The Nature of Accidents: What can we expect towards 2038?

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FLYING TEST BED
G-BWWW
BAE SYSTEMS
G-NFLA
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NATIONAL FLYING LABORATORY CENTRE

Aircraft Accident Investigation 1977 Style


G-CRAN

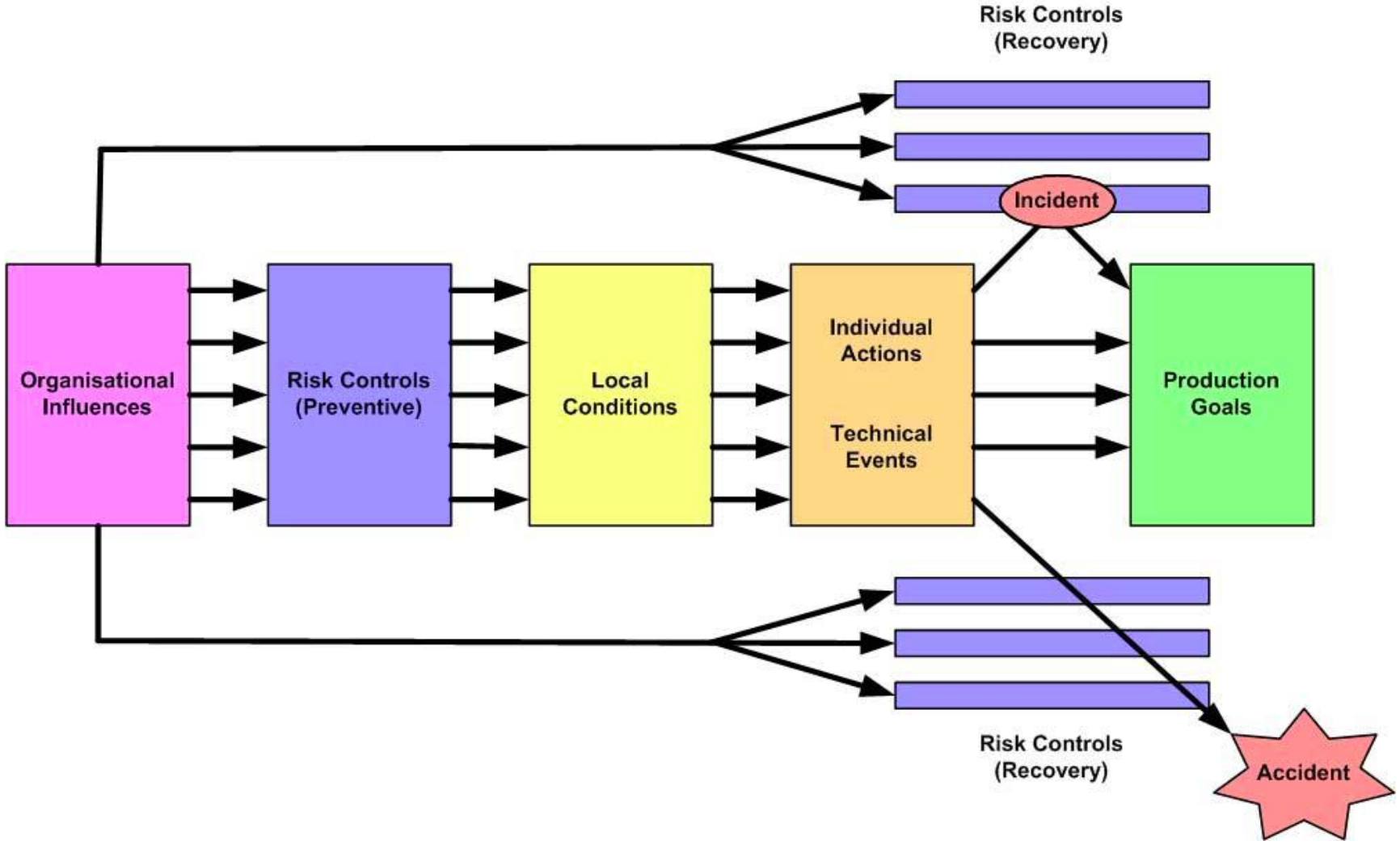
