



Military Simulation Trajectories — Past, Present & Future?

Andy Fawkes | Joint Military Training
& Simulation Conference | Bristol |
5/6 March 2024

Career

- 1985 - 2000 - RCNC/MoD - Submarines
- 2000 - 2012 - MoD - Simulation & Training
- 2012 - Now - Industry/Media - Simulation & Training

What are We Seeking in Training?

Faster



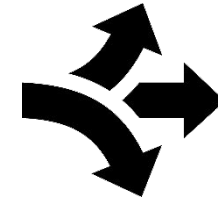
Cheaper



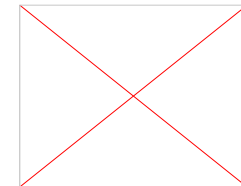
Better



Flexible



Multi-Domain



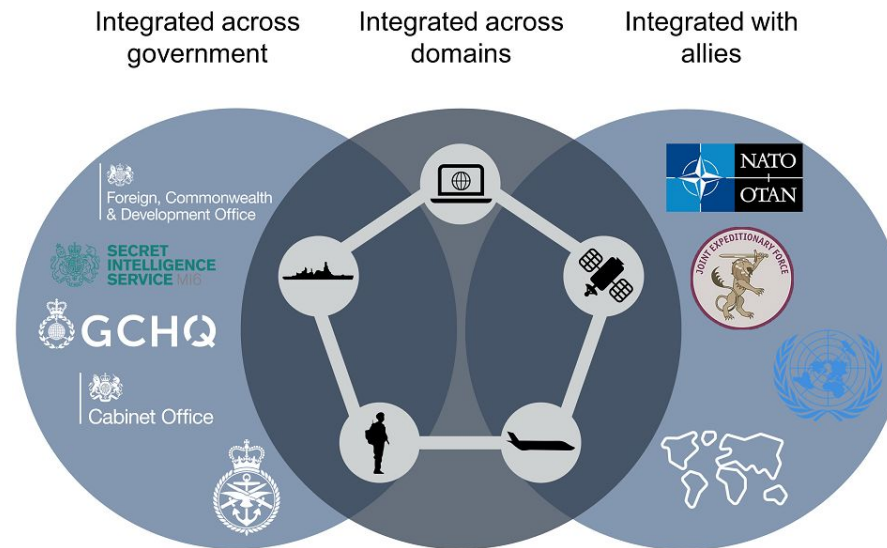
Greener



The Requirement

There is a need to bring teams and teams of teams together to experiment, train and collaborate in complex multi-domain (and Joint) battlespace operations ...

the first time should not be in the face of an enemy



UK Multi-Domain Integration Guidance - Jan 22

Past



Dome Trainer Portsmouth 1951

Pathé

USAF Capt Jack Thorpe's White Paper (1978)



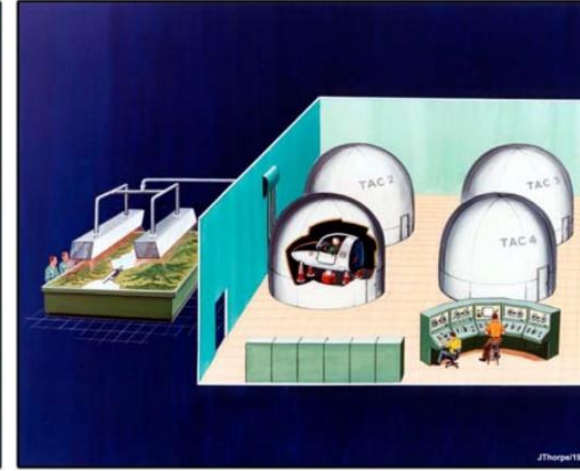
1

Enemy aggression detected by overhead sensor



2

Planning a response using the holographic electronic sand table



3

Air crews rehearse the plan and planners assess suitability



4

Mission execution with real time observation

"advances which are seen on the horizon are not simple improvements in teaching techniques or higher fidelity simulators, but rather bold concepts which tightly align training systems with real combat readiness and make them indistinguishable."

Still Relevant

...

DARPA (Cybernetics Technology Office 1977-1980)

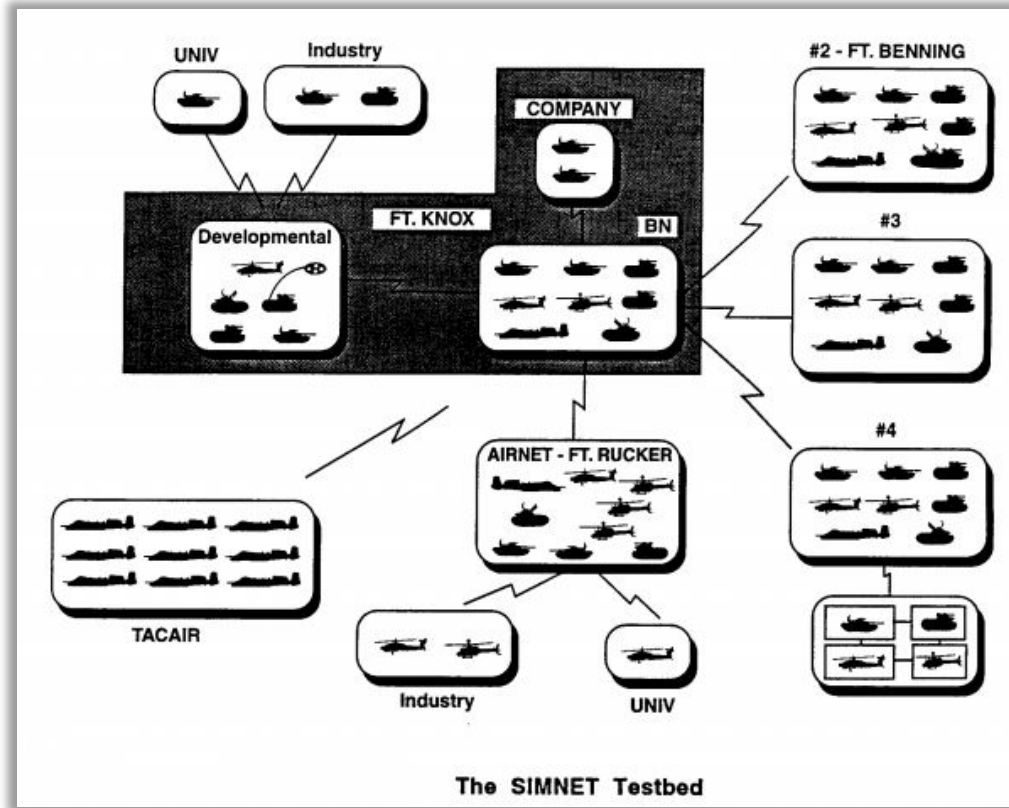
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J. Dexter Fletcher

An Historical Review Of Selected
DARPA Projects 1991

- Fletcher proposed a Tank Team Gunnery Trainer (TTGT) for tank gunnery training, where both live training and traditional simulators (\$18m) were high cost.
- DARPA tank gunnery trainer objectives:
 - a) Procured in quantity for \$10,000 or less each;
 - b) accessible, for example as a stand-alone "game" in military barracks or dayrooms;
 - c) motivating, for example in supporting competitive score keeping;
 - d) of sufficient fidelity to satisfy the training objectives, within the cost constraints; and
 - e) suitable for documenting training effectiveness in terms of transfer-of-training data".
- The TTGT concept was based on networked trainers viewing a single videodisc-generated scene, with the trainees competing to the first to sight and fire at an "enemy" tank.

