ALIAS | Aircrew Labor In-cockpit Automation System

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On-Demand Mobility and Emerging Aviation Technologies

Joe F. Edwards
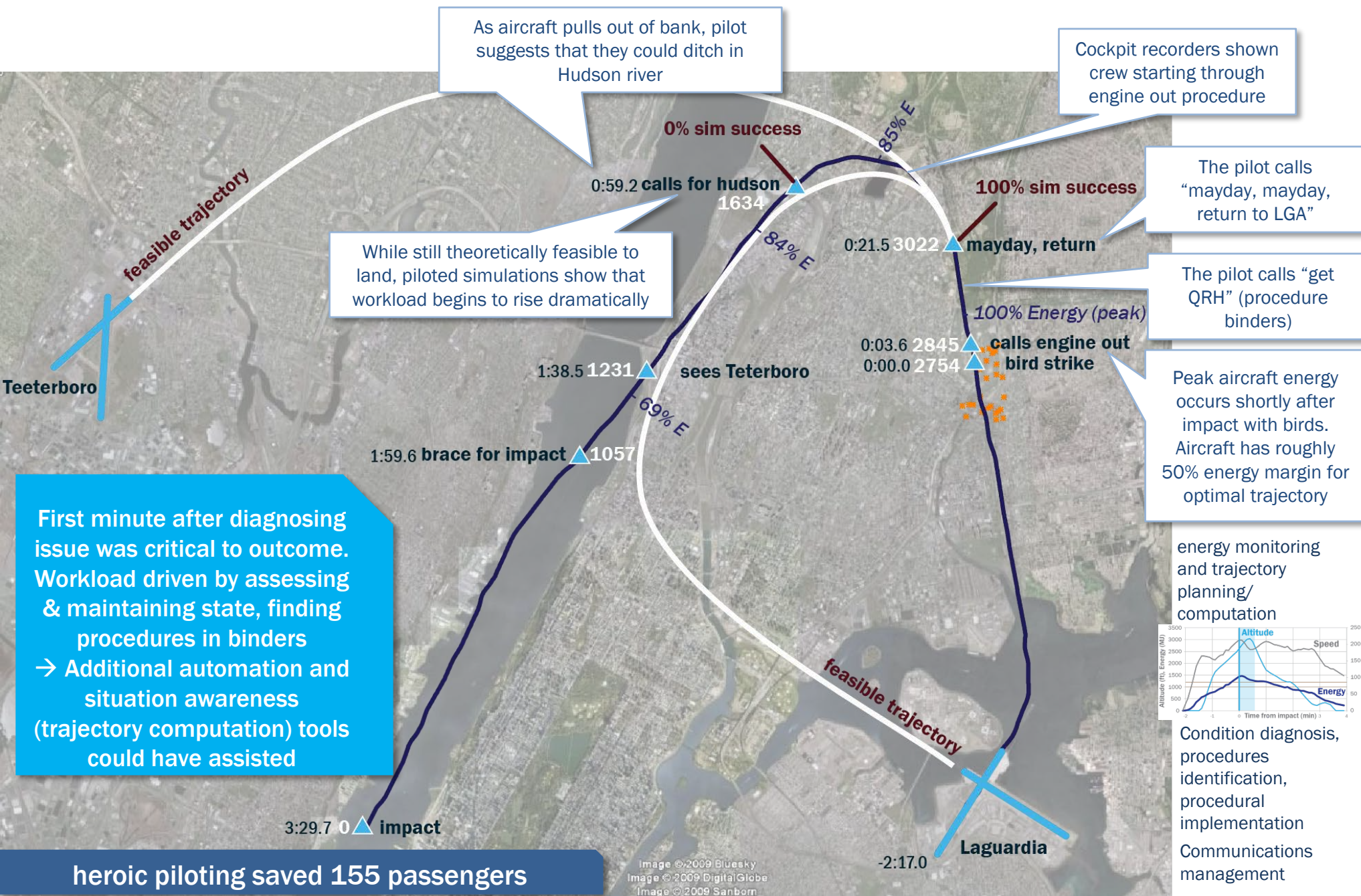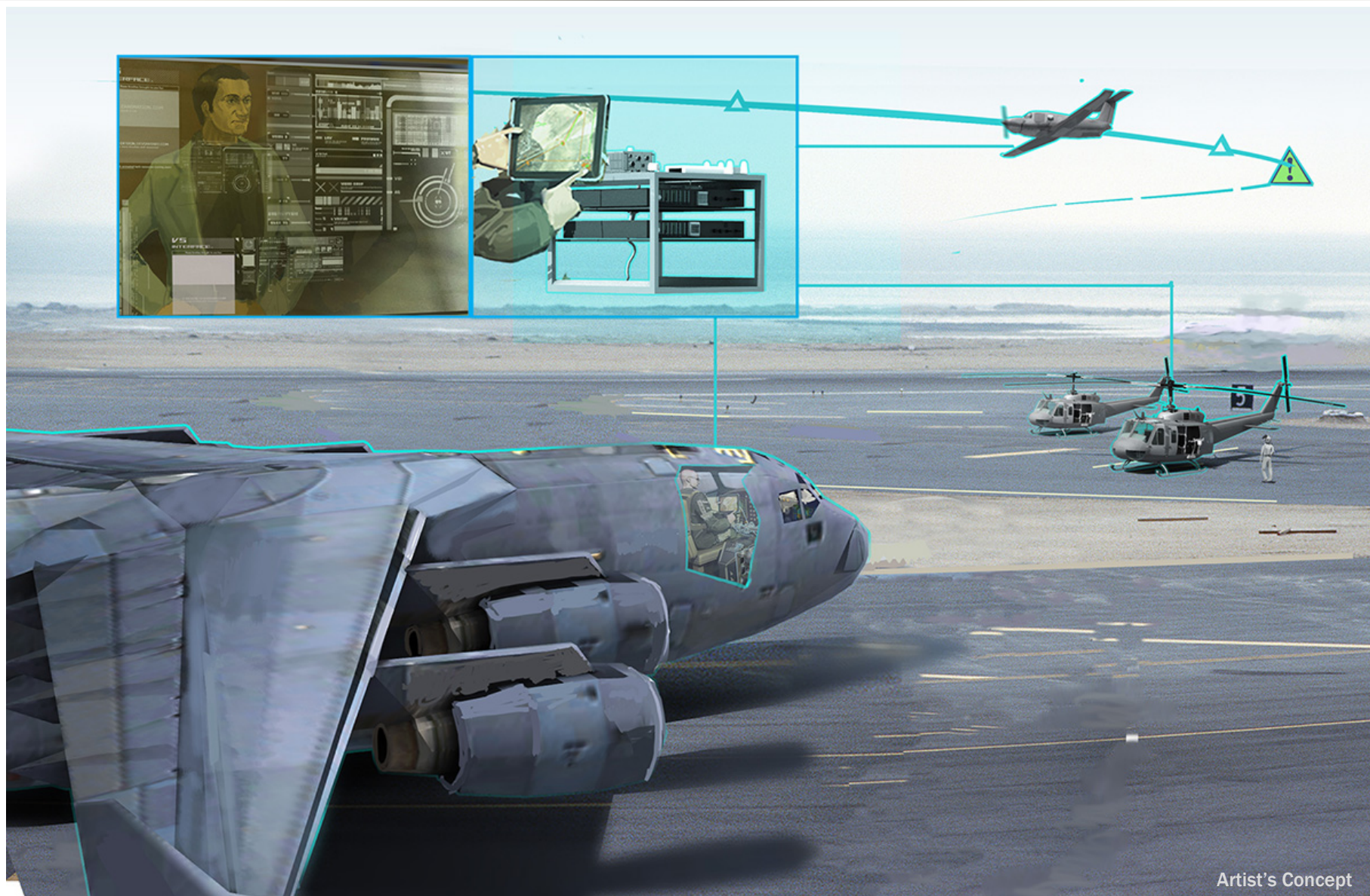
9 March 2016

