# Increasing Learning from Accidents: A Systems Approach Illustrated by the UPS Flight 1354 Birmingham Airport Accident

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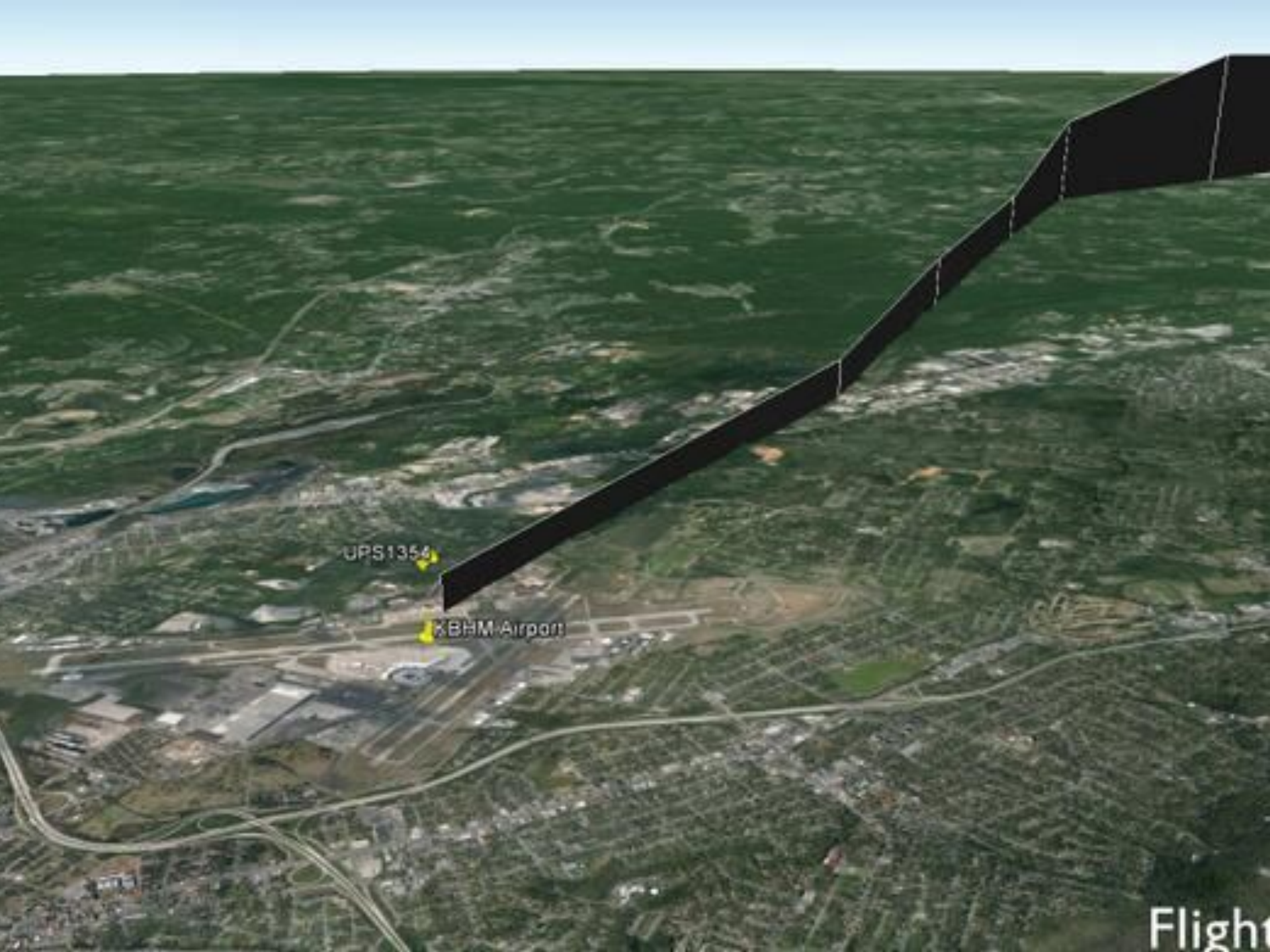
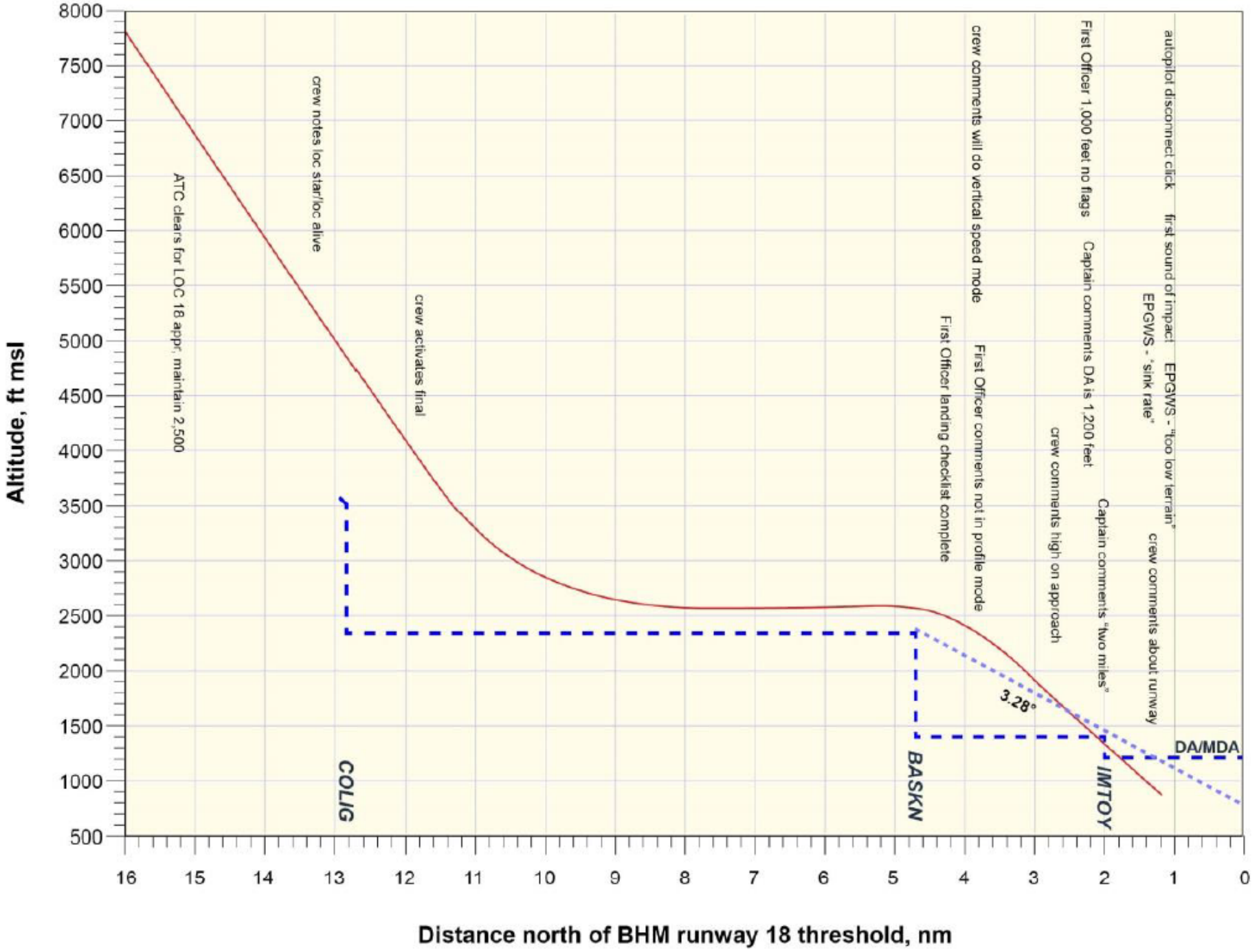
# Outline

