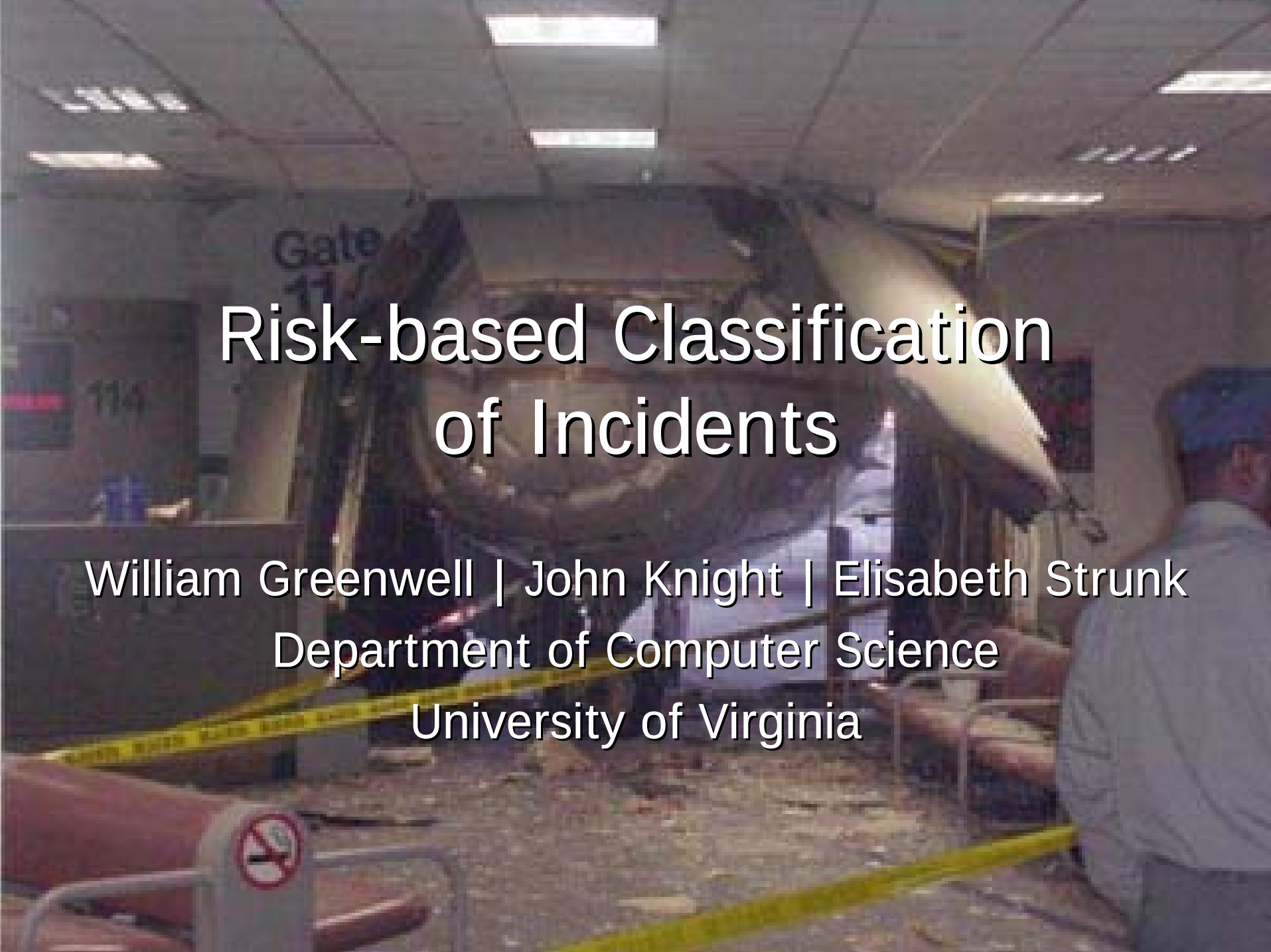

Risk-based Classification of Incidents

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Overview

- Accidents & Incidents Defined
- Investigative Procedures
- Case Studies
  - Korean Air Flight 801
  - British Airways Flight 027
- Event Comparison
- Risk-based Incident Classification

Accident vs. Incident

- Aircraft accident – an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage.