The Queen's Anniversary Prizes

For Higher and Further Education

2011

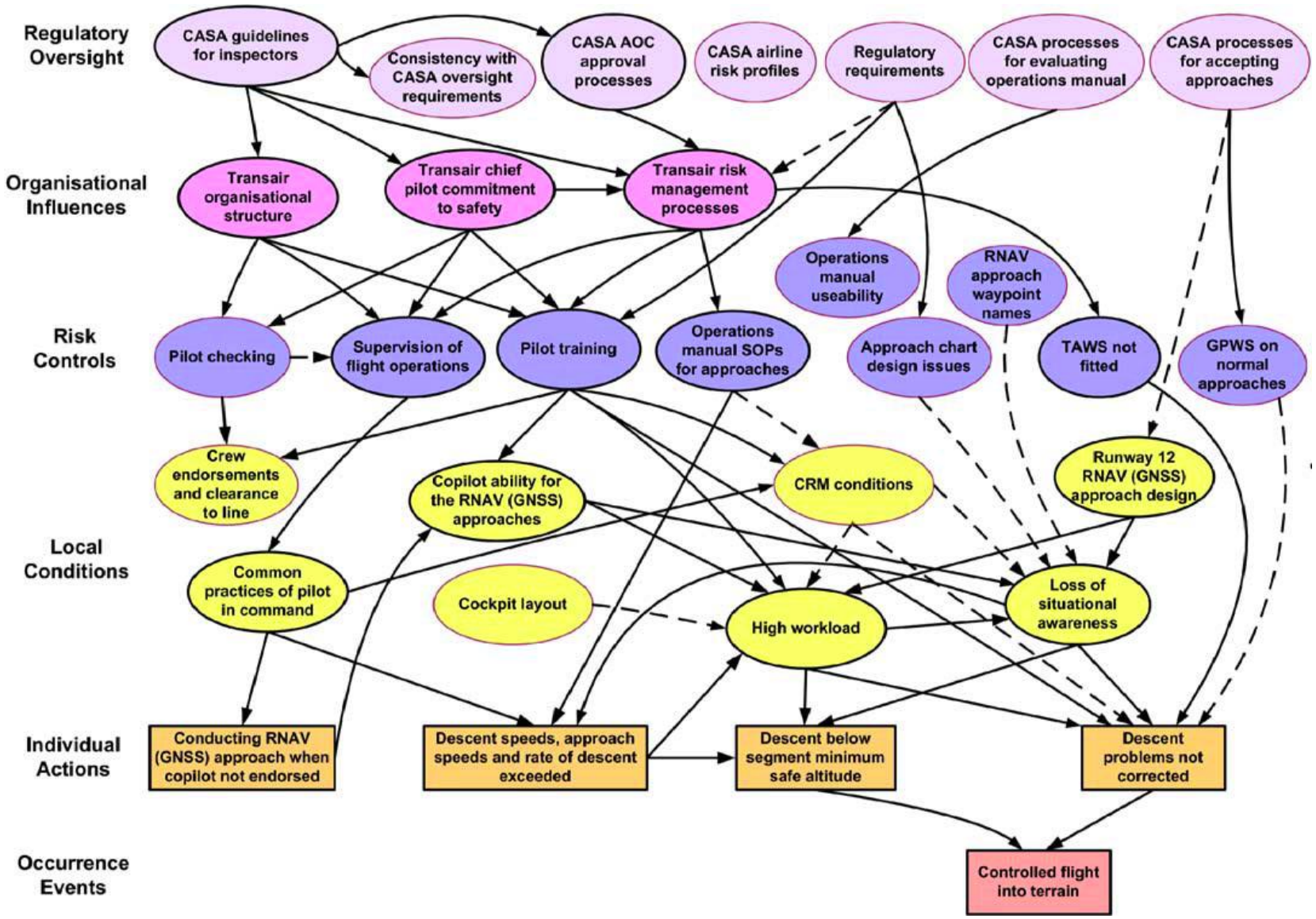
Air France Flight 447, 2009

A more enlightened approach to accident causation



Source: Reason, Adapted by Walker and Bills, 2007

Example - Lockhart River, Australia (Source: ATSB)