- What Happened
- Why did it Happen?
  - NTSB Conclusions
  - CAST Conclusions
  - Comparisons


UPS1354
KBHM Airport


Altitude, ft msl
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Distance north of BHM runway 18 threshold, nm
ATC clears for LOC 18 appr, maintain 2,500
crew notes loc star/loc alive
crew activates final
crew comments will do vertical speed mode
First Officer comments not in profile mode
First Officer landing checklist complete
First Officer 1,000 feet no flags
Captain comments DA is 1,200 feet
crew comments high on approach
Captain comments "two miles"
autopilot disconnect click
first sound of impact
EPGWS - "too low terrain"
EPGWS - "sink rate"
crew comments about runway
COLIG
BASKN
IMTOY
3.28°
DA/MDA

# What Happened? (from NTSB report)

- On August 14, 2013, 0447 CDT, UPS flight 1354, an Airbus A300-600, crashed short of runway 18 during a localizer nonprecision approach to runway 18 at BHM.
- Captain and first officer were fatally injured and plane destroyed by impact and fire.
- Variable instrument meteorological conditions with a variable ceiling prevailed on approach course.
- Flight came from Louisville about 0503 EDT
- NOTAM in effect indicted runway 06/24, longest runway at airport and the one with a precision approach, would be closed from 0400 to 0500 CDT.
  - Because fight scheduled to arrive at 0451, only a shorter runway with a nonprecision approach was available to crew.
  - Forecasted weather at BHM indicated low ceilings upon arrive required an alternative airport
  - Dispatcher did not discuss the low ceilings, the single approach option to the airport, or the reopening of longer runway about 0500 with crew.
  - During flight, information about variable ceilings at airport not provided to FC

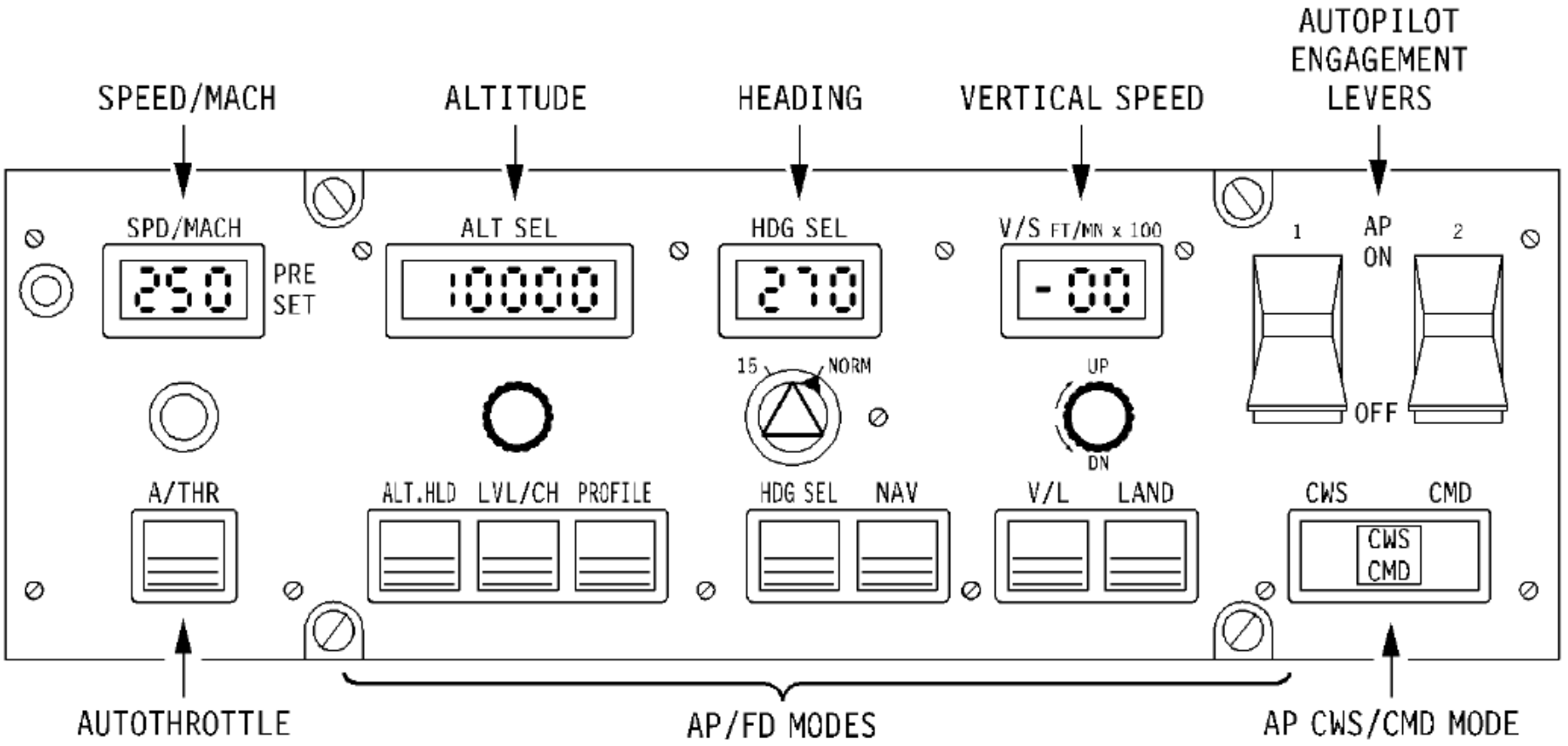
# ATIS

- Birmingham Airport information Papa zero eight five three Zulu observation wind calm **visibility one zero**. sky condition **ceiling one thousand broken**. seven thousand five hundred overcast. temperature two three. dewpoint two two. altimeter two niner niner seven. **localizer runway one eight in use. landing and departing runway one eight. notice to airmen runway six two-four closed.** all departing aircraft **contact tower one one niner point niner for clearance taxi and takeoff**. advise controller on initial contact you have Papa.