- Incident – an occurrence other than an accident, associated with the operation of an aircraft, which affects or could affect the safety of operations.

Source: 49 CFR 802


Gate
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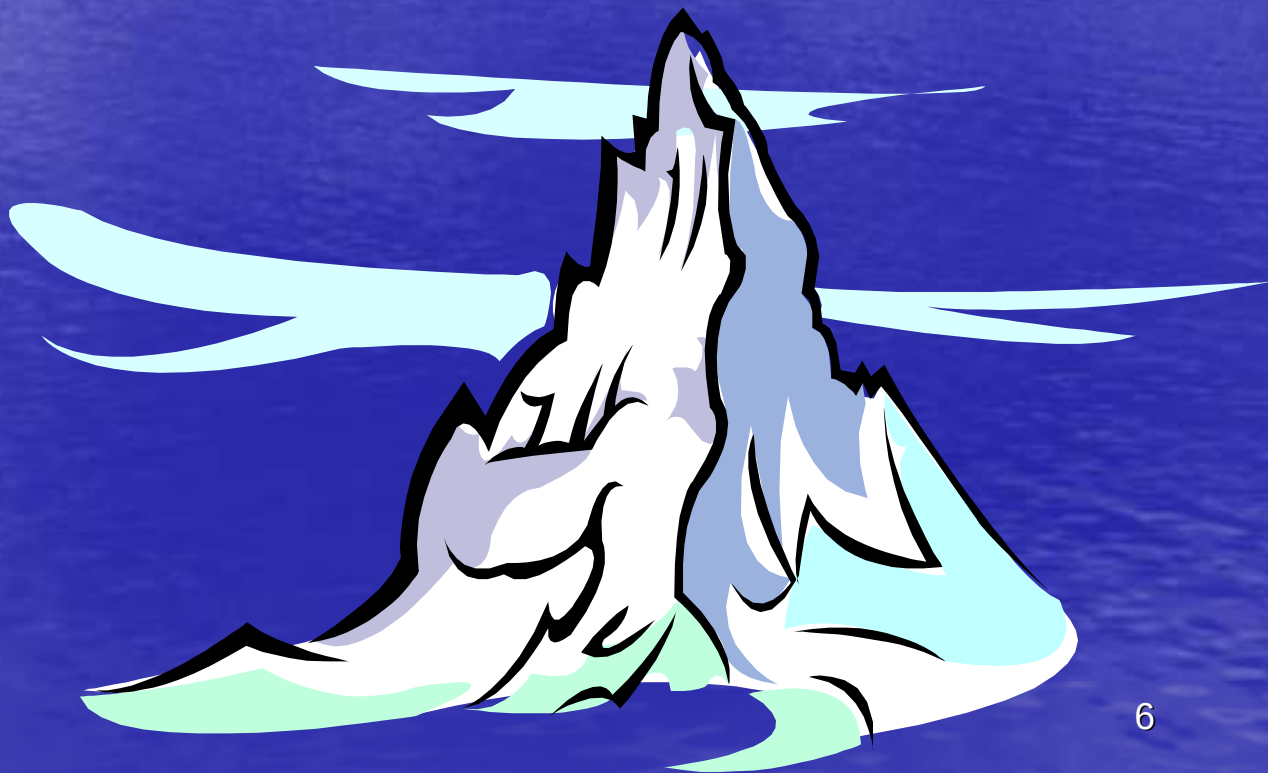
Loss

- Loss – death or serious injury to persons, or substantial damage to an aircraft.
- Incident + Loss Event → Accident
- Incidents & accidents may share similar characteristics and lessons.