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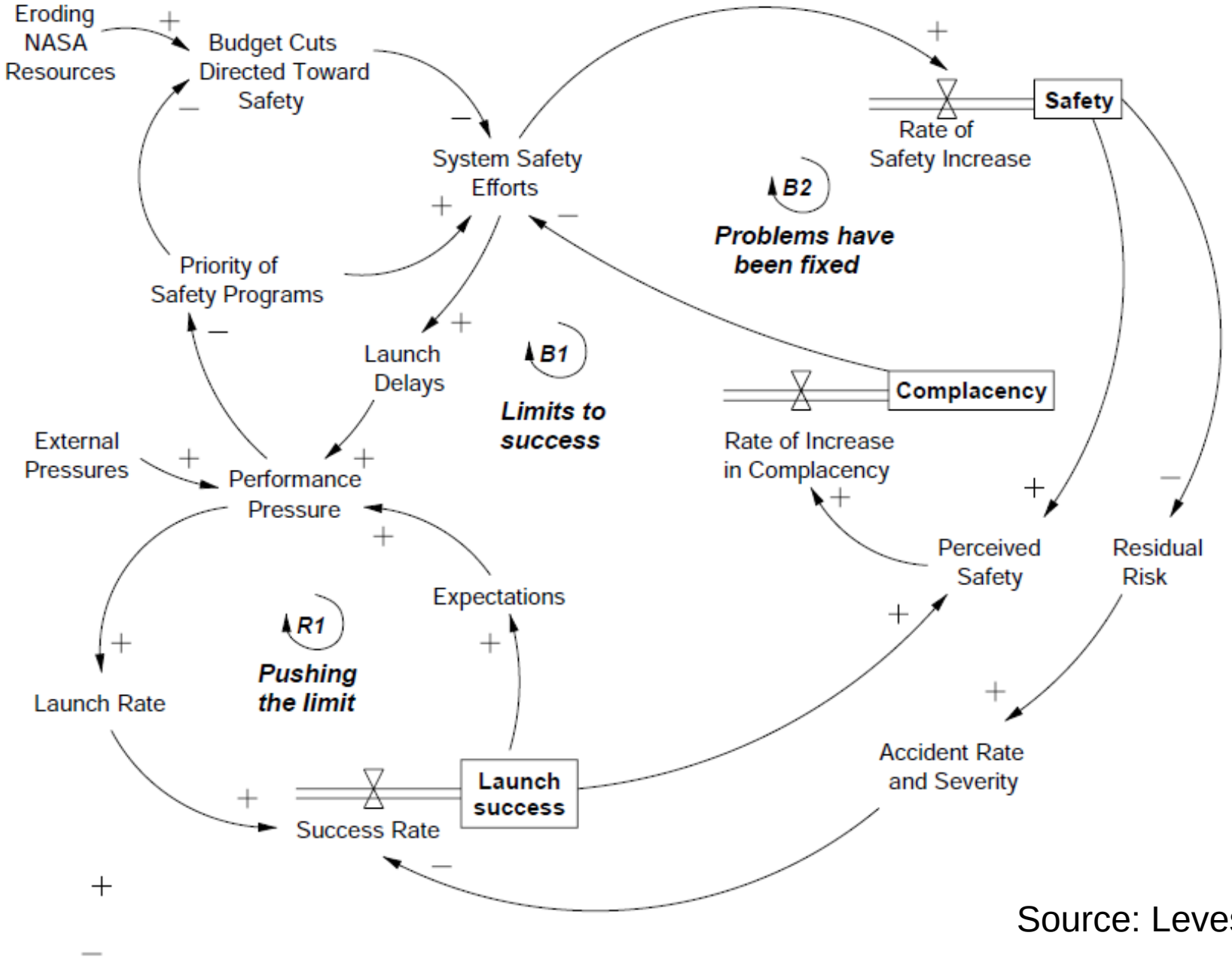


Source: Leveson, 2009

Figure 13.1
A simplified model of the dynamics of safety and performance pressures leading up to the *Columbia* loss. For a complete model, see [125].

Manx2 Flight 7100 - Cork, Ireland 2011

…’ the most challenging of the more than 500 Investigations that have been completed by the Unit since its formation in 1994 (AAIU, 2015)

We are starting to learn from ‘successes’ as well as failures

What will 2038 look like?

“Brexit negotiations almost complete”

Transport is becoming one aspect of mobility

TECHNOLOGY STRATEGY | 2016
FOR INTELLIGENT MOBILITY

imex

CATAPULT Transport Systems

UK Transport Systems Catapult

Vision for Intelligent Mobility…

- Make travelling an end-to-end user-centric experience
- Make our transport system more sustainable and reduce its environmental impact
- Save many lives
- Generate billions when moving people and goods
- Make our transport systems more resilient
- Make our transport assets more productive
- Improve accessibility for all segments of society
- Make transport of people and goods quicker

Predictions for the Future

The amount of automation will increase

Rod Matheson, Scientific Solutions Division, Olympus

Air travel will be a seamless experience

Jude Schramm, CIO, GE Aviation

Big data will improve the airport experience

Ben Vogel, Editor, IHS Jane's Airport Review

Digital design will change how we make planes

Professor Herve Morvan, Institute for Aerospace Technology, University of Nottingham

Source: Businessinsider.com

Predictions for the Future

Digital analytics will improve airline operations

Tom Palmer, Senior Vice President of Services, Civil Aerospace, Rolls-Royce

Security processing time will shorten

Clement Cesarine, Spherea Test & Services Limited

Big data will drive smarter operations

Kevin Crowley, Vice President of Digital Aviation, Boeing

Source: Businessinsider.com

Drivers of change

Society	Technology	Environment	Economy	Politics
• Terrorism	• Cybersecurity	• International regulation of emissions and noise pollution	• Global income inequality	• Bribery and corruption
• Urbanization and the growth of megacities	• Expanding human potential	• Resource nationalism	• Strength and volatility of global economy	• Geopolitical (in)stability
• Passenger identity and fraud	• Robotics and automation	• Personal carbon quotas	• Price of oil	• Government ownership of airspace and critical infrastructure
• Global aging	• 3D Printing and new manufacturing techniques	• Water and food security	• Level of integration along air industry supply chain	• Strength of governance
• Middle class growth in China and the Asia-Pacific region	• Virtual and augmented reality	• Environmental activism	• Shift to knowledge-based economy	• Anti-competitive decisions
• New modes of consumption	• Internet(s) of Things	• Extreme weather events	• Privatization of infrastructure	• Defense priorities dominate civilian needs
• Tensions between data privacy and surveillance	• Alternative fuels and energy sources	• Rising sea levels and reclaimed habitats	• Concentration of wealth into a "Barbell economy"	• Shifting borders, boundaries, and sovereignty
• Global population growth driven by Asia and Africa	• New aircraft designs	• Human-controlled weather	• Unionization of labor and regional independence	• Increasing influence of alternative regional and global institutions
• Shifting ethnic, political and religious identity	• Alternative modes of rapid transit	• Circular economy	• Open data and radical transparency	• Trade protection and open borders
• Disability, fitness and health	• Geospatial technology	• Infectious disease and pandemics	• Changing nature of work and competition for talent	• Rise of populist movements

Figure 2: 50 Drivers of Change for the Airline Industry

How will aircraft change over the next 20 years?