SIMNET 1980s SIMulator NETworkin g



SIMNET M1 Tank Simulator 1986

<https://catalog.archives.gov/id/6596895>



SIMNET & Battle Force In-Port Trainer (BFIT) (1990/91)

SIMNET WARFIGHTING



“We had Army, Navy and Marines all playing in the same network on their own systems, that's the first time that has ever been done.

Right now we can put on a very complex battalion level battle and have your new weapons system or your new tactical organisation try to operate in that environment.

See how it works out, with real soldiers driving, real sergeants gunning, real soldiers trying to command and control your new force out there on the battlefield.

One of the neat things we're able to do, for example, would be to have naval call for fire being called for by the Marine crewman in the tanks here at Fort Knox and by the aviation crewmen who were flying the helicopters.

As we flew over the USS Wasp icon that we saw in our screens our signal showed up on their radar screens, which is an amazing feat when you think of that.

It's actually going to be a revolution.“

US Senate Armed Services Committee Hearing on Advanced M&S (21 May 1992)

Dr Victor H. Reis, Director Defense Research & Engineering



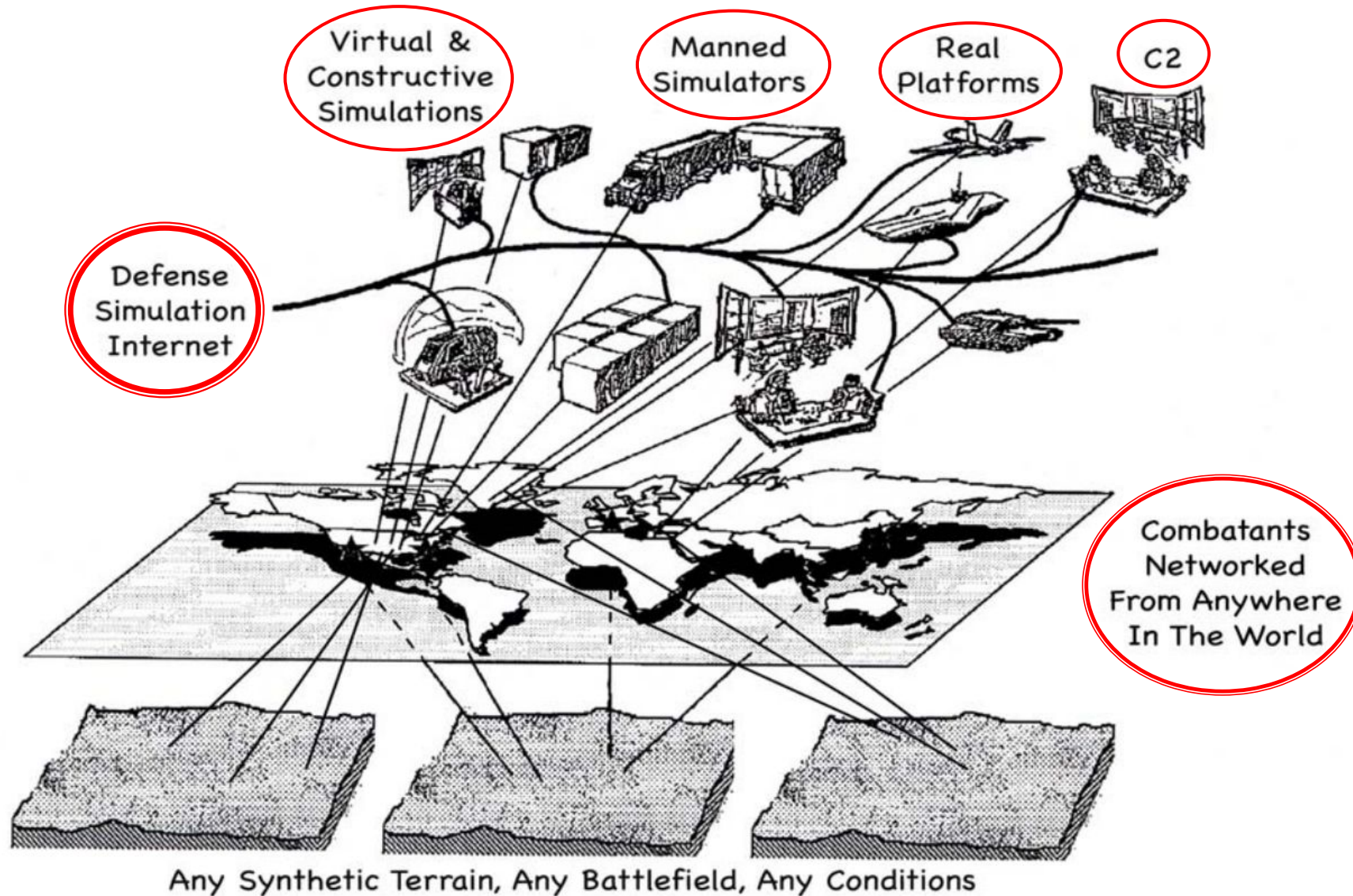
“Network simulation is a technology that elevates and strengthens the collective problem-solving abilities of human beings.

People acting as teams, learning and getting better, and this is true whether they are design teams, manufacturing teams, education teams, training teams, acquisition teams or warfighting teams.