Even the best pilots have physical & mental limits
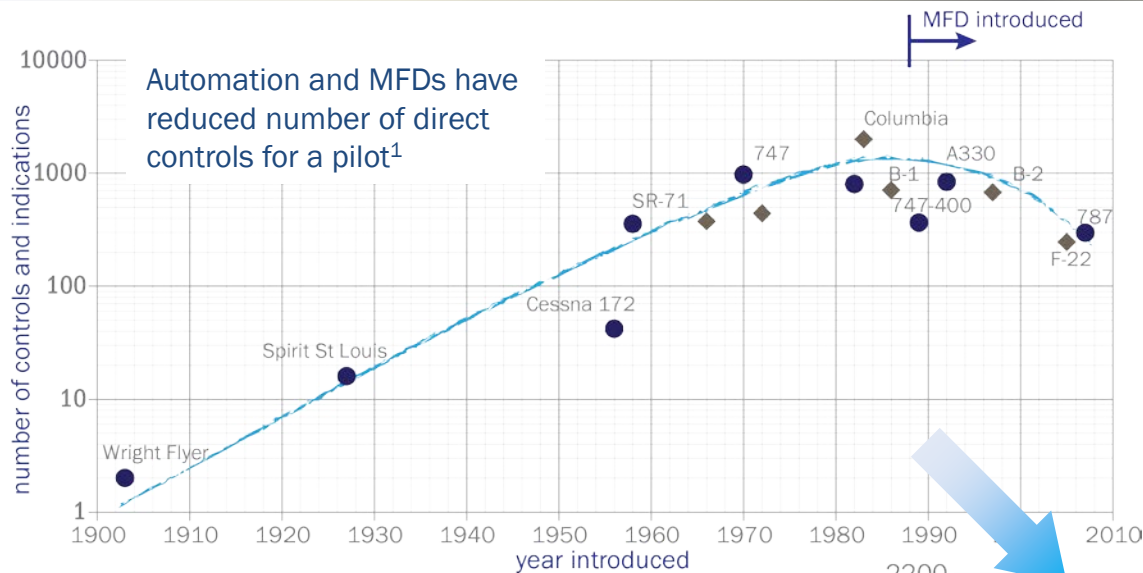## ►how could an ALIAS assistant extend these?◄