Aircraft losses will be increasingly unaffordable

The future will be increasingly disruptive

‘Passenger drones’ or variants on personalized aircraft (for example with rooftop take-off) may have some impact, but a more substantial threat may come from the extension of an Uber-type algorithm-based integrated transport system that links up small aircraft capacity at local airfields (possibly upgraded with ‘remote tower’ technology) to provide medium to long distance ground-air-ground travel options.

(IATA, 2017)

The concept of ‘aviation’ will be very different

- RPAS, UAV, UAS, Drones etc.
- New user groups are taking to the skies
  - Manufacturers
  - Operators
  - Passengers…
- Consumers will increasingly access aviation directly

Growth in ‘drones’

- In 2012, drone activity in USA was worth $40 million
- By 2017 this had grown to about $1 billion
- By 2026 this is expected to translate to an annual impact of $31 to $46 billion on the US GDP

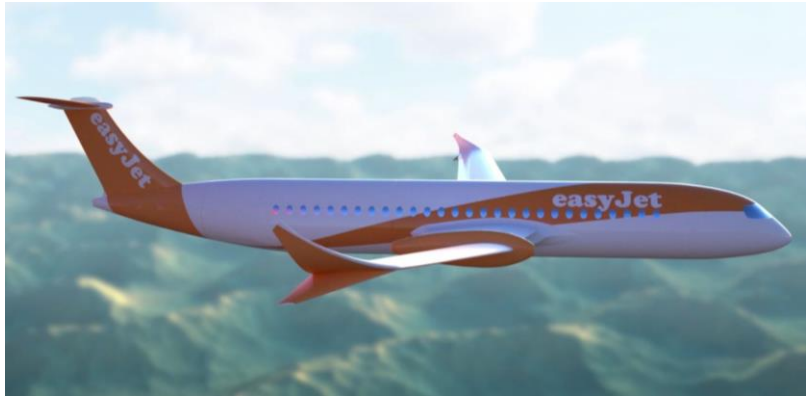
(Source: McKinsey, 2017)

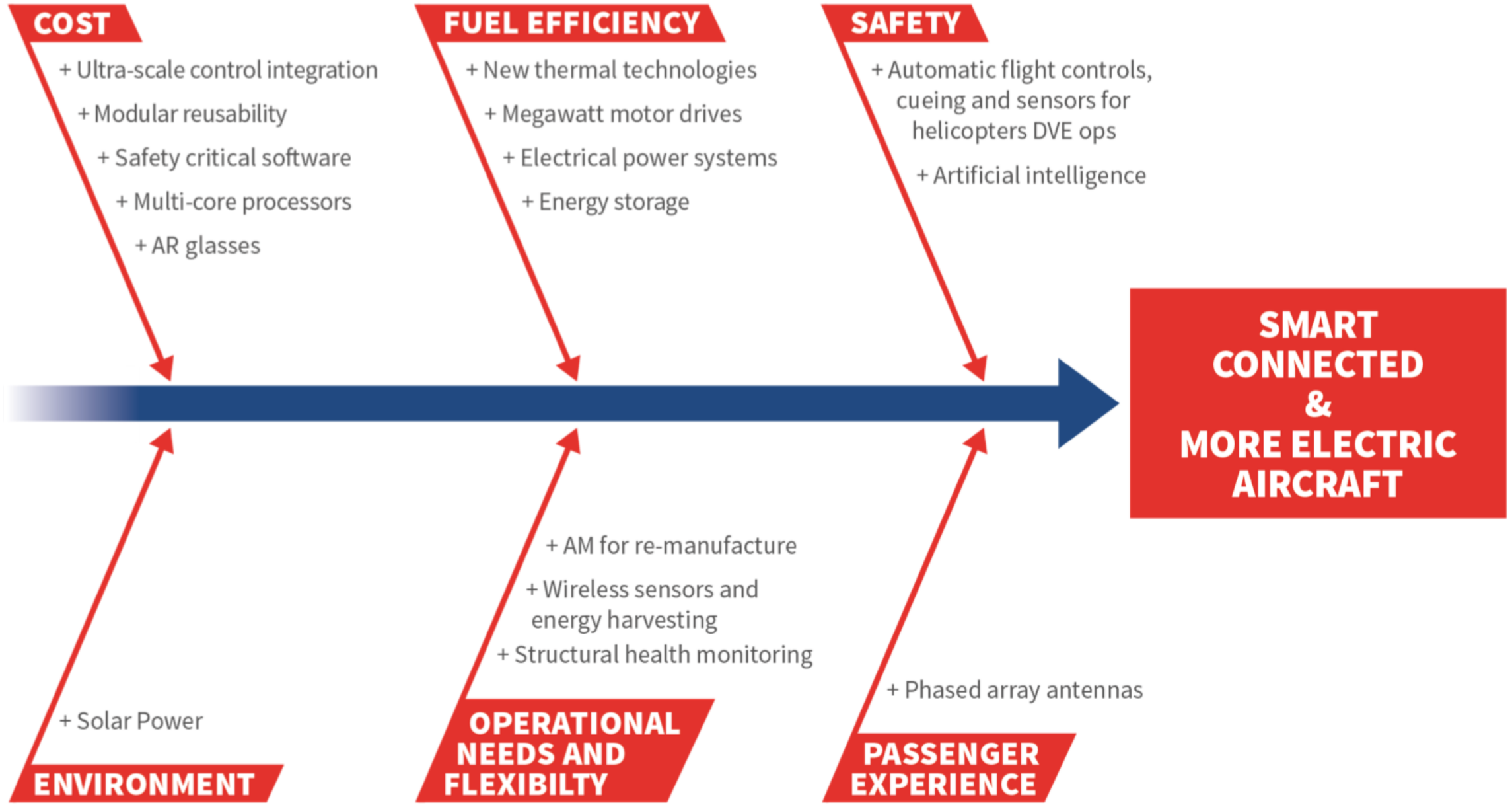
Economic, political and regulatory challenges