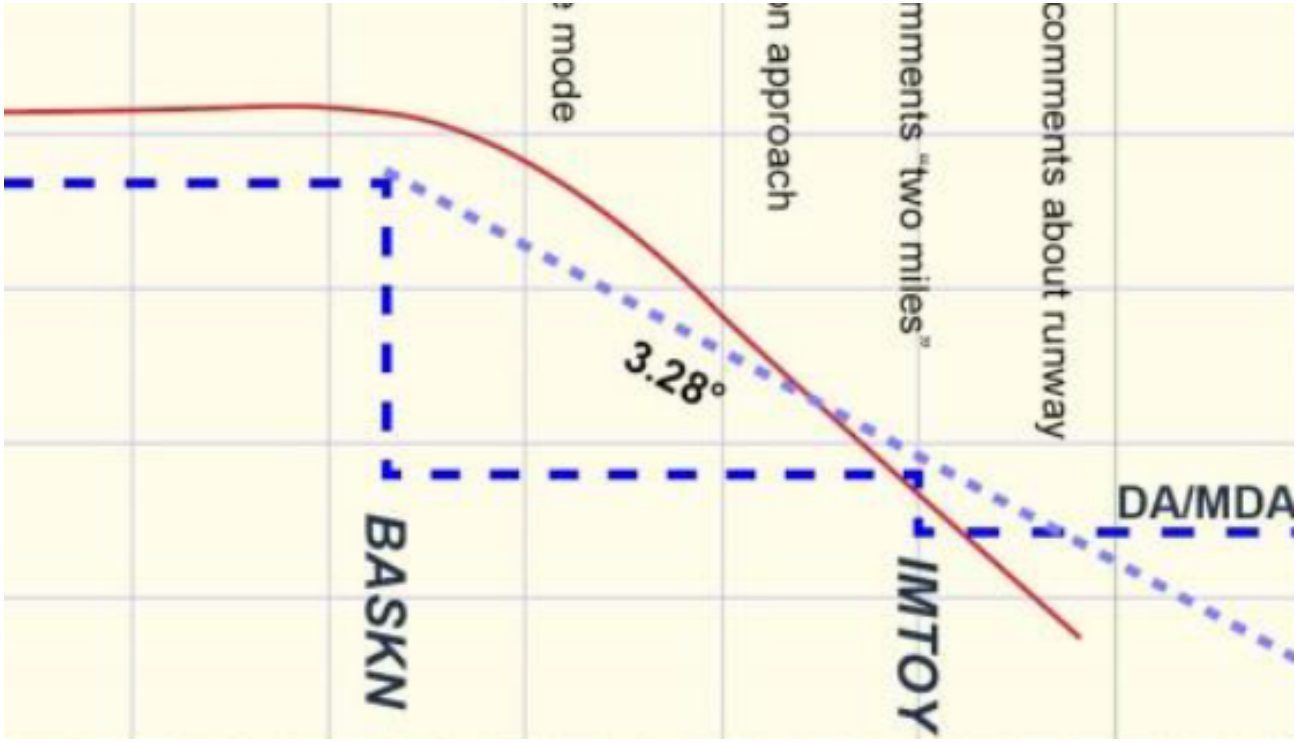
- Before descent, while on direct-to-KBHM leg of flight, captain briefed the localizer runway 18 non-precision profile approach.
- First officer entered approach into airplane's flight management computer (FMS).
- Intended method of descent (a "profile approach")
- glidepath generated by the FMS to provide vertical path guidance from the final approach fix (FAF) to the decision altitude
- Runway 18 decision altitude of 1200 ft msl
- Air traffic controller cleared the flight for the localizer 18 approach.
- Crossed FAF 200 feet high


FROM 1354 →
T-P 1543 210/ 3000
KBHM 54 227/ 2500
---F-PLN DISCONTINUITY--
COLIG 1558 227/+ 3500
BASKN 1608 208/+ 2300
-3.3°
RW18A 12 136/ 690
DIR
MODE
TACT MODE
INIT
REF
BRT