Ex: Descent Below Safe Altitude

Minimum Safe Altitude (MSA)



Accident

Incident Investigation

- Major Accidents
  - Full inquiry by independent safety board
  - Report w/ findings & recommendations
- Minor Accidents / Serious Incidents
  - Review by safety board / aviation authority
  - Incident synopsis w/ identification of cause
- Other Incidents
  - Catalogued by aviation authority
  - Third-party analysis for recurring safety problems

Loss-based Prioritization

- Easy to perform
  - Loss is known almost immediately.
  - Objective assessment; done only once
- Consistent with demands of the public

- Strictly prioritizes accidents over incidents

Danger that safety problems will not be addressed until they contribute to losses

Software Failures

- Software faults are extremely difficult to detect, eliminate, or tolerate.
- Failure behavior often difficult to predict
  - Hazardous operation of the aircraft
  - False advice to flight crew
- Consequences depend on flight crew's ability to detect and respond to failure.

Korean Air Flight 801

- Impacted Nimitz Hill, Guam on 8/6/1997.
- 228 killed, 26 injured
- Crashed on approach to Guam Int'l Airport.
- NTSB's findings:
  - Improper descent below safe altitude
  - FAA's inhibition of Minimum Safe Altitude Warning (MSAW) system at Guam

British Airways Flight 027

- Nearly collided with Korean Air Cargo Boeing 747 on 6/28/1999 over China.
- 419 *uninjured*
- Incident occurred in uncontrolled airspace.
- Erroneous climb instruction from CAS
- U.K. CAA's findings:
  - CAS damaged during maintenance.

Loss Comparison

	KA 801	BA 027
Classification	Accident	Incident
POB	254	419
Fatalities	228	0
Injuries, Serious	26	0
Injuries, Minor	0	0
Total Casualties	254	0
Acft. Damage	Destroyed	None

Investigation Comparison

	KA 801	BA 027
Investigation	30 months	4 months
Final Report	212 pages	3 pages
Factual Info.	134 pages	2 pages
Analysis	37 pages	1 page
Findings	36	1
Recommendations	15	3

Context

- *Precedent* existed for both incidents concerning problems with MSAW & TCAS.
  - KA 801: Follow-up actions were inadequate.
  - BA 027: TCAS design issues found too late.
- MSAW configuration errors *continued* to contribute to accidents after KA 801 crash.

Preventing Accidents

Incident + Loss Event → Accident

- Option 1: Mitigate Loss Event
  - Accident still possible; however consequences will hopefully be less severe.

- Option 2: Prevent Incident Recurrence
  - Incident prevention precludes loss event, thereby preventing accident entirely.

Risk-based Classification

- Total Risk = Exposure × P[Recurrence] × E[Cost]
  - Exposure – number of opportunities for recurrence
  - P[Recurrence] – probability of incident recurrence
  - E[Cost] – expected cost of recurrence
- Proactive approach: incidents with higher risk of recurrence investigated with higher priority.
- Magnitude of Total Risk determines importance of recommendations required to mitigate risk.

Ex: British Airways Flight 027

- Exposure
  - Every TCAS-equipped aircraft?
- P[Recurrence]
  - Statistical data for loss of separation incidents
  - P[Undetected damage to TCAS circuitry]
- E[Cost | Loss of Separation Incident]
  - Estimate from statistical data / analytical arguments

Iterative Reclassification

- Total Risk estimate will change as investigation progresses.
  - Greater precision as details are uncovered
  - New findings might raise risk of recurrence.
- Risk of recurrences changes as recommendations are implemented.
- Investigators must periodically reassess Total Risk to account for these factors.

Conclusions

- Incidents are recurring, sometimes with losses, because lessons are being missed.
- Loss-based prioritization schemes can undervalue high-risk incidents.
- Using risk to assess incidents can lead to a more proactive approach to investigation.