Resiliency is no Accident

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Session K6

Thesis

Resiliency only occurs with the proper investment, architecture, planning, training, and execution.

In this session, we'll examine a very well-known non-IT incident that demonstrates several key factors in 'being resilient' and discuss how these can be a part of our systems and our careers.

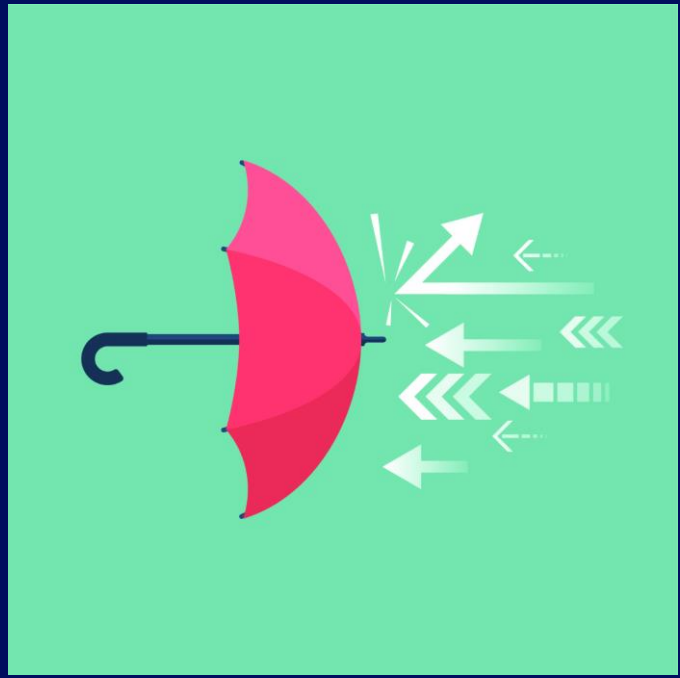
Thinking about Resilience

Merriam-Webster Definition of Resilience:

- An ability to recover from or adjust easily to misfortune or change

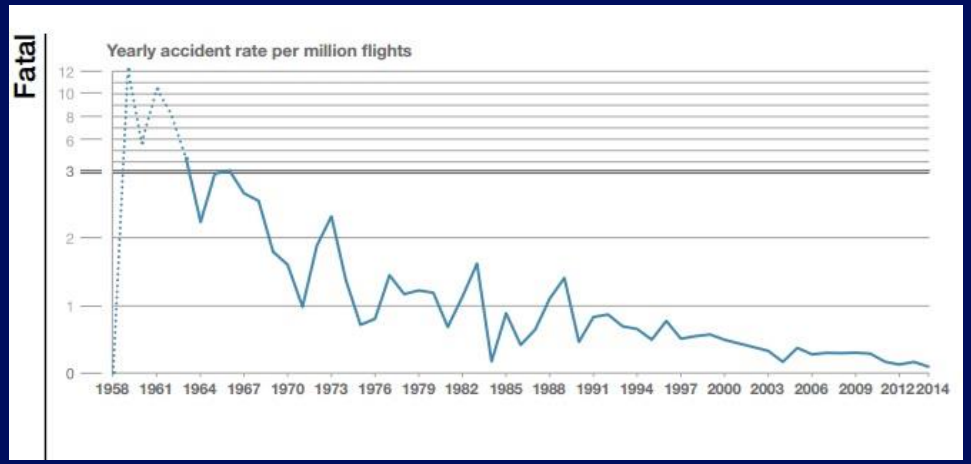
Every industry, every business has its own resilience characteristics

Can we learn lessons about resilience from other industries?



Improving Resiliency

- One industry which successfully raised its resiliency profile: The aviation industry.



Let’s look at one example from the aviation industry

Why am I Interested in Aviation Safety?

The Story of Cactus 1549

Cactus 1549: The Miracle on the Hudson

US Air (“Cactus”) Flight 1549

- Airbus A320-214, N106US
- Departed from runway 4 (7003’ x 150’) NY LaGuardia Airport for Charlotte Douglas International Airport at 3:27 P.M. (20:27Z) on 15 January, 2009
- It was a good day for flying (wind was from 340 at 13 kts, visibility 10, ceiling 3,500’ broken, altimeter 30.23)
- Two minutes and fifteen seconds into the flight, both engines ingest geese and cease to develop thrust
- Five minutes and fifty seconds into the flight the aircraft lands in the Hudson River, near midtown Manhattan