GS 210
TAS 220
KOR
256°
13NM
21
22
23
24
25
26
27
28
LGA
WPT2
EGN
40
WPT1
20
KOR
215/20
.5R

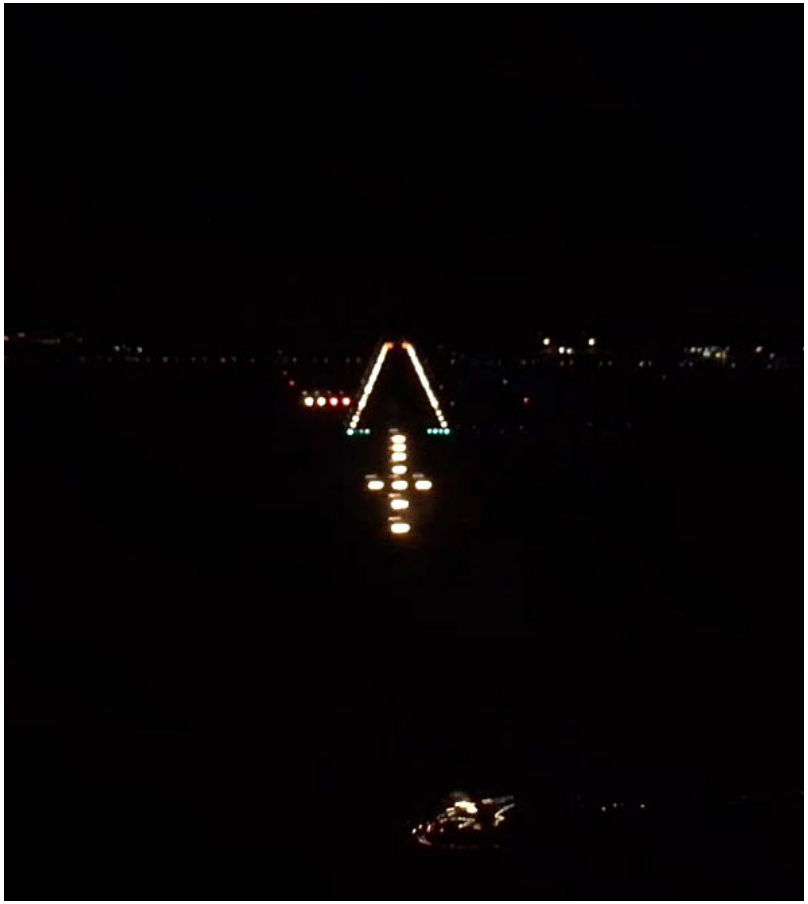


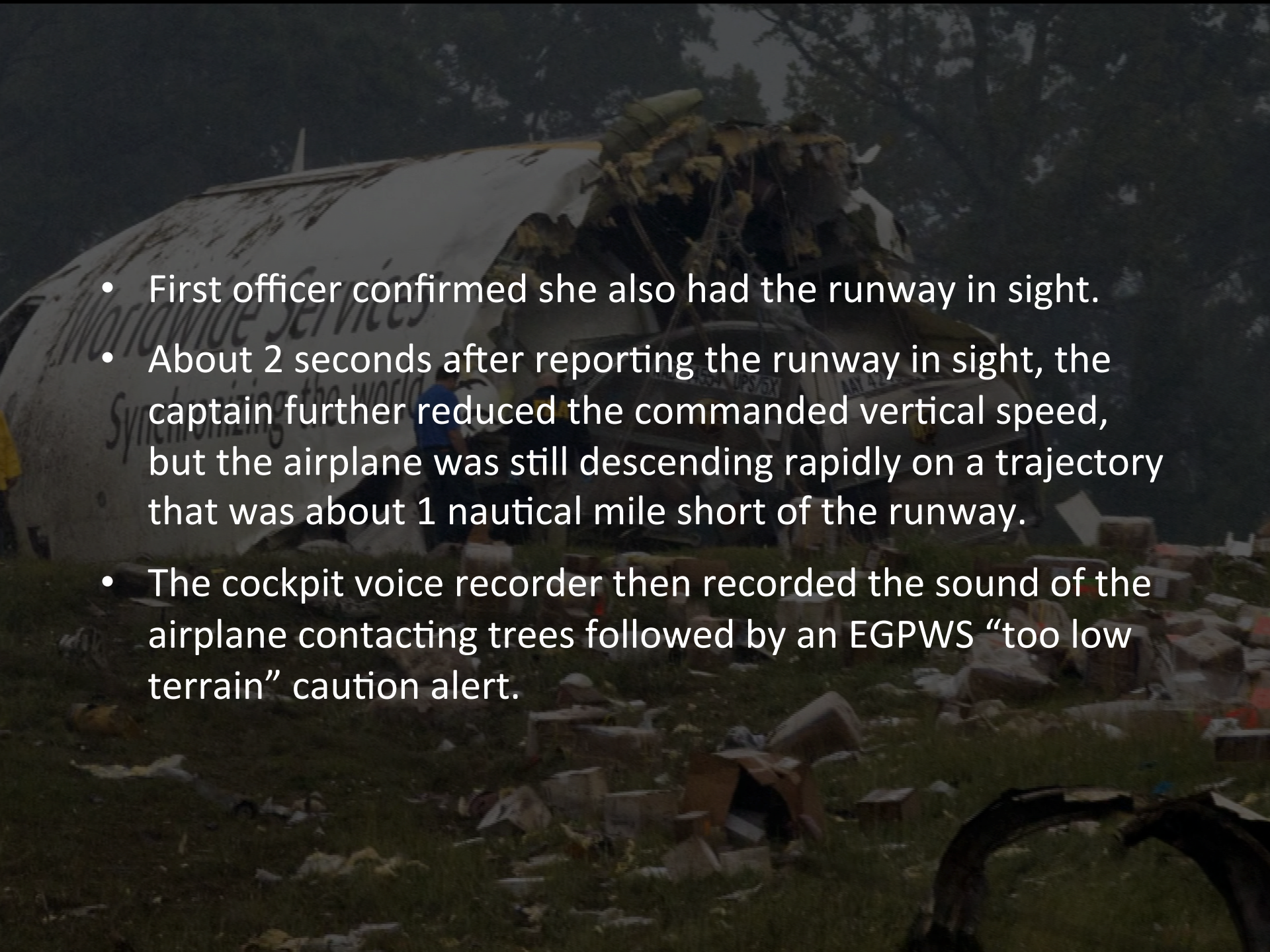

- About 7 seconds after the first officer completed the Before Landing checklist, the first officer noted that the captain had switched the autopilot to vertical speed mode; shortly thereafter, the captain increased the vertical descent rate to 1500 fpm.




- First officer made the required 1000-ft-above-airport-elevation callout, and the captain noted that the decision altitude was 1200 ft msl but maintained the 1500 fpm descent rate.
  - Although the approach violated the stabilized approach criteria defined in the UPS flight ops manual, they did not perform a go-around.
  - As the airplane descended to the minimum descent altitude, the first officer did not make the required callouts regarding approaching and reaching the minimum descent altitude
  - The Captain did not arrest the descent at the minimum descent altitude.

- The airplane continued to descend.
- At 1000 ft msl (about 250 ft above ground level, an enhanced ground proximity warning system (EGPWS) “sink rate” caution alert was triggered.
- The captain began to adjust the vertical speed in accordance with UPS’s trained procedure.
- He reported the runway in sight about 3.5 seconds after the “sink rate” caution alert.
- Airplane continued to descend at a rate of about 1000 fpm.





- First officer confirmed she also had the runway in sight.
- About 2 seconds after reporting the runway in sight, the captain further reduced the commanded vertical speed, but the airplane was still descending rapidly on a trajectory that was about 1 nautical mile short of the runway.
- The cockpit voice recorder then recorded the sound of the airplane contacting trees followed by an EGPWS “too low terrain” caution alert.


# Given this description:

- What cause(s) would you ascribe to the accident?
- Are there any additional questions you would want answered?

# NTSB Conclusions

- **Probable Cause**:
  - Flight crew's continuation of an unstabilized approach and their failure to monitor the aircraft's altitude during the approach, which led to an inadvertent descent below the minimum approach altitude and subsequently into terrain.
- **Contributing** to the accident were:
  1. Flight crew's failure to properly configure and verify the FMS computer for the profile approach
  2. Captain's failure to communicate his intentions to the first officer once it became apparent the vertical profile was not captured.
  3. Flight crew's expectation they would break out of the clouds at 1000 ft above ground level due to incomplete weather information.
  4. First officer's failure to make the required minimum callouts
  5. Captain's performance deficiencies due to factors including, but not limited to fatigue, distraction, or confusion, consistent with performance deficiencies exhibited during training
  6. First officer's fatigue due to acute sleep loss resulting from her ineffective off-duty time management and circadian factors.

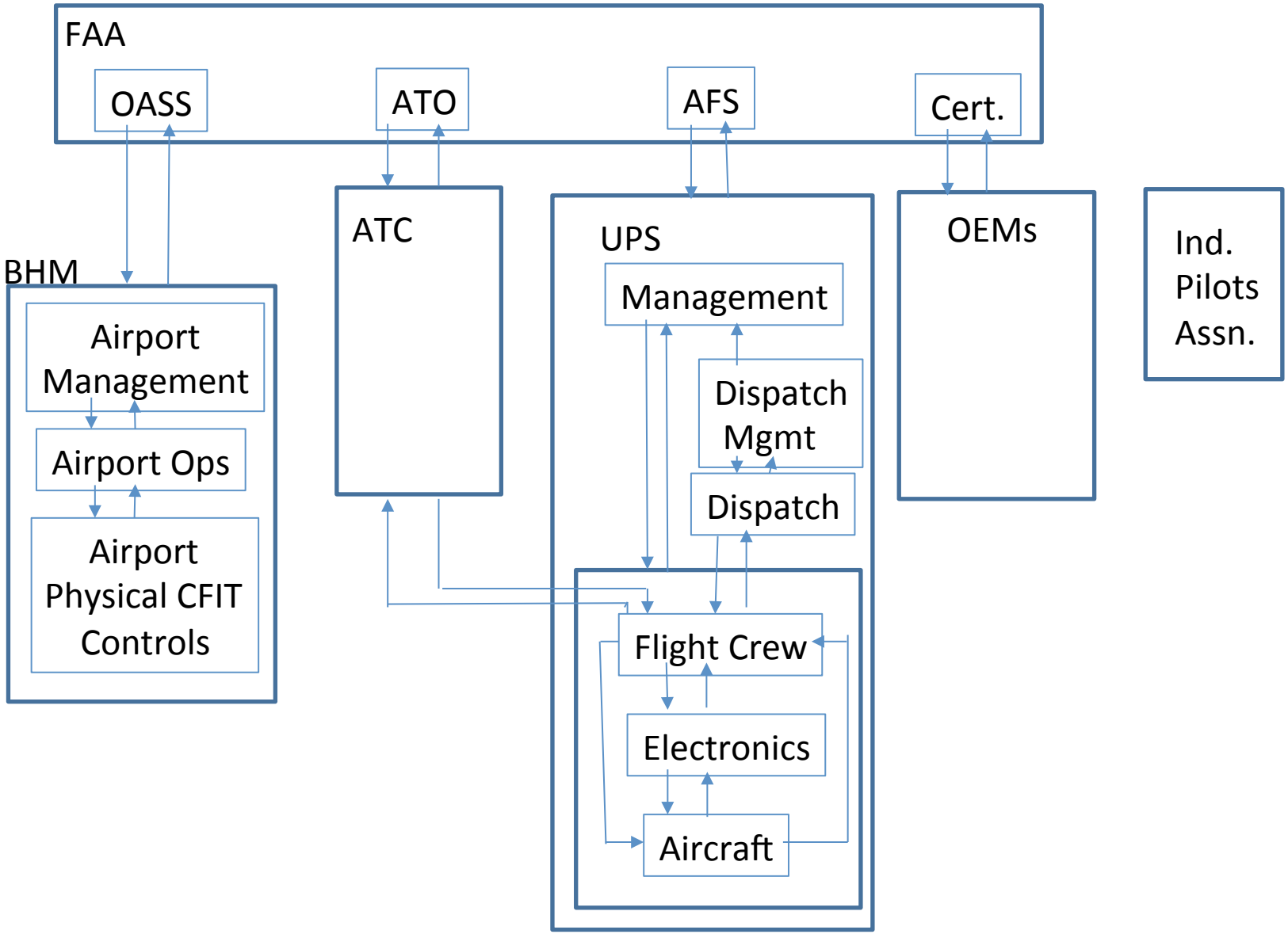
# System's Approach

- Looks not only at how pilot's contributed to accident but why they believed it was the right thing to do at the time.
- Safety treated as a control problem, not a failure problem
  - Why were controls not effective in this case?
  - How can they be improved for the future?

