
that we're working in.

532

00:26:50,856 --> 00:26:53,096
Micrometeoroids could
turn parts of the station

533
00:26:53,096 --> 00:26:55,966
from an EVA perspective in
areas that we don't want to go.

534
00:26:56,516 --> 00:27:01,806
[Music]

535
00:27:02,306 --> 00:27:04,476
The world at EVA
can be demanding,

536
00:27:04,756 --> 00:27:07,736
requiring sustained
concentration and attention

537
00:27:07,736 --> 00:27:12,406
to detail, adaptability,
and a sense of urgency.

538
00:27:12,406 --> 00:27:15,156
Through it all, one of the
greatest lessons learned

539
00:27:15,156 --> 00:27:17,836
in EVA is how to work
under these conditions.

540
00:27:18,096 --> 00:27:20,876
>> I call it the
Allen Flynt era.

541
00:27:20,876 --> 00:27:24,216
And as a manager, as he
came in, and as he moved

542
00:27:24,216 --> 00:27:27,096

up into the supervisory
roles, and then as the head

543
00:27:27,096 --> 00:27:29,076
of our office, he kind

544
00:27:29,076 --> 00:27:31,876
of instilled what we call
a family first, work hard,

545
00:27:31,876 --> 00:27:33,666
play hard, kind of environment.

546
00:27:34,126 --> 00:27:37,276
>> And one thing is family
oriented, I think of fun.

547
00:27:37,396 --> 00:27:39,306
I think of comfortable.

548
00:27:39,306 --> 00:27:42,886
Of an ability to have honest
and open communications.

549
00:27:43,326 --> 00:27:45,926
>> See, I meet large
organizations you potentially

550
00:27:45,926 --> 00:27:49,216
can fall into this thing where
people are protecting, I guess,

551
00:27:49,516 --> 00:27:51,556
their information, which
protects their power.

552
00:27:51,776 --> 00:27:54,396
In our office, I feel like
you were, again, kind of being

553
00:27:54,396 --> 00:27:56,836
that right size that's
almost that family size.

554
00:27:56,926 --> 00:27:59,696
So everybody in the
family talks [inaudible].

555
00:27:59,896 --> 00:28:02,796
>> Well from the context that
we don't recognize so much

556
00:28:02,796 --> 00:28:06,736
who each person works for as
much as the fact that we're EVA.

557
00:28:06,736 --> 00:28:08,306
That we're supporting EVA.

558
00:28:08,306 --> 00:28:08,506
Yeah.

559
00:28:09,446 --> 00:28:11,746
>> So, yeah, I think it just
helps set that positive tone

560
00:28:11,746 --> 00:28:14,666
which makes that difficult
time easier to manage.

561
00:28:14,886 --> 00:28:17,996
>> And it's a trusting
environment.

562
00:28:18,656 --> 00:28:20,086
You get the best out of people.

563
00:28:20,216 --> 00:28:23,246
People are excited

to be a part of that.

564
00:28:23,246 --> 00:28:25,326
It helps you, I think,
establishing a [inaudible],

565
00:28:25,566 --> 00:28:28,786
which I felt like we
had on the EVA office.

566
00:28:29,426 --> 00:28:31,116
We were able to take
an organization

567
00:28:31,186 --> 00:28:32,816
where sometimes people
were looking to leave,

568
00:28:32,996 --> 00:28:36,296
and creating an organization
where people were wanting

569
00:28:36,296 --> 00:28:41,656
to come to the, which is
a nice problem to have.

570
00:28:42,686 --> 00:28:45,166
>> The importance of
EVA is well documented.

571
00:28:46,816 --> 00:28:49,076
Having human hands
present for exploring,

572
00:28:50,506 --> 00:28:52,396
building, maintaining.

573
00:28:52,556 --> 00:28:58,136
As human space flight continues,
new technologies, new ideas,

574
00:28:58,656 --> 00:29:02,056
and new processes will be
used to pursue exploration.

575
00:29:03,526 --> 00:29:06,506
But the success of these
future journeys will build

576
00:29:06,756 --> 00:29:08,456
on the lessons learned today.

577
00:29:08,556 --> 00:29:11,926
Understanding of what worked

578
00:29:12,496 --> 00:29:14,866
and what didn't work
will benefit those

579
00:29:15,486 --> 00:29:17,176
who are willing to listen.

580
00:29:18,436 --> 00:29:19,696
>> And so looking forward,

581
00:29:19,696 --> 00:29:22,486
whether we're designing EVA
system or as an EVA team,

582
00:29:22,896 --> 00:29:27,676
or part of a program that's
developing a new system

583
00:29:27,936 --> 00:29:30,716
in spacecraft, think
about what can go wrong.

584
00:29:31,696 --> 00:29:34,156
>> These future missions

with constrained budgets,

585
00:29:34,696 --> 00:29:36,426
constrained resources,
people say,

586
00:29:36,496 --> 00:29:39,816
well maybe I'll add
EVA later if I need it.

587
00:29:40,226 --> 00:29:43,756
But we're constantly struggling
to get people to understand

588
00:29:43,756 --> 00:29:46,206
that it's not just
a nice to have.

589
00:29:46,456 --> 00:29:49,926
You're going to need it,
whether you realize it or not.

590
00:29:51,096 --> 00:29:54,856
>> When shuttle got
started, we just left Apollo

591
00:29:54,856 --> 00:29:57,136
in the rearview mirror where EVA
was the reasons we were going

592
00:29:57,306 --> 00:29:58,086
to the moon.

593
00:29:59,726 --> 00:30:01,406
For all those discoveries
that we were making.

594
00:30:01,886 --> 00:30:05,356
And in our future, we'll
be back into an environment

595
00:30:05,356 --> 00:30:07,836
where discovery is
the main thing,

596
00:30:08,236 --> 00:30:11,456
and you need human aspect
to do that discovery.

597
00:30:12,346 --> 00:30:15,116
So EVA will be again,
sort of an aspect

598
00:30:15,116 --> 00:30:17,746
of that exploration
phase in our future.

599
00:30:18,516 --> 00:30:23,216
So I think we did take it to an
area that it's a core competency

600
00:30:23,216 --> 00:30:24,576
of what we do here at NASA.

601
00:30:25,156 --> 00:30:28,916
And to the credit of all the
folks that are in the community

602
00:30:28,956 --> 00:30:32,146
that worked each
one, one at a time,