Cactus 1549: The Flight Crew – Captain Sullenberger

Chesley “Sully” Sullenberger, III, age 57

- 1973 graduate of the US Air Force Academy, “Outstanding Cadet in Airmanship”
- Commercial airline pilot from 1980 until 2010
- Highly experienced:
  - 19,663 total flight hours
  - 8,930 as pilot in command (“PIC”)
  - 4,765 PIC in A320
  - No accident/enforcement/retest history

Cactus 1549: The Flight Crew – First Officer Jeffrey Skiles

Jeffrey “Jeff” Skiles, age 47

- Both parents were pilots; began flying at age 15.
- Was flying as First Officer on Cactus 1549 due to staff reductions at US Air
- Highly experienced:
  - 15,643 total flight hours
  - 8,977 as second in command (“SIC”)
  - 37 SIC in A320
  - No accident/enforcement/retest history

Cactus 1549: The Flight Crew – Flight Attendants

Donna Dent (lead), Sheila Dail and Doreen Welsh

- Combined 95 years of flying experience
- Had to deal with panicking passengers before and after the landing
- Did not realize that they had landed in the Hudson until after the landing

The Man on the Other End of the Radio: Patrick Harten, ATC

- 10 years ATC experience
- Had worked 10-12 emergencies
- Had worked as a controller in the Newark sector and knew the approaches into both Newark and Teterboro

Key Background Concepts

Commercial aircraft operations are one of the most regulated operations in the world

Process standardization is the norm in commercial aviation. We will focus on:

- Communication and terminology
- Operational procedures
- Crew resource management (CRM)

Examples of Standardization

- In the aircraft:
  - Training, certification
  - Instrument location/layout within the aircraft
  - Instrument display
  - Chart format and notations
  - Checklists
  - Interactions with ATC (time and manner)

- Outside the aircraft
  - Airspace definition
  - Obstacle clearance
  - Runway/taxiway markings and signage
  - Maintenance

- … and so much more

- https://www.faa.gov/regulations_policies/

Integration with the ATC System

Like any air carrier flight, the “control” of Cactus 1549’s flight goes through several Air Traffic Control (ATC) stages:

- Clearance delivery
- Ground control
- Tower control
- Departure control
- Enroute centers
- Approach control
- Tower control
- Ground control

- Control transfers at either specific points in the flight (such as arriving at the take-off runway) or on command (“Contact departure”)

Pilot in Command

Federal Aviation Regulation (FAR) § 91.3: Responsibility and authority of the pilot in command

(a) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft.

(b) In an in-flight emergency requiring immediate action, the pilot in command may deviate from any rule of this part to the extent required to meet that emergency.

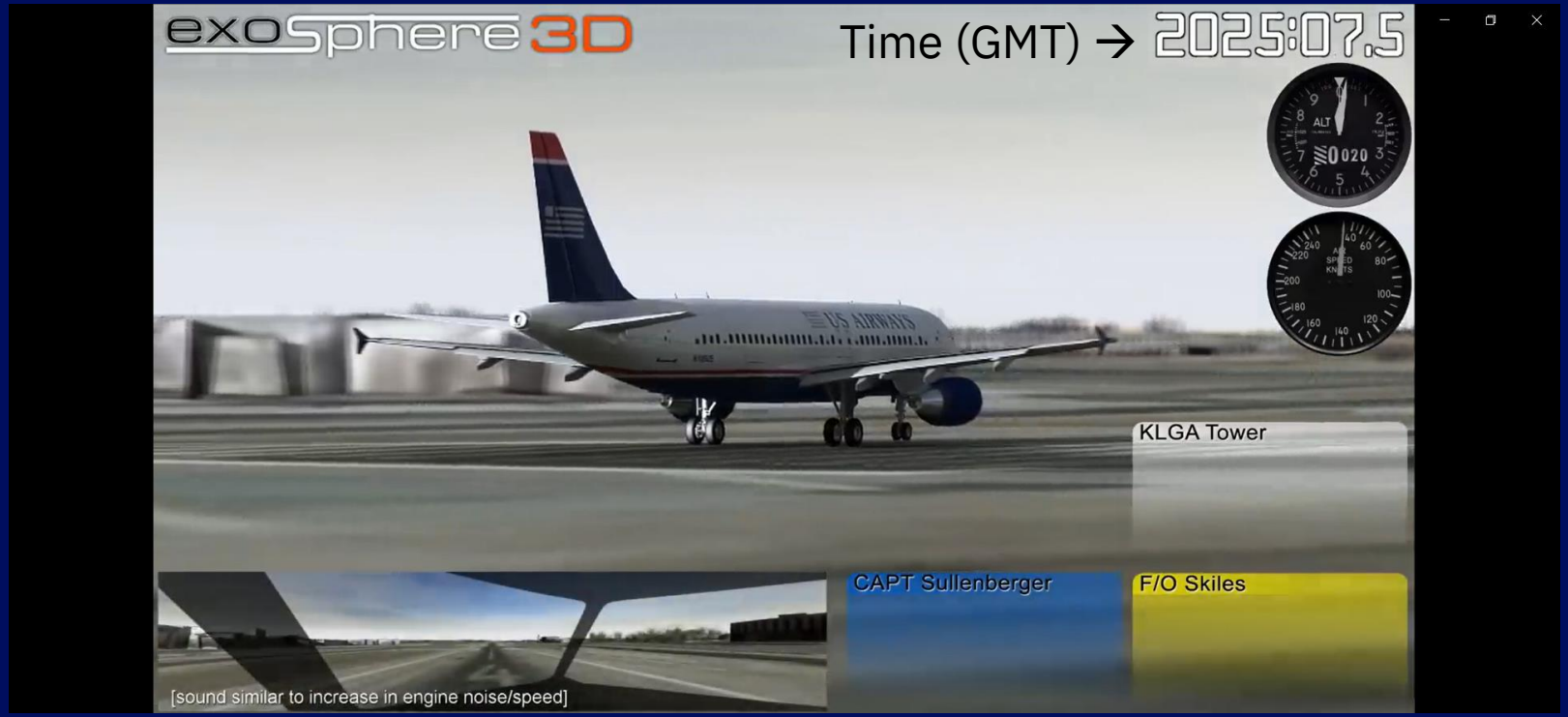
(c) Each pilot in command who deviates from a rule under paragraph (b) of this section shall, upon the request of the Administrator, send a written report of that deviation to the Administrator.