As aircraft pulls out of bank, pilot suggests that they could ditch in Hudson river

Cockpit recorders shown crew starting through engine out procedure

0% sim success

85% E

100% sim success

0:59.2 **calls for hudson** 1634

The pilot calls "mayday, mayday, return to LGA"

84% E

0:21.5 3022 **mayday, return**

While still theoretically feasible to land, piloted simulations show that workload begins to rise dramatically

The pilot calls "get QRH" (procedure binders)

feasible trajectory

100% Energy (peak)

0:03.6 2845 **calls engine out**
0:00.0 2754 **bird strike**

Teeterboro

1:38.5 1231 **sees Teterboro**

69% E

Peak aircraft energy occurs shortly after impact with birds. Aircraft has roughly 50% energy margin for optimal trajectory

1:59.6 **brace for impact** 1057

First minute after diagnosing issue was critical to outcome. Workload driven by assessing & maintaining state, finding procedures in binders → Additional automation and situation awareness (trajectory computation) tools could have assisted

energy monitoring and trajectory planning/ computation

feasible trajectory

Condition diagnosis, procedures identification, procedural implementation

3:29.7 0 **impact**

Communications management

Laguardia

-2:17.0

heroic piloting saved 155 passengers

ALIAS introduction

Artist's Concept

"The objective of the ALIAS program is to develop and insert new automation into existing aircraft to enable operation with reduced onboard crew"
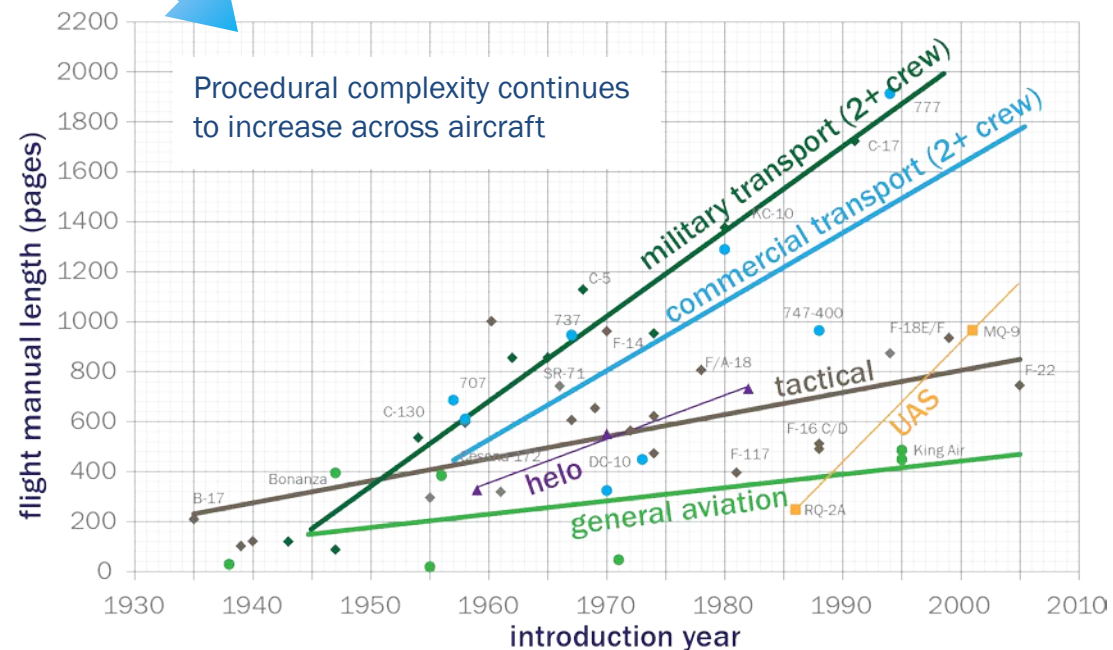
Dangerous trends in aircraft complexity and automation

Automation and MFDs have reduced number of direct controls for a pilot[1]

MFD introduced

Columbia, 747, SR-71, A330, B-1, B-2, 747-400, F-22, 787, Cessna 172, Spirit St Louis, Wright Flyer

number of controls and indications

year introduced

procedural complexity pushing past limits of human capacity

Operational Use of Flight Path Management Systems

Final Report of the Performance-based operations Aviation Rulemaking Committee/Commercial Aviation Safety Team Flight Deck Automation Working Group

September 5, 2013

part-time automation is creating a crisis in the cockpit[2]

Procedural complexity continues to increase across aircraft

flight manual length (pages)

military transport (2+ crew)
commercial transport (2+ crew)
tactical
UAS
helo
general aviation

777, C-17, MC-10, C-5, 737, F-14, 747-400, F-18E/F, MQ-9, 707, SR-71, F/A-18, F-22, C-130, F-16 C/D, King Air, Bonanza, Cessna 172, DC-10, F-117, RQ-2A, B-17