**Hazard**: Controlled Flight into Terrain (CFIT)

- Used to be most common type of accident
- Much has been done to reduce occurrence
- Why didn't these controls work this time?

# control structure



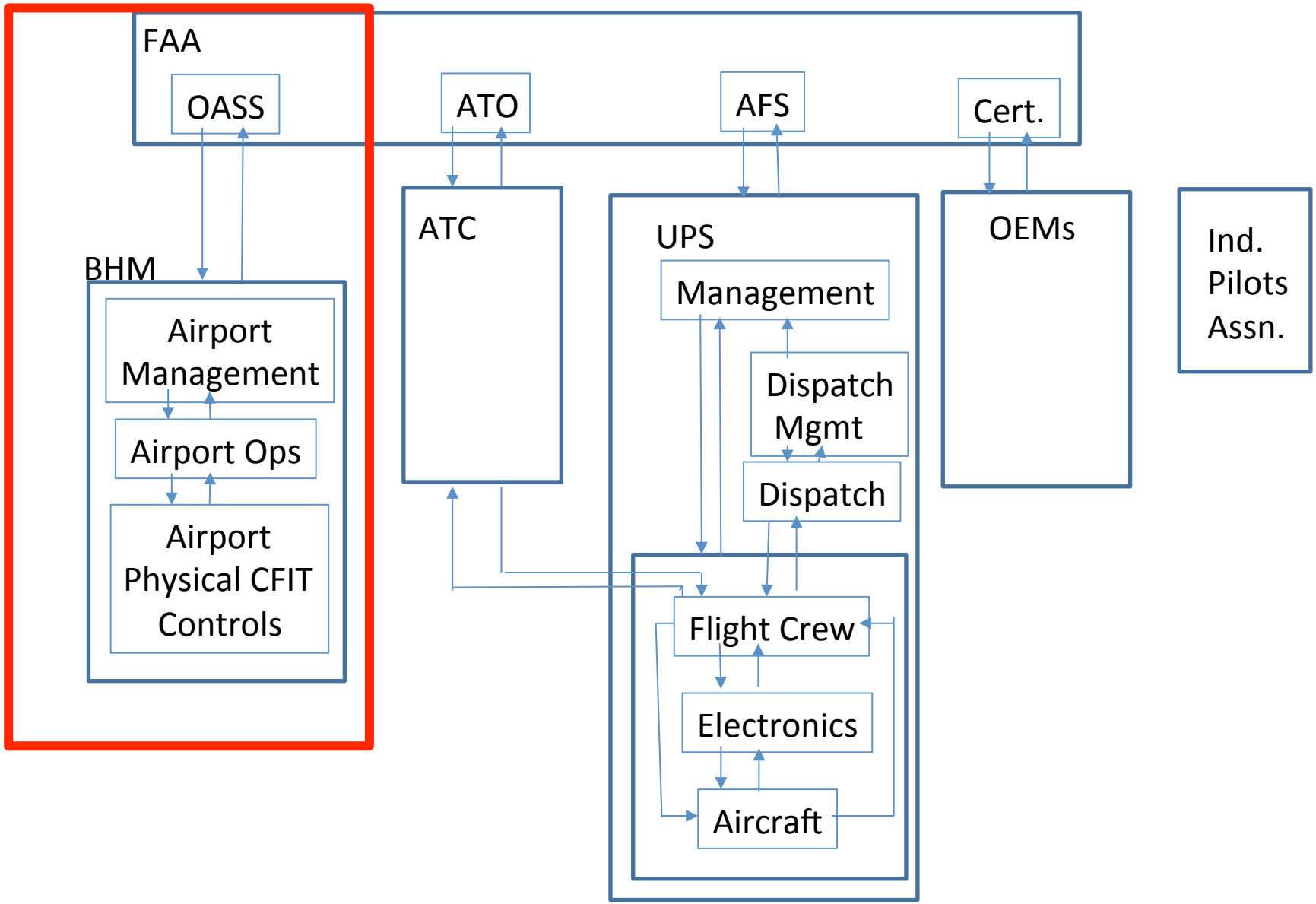
# Controls for CFIT

- Airport physical controls
  - ILS
  - PAPI
- MSAW and ATC
- Aircraft Electronics
  - FMS
  - EGPWS
  - Autopilot
  - Displays
- Capt. Flying, Pilot Monitoring
- UPS Dispatcher
- UPS Dispatch management
- Airbus/Honeywell
- Ind. Pilot's Association
- FAA (Flight Standards, Airport Safety and Standards, ATO, Cert.)

# Comparison of Factors Identified

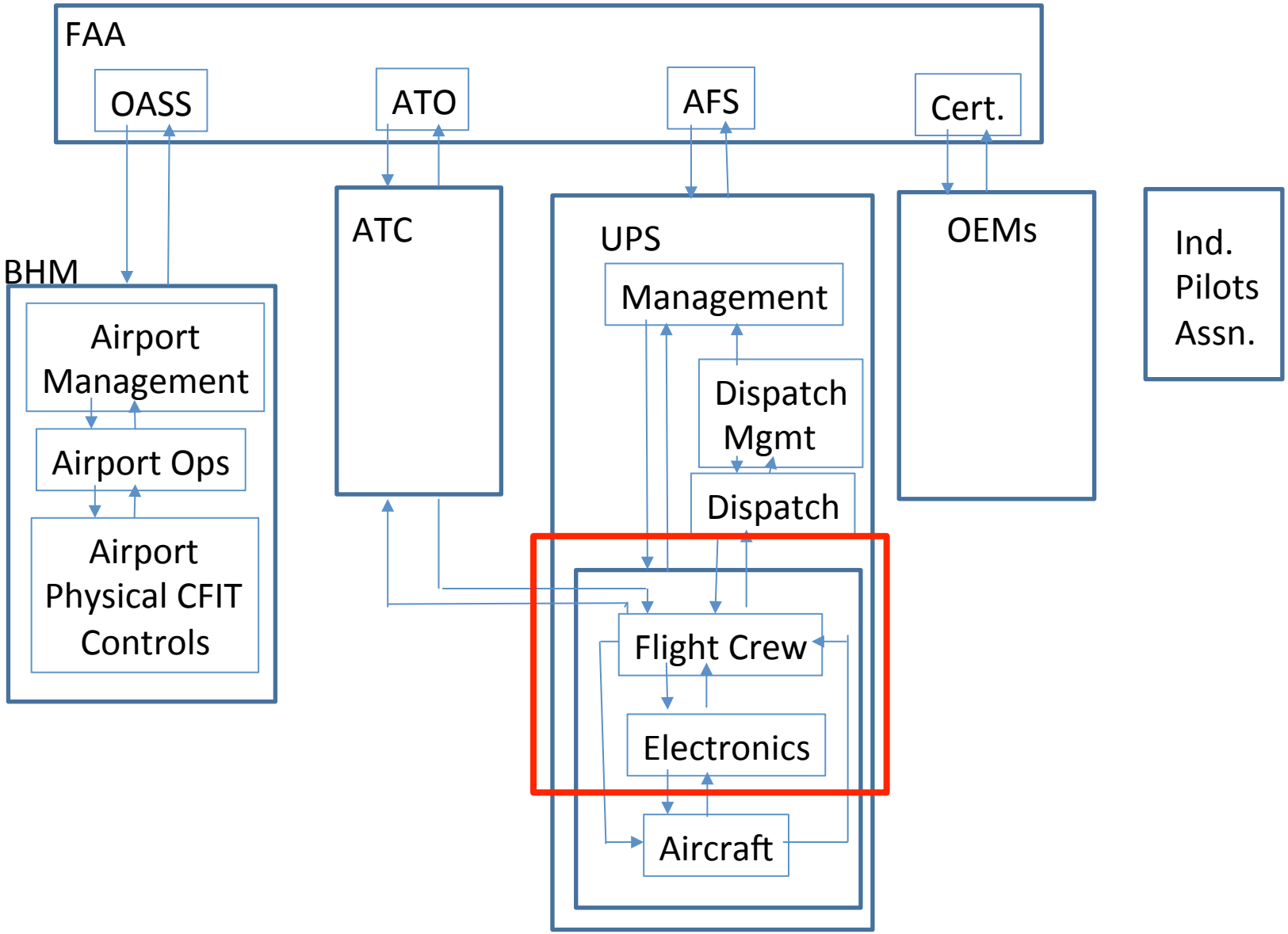
- NTSB (probable cause, contributory causes, findings) vs. CAST
- CAST found some contributing factors not identified by NTSB
- CAST identified all of NTSB findings
- CAST identified several additional findings