The Simulation Display

https://www.youtube.com/watch?v=tE_5eiYn0D0&t=234s

The Simulation Display

The Simulation Display



The Simulation Display

The Simulation Display

The Simulation Display

The Simulation Display

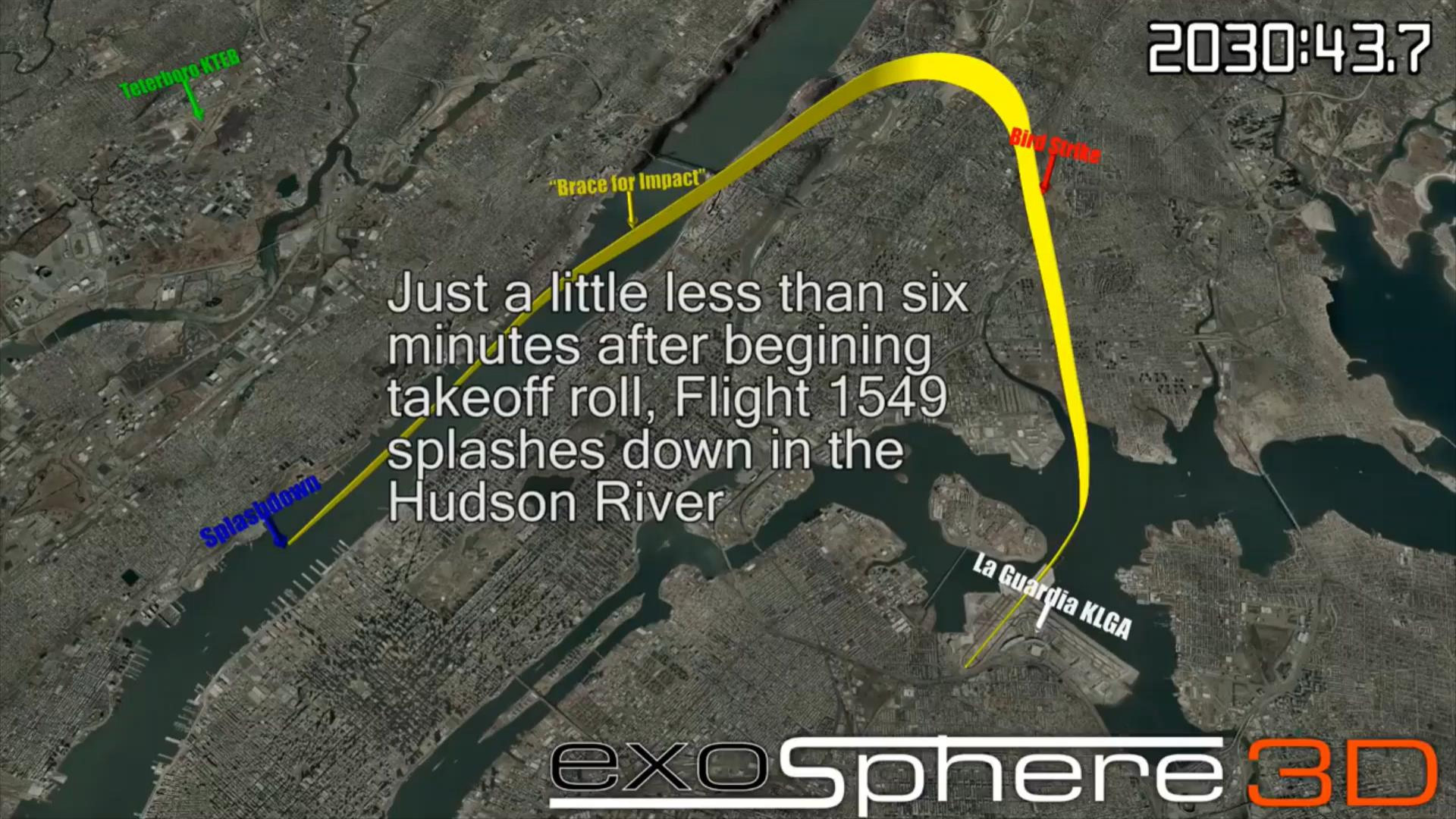
The Simulation Display

Part 1: Departure and Climb Out

00:00-02:15
(20:24:51Z-20:27:11Z)

Part 1: Pre-Video Discussion Points

- Crew resource management:
  - FO Skiles was the “pilot flying”
  - CPT Sullenberger was the “pilot monitoring”
  - Note the structure, coordination, and focus
- Words are important:
  - “TOGA”: Set the flight management system to “take off/go around” mode
  - “Contact NY Departure” instructs crew to change to talking to the next controller
- The recreation video starts at the point where Cactus 1549 has been “cleared for takeoff”


2030:43.7
Teterboro KTEB
"Brace for Impact"
Bird Strike
Just a little less than six minutes after begining takeoff roll, Flight 1549 splashes down in the Hudson River
Splashdown
La Guardia KLGA
exoSphere 3D

Part 1: Post-Video Discussion Points

"A completely unremarkable flight"

- Flight deck discipline:
  - Complete focus on the flight
  - No conversations unrelated to the flight below 10,000' ("Sterile")
  - Use of checklists
  - Callouts of key items ("V1, Rotate", "Positive Climb")
  - Sharing of duties ("Gear up, please", "Gear up")

Part 2: “Birds”

02:16-04:35
(20:27:08Z-20:29:29Z)

Part 2: Pre-Video Discussion Points