introduction year

ALIAS could provide a full-time hierarchical abstraction to manage cockpit workload
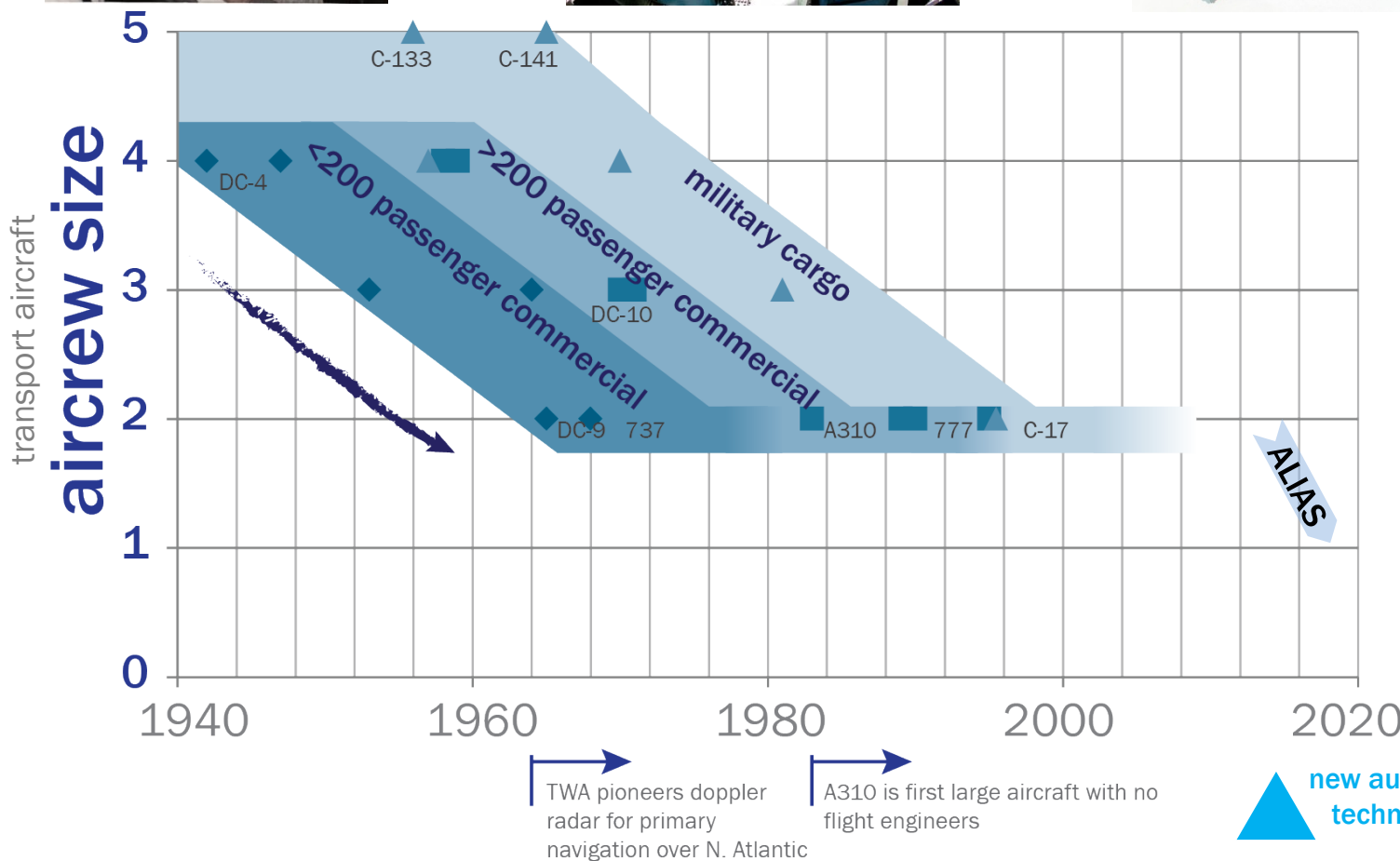
Downward trend in transport operating aircrew
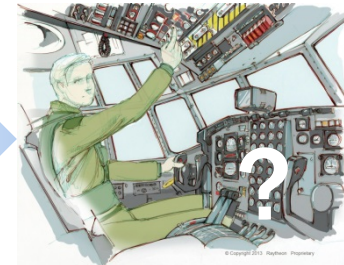
Theoretic advantages of increased automation in aircraft
- Better abilities for *some* operations
- Reduced pilot workload
- New capabilities and missions

transport aircraft
aircrew size

- C-133
- C-141
- DC-4
- <200 passenger commercial
- >200 passenger commercial
- military cargo
- DC-10
- DC-9 737
- A310 777 C-17
- ALIAS

challenges to further reducing onboard aircrew: safety, trust, cost

1940   1960   1980   2000   2020

TWA pioneers doppler radar for primary navigation over N. Atlantic

A310 is first large aircraft with no flight engineers

▲ **new automation technologies**

ALIAS would provide a path to addressing challenges of safety, trust, and cost

Image source: propspistonsandoldairliners.blogspot.com

What is ALIAS?