# FAA Office of Airport Safety and Standards



| | |
|---|---|
| Birmingham Airport Authority | **Role**: Did not have ILS on all runways, probably for cost or feasibility reasons. Performed maintenance on the primary runway when large aircraft operations were scheduled to commence.<br><br>**Open Questions**: Why was ILS maintenance scheduled during scheduled arrival times for large aircraft? Is as much weight put on cargo aircraft safety as passenger aircraft? When and what type of information was provided to the scheduled airlines about maintenance that night?<br><br>**Recommendations**:<br>Review criteria for scheduling maintenance and notifying airline dispatchers. Review criteria for installing precision approach equipment if there was not a good reason for the decision to omit it from the secondary runway. |
| FAA Office of Airport Safety and Standards | **Role**: Did not provide oversight on (1) the use of runways with navigational aids that are not appropriate for larger aircraft (2) the scheduling of maintenance on navigational aids during periods of scheduled arrivals, and (3) did not require methods in additional to NOTAMs to assure safety during maintenance outages.<br><br>**Recommendations**: (1) Review criteria for installation of precision approach guidance at runways that are used for jet transport aircraft. (2) Review criteria allowing the flying of approaches to runways that use aids not designed for that size/type of aircraft. |

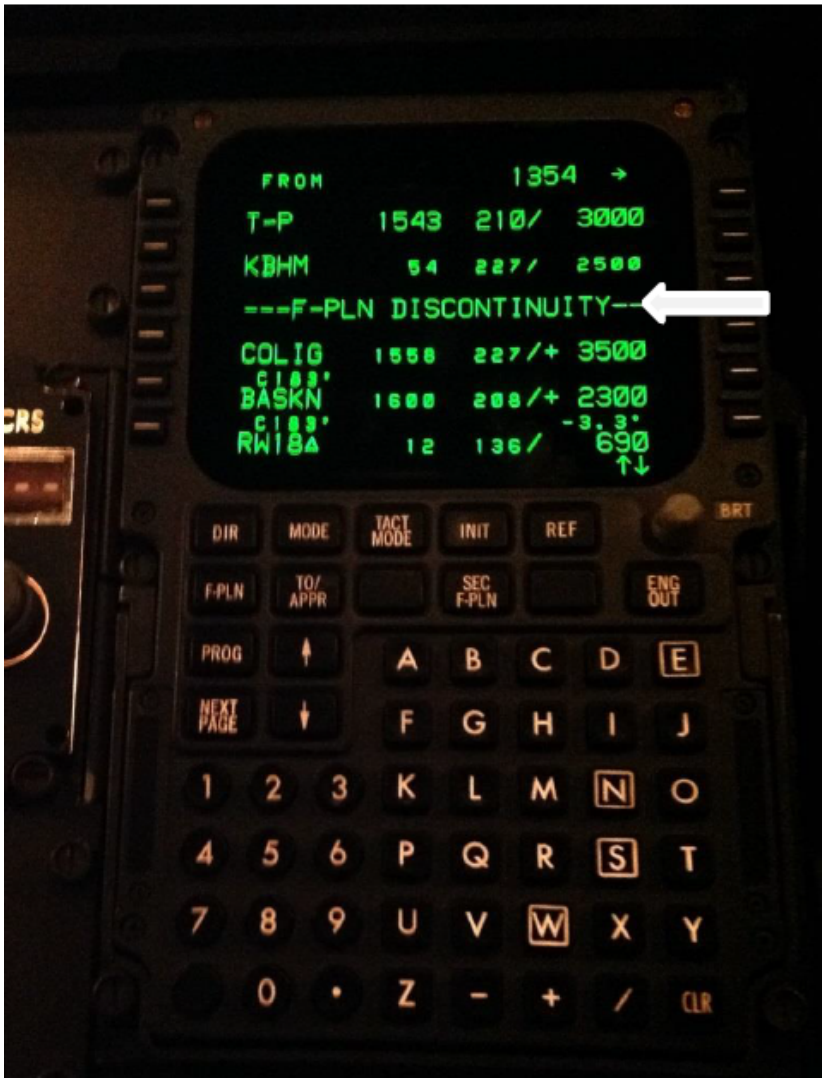
# Flight crew - Electronics



**Unsafe Control Action**: Did not properly configure (program) the FMC for a profile approach. Did not call for pilot monitoring to verify the flight plan in the FMS.

*Why?*

| Process Model Flaws | Questions Raised |
|---|---|

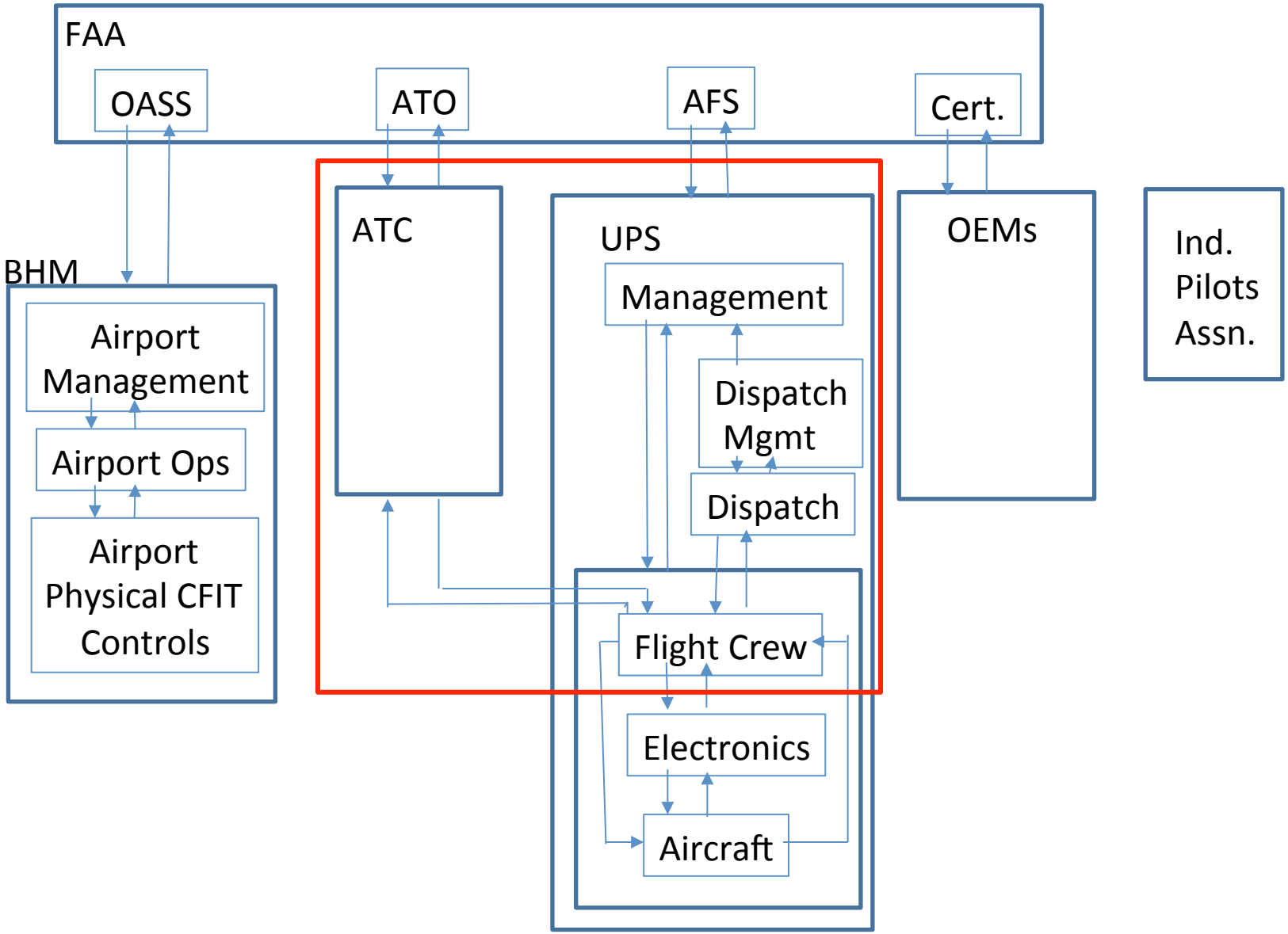
**Unsafe Control Action**: ND depiction showed aircraft on route even though points had not actually been sequenced.

