A STAMP Case Study

Comair 5191 LEX Accident

First STAMP/STPA Workshop and Conference
MIT April 17-19, 2012

Overview

- STAMP complementary HF concepts
- 5191 accident overview
- Some STAMP model revelations
- Conclusions
- Q&A

Human Factors New View

- **Local rationality**—each person acts according to what make sense at the time.

- **Variability of Human action** is consequential in successes *and* failures

- Analysis after the occurrence <u>always possesses more information</u> than known at the time of occurrence.

HINDSIGHT BIAS

Before the Accident

After the Accident

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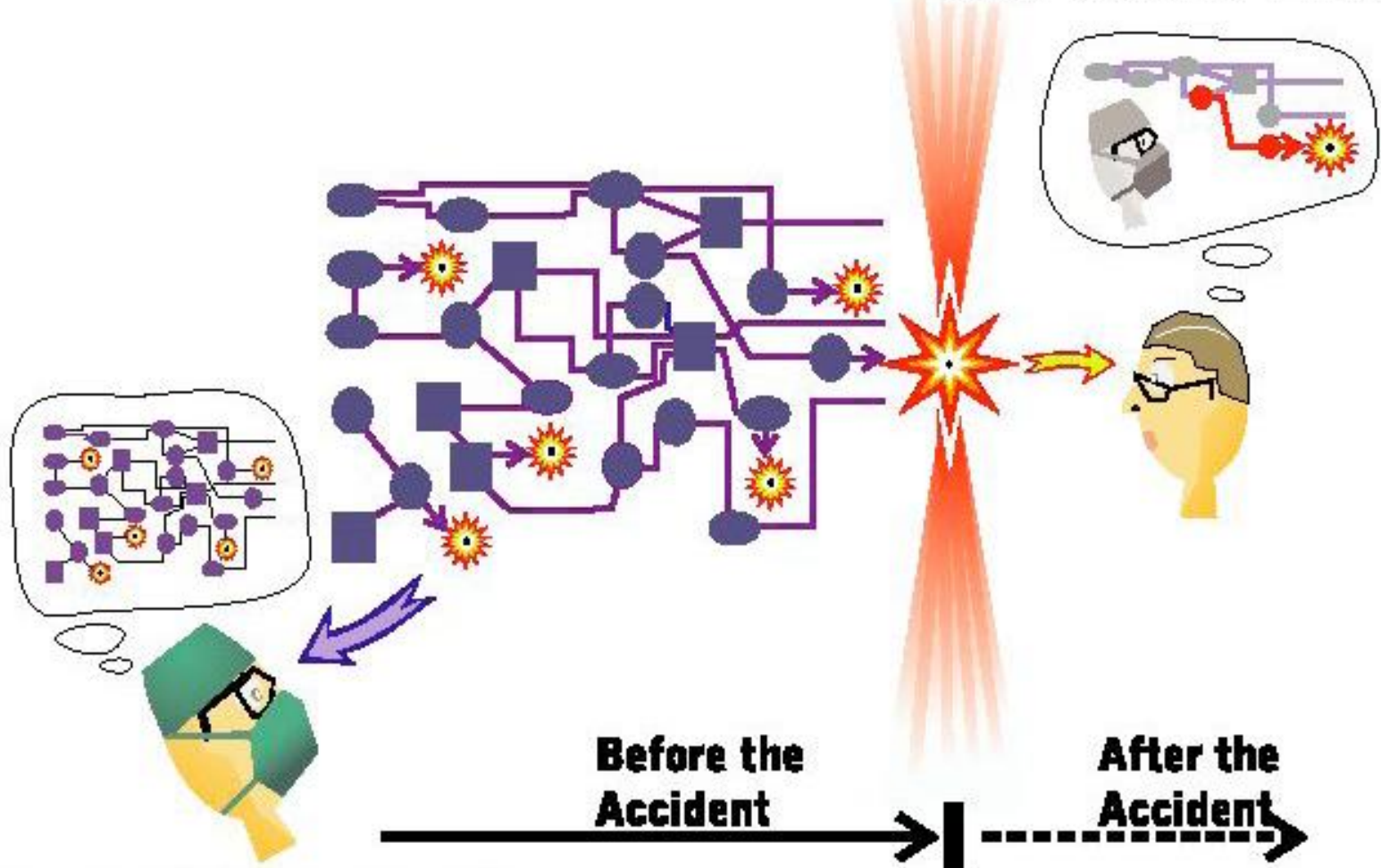
High Level Context: The Flight