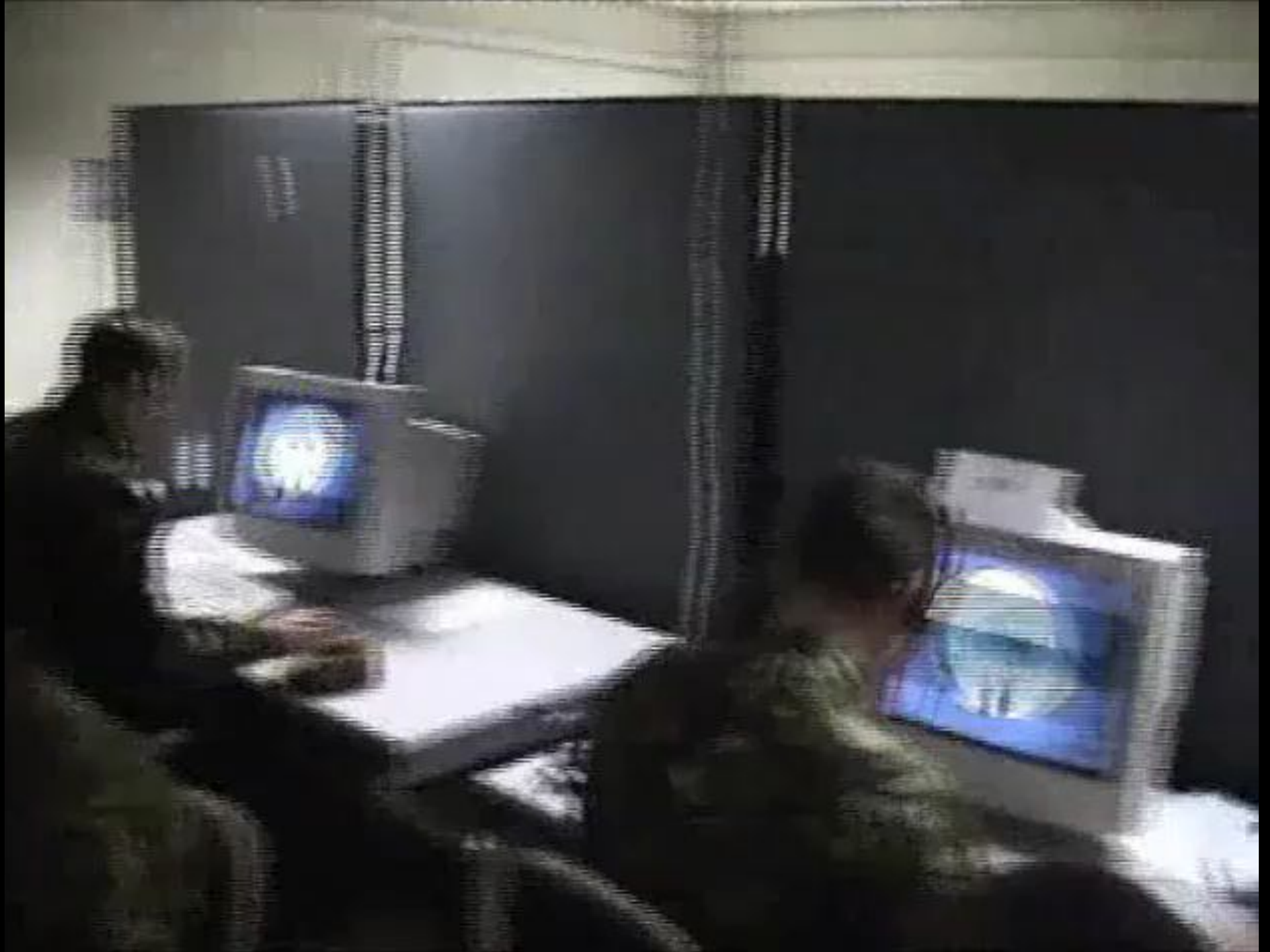
Network simulation with modern information technology can connect people together in an aligned, coherent, integrated enterprise.

It is at the very heart of the department's technology strategy.”

Thorpe's SIMNET Distributed Simulation Vision (early 1990s)



**DIVE
UK
Dismounted
Infantry
Virtual
Environment
(2002)
(QinetiQ)**



2002 - Training Cost Effectiveness?

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War simulator unveiled



Soldiers sit inside a replica tank to use the simulator
One of the largest war simulators in the world has been unveiled by high-ranking officers from the British Army.
The £290m unit, at the Warminster army barracks in Wiltshire, can recreate a tank battle involving 1,000 armoured vehicles in virtual reality.
The army hope the training simulator will give British troops the edge over any enemy in combat.
The combined arms tactical trainer, CATT, is also designed to reduce the massive costs of live military exercises.
Training 'watershed'
The simulator can reproduce vast sections of terrain from Salisbury Plain and other regions across Western Europe.

BBC Wiltshire
WHERE I LIVE >>>
Internet links:
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▶ Defence Procurement Agency
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Troops in virtual combat



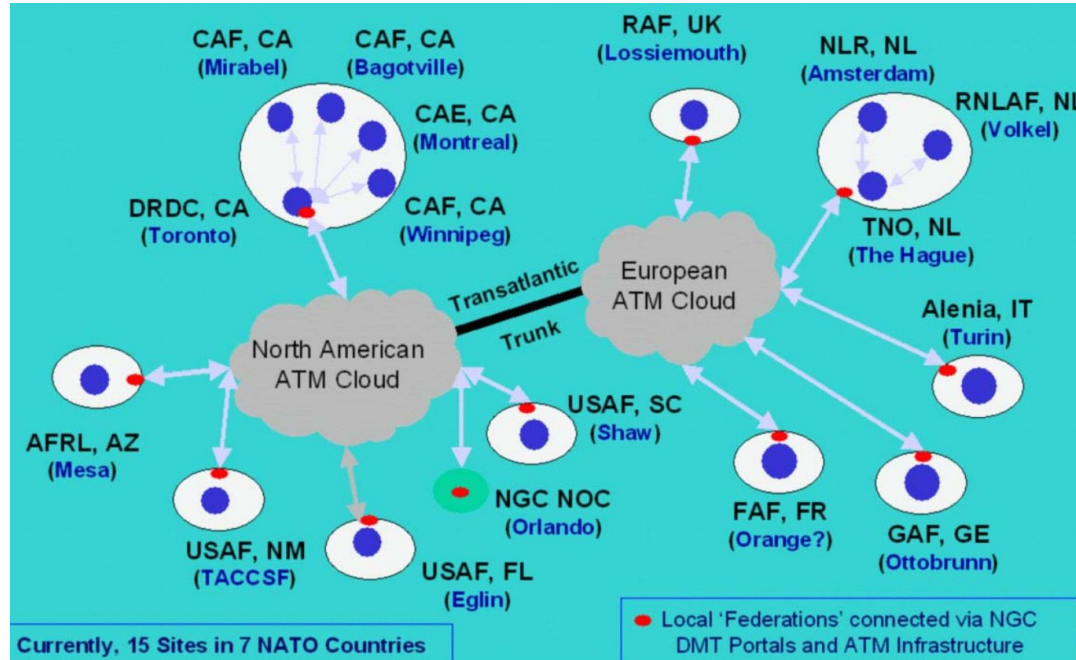
Up to eight soldiers can play together
The British Army is using a specially developed version of the celebrated computer game Half-Life to train its troops.
With the first-person shoot-em-up soldiers can try out new weapons and new tactics without encountering real bullets and bombs.
The Ministry of Defence hopes the system may help reinforce some of the lessons learned on more traditional training exercises.
Like the popular modification, or mod, of Half-Life known as Counterstrike, the army version allows up to eight soldiers to go into virtual combat at any one time.