ALIAS would be an automation kit; a toolbox
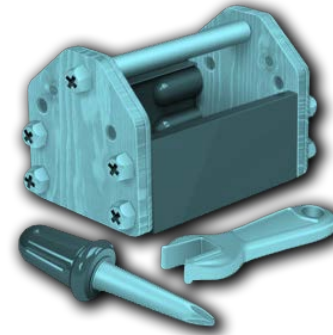
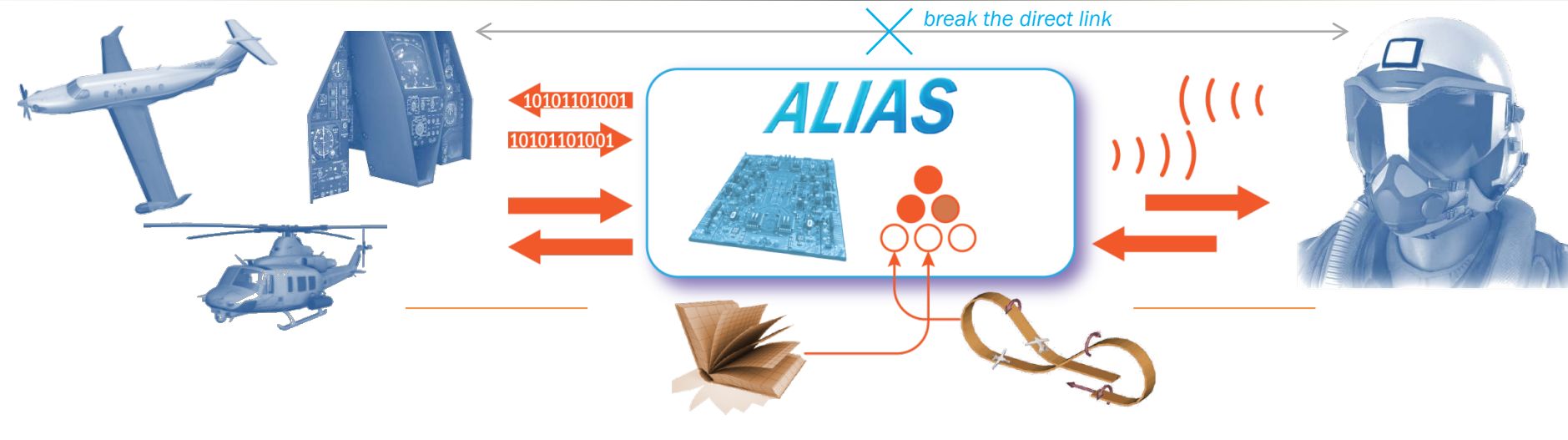that enables operation with *variable onboard crew* on a variety of *existing aircraft*
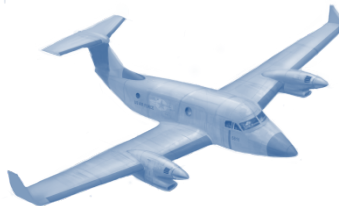
installed in a *portable, reversible* manner

controlled at a "mission commander" level from a latency tolerant, low-workload user interface

Technology framework: three key technical thrusts

break the direct link

ALIAS

`10101101001`
`10101101001`

(1) ALIAS-aircraft interface

[aircrew motor functions]

- Operation and automation of aircraft functions without extensive aircraft modifications

metrics
- installation time of 1 day
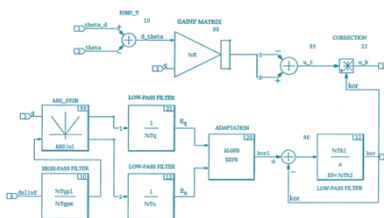- automatic flight operability from takeoff-to-landing flight via installable in-cockpit system

(2) Knowledge acquisition

[aircrew training]

- Adaptable core flight controller and machine-assisted assimilation of procedural knowledge

metrics
- time-to-adapt in <1 month

(3) Human-machine interface

[capture & inform operator intent]

- High-level mission direction
- Condensed display of expert system logic and system status

metrics
- control of flight via a single-screen and/or voice

Current Platforms

ALIAS extensibility to future applications

- ALIAS could provide a simpler way to interface with complex machines
- ALIAS could provide low cost means to bridge between automation and autonomy in field of aerospace, burdened with high capital costs
- Defies current platform-centric model for advances

mission capabilities

autonomy "apps" *(demonstrating autonomy "apps" is not encompassed by ALIAS effort)*

Breaks expensive platform-dependence in autonomy development
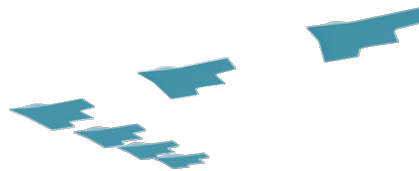
onboard or offboard operator