- Comair 5191 operated for Delta Air Lines

- Lexington, KY to Atlanta, GA

- Scheduled Departure 0600

- Unintended Runway 26 departure attempt

- Accident occurred 0606, September 27, 2006

System Hazard Mitigation

- It's easy to stop at Hazard ID and containment

- Move beyond—set the system up to succeed

High Level Context: The Environment

- # Night Visual Operation
  - Dark, before sunrise
  - No moon
  - Light southerly winds
  - 8 mile visibility
  - Scattered Clouds at 12,000 ft.

High Level Context: The LEX Airport

- Runway Safety Area Construction
- North Runway Threshold movement (325'sw)
  - 7 days prior to Accident
- Altered Taxi route to Runway 22
- Altered Signage and lighting
- Perfect regulatory compliance
  - Unaware of the unconstrained safety hazards

High Level Context: The Airline Culture

- First bankruptcy reorganization

- Implied fleet reduction

- Imposed contract concessions

- Threatened Furloughs

- Crew "topic of conversation"
  - Preflight and taxi
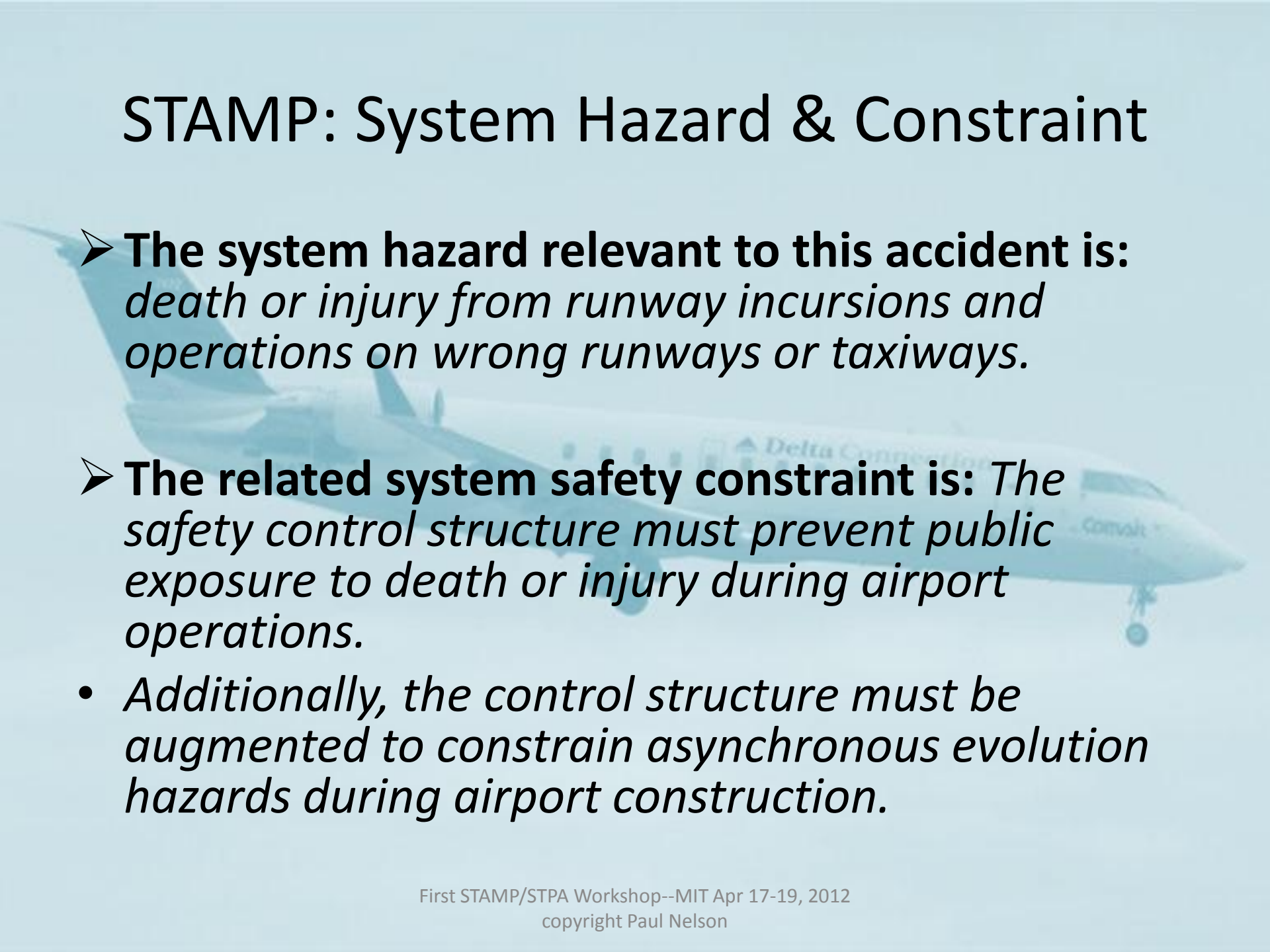
Proximate Event Chain