- Transition of control: Challenge/response (four words)
- QRH: Quick Reference Handbook
- Differences in call sign (Cactus 1549, Cactus 1539, Cactus 1529) didn’t matter
- Lots of information coming to the flight deck
- Prioritization of tasks (“Aviate, navigate, communicate”)
- Words Matter:
  - “Unable”, “Brace for Impact”


exoSphere 3D
2027:08.7
ALT
2830
AIR SPEED KNOTS
New York Departure
jetlink twenty seven sixty climb maintain one zero thousand
CAPT Sullenberger
F/O Skiles

Part 2: Post-Video Discussion Points

- Transition of control: “My aircraft”, “Your Aircraft”
- Use of checklists throughout
- “Aviate, navigate, communicate”: It’s twenty-five seconds from “Birds” to “Mayday, Mayday, Mayday”
- ATC continues to provide options: “What do you need to land?”
    - Clears return path to LaGuardia and Teterboro
- “This is the captain. Brace for impact” words chosen carefully

Part 3: “We’re Going to be in the Hudson”

04:35-5:50
20:29:27Z-20:30:51Z

Part 3: Pre-Video Discussion Points

- Watch how the crew continues to “work the problem” to restart the engines
- ATC continues to provide options
- Captain Sullenberger manages the altitude, airspeed, and vertical descent speed to minimize the G forces and prevent a nose/wing over on contact with the water
- “Radar Contact Lost”
- “Got any ideas”


exoSphere 3D
2029:21.0
US AIRWAYS
New York Departure
CAPT Sullenberger
F/O Skiles
is that all the power you got?
* (wanna) number one? or
we got power on number
one.