*Why?*

| Process Model Flaws | |
|---|---|
| Thought the aircraft was in the position displayed | |
| Context | Questions Raised |

- As the LOC was providing lateral guidance the aircraft could still track the displayed final approach track despite the lack of waypoint sequencing.

# control structure



# Contextual factors example

How did flight end up flying the LOC?

From Pilot interactions

- Crew missed NOTAM

From pilot interactions

- LOC approach shown earlier in charting sequence

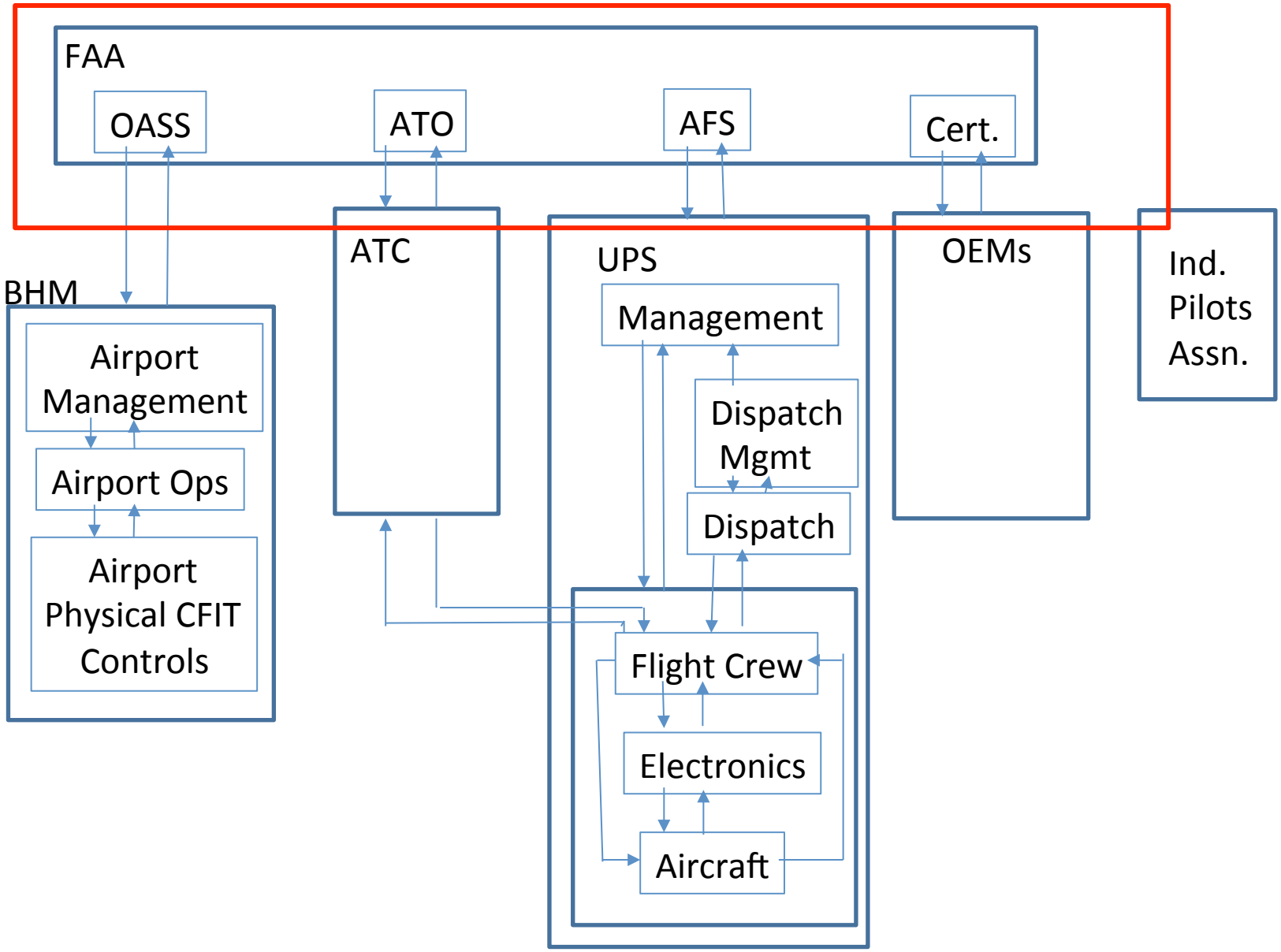
From ATC-Pilot interactions

- Controller offered it

# Dispatch recommendations

- Dispatchers should proactively provide information to flight crews regarding the status of approaches and why a particular runway and approach is listed in flight plan.
- Ensure that dispatchers consider if a crew might be fatigued and how that might impact the pilot's cognitive processes so dispatcher can act proactively accordingly.
- Review workload for dispatchers to ensure they can provide actual joint authority for individual flights. Current workload does not allow for the individualized attention to details that can prevent accidents.
- Provide computer assistance that does not encourage reliance and unquestioning acceptance of outputs.