➢Typical Flight Prep (20min)

➢FO's: T/O brief **-"lights out all over the place"**

➢Taxi brief –"taxi Rwy22, its a short taxi".

➢During taxi : 40 sec nonessential conversation, FO performs before T/O flow (44 actions/conf.).

➢Capt. stopped short Rwy26(**Rwy22**).

➢T/O clearance

➢Capt. trans controls to FO.

➢FO comment: **"dat is weird with no lights" =>Capt. "yeah"**

➢V1, Rotate, Whoa

➢4 sec. CVR rec. ends

➢49 people dead.

Elev 973'

22
226°

G

A

A5

26
265°

F
C

1044' 1034'
1029'

C

A4

A

Elev 973'

8
085'

3500'
1067m

C

C

Co

109

Elev
970'

ARP

A3

A

1023'

7003' 2135m

A2

A

C
C

C

A

12'

D
A

H E

4
046°

A1

I

0'
A

PARKING
GATE COORDINATES

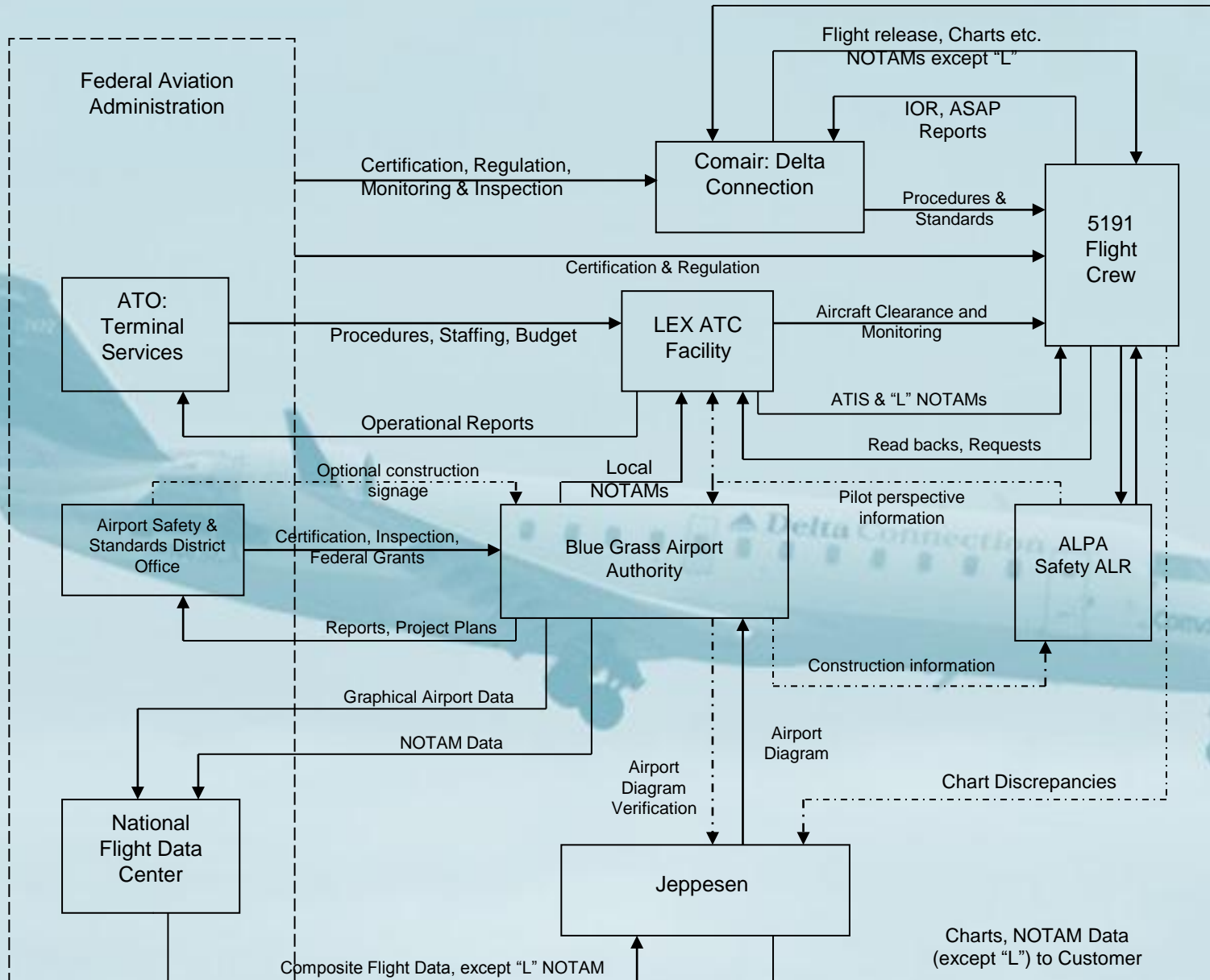GATE NO.   COORDINATES

B-2   N38 02.2 W084 35.9

Accident Scene

STAMP: System Hazard & Constraint

➢ **The system hazard relevant to this accident is:** *death or injury from runway incursions and operations on wrong runways or taxiways.*

➢ **The related system safety constraint is:** *The safety control structure must prevent public exposure to death or injury during airport operations.*

• *Additionally, the control structure must be augmented to constrain asynchronous evolution hazards during airport construction.*

Basic Aviation Safety Control Structure

Federal Aviation Administration

Flight release, Charts etc.