- Strong political and economic drivers
- Fast developing technology
- Regulatory burden of ‘small’ UAVs
- Economics incompatible with traditional approach to safety regulation
- Multiple regulatory domains

Evolution of the ‘passenger aircraft’

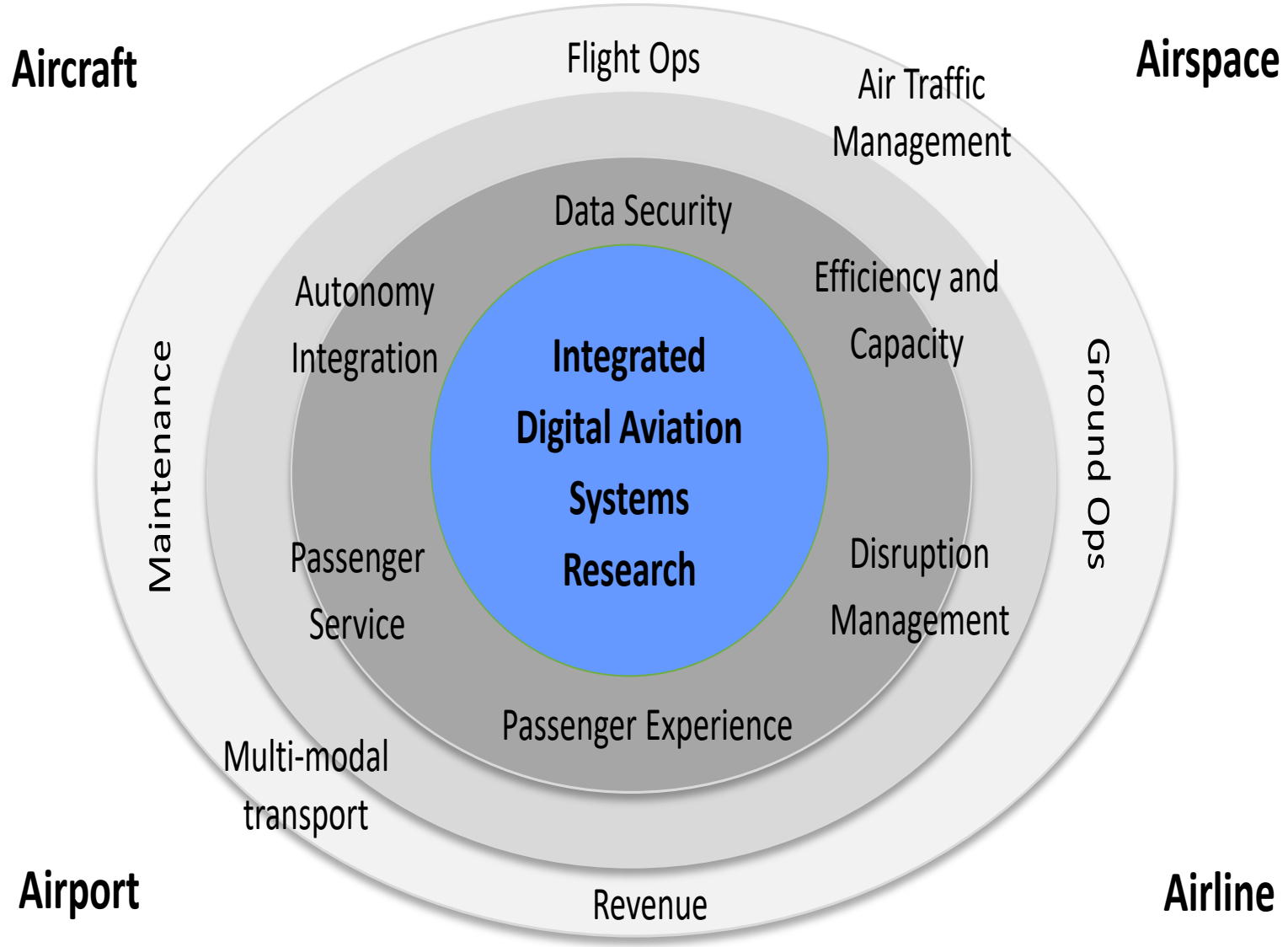
- The scalability of gas turbine technology is limited
- Alternative energy systems are becoming available
- Increasing opportunities for connectivity
- Push to reduce maintenance downtime
- …Enter the Smart, Connected and More Electric Aircraft