Part 3: Post-Video Discussion Points

- Altitude, airspeed callouts from FO Skiles helped CPT Sullenberger manage the final descent
- Flaps discussion to get the minimal vertical descent, slowest, nose-up contact configuration
- “Radar Contact Lost”
- “Got any ideas”
- A320 aircraft automation assisted in minimizing the descent speeds

Part 4: It isn’t Over Until it’s Over

Cactus 1549: The Miracle on the Hudson

Next challenge: Evacuation!

- Water temperature was 41 degrees, air temperature 19 degrees. Any time in the water was hazardous.
- Landing location was ideal as NY Waterways, NYPD, NYFD, and other watercraft were quickly there to take passengers off the wing and out of the water
  - 7 ferries, 2 small boats a 1 FDNY rescue boat

Cactus 1549: The Miracle on the Hudson…

- Had to get passengers to move from the back of the aircraft to the wing and front exits due to water ingestion
- Had to deploy the 1L slide manually, but not before passengers started jumping into the frigid waters. 1R slide deployed, but risked puncture from the swinging door.
    - Assigned a passenger to hold it open

Learning from the Past: NTSB Recommendations

- Equip all aircraft with life vests and seat cushions that can be used for flotation, not just those which are scheduled for extended overwater operations.
- Redesign floatation vest location to make vests easier to retrieve
- Change the location of the life rafts to make them more likely to survive a hard ditching

Learning from the Past: NTSB Recommendations

- Implement quick-release evacuation ramps as they became defacto rafts
- Require low-altitude, dual-engine failure checklists and pilot training.

- Just like in other industries, the implementer of these recommendations has resisted implementing some.

Final Thoughts: Lessons for Resilience

- The parallels to between the aviation industry and information technology industry abound:
  - Both involve technology, people, and complex interactions
  - Both require education and training
  - Both require the constant evaluation of tradeoffs in a constantly changing/evolving environment
  - Success is often dictated by our ability to interact clearly and to leverage each other's expertise

Final Thoughts: Lessons for Resilience in our systems and careers

- Everyone talks the same language
- Preparation was key, initial responses were almost automatic
- Complete focus on the problem at hand
- “Multitasking is a myth”
- Multiple teams were taking actions independently but with clear lines of control
- Everyone contributes
- There’s one person in charge

References

References

Transcript

- https://www.tailstrike.com/150109.htm

NTSB Reports

- https://www.ntsb.gov/investigations/AccidentReports/Reports/AAR1003.pdf

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- https://data.ntsb.gov/Docket/Document/docBLOB?ID=40314365&FileExtension=.PDF&FileName=Cockpit%20Voice%20Recorder%2012%20-%20Factual%20Report%20of%20Group%20Chairman-Master.PDF

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Captain Sullenberger's Minute-by-Minute Description

- https://www.youtube.com/watch?v=w6EblErBJqw

Flight Attendants of Cactus 1549

- https://confessionsofatrolleydolly.com/2013/01/15/angels-of-the-sky-flight-attendants-of-flight-1549/

10 Year Anniversary Interview with Patrick Harten

- https://www.youtube.com/watch?v=iJB-cU8Y8PY

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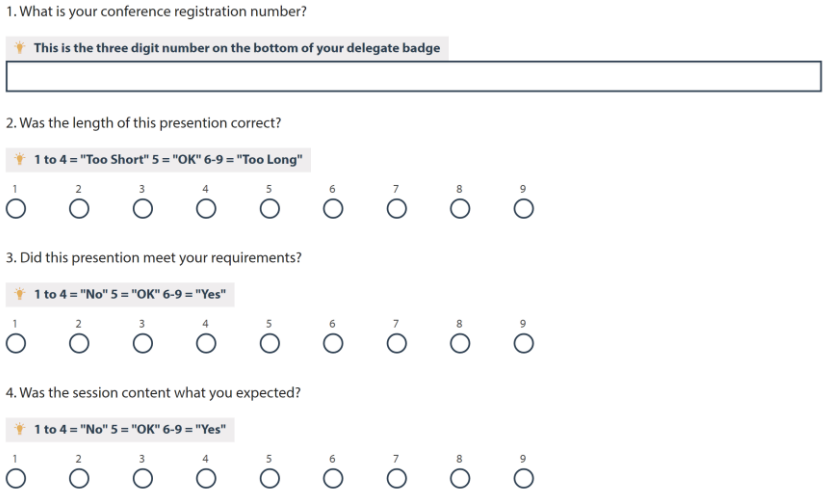

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