



Trends in Training and Simulation Technologies



The Digitisation of Training?

Andy Fawkes

Training & Simulation Background

12

MoD/NATO

5

Industry



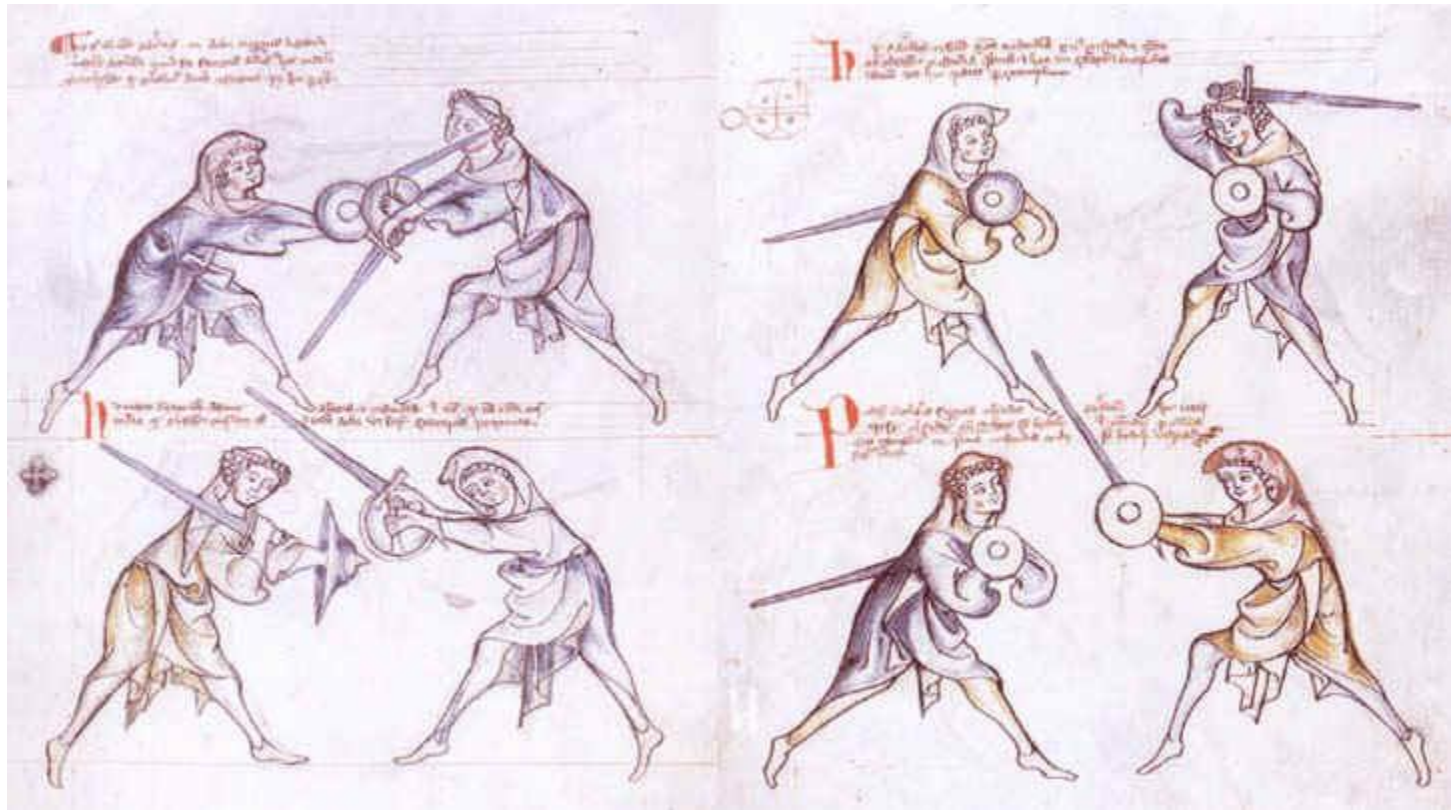
Presentation Outline

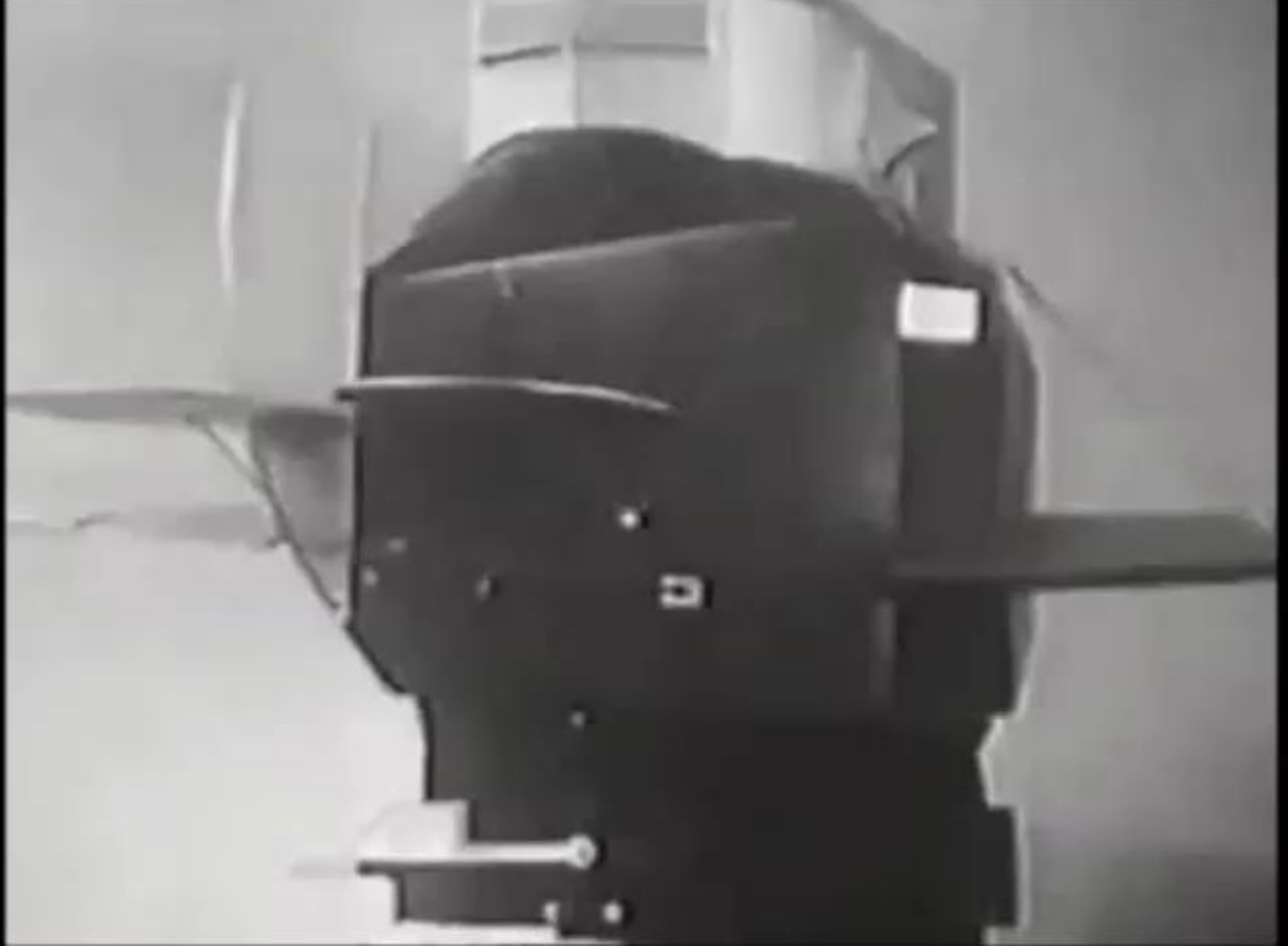
- **The Digitisation of Training**
- **Digital Media Advances**
- **Digital Device Advances**
- **Impact of AI on Training**
- **A More Analytical Future?**

The Digitisation of Training

Oldest Surviving Training Media

13th Century German Sword & Buckler Manual





Link Trainer (1940s)

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(Quite) Recent Teaching Aids



Digital Media



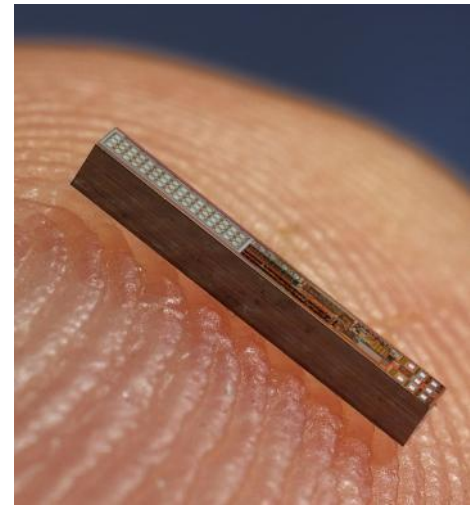
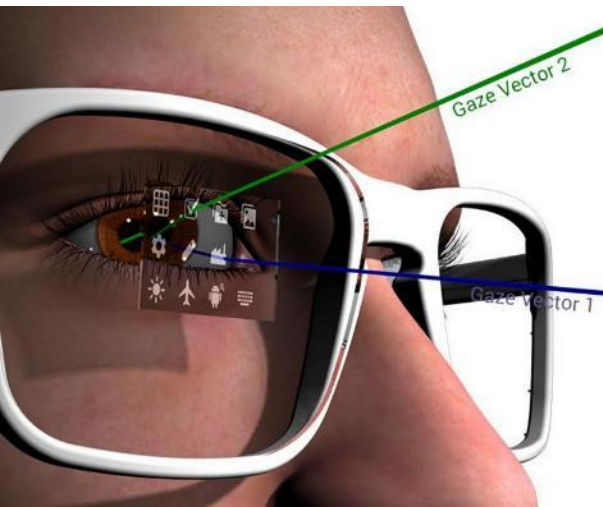
Digital Media Consumption



E-Learning

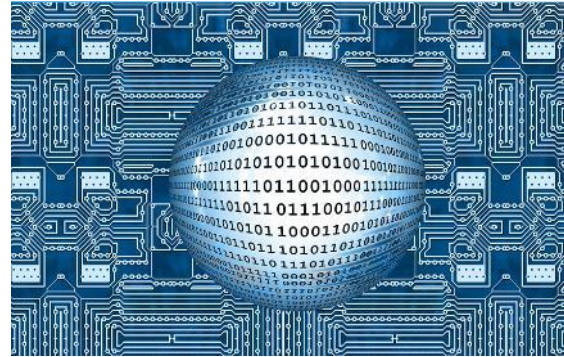


Quantified Human



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Technology Now – Choices, Choices...



Changing Demographics

theguardian

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Television
Shortcuts

A dying habit: why the average BBC1 viewer is 61

Broadcasters may be desperate for younger audiences but older telly-watchers dominate - the average ITV fan is 60, 55 if they prefer Channel 4. How worried should programme-makers be?



476 709

Simon Usborne

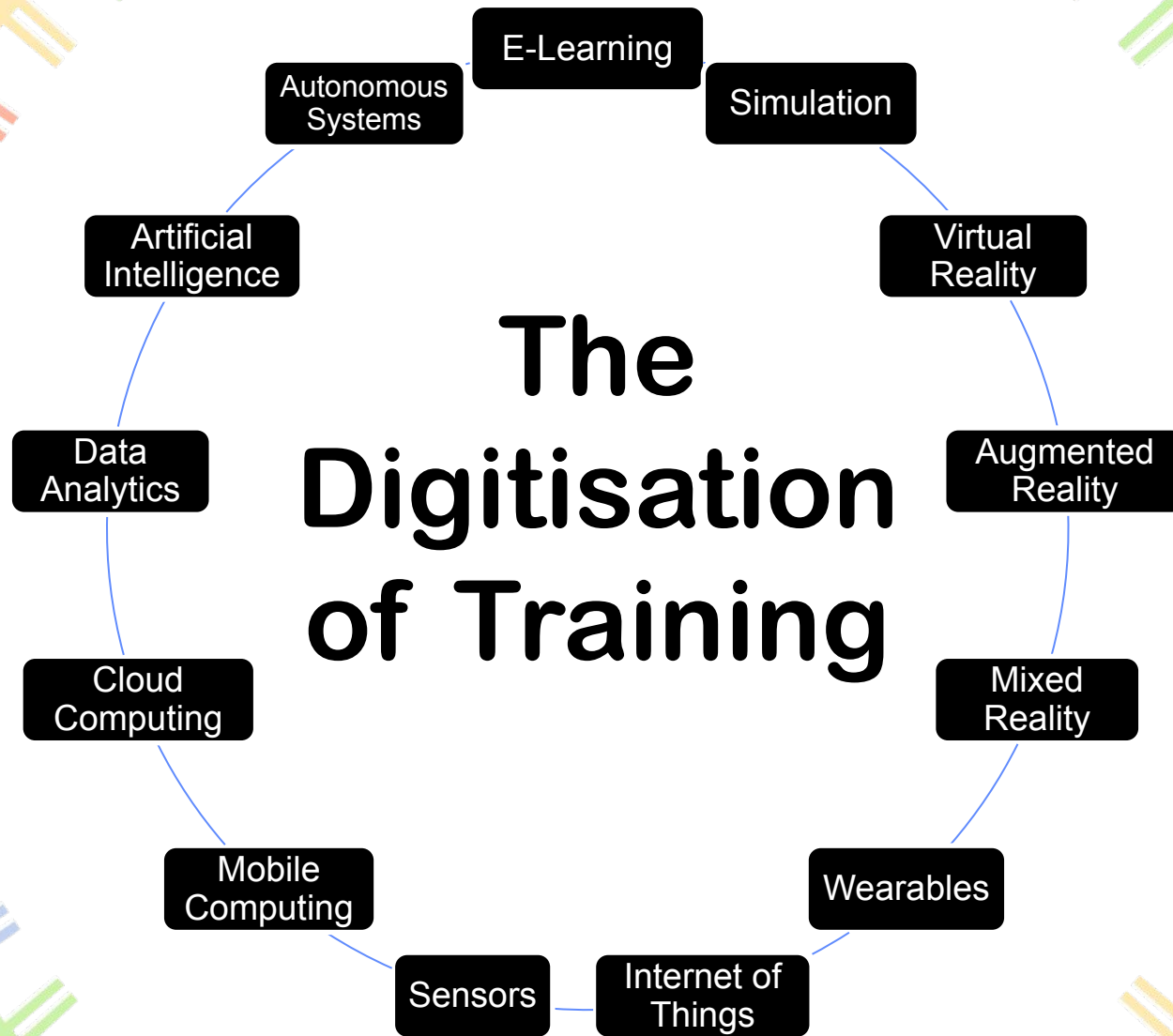
Wednesday 29 March 2017 17:38 BST



Old medium ... has TV lost its appeal to young people? Photograph: simonkr/Getty Images/iStockphoto

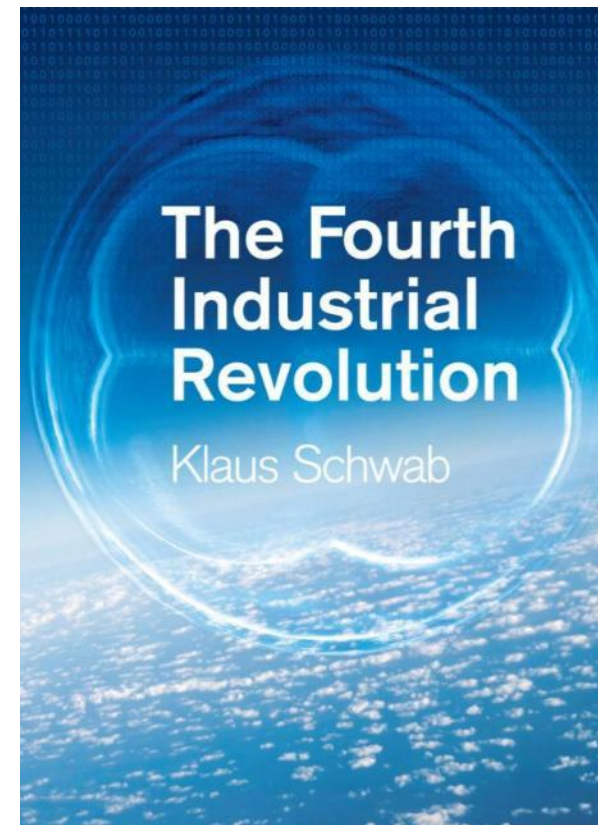
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The Digitisation of Training



Parallels...

- Previous industrial revolutions
 - liberated humankind from animal power
 - made mass production possible
 - brought digital capabilities to billions of people
- The Fourth Industrial Revolution is characterized by a
- range of new technologies that are fusing the physical, digital and biological worlds,
- impacting all disciplines, economies and industries, and
- even challenging ideas about what it means to be human.



A Fourth Revolution - Training 4.0 (?)



1st

2nd

3rd

4th

**Paper,
Chalk**

**Paper,
Electro-Mec
hanical**

**Digital
Media**

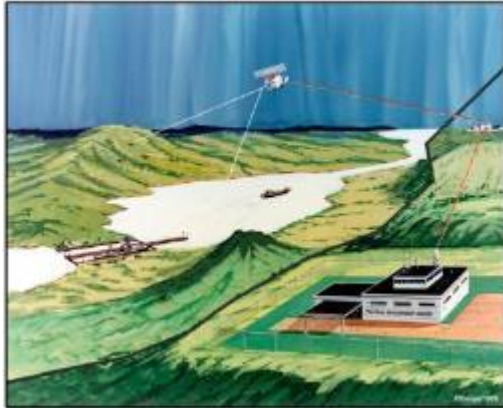
**Digitisation
of Training**

Digital Media Advances

“Future Views: Aircrew Training 1980-2000”

Captain Jack A. Thorpe, US Air Force Office of Scientific Research - 1978

1



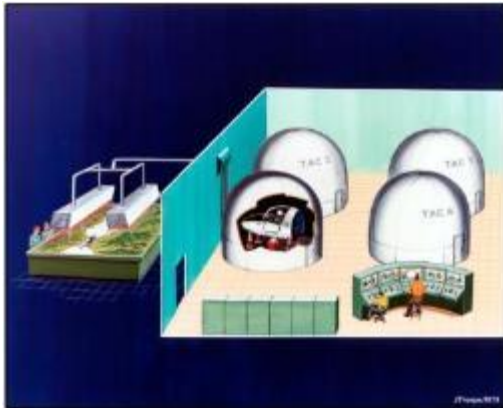
Enemy aggression detected

2



Planning a response

3



Rehearsal and analysis

4



Real time mission observation

Whole Earth

VBS BLUE IS A WHOLE-EARTH RENDERING TECHNOLOGY

FOR MILITARY

Rapidly Reconfigurable Simulation

Simulation/Visualisation can be rapidly adapted and exploited for mission training and rehearsal



Pix4D

Digital Device Advances

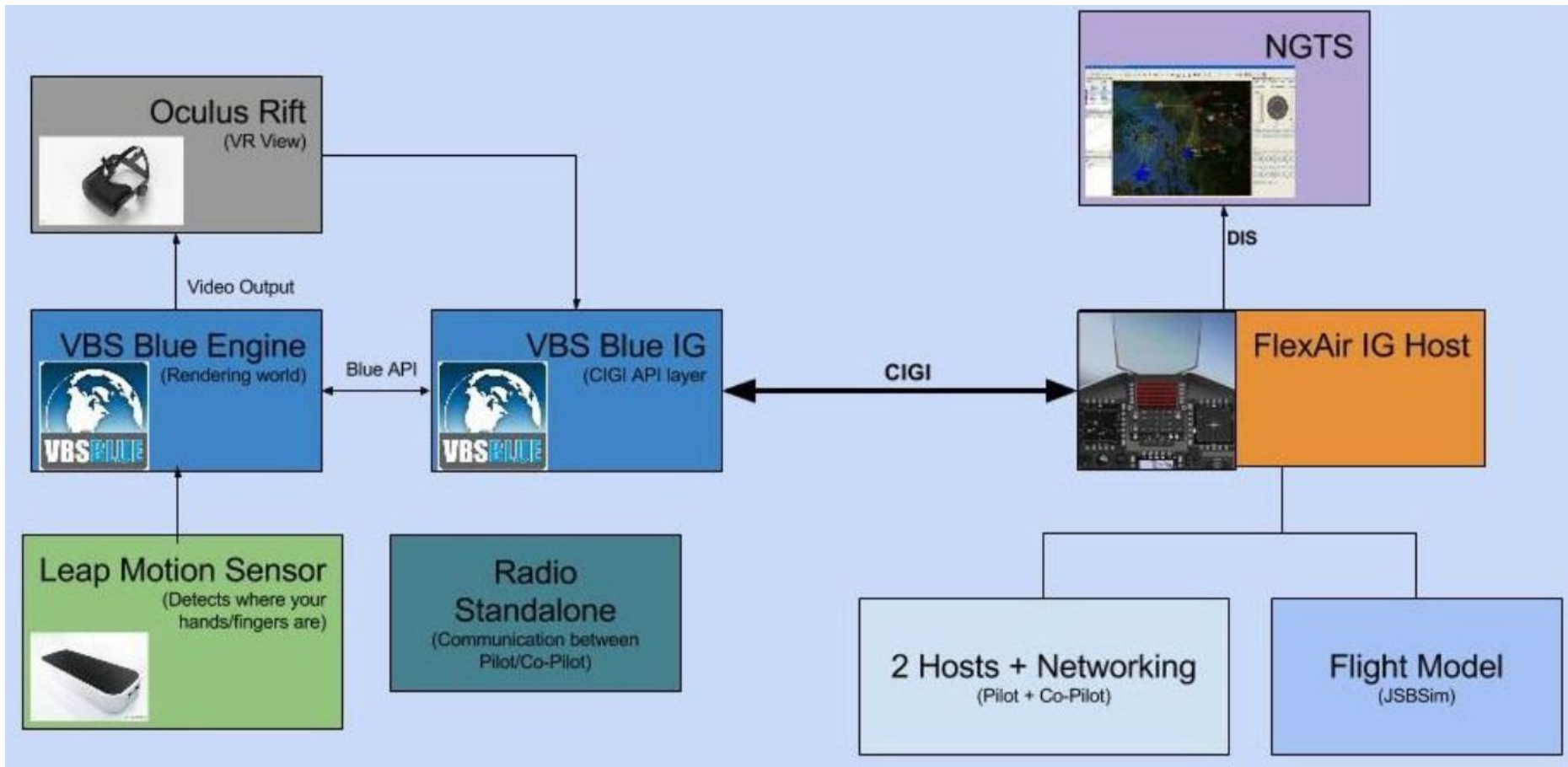
Bohemia/US Navy F-18F Rapid Innovation Project

VR Training for F-18F Pilot and WSO

- Portable system designed to deploy on a carrier
- Full field of view immersive environment
- Intuitive user interface to develop muscle memory
- Global gaming area for mission rehearsal
- High-fidelity, full-featured
- Interoperable with legacy systems



Architecture



In action...



Results

- Virtually no simulator sickness, even after long exposures
- Suitable for a wide variety of training across the continuum where the trainee does not need to feel physical forces
- Full field of view and multi-ship networking enables transition of training tasks from live to virtual
- Mixed Reality Virtual Crew Station has tremendous potential, but tracking must improve
- Display resolution is a major challenge



Future Plans

- Enhance the interface
- Intelligent Tutors
- Feature Development
 - NVG
 - Joint Helmet Mounted Cueing System
 - Virtual knee board
- Alternate Technologies
 - Wider FOV, higher resolution HMDs
 - Google sensors
- Augmented Reality Visuals



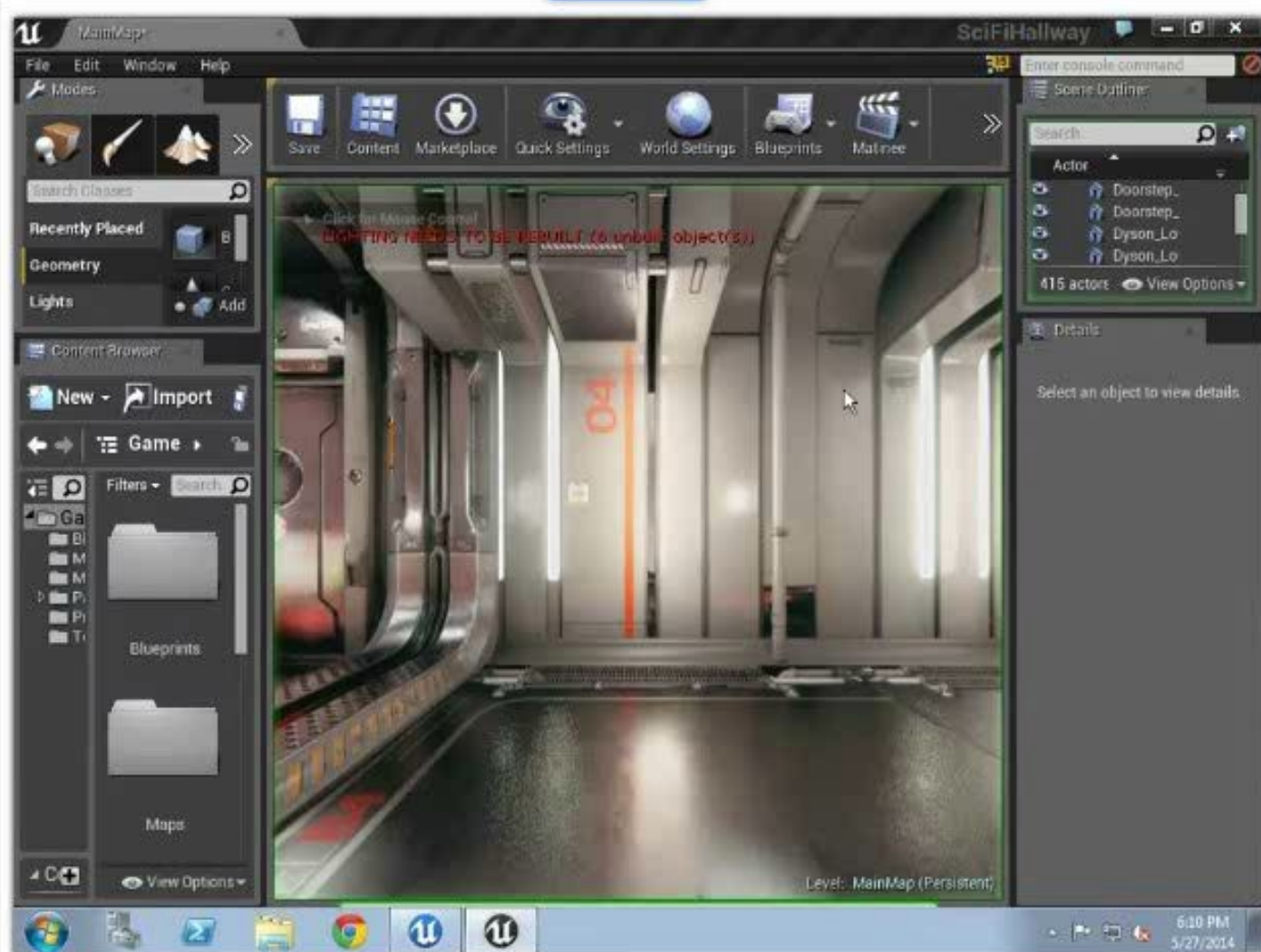
Google WorldSense (2017)



Cost Effective Motion



Unreal 4 on Amazon Cloud PC



Wikipedia

Fujitsu/VBS3 DSEi Sep 15



Zero Client
Shared 20MB + WiFi
55 miles

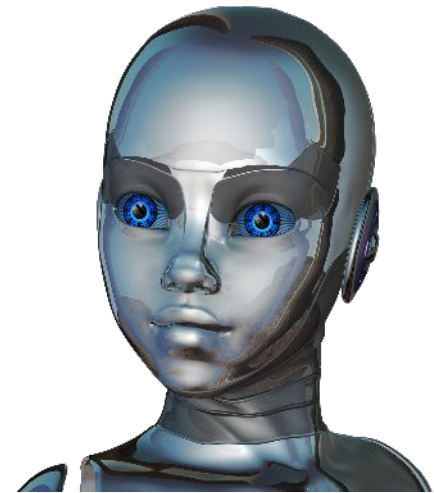


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Impact of Artificial Intelligence (AI) on Training

What is AI?

- Artificial intelligence is intelligence exhibited by a machine that perceives its environment and takes actions that maximize its chance of success at some goal, which can be:
 - Reasoning, problem solving
 - Knowledge representation
 - Planning
 - Learning
 - Natural language processing
 - Perception
 - Motion and manipulation
 - Social intelligence
 - Creativity
 - General intelligence

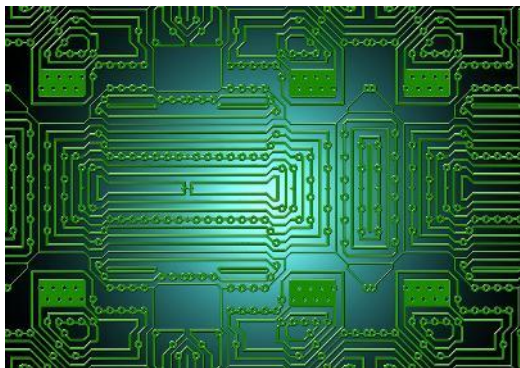


Why Concern Ourselves with AI?

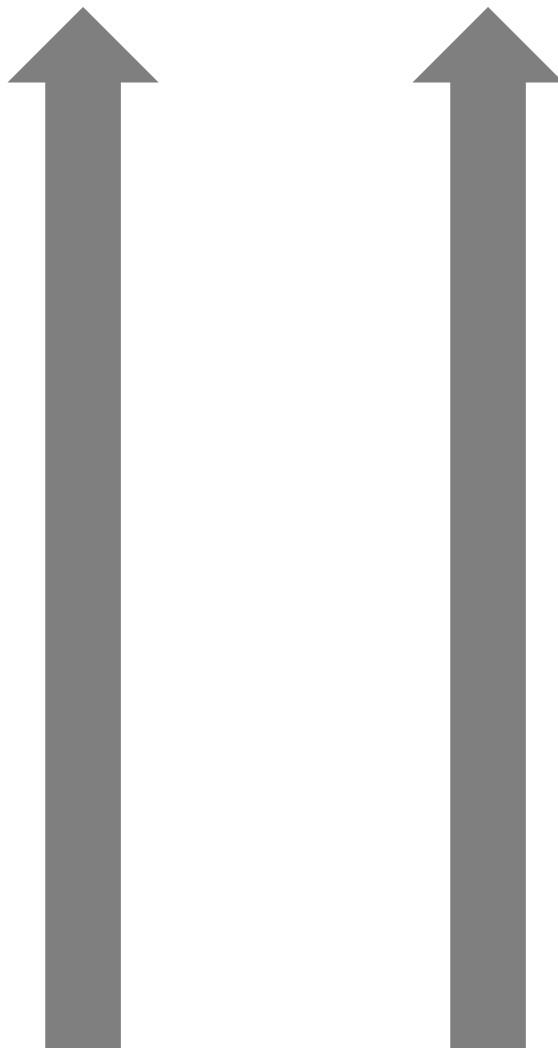
- **More Autonomous Systems in the Battlespace**
- **Significant progress in AI technology**
- **AI can help tell us a lot about what humans are good at and not so good at**
- **AI may in future help humans learn and support their decision making**
- **Simulation can train both people and AI/autonomous systems**

The Drivers of AI...

**Computational
Power**



Big Data



US Navy X-47B Drone



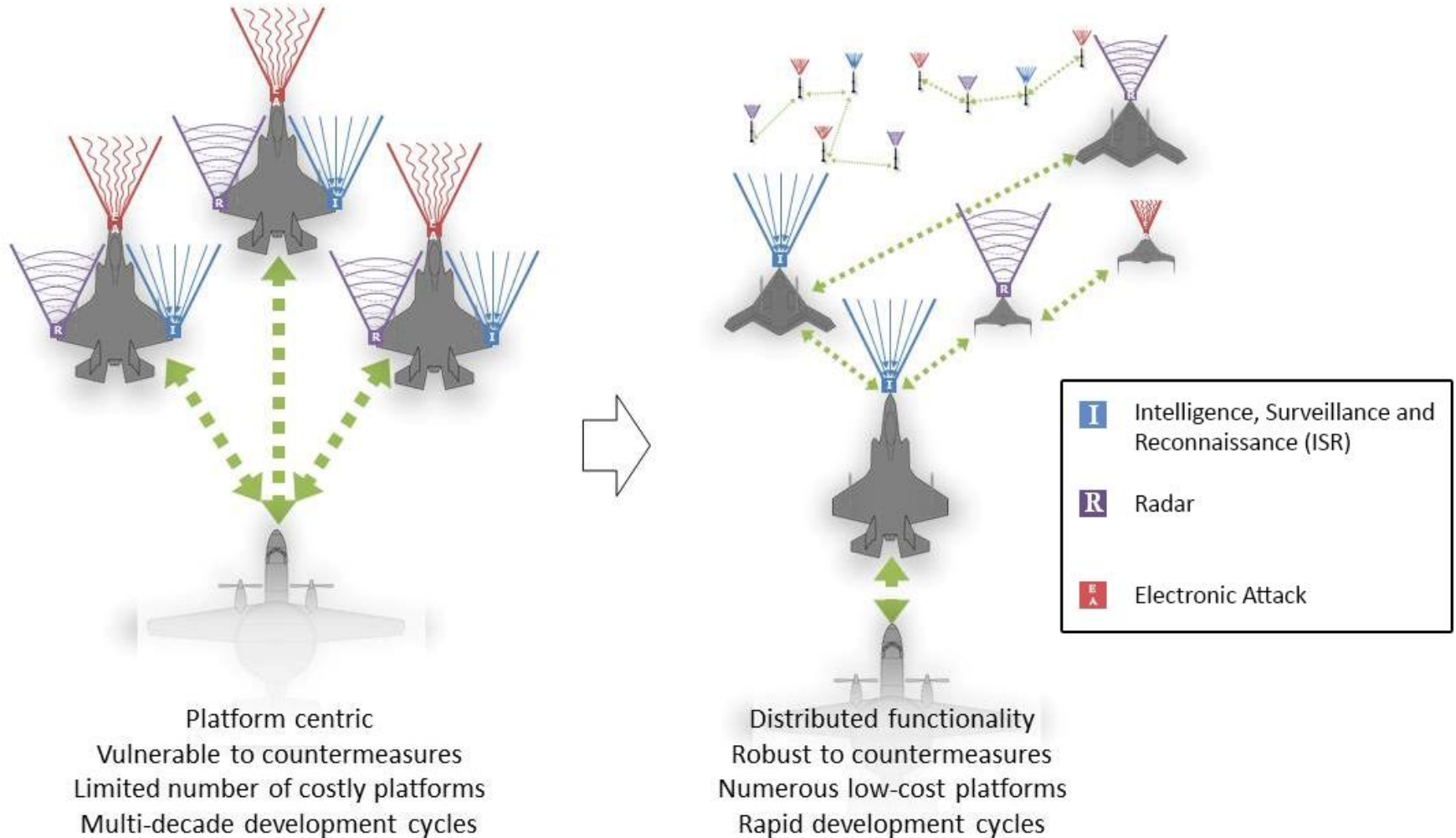
**August
2014**

**April
2015**



DARPA's System of Systems Integration Technology and Experimentation (SoSITE) (2015)

concepts for maintaining air superiority through novel system-of-systems architectures





US DoD Perdix Drone

News Brief

Release No: NR-008-17

Jan. 9, 2017

DroneMission, a member of the Defense Video Imagery Distribution System

Naval Air Systems Command, successfully demonstrated one of the world's largest micro-drone swarms at China Lake, California

103 Perdix drones launched from three F/A-18 Super Hornets. The micro-drones demonstrated advanced swarm behaviors such as collective decision-making and adaptive formation flying, originally developed by MIT.

Perdix Swarm Demo

103 Perdix Drone Swarm (Oct 16)

AI Learning in Games (2015)

Google DeepMind's Deep Q-learning

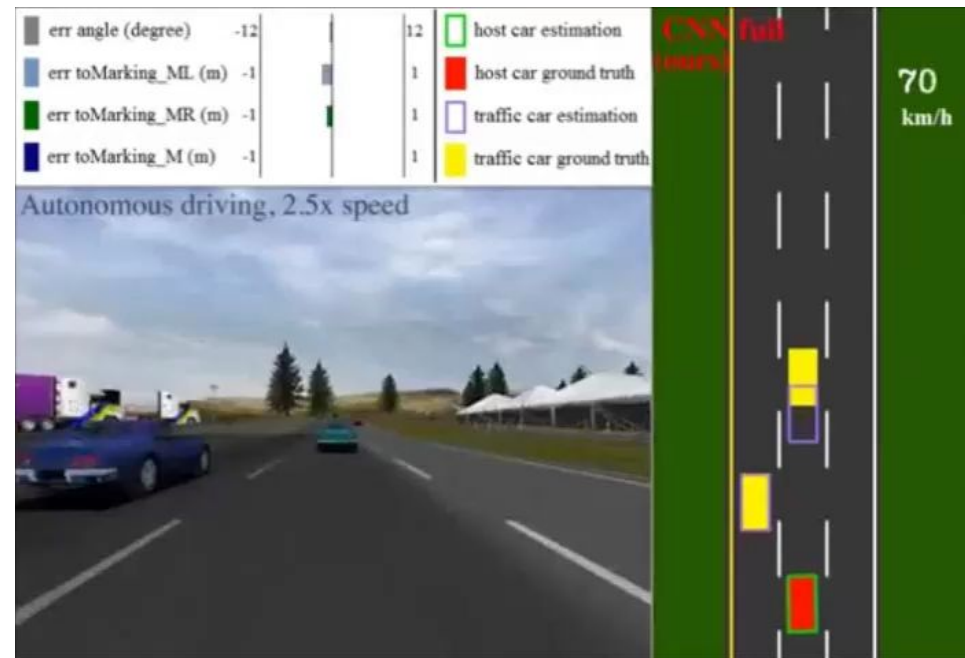
The algorithm will play Atari breakout.

The most important thing to know is that all the agent is given is sensory input (what you see on the screen) and it was ordered to maximize the score on the screen.

No domain knowledge is involved! This means that the algorithm doesn't know the concept of a ball or what the controls exactly do.

Princeton University
(TORCS Racing Simulator)

Google DeepMind (Atari Breakout)



Google DeepMind AI and “Go” (2016/17)

sign in search jobs more UK edition

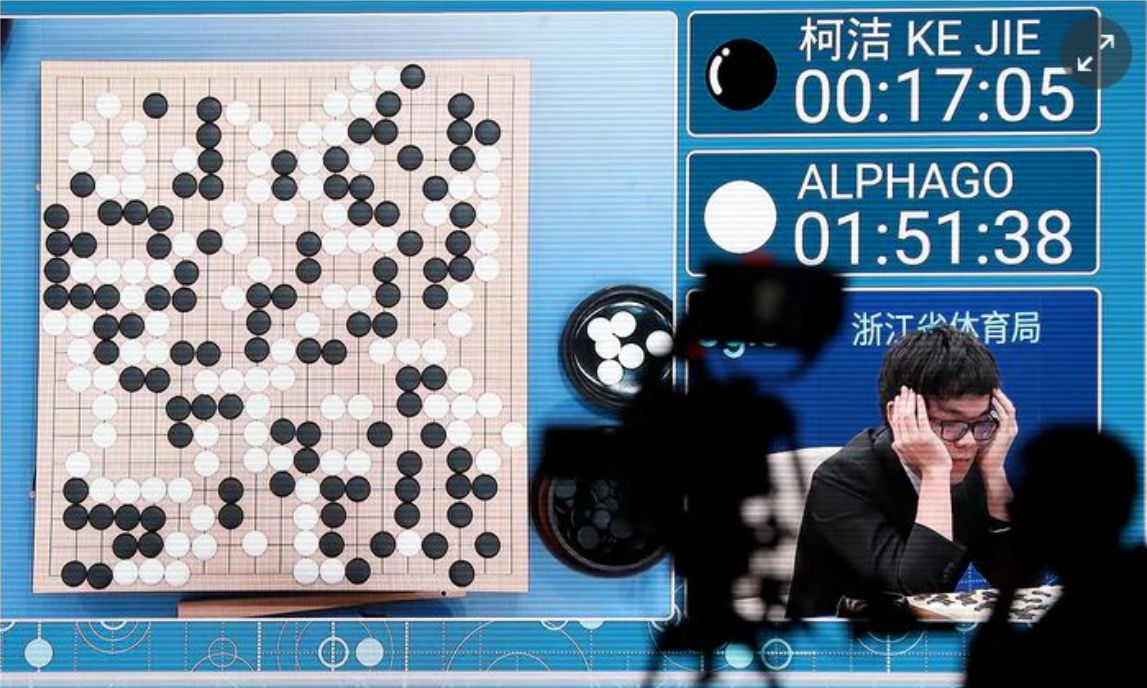
theguardian

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Artificial intelligence (AI)

World's best Go player flummoxed by Google's 'godlike' AlphaGo AI

Ke Jie, who once boasted he would never be beaten by a computer at the ancient Chinese game, said he had 'horrible experience'



浙江省体育局

i A screen at the Future of Go summit in Wuzhen, China, keeps score during the match between Chinese player Ke Jie and Google's AI AlphaGo. Photograph: Wu Hong/EPA

Nvidia Isaac Robot Training (May 2017)



Artificial intelligence
(AI)

StarCraft II: DeepMind unveils latest game its AI plans to conquer

The AI research firm is teaming up with gaming company Blizzard to take on the real-time strategy game

Alex Hern

@alexhern

Friday 4 November 2016 18.45 GMT



Shares

379

Save for later



A screenshot from StarCraft II, one of the most popular eSports in the world. Photograph: AP

After its success at mastering the ancient Asian boardgame of Go, DeepMind is planning to learn its next game - and it's about as different as it can possibly be.

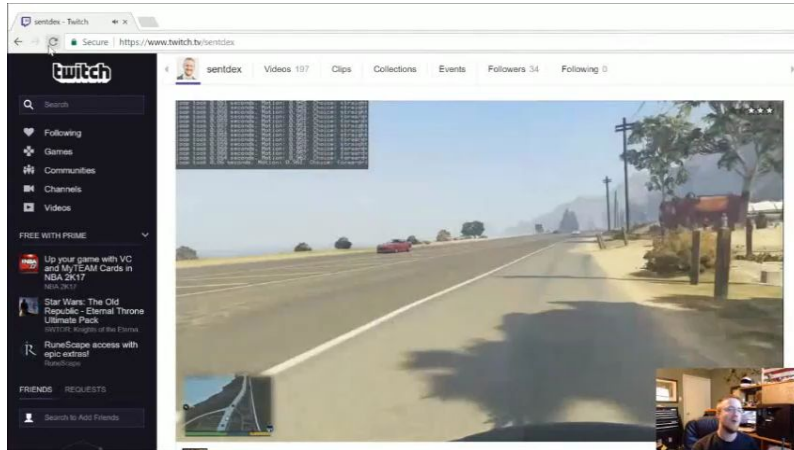
The London-based AI research firm, a subsidiary of [Google](#), is teaming up with Californian gaming company Blizzard to take on the real-time strategy game StarCraft II.

AI v Humans – Strategy Games

So What?

**Computers are being
programmed to learn
how to play games, not
how to play games**

Vast Resources not always Required...



GTA V AI



UC Berkeley – Curiosity AI

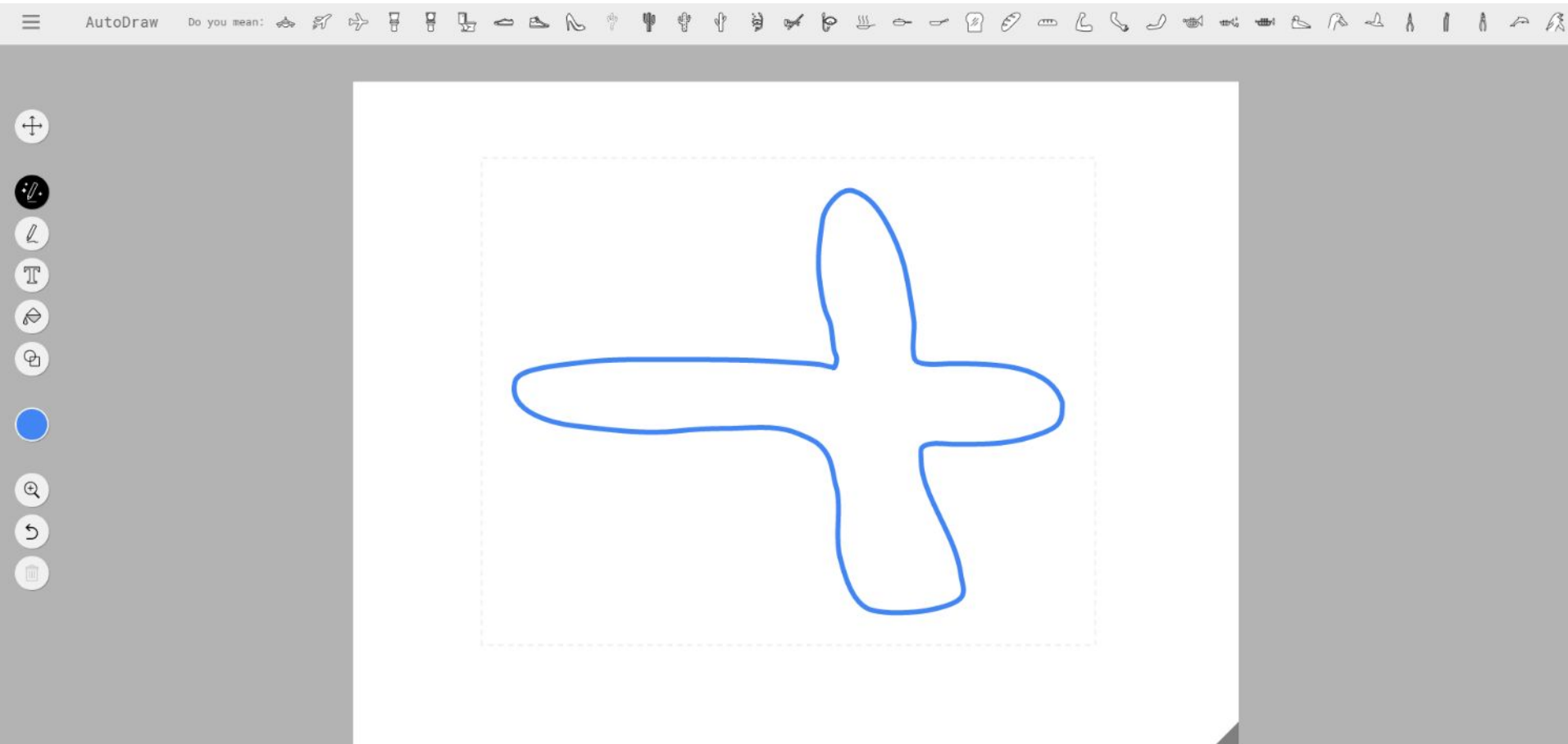


University of Texas –
Mari/O

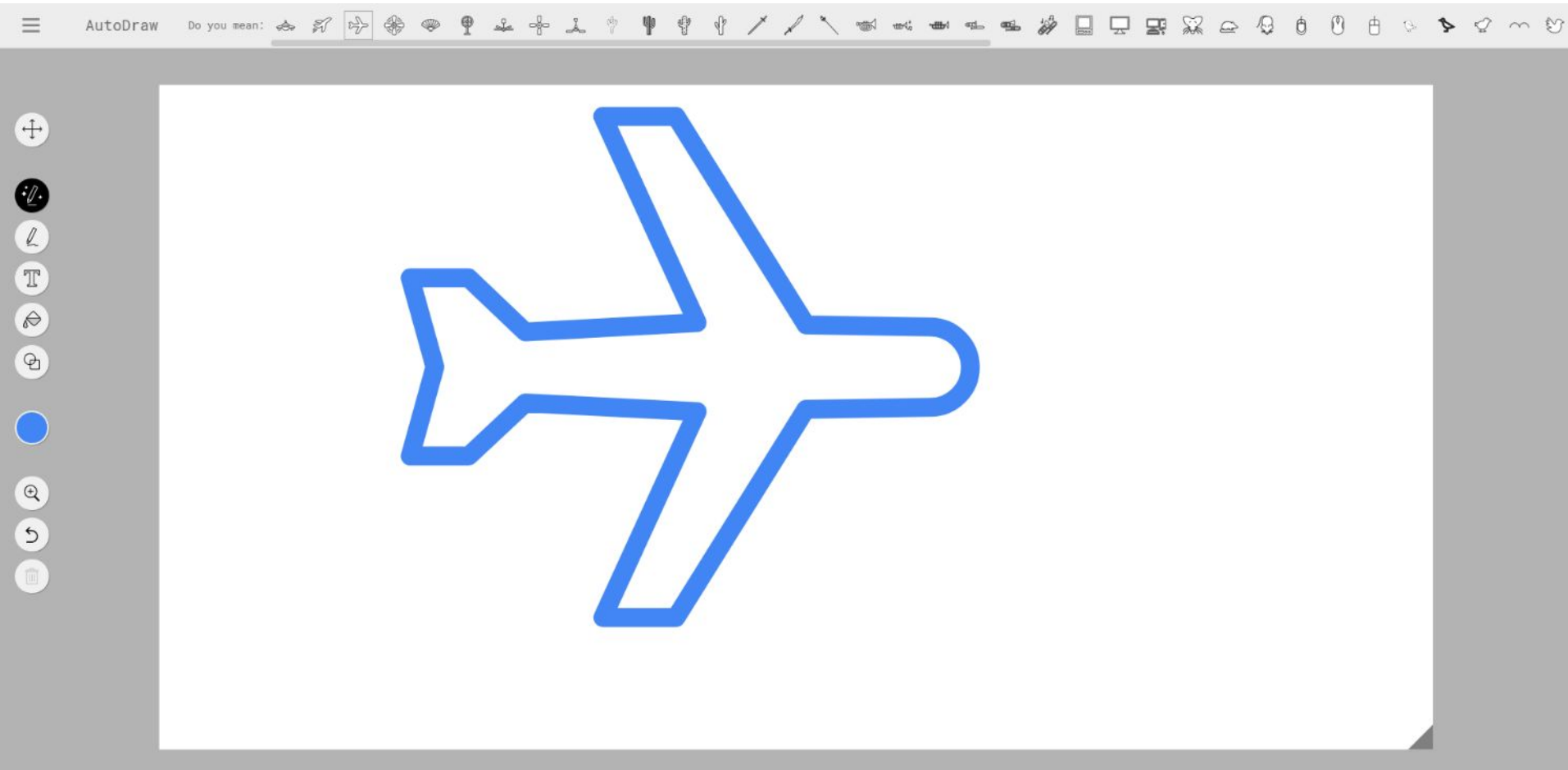


University British Columbia –
Locomotion Skills AI

Google AutoDraw with Machine Learning



Google AutoDraw with Machine Learning



Computers still aren't that clever



Good Communicators?

Google Home

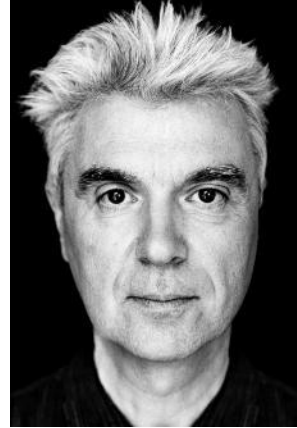


amazon echo



Humans are (Somewhat) Unpredictable

- We get the benefit of surprises, happy accidents and unexpected connections and intuitions.
- Interaction, cooperation and collaboration with others multiplies those opportunities.



“Eliminating the Human”
David Byrne | May 15, 2017

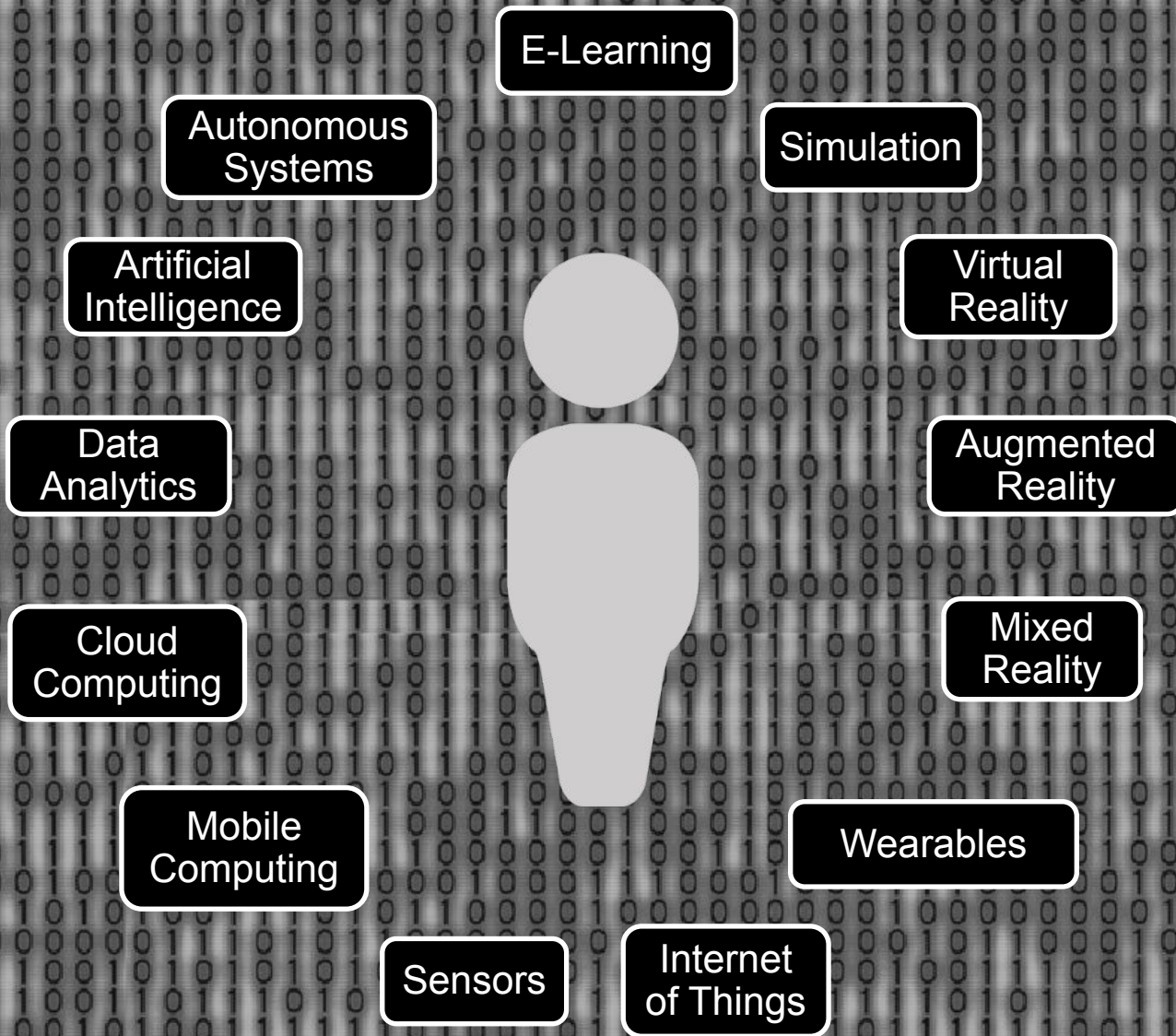
UK Royal Navy Training



- “are we ready to fight tonight?”
– *rules/machine focus*
- “are we prepared to fight tomorrow?”
– *innovation/human focus*

A More Analytical Future?

A Data Rich Future



Better Training Systems?

Better Management of Training?



[illegible]

How do you know where to invest?



More e-Learning
for all?

A more expensive
Simulator for a few?

Value for Money? - US GAO Aug 16 Report

- Seven (US Army) virtual training devices are used on average for 21% of their total availability
- Four of the low-use systems cost more than \$70 million to procure and \$15 million to operate in FY2015

	Utilisation
Engagement Skills Trainer II (EST II)	38%
Call for Fire Trainer II	37.8%
Games for Training VBS coming	30.8%
Dismounted Soldier Training System (DSTS)	15.4%
Stryker Mobile Gun System Advanced Gunnery Training System (MGS AGTS)	8.6%
Intelligence and EW Tactical Proficiency Trainer (IEWTPT)	8.4%
Common Driver Trainer (CDT) Mine Resistant Ambush Protected (MRAP) vehicle device	1.3%

- **Gaps in Governance:**
 - Front-end analysis
 - Effectiveness analysis
 - Linkage with training strategies

Problems...

Dr J. Michael Gilmore, US Director of Operational Test and Evaluation's Report on F-35 Problems (Jan 16):

A lack of high-fidelity simulators to rehearse combat missions and specialized data for each major geographic area that pilots will use to test sensors and track enemy radar.





Islands of Training Data

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A World of Change...



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Increase Focus on Learning Analytics

- Learning analytics is the:
 - Measurement
 - Collection
 - Analysis, and
 - Reporting of Learning Data
- To understand and optimize learning and the environments in which it occurs



DEFINE



MEASURE



ANALYZE

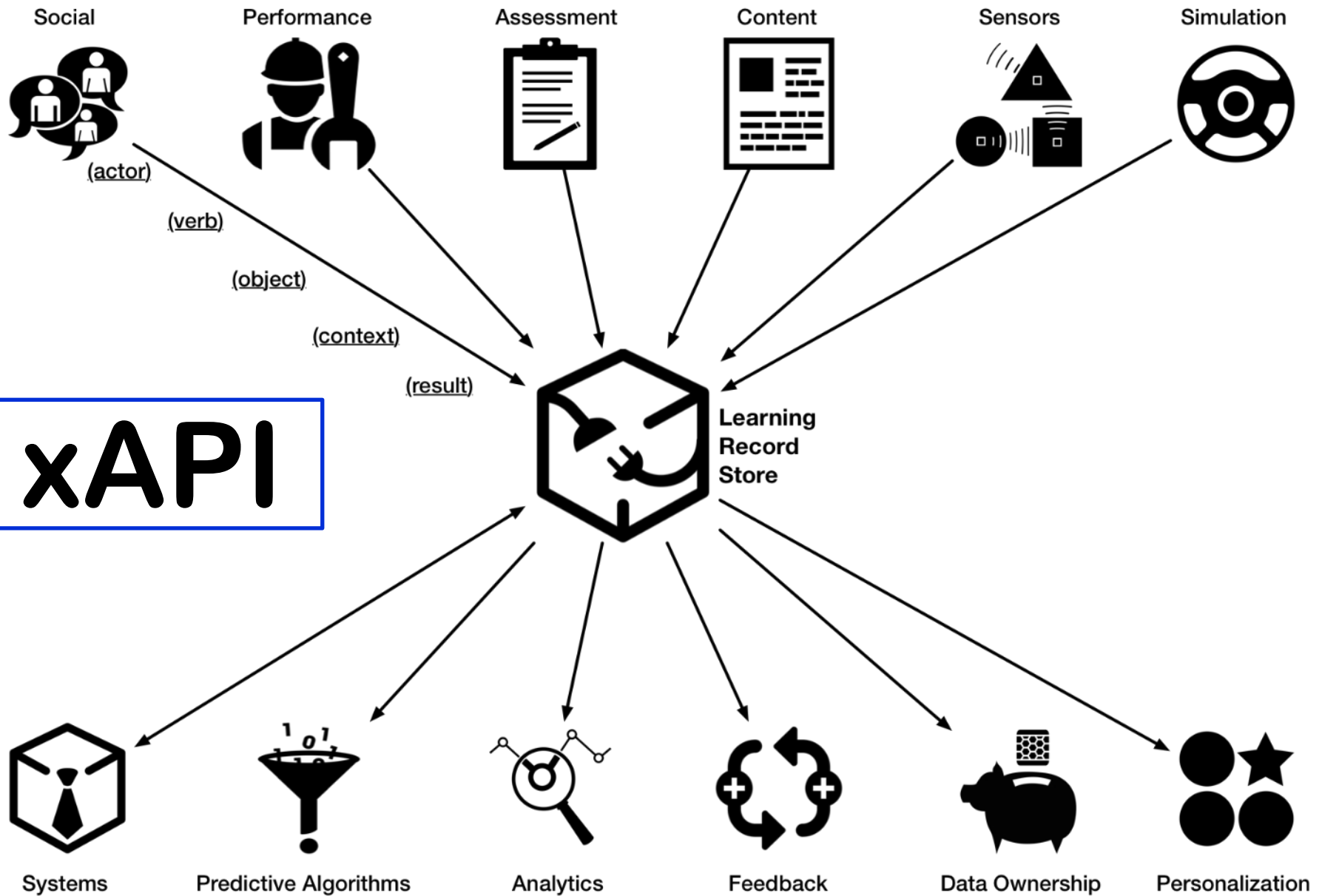


IMPROVE

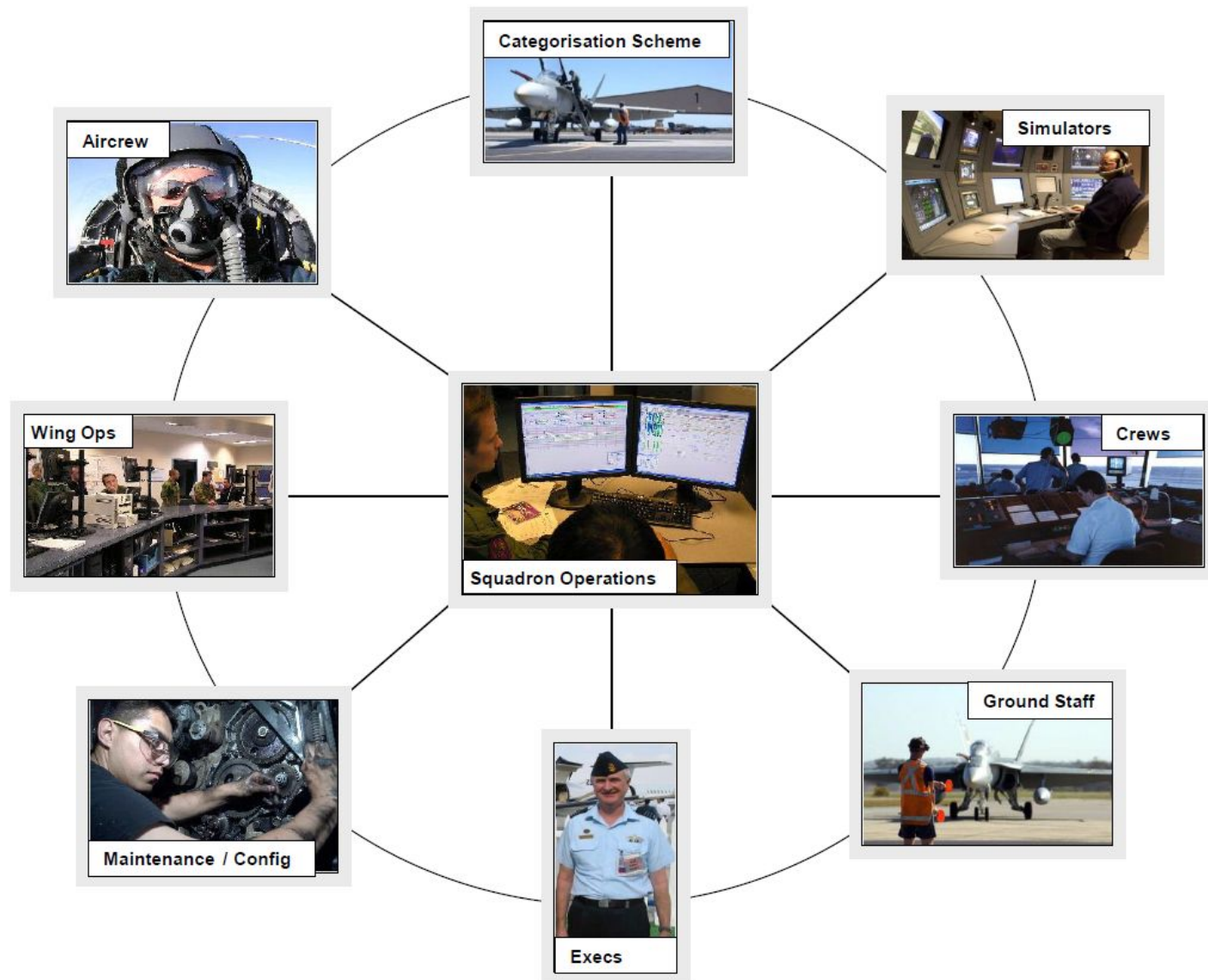


CONTROL

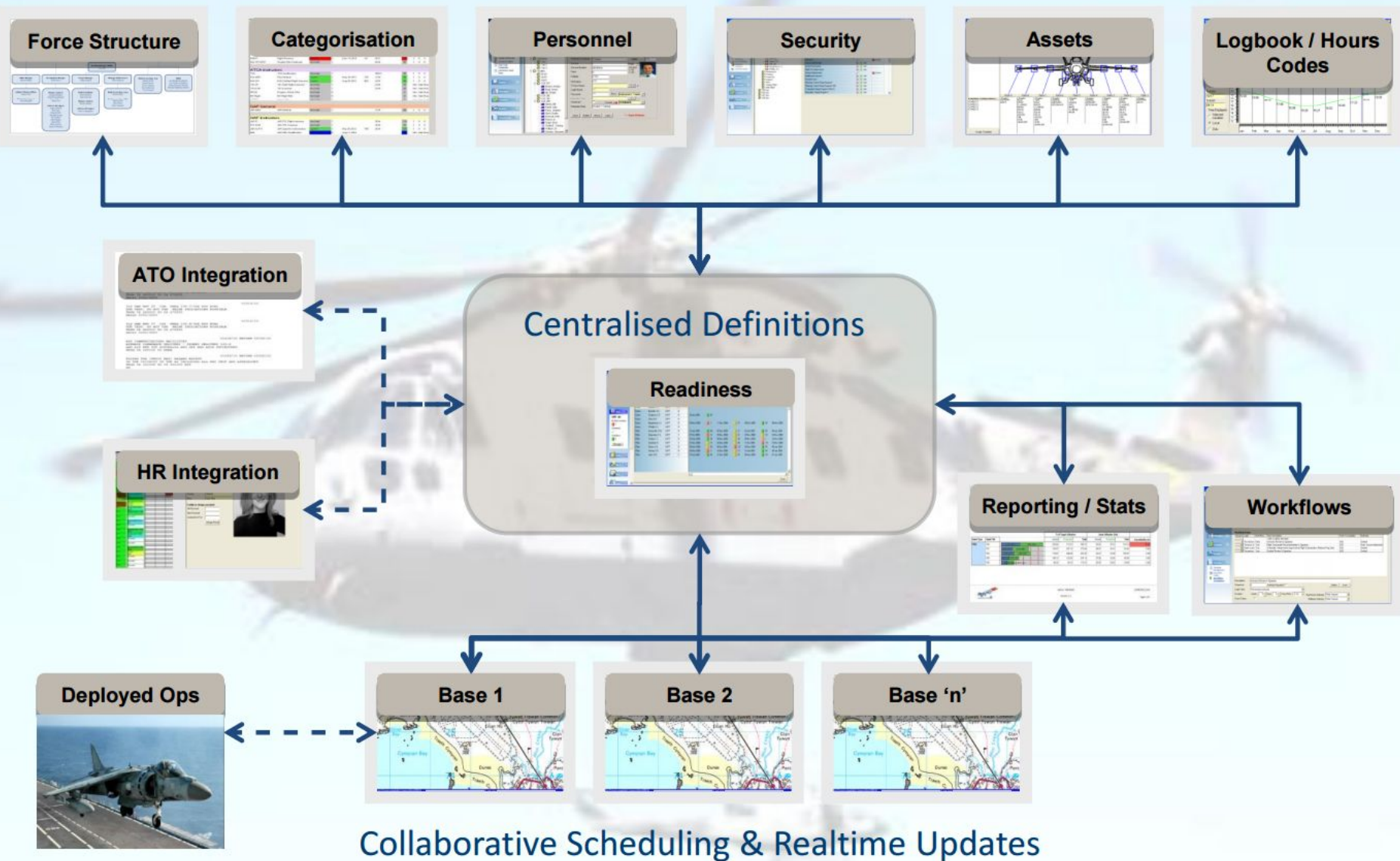
xAPI



Training & Operations Management Software (FlightPro)



Training & Operations Management Software (FlightPro)

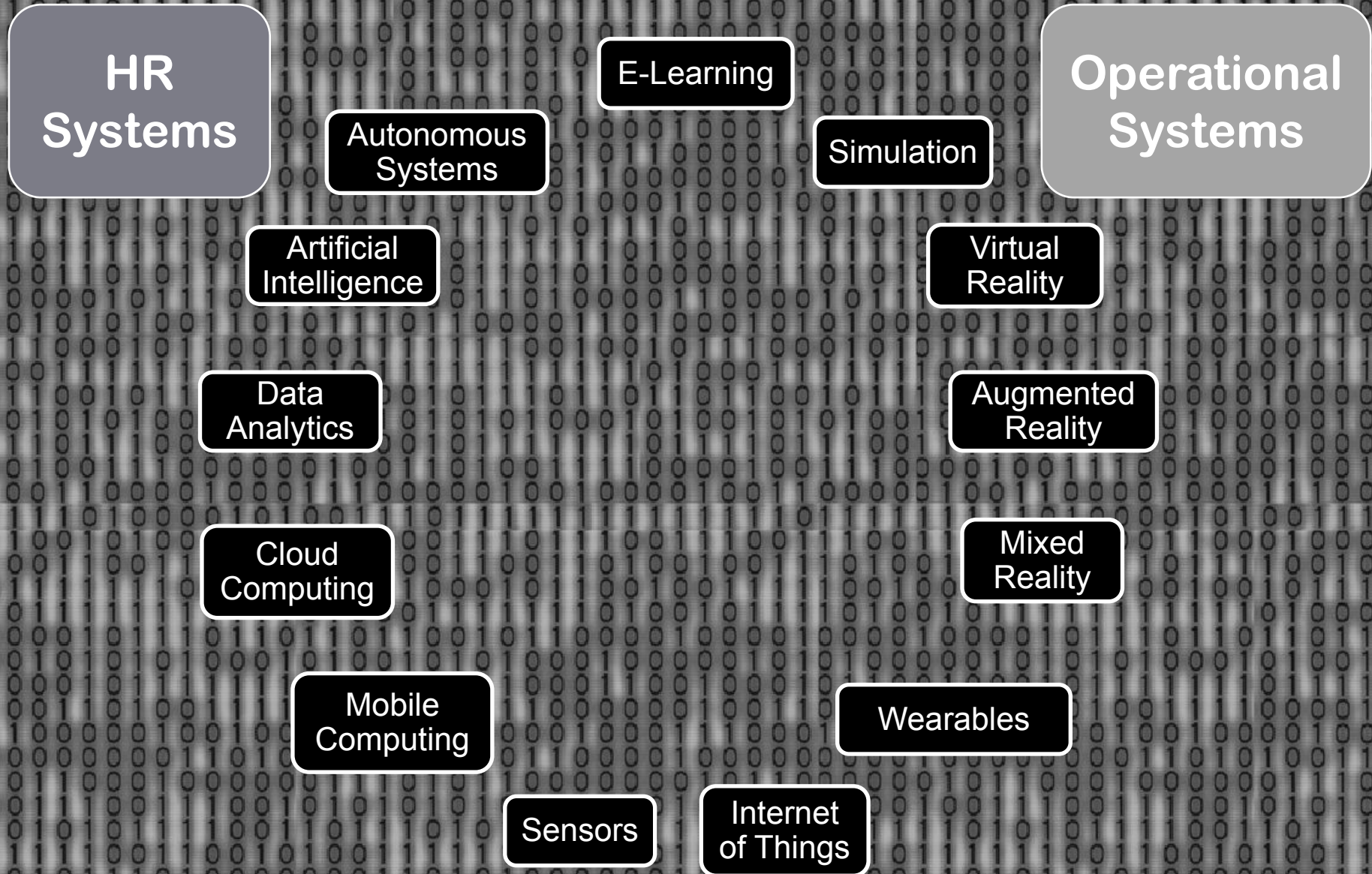


A Flight Deck for Training?

Sensors, Data, Displays, Automation, Human Skills...



Digitisation Extended...



SUMMARY

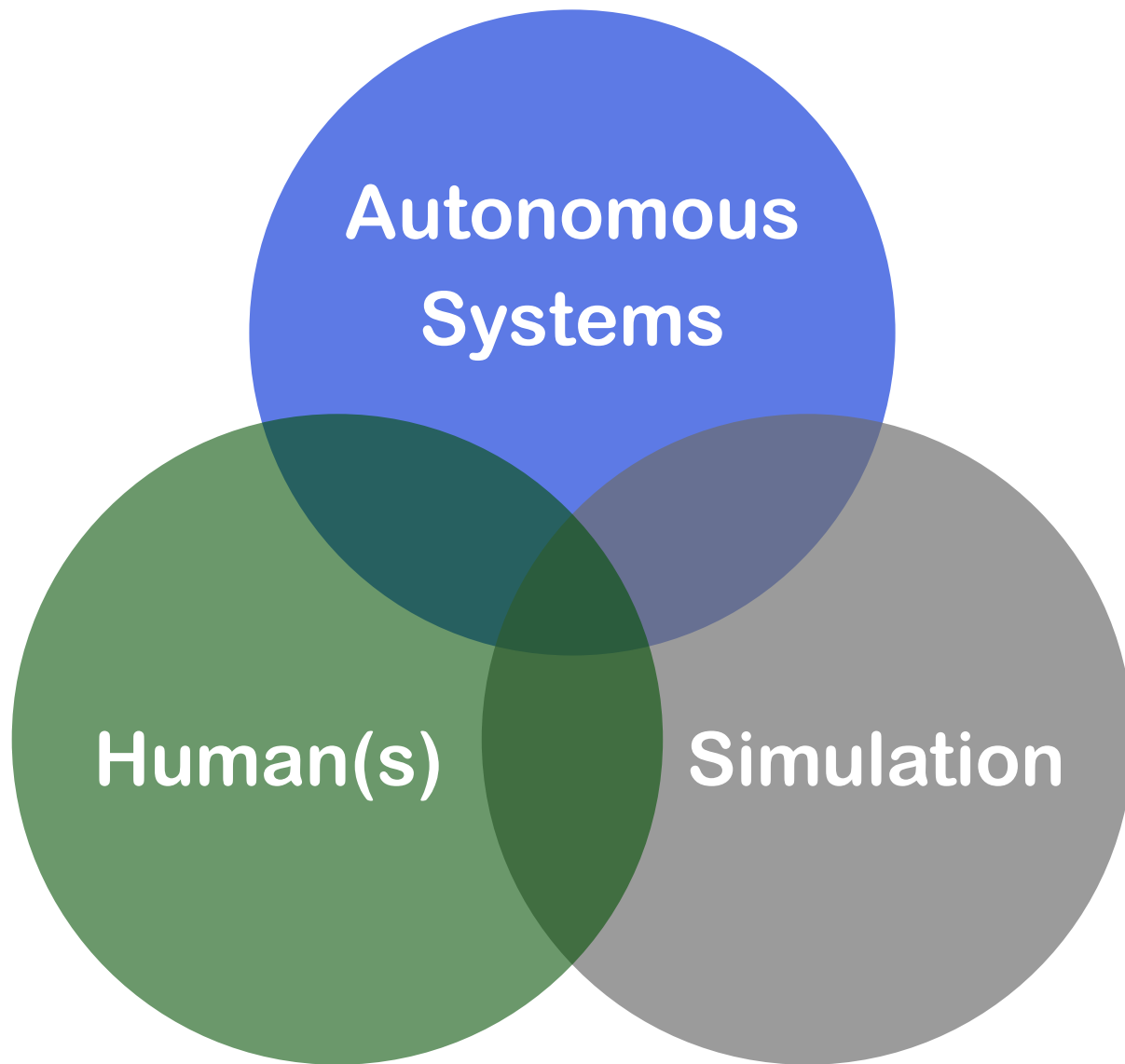


The Whole World in Simulation



VR is Looking More Promising

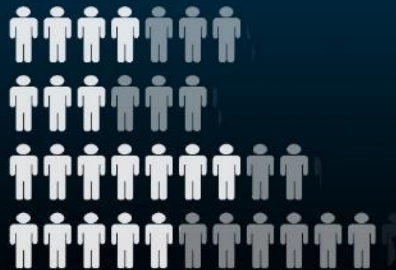




Data



Analysis



A Fourth Revolution - Training 4.0



1st

2nd

3rd

4th

**Paper,
Chalk**

**Paper,
Electro-Mec
hanical**

**Digital
Media**

**Digitisation
of Training**

Questions?



Questions?