Source: Aerospace Technology Institute, 2017

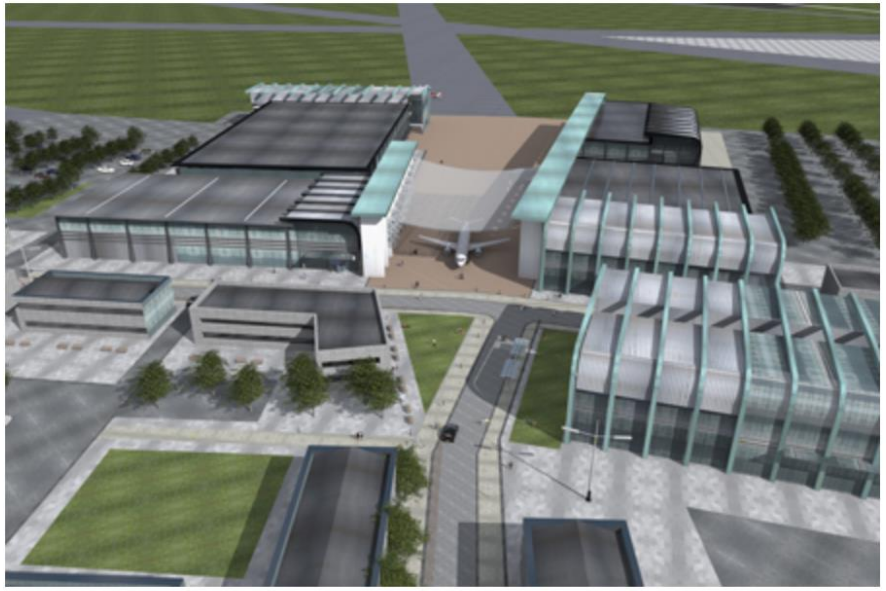
Aviation is becoming increasingly ‘Digital’



THALES PART OF NEW £65 MILLION CENTRE TO SPEARHEAD UK RESEARCH IN DIGITAL AVIATION TECHNOLOGY

| 25.07.2017 | RESEARCH AVIATION AEROSPACE AIR TRAFFIC MANAGEMENT DARTEC SHARE

Thales is a founding member of a consortium of leading aerospace and aviation companies which, with Cranfield University are creating a new £65 million Digital Aviation Research and Technology Centre (DARTeC).



DARTeC will be built at Cranfield University and will spearhead the UK's research into digital aviation technology, and will provide research facilities unprecedented in Europe.

Failures become increasingly traceable and self-reporting

- Intelligent and connected aircraft will report their faults in real time
- The flight deck will become increasingly visible
- Aircraft will become ‘conscious’ and possibly self-repairing
- ‘Digital twins’ give an opportunity to identify failures before they occur for real

An increasingly connected ecosystem

“Opportunities in artificial intelligence will ultimately succeed or fail based on the security systems that surround them. The current state of aerospace security is appropriate for current systems. However, the increasing pervasiveness of smart devices with ‘Internet of Things’ (IoT) connectivity is already targeting hitherto everyday household items.

For example, the security provisions included for a smart kettle were commensurate with the criticality of a kettle, but the unexpected weakness became clear when they were collectively hacked and used to target another system by over-loading it with spurious messages.”