See also:
▶ 24 Jan 02 | England War simulator unveiled
▶ 23 May 02 | New Media US military reveals computer game
▶ 21 Dec 01 | Reviews Half-Life revives for new generation
Internet links:
▶ QinetiQ
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Obviously, being killed in the virtual world isn't quite so serious
Major Bruce Pennell

NATO Exercise First WAVE 2004



- Aimed at enhancing the readiness of aviators and supporting staff
- A collaboration of seven nations - Canada, France, Germany, Italy, the Netherlands, UK, and the US
- Distributed international collective training leveraging national simulation resources and expertise

Fleet Synthetic Training FST-J

2006 ish



USN Carrier
Group



Combined Tactical Trainer
HMS Dryad

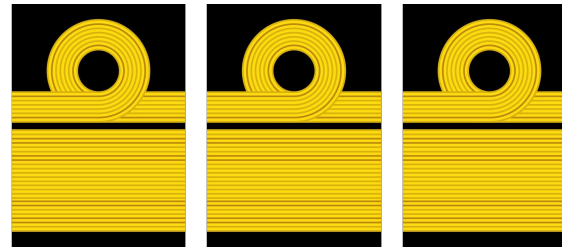


German
Navy

Type 22 Frigate, Type 23 Frigate, Type 42
Destroyer
+ Flight Sim (Bedford)



Type 23 Operations Room (simulator)

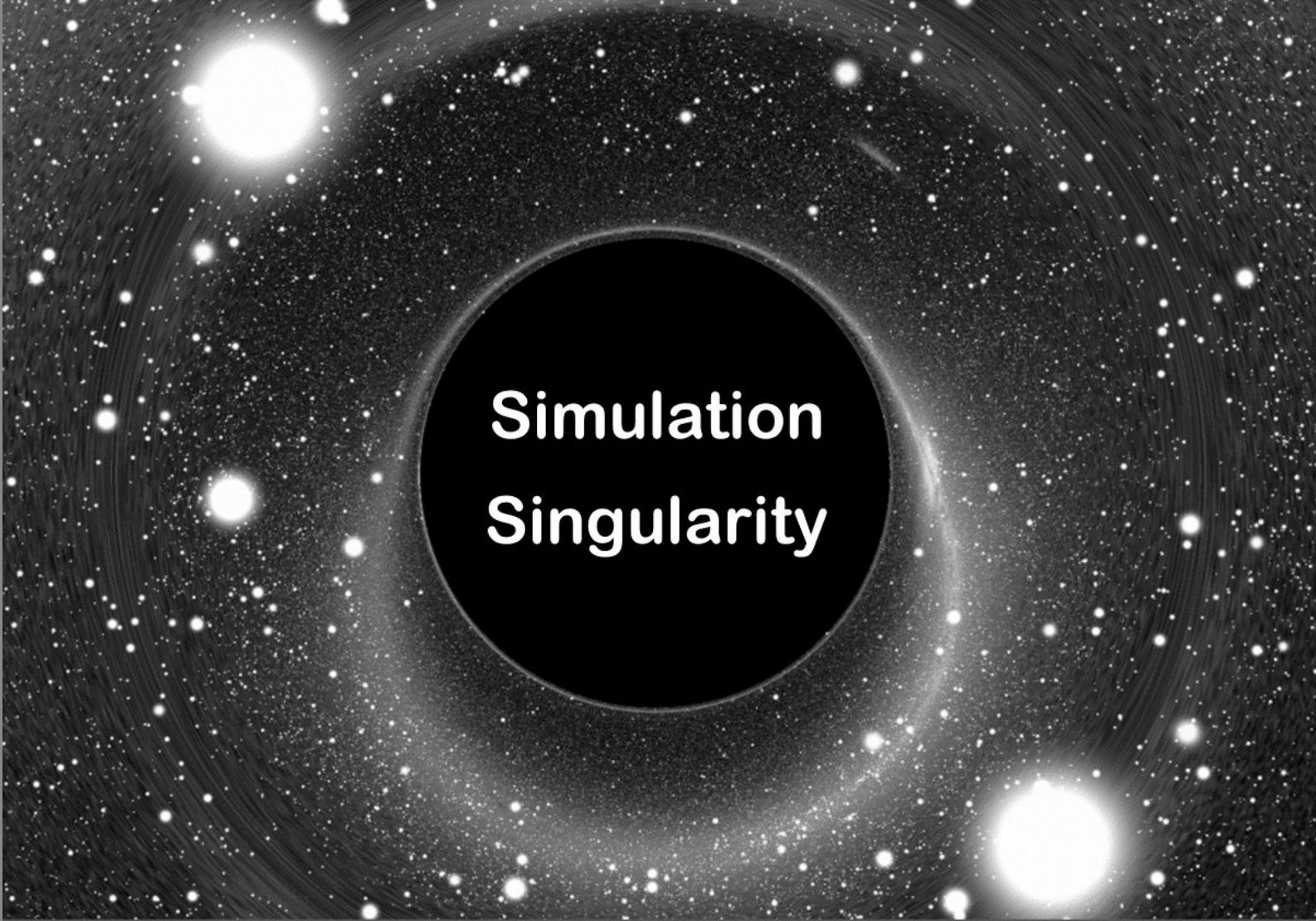


“This is the way we are going to train in
future”

MoD Journey - Joint Training & Simulation

- 2005 – Common/Joint Simulation Infrastructure (JCNTC)
 - Project funding line established; Op JCOVE
- TELIC/HERRICK
- 2008 - UK MoD Simulation Strategy
 - More Adaptive, Responsive and Cost Effective Simulation
 - Common Network, Open Standards, COTS/GOTS, Common URD/SRD Statements
- 2010 – SDSR (Strategic Review)
 - Save Money!
 - Targets to Transfer Live Training to Simulation and Instrument Live Training
- 2012 - Defence Training & Education Capability (DTEC)
 - Training System Investment BOI (e.g. iPad v Big Sim); Common M&S Catalogue and DSC

**what if in
future we
could simulate
the world such
that we could
not tell the
difference
between the
simulation and
the real world?**

A black and white image of a galaxy, possibly a spiral galaxy, with a central black circle. Inside the circle, the words "Simulation Singularity" are written in white, sans-serif font. The galaxy's arms are filled with numerous stars of varying brightness, and the overall image has a grainy, high-contrast appearance.