ALIAS system

Architecture supposes the future, at low cost: trusted, reliable system at the heart of mission capability, human provides high level guidance

ALIAS architecture advances technology
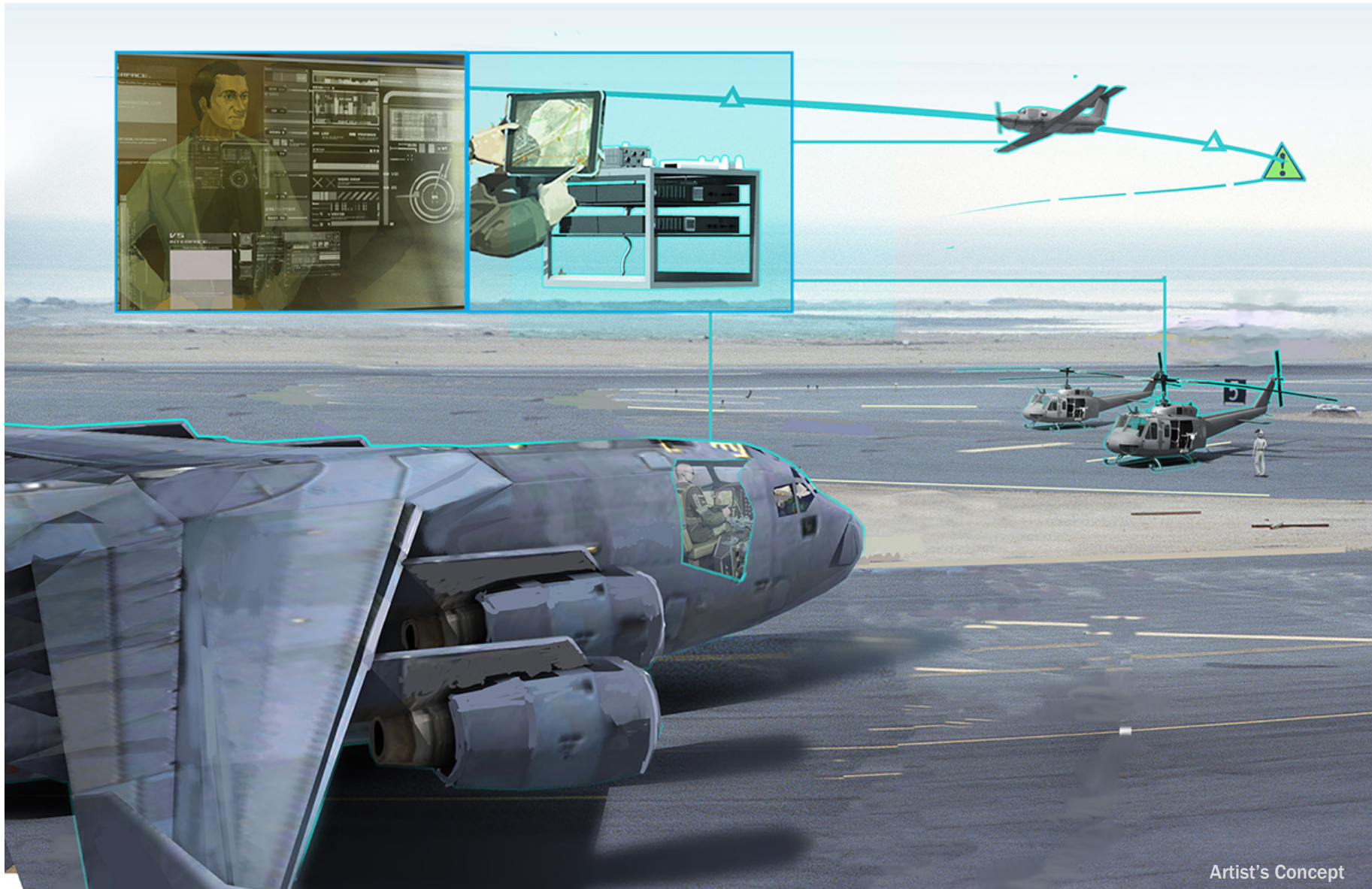
capability development   *freed from dependence on*   **platform development**

Image source: defense.gov; appadvice.com

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www.darpa.mil