# FAA


FAA
OASS
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UPS
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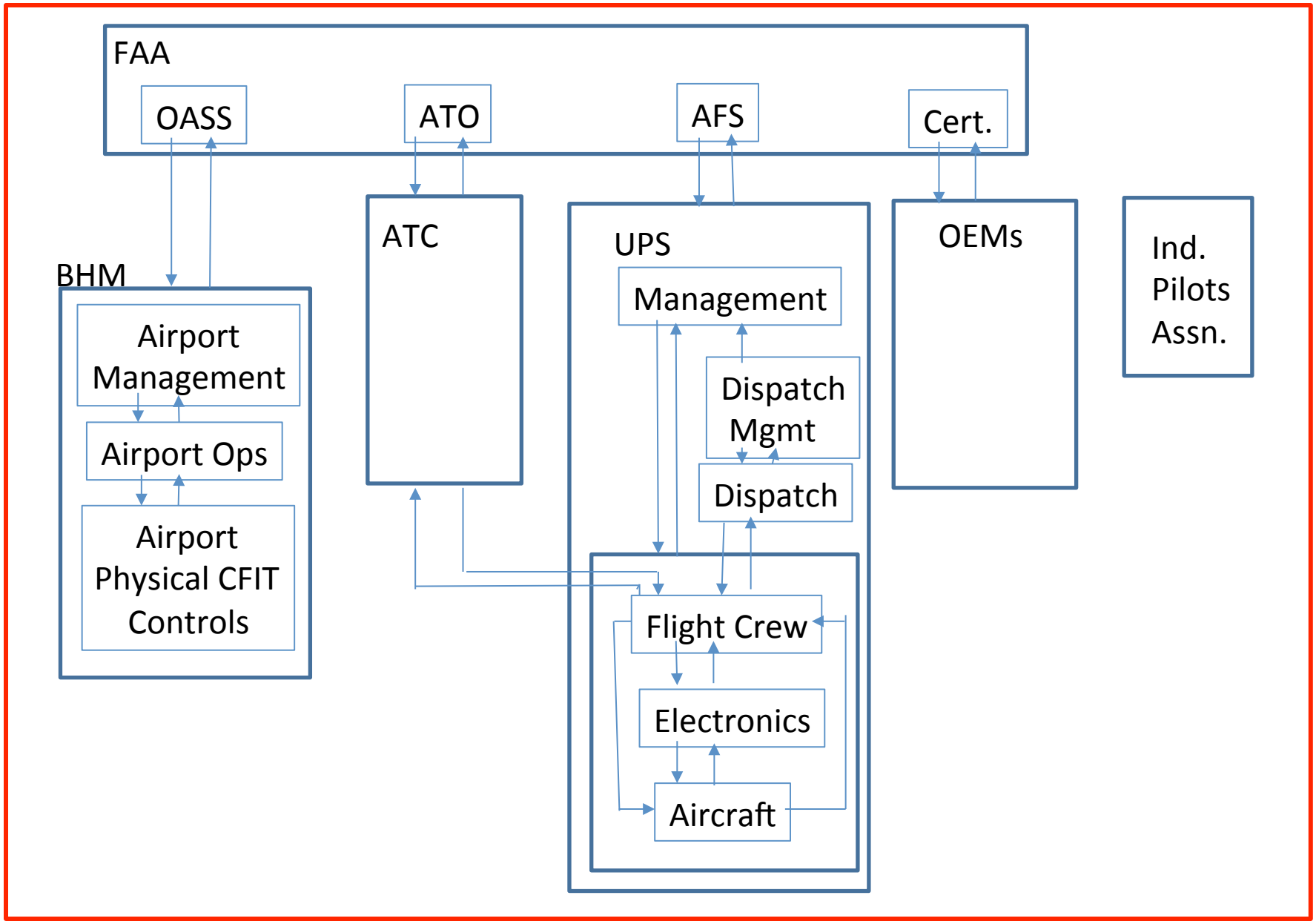
Ind.
Pilots
Assn.
BHM
Airport
Management
Airport Ops
Airport
Physical CFIT
Controls
Management
Dispatch
Mgmt
Dispatch
Flight Crew
Electronics
Aircraft

# FAA recommendations

- The FAA should consider evaluating the communications and coordination deficiencies implicated in this loss and whether they are more widespread than they are believed to be. Was this just a one-time event or are communication and coordination deficiencies more wide-spread than believed?

- The roles of dispatch and pilots and how they interact need to be clarified.

# Systemic factors




# Systemic Factors

- Safety Culture (cargo pilots)
- Safety information system
- Dynamics and change over time
- Communication and Coordination among controllers

## Systemic recommendations

- FAA and cargo aircraft pilot associations should investigate whether the actions of the cargo operator industry has led to more suspicion and less trust by the pilots of those carriers.

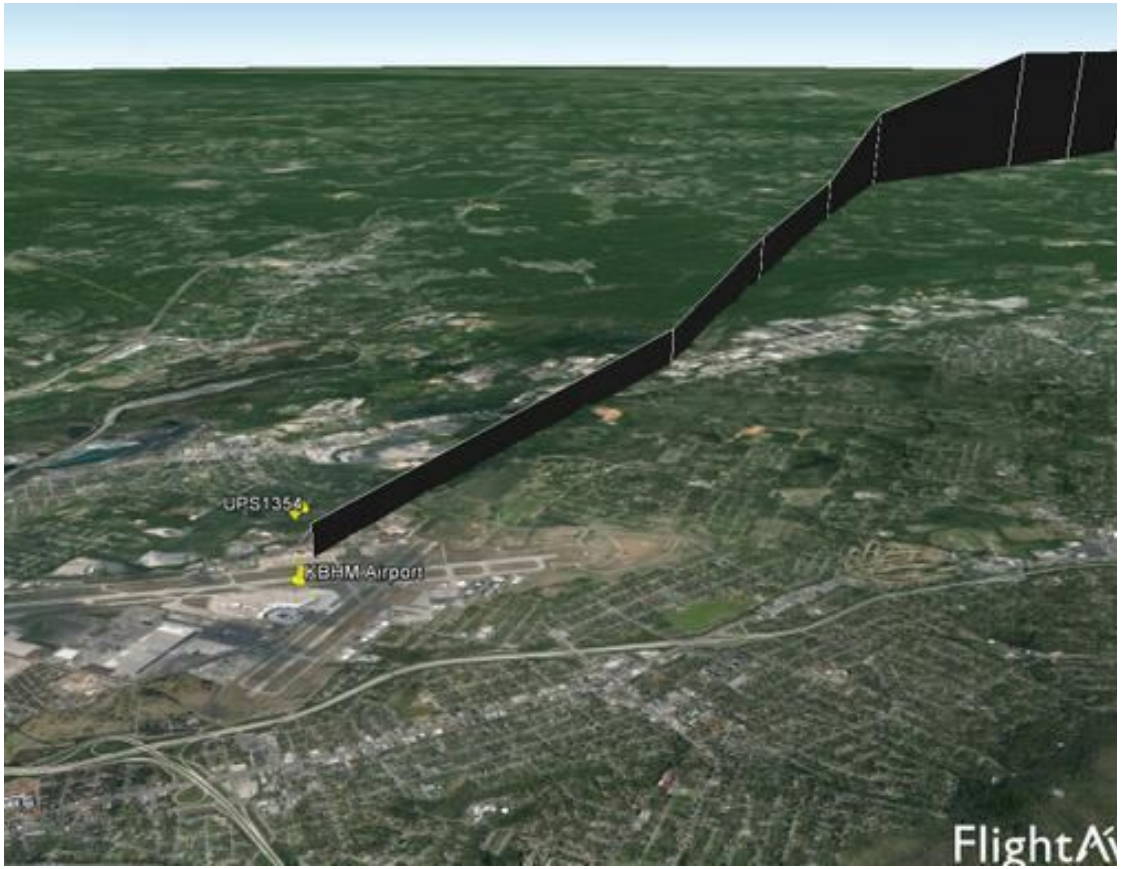
- The FAA and cargo aircraft pilot associations should institute a study of whether cargo aircraft are treated differently by airports and whether any differences result in higher risk for cargo aircraft.

# Systemic recommendations

- Identify and implement changes to the information system to ensure that accurate weather information is available when needed and to those who need it.

- The FAA and other industry groups should study whether the increase in cargo operations has changed or increased the level or types of hazards such that they are no longer adequately mitigated by current procedures and controls.

- Subject changes in the provision of critical information to a hazard analysis.




# Summary

- Utilized Group Chair factual reports
- Contributing control actions (factors) easily identifiable from control structure
- Recommendations stemmed from contributing control actions.