**Simulation
Singularity**

Digital Shoreditch 13-05-15 Andy Fawkes

THINKE

UK Virtual Reality in Land Training (VRLT) Pilot

2019



The aim of the VRLT pilot was to identify the opportunities that Virtual Reality technology offered the CTFP Future Collective Training System



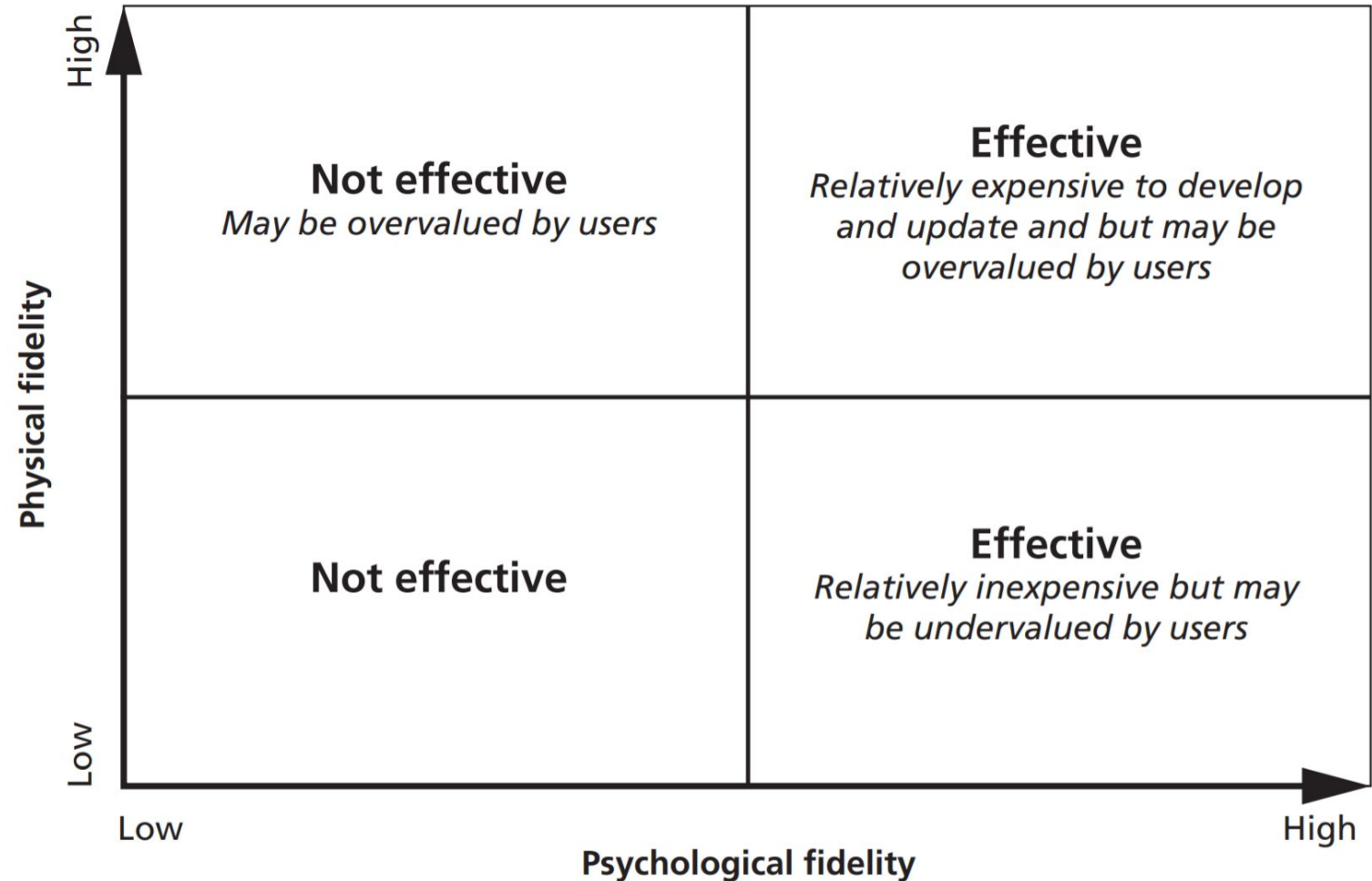
RAND Report (2019)



Collective Simulation-Based Training in the U.S. Army

User Interface Fidelity, Costs, and Training Effectiveness

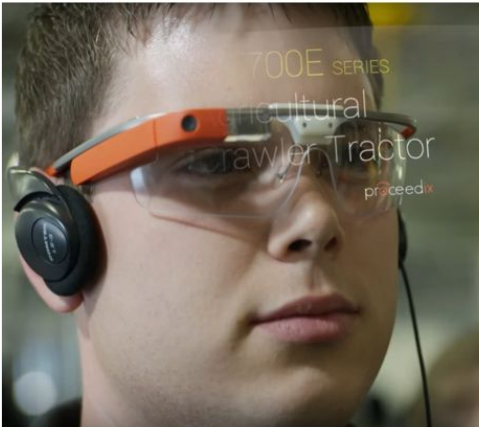
Susan G. Straus, Matthew W. Lewis, Kathryn Connor, Rick Eden, Matthew E. Boyer, Timothy Marler, Christopher M. Carson, Geoffrey E. Grimm, Heather Smigowski



Present

XR

eXtended Reality (XR)

Reality	Augmented Reality	Mixed Reality	Virtual Reality
The real world	Information layered over vision	Blend of real & digital information to enhance reality	Fully virtual world
			

XR for Professional Use



HalldaleGroup

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EASA Qualifies World's First VR Flight Training Device



EASA calls the VRM Switzerland Virtual Reality FSTD qualification "a further step towards Agency and industry objectives to improve overall rotorcraft safety by 50% by 2028." Image credit: VRM Switzerland.

[RICK ADAMS](#)

APRIL 26, 2021

VRM Switzerland has received approval from the European Union Aviation Safety Agency (EASA) for pilot training credits in a type-specific Robinson R22 virtual reality flight simulation training device, the world's first VR-driven FSTD to receive approval from an aviation regulatory authority.