Source: Aerospace Technology Institute, 2017

Cyber-security will remain a continuous challenge

- Cyber security issues may affect:
  - Manufacturing
  - Regulatory approval
  - Provenance of spares
  - Software and updates
  - Paperless aircraft aspirations

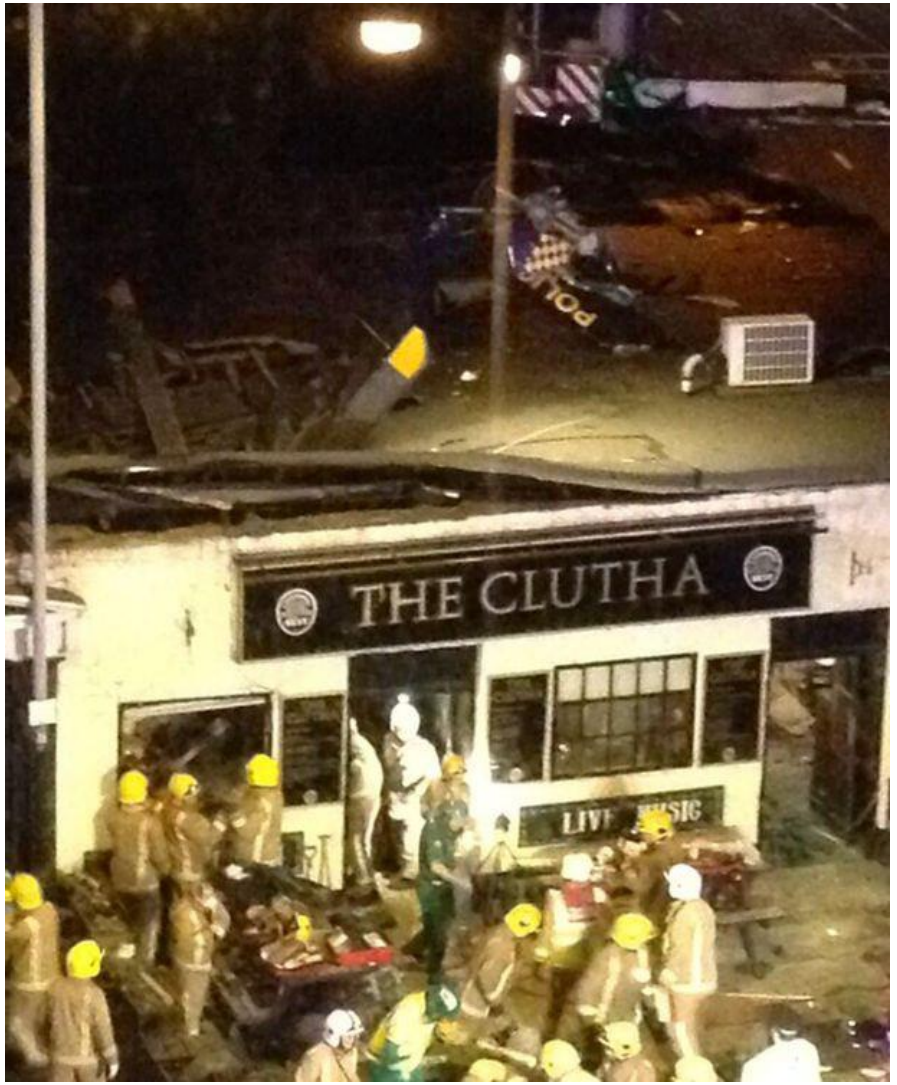
- Evidence may be very well hidden
  - Data persistence
  - Encryption
  - Anti-forensic techniques
  - Volume of recorded data

…and when things do go wrong…

Accidents are increasingly ‘live-streamed’

Evidence is increasingly ‘available’ to public

Changing societal demands for ‘transparency’




NO
TURN
ON RED

Investigations will need to deliver outcomes more rapidly

- On what basis is ‘one year’ acceptable?
- Larger, more homogeneous fleets necessitate faster response
- ‘Instant answers’ are increasingly the expectation
- Greater analytical power should accelerate the investigative process

Grounding aircraft has a significant effect

BUSINESS NEWS OCTOBER 26, 2016 / 2:09 PM / 2 YEARS AGO

Airbus fumes over UK ban on Super Puma helicopter flights

Cyril Altmeyer, Tim Hepher 4 MIN READ

PARIS (Reuters) - Airbus Group (AIR.PA) voiced frustration on Wednesday at a continued ban on Super Puma oil industry flights in Britain, weeks after European safety regulators cleared the helicopter to fly again.

BREAKING: Super Pumas to Remain Grounded Say Air Regulators

*Published in **Oil Industry News** on Friday, 28 April 2017*

The Norwegian CAA and the UK CAA have opted to uphold the flight ban on EC 225 and AS 332 L2 Super Puma helicopters following the issue of a new preliminary report into the Norwegian crash that killed 13 people on the 29th of April 2016.

Regulators will increasingly be called to account for their own safety assurance performance

Transportation

NTSB and Tesla executives clash over investigation into deadly California crash

Emergency personnel work at the scene where a Tesla electric SUV crashed into a barrier on U.S. Highway 101 in California. (KTVU via AP) (AP/AP)