NOTAMs except "L"

IOR, ASAP Reports

Certification, Regulation, Monitoring & Inspection

Comair: Delta Connection

Procedures & Standards

5191 Flight Crew

Certification & Regulation

ATO: Terminal Services

Procedures, Staffing, Budget

LEX ATC Facility

Aircraft Clearance and Monitoring

ATIS & "L" NOTAMs

Operational Reports

Read backs, Requests

Optional construction signage

Local NOTAMs

Pilot perspective information

Airport Safety & Standards District Office

Certification, Inspection, Federal Grants

Blue Grass Airport Authority

ALPA Safety ALR

Reports, Project Plans

Construction information

Graphical Airport Data

NOTAM Data

Airport Diagram

Chart Discrepancies

Airport Diagram Verification

Airport Diagram

National Flight Data Center

Jeppesen

Charts, NOTAM Data (except "L") to Customer

Composite Flight Data, except "L" NOTAM

- - - - - - ▶ = missing feedback lines

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Flight Crew: TAXI

- Taxiway A had been changed
 - Rwy 22 Threshold moved 325' SW
  - Taxiway A5 renamed A (new route to Rwy 22)
  - Slight left turn—70 degree turn across runway 26

- Route as cleared and expected
  - "taxi runway 22 via A(lpha)"
  - Clearance good for old and new routes to Rwy 22
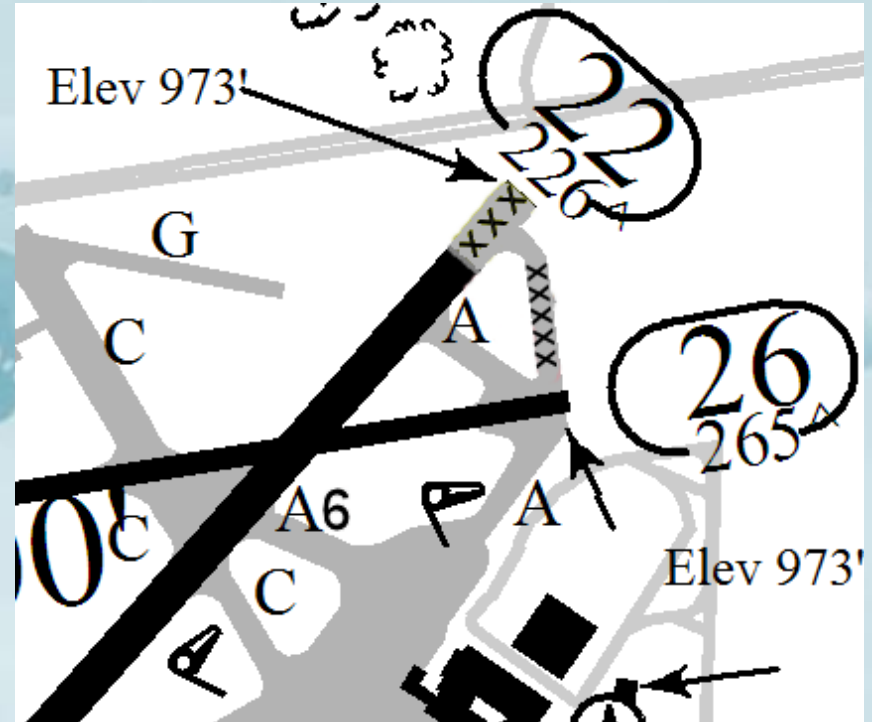
Flight Crew: Rwy 22 (Rwy 26) visual context