Support



Credit – Kognitiv Spark



RAAF Test Microsoft HoloLens



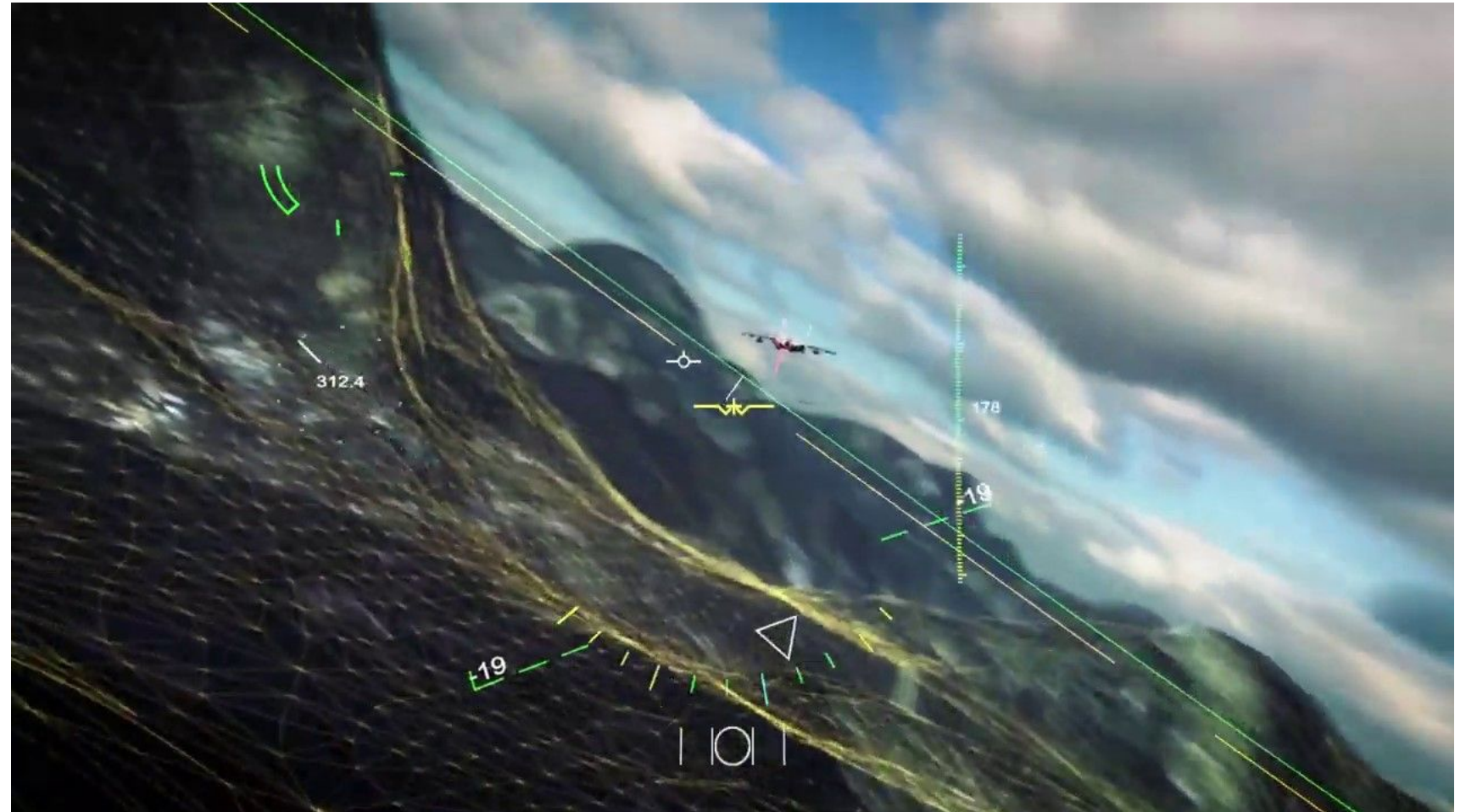
Image credit: RAAF.

MIKE RAJKUMAR

SEPTEMBER 4, 2020

The Royal Australian Air Force (RAAF) recently commenced a trial initiative for maintenance of its C-17A Globemaster III transport aircraft using Microsoft HoloLens mixed-reality devices with software developed by Boeing. The trials commenced in July with aircraft technicians from No. 36 Squadron at RAAF Base Amberley, the service announced in a statement.

BAE Systems' Striker® II Helmet-Mounted Display (HMD) – Late 2020s

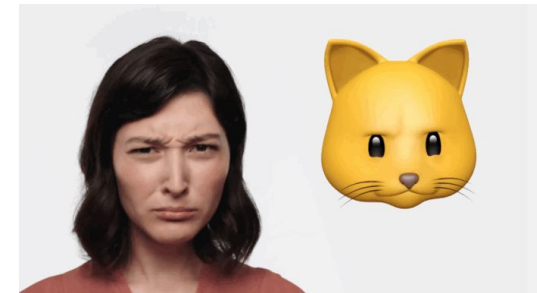
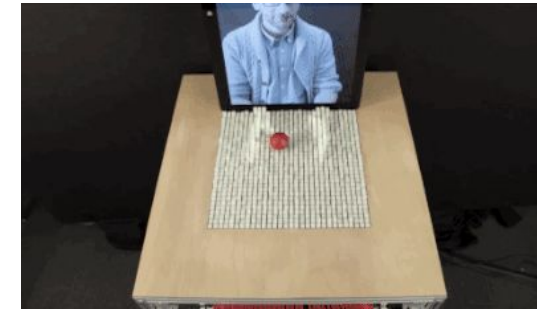
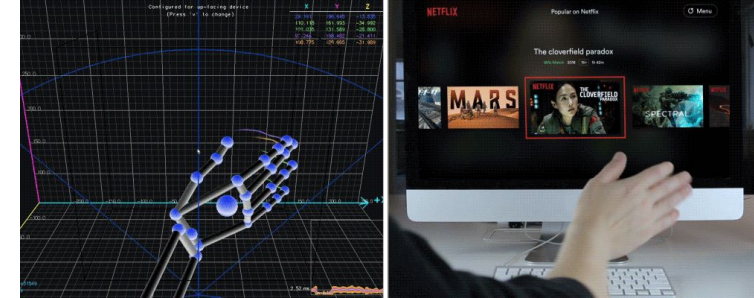


Eye Tracking



User Interfaces

- Gesture Interfaces
- Tangible User Interface
- Emotion Sensing
- Brain-Computer Interface



Human Data



Data Exploitation in Military Training

- USAF Pilot Training Next & Pilot Training Transformation initiatives
 - Explored wearable biometric devices to collect and monitor physiological data, such as changes in heart rate.
 - Instruction was assisted by data collection software and artificial intelligence-based applications designed to assist students in identifying training tasks for self-guided learning.
- The British Army's Collective Training Transformation Programme (CTTP) has placed emphasis on training data exploitation:
 - “data will be captured and exploited to drive change and efficiency ... creating the ability to dynamically control the training environment to set an appropriate level of complexity and challenge ... and bring data to a single place for analysis, with common data standards enabling an ambitious use of data analytics pan-Army”
- UK Royal Air Force (RAF) Project iDAS (immersive Data driven Airmanship Simulator)
 - Aimed at helping the explore the benefits of data analysis to assess pilot behaviour and identify characteristics of good airmanship.

UK Air Training Capabilities - Data Stovepipes?

A400M

Apache

WIST

UAV

C-130

C17

Gladiator

(JFST)

E-3

F-35

iASTC

LTPA

MFTS

MSHTF

P-8

STARS

TFST

TyTan

Warfighter Data Here, There, Everywhere



“(Personal) Data is hard to access, technology is ageing, and processes and culture are not suited to the information age.

A fractured ecosystem has created the need for manual workarounds and interventions across the force

...

With many systems in play that either speak different data languages or are unable to communicate at all, there is no single view of data across the Armed Forces.”



Digihuman?

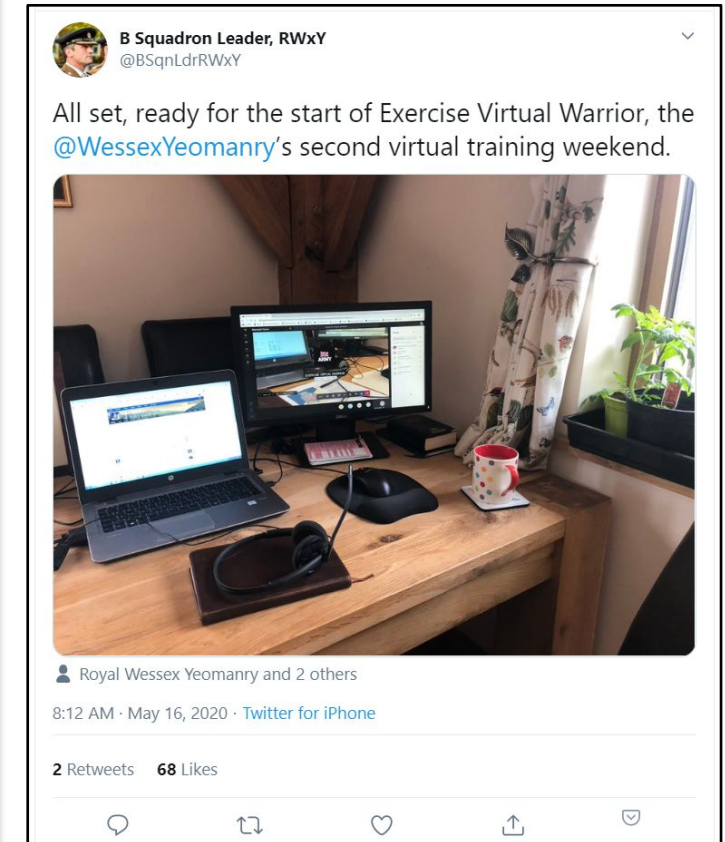
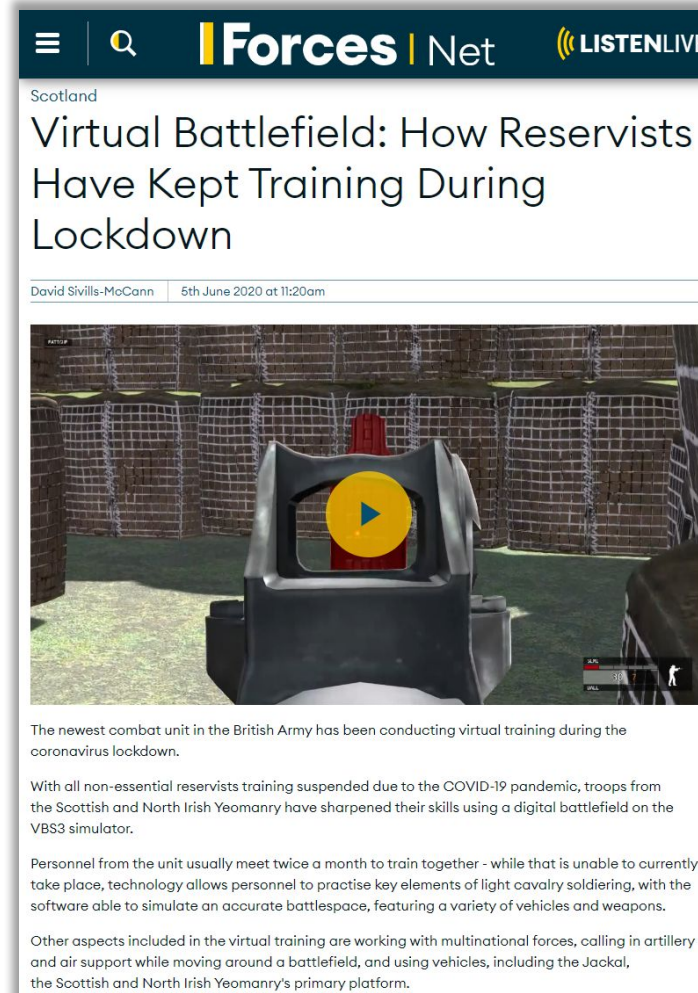


Defence Acquisition Strategies?

- CTPP/ACTS – 2018 ... ?
- Gladiator ... Contract 2019
- Spartan?
- Strat Com? – 4 CASTs?

Compete or Collaborate?

**The underlying technology
is become more common
and more commoditised**
Networks, software, hardware



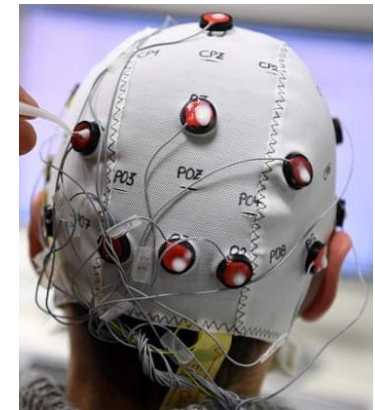
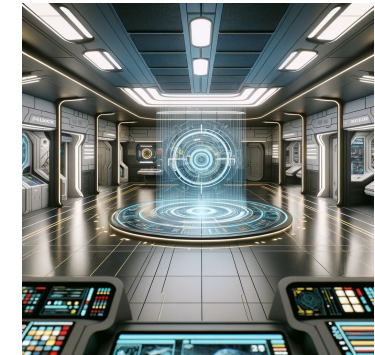
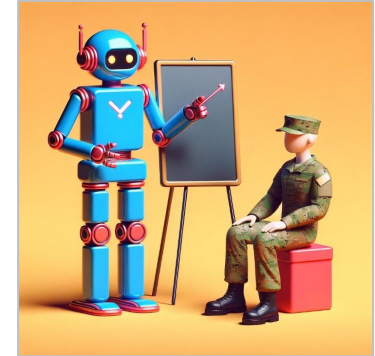
Future?

Recent Work

- Home Office
 - XR Headset Data Framework
 - Learning from Computer Games
- Dstl
 - Gaming Ecosystem Study
 - Military Metaverse study
 - Military Metaverse Sandpit
 - Simulation Enterprise Analysis Study
 - Novel Simulation
 - XR Standards and Security
 - Data and Evaluation
 - Learning Futures

Learning Futures

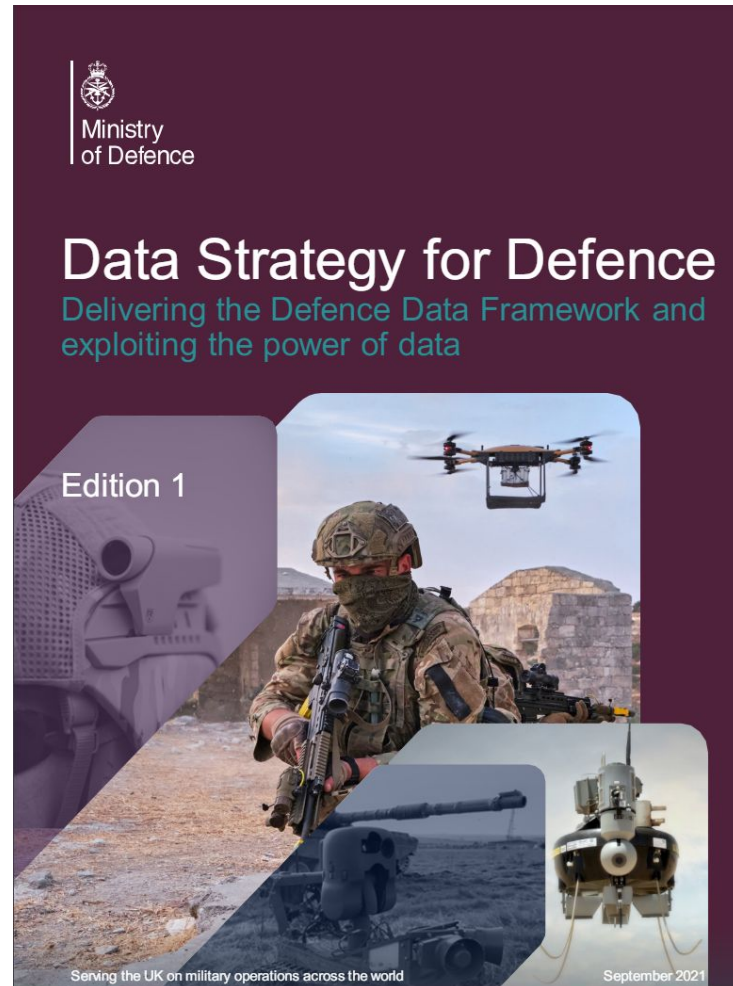
- AI-Supported Learning
- Holodeck in Every Barracks
- Ubiquitous Learning
- Brain-Computer Interfaces
- Persistent LVC



But ... Do This First



May 2021



Sep 2021



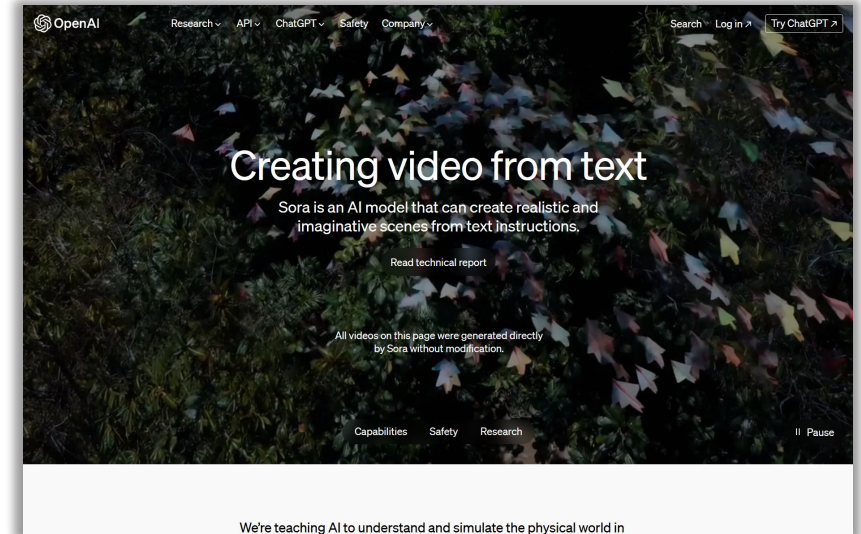
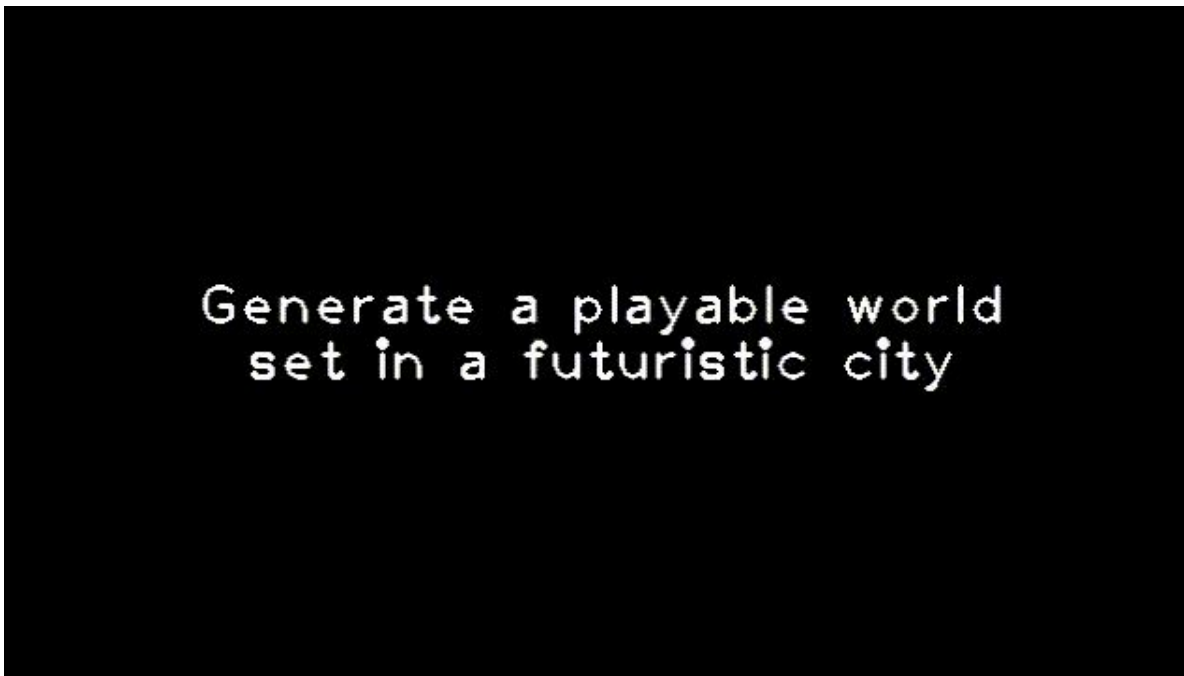
Feb 2023



Holodeck?



AI ...



Text to Video

Google DeepMind  Genie: Generative Interactive Enviro...

Genie: Generative Interactive Environments

Genie Team

We introduce Genie, a foundation world model trained from Internet videos that can generate an endless variety of playable (action-controllable) worlds from synthetic images, photographs, and even sketches.

Interactive World/Game Generation

In Vogue Tech Speak

~~Metaverse~~

....