By Michael Laris April 12 Email the author

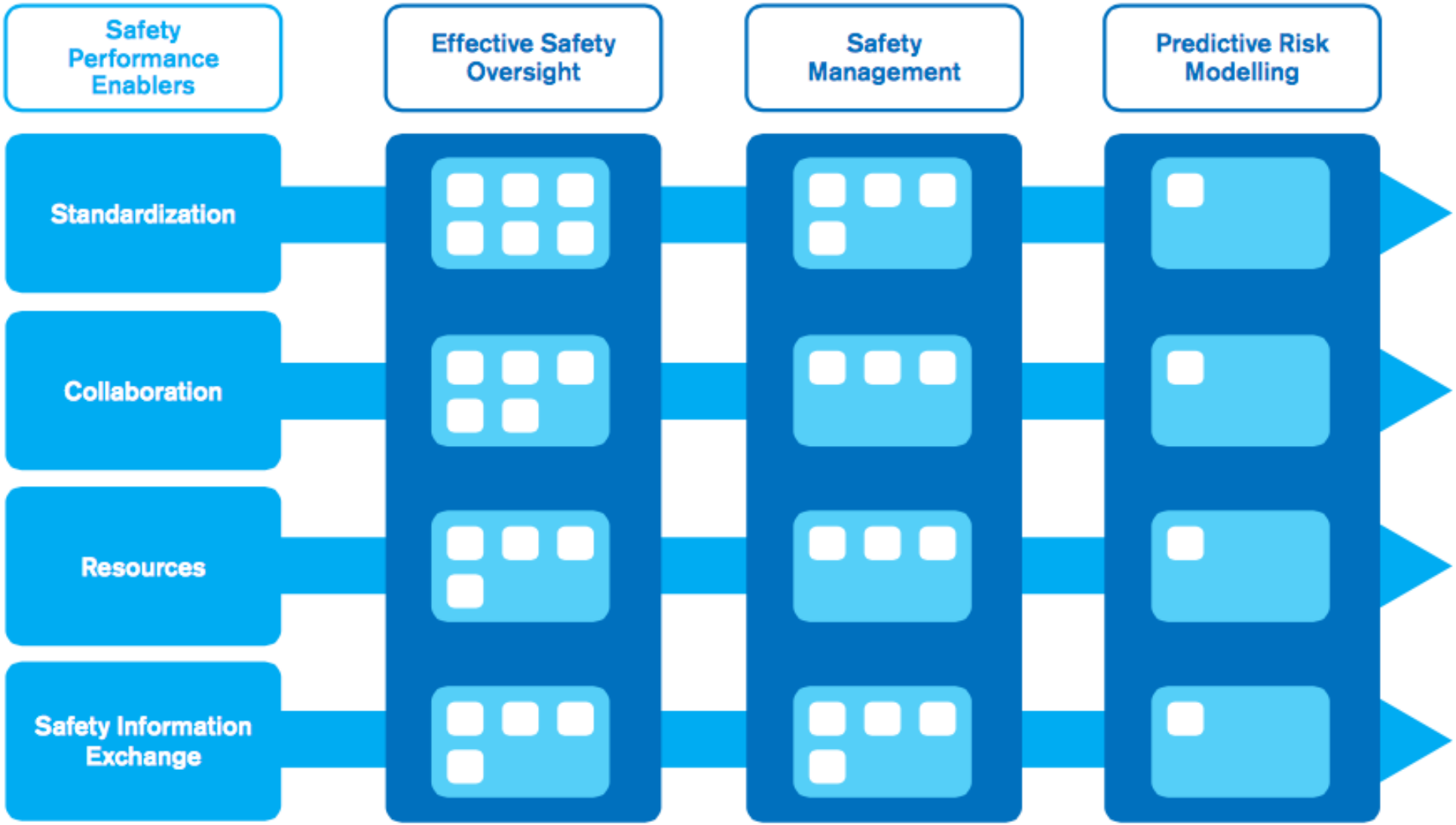
Investigation agencies will need to work harder to maintain preparedness for major events

- Infrequent major accidents will need a rapid response from teams that are increasingly inexperienced in dealing with them.
- How best to practice the scale and complexity of major accidents?
- Need to go beyond immediate response

Safety investigators will need to work harder to stay current

- Improvements in aviation safety means fewer on-the-job training opportunities.
- Achieving *competence* is not the same as maintaining *competency.*
- The pace of technological change is increasing.
- Technologies are becoming increasingly ‘digital’, integrated and opaque.

The focus will shift to prognostics



Source: ICAO

Airbus Helicopters is facing three separate lawsuits from owners of EC225LP/H225 Super Pumas who, among a range of damning allegations, are claiming Airbus sold the helicopters in a defective state due to an inherent problem in the main gearbox (MGB).

Airbus has yet to respond to Era and ECN Capital's claims in a legal capacity, but

1. **Great Slave Helicopters announces approval of sale and investment solicitation process**
2. **Universal Helicopters announces purchase of Lakelse Air**
3. **Northrop begins flight tests for U.S. Navy MQ-8C unmanned helicopter**
4. **Bell 505 MAGnificent interior receives multiple approvals**
5. **A leading southern light:**

DART AEROSPACE
TUNE UP

Lifelong commitment

- Hundreds of millions of people fly every year and the industry's safety record is superior, better regulated and better implemented than any other means of transportation on the planet. This has not just come about because of legislation but because of the aviation industry's lifelong commitment to sharing data and implementing change, based upon lessons learned.

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