- ## While holding short of Rwy 26
  - View appeared as holding short Rwy 22
  - View **NOT** as expected if short Rwy 26.
- ## Appearance match to Rwy 22:
  - Taxiway/Runway angles
  - Lighting/dark areas
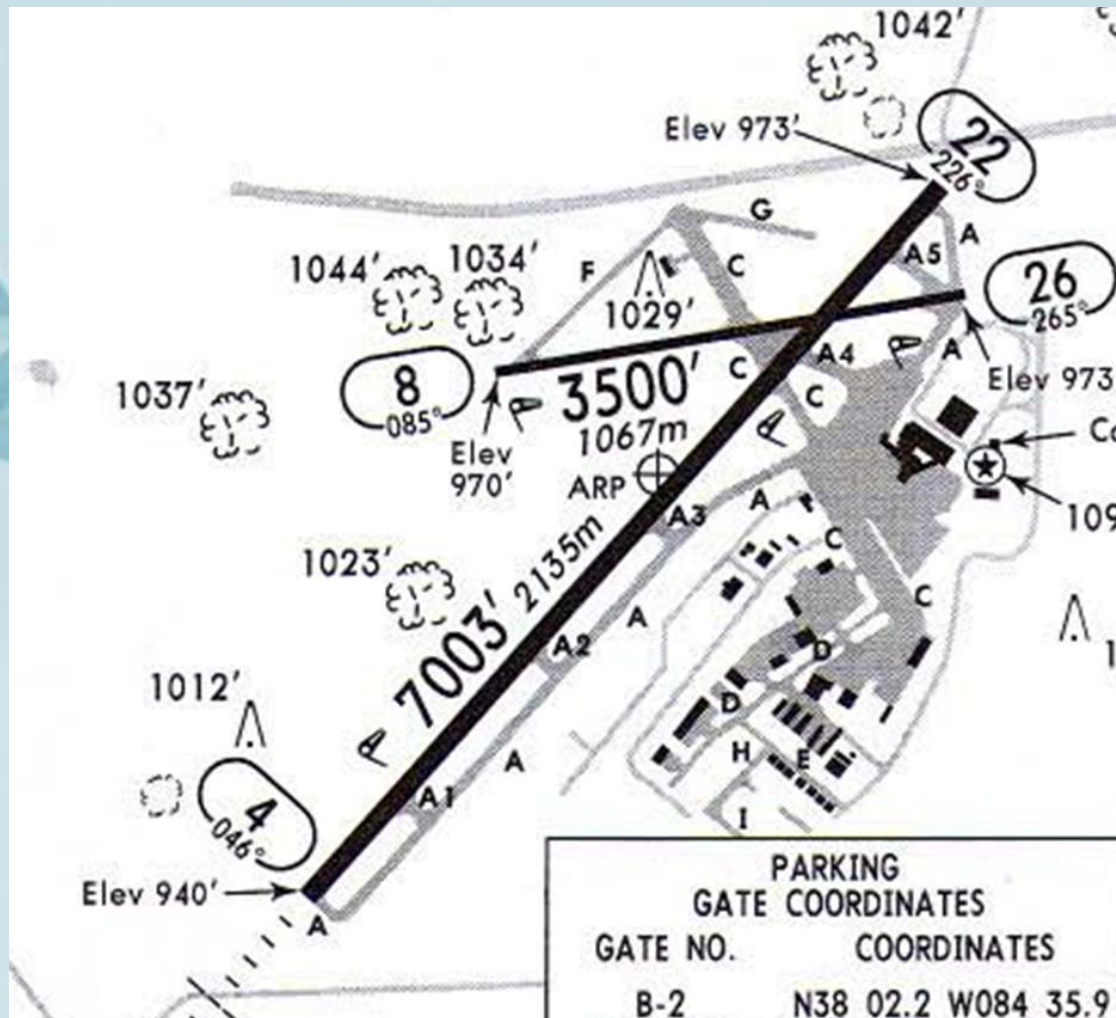 - Pavement width

The Airport Diagram

What The Crew had
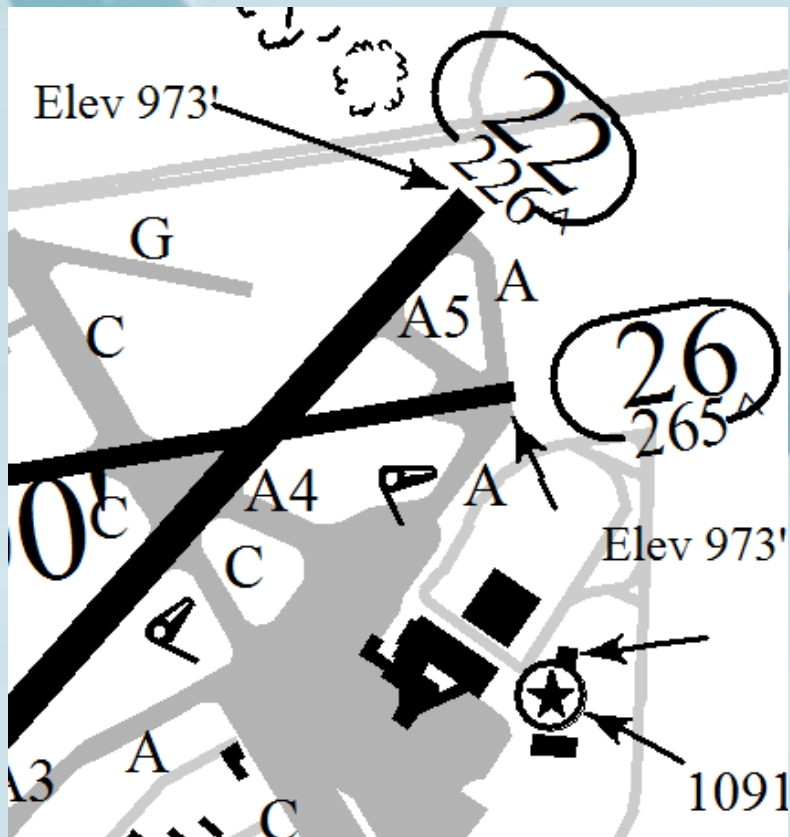
What the Crew Needed

Controllers Visual Differences

Control Tower View

LEX ATCT: Why Only 1 Controller?

- LEX Tower Manager: Goal Conflicts, Production Pressure

- Verbal guidance: Staff Tower and Radar functions separately

- Reallocate airspace during night shift
  - Indy Center take Approach/Departure

- 2 yrs trying to:
  - Increase Staffing and/or budget
    - Overtime budget only 35 days

LEX ATC Double Bind

- Email from mid level Management "stay with in budget"
  - "**essential to** the overall **fiscal success** of the hub that **every manager** does their part and **manages responsibly** and **ensures** that the **Hub Manager is informed** immediately **when issues** arise that may **adversely impact the budget**"
- LEX Manager understood—when push comes to shove—protect the budget

Air Traffic Organization: Terminal Services

- Top Management's primary information channel—verbal communication with subordinate management.

- Believed guidance was clear and consistently followed.

- Surprise that LEX was routinely combining Tower and Radar functions with one controller

  – Despite email from LEX manager stating such

Conclusion

- Model used determines what is relevant

- STAMP guides the gathering of "systemic" behavior.

- STAMP frames system behavior so impact of non-linear aspects are validated as relevant.

- STAMP turns "Human error" into the beginning of investigation not the end.

References

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Complete STAMP analysis of 5191
http://sunnyday.mit.edu/papers/nelson-thesis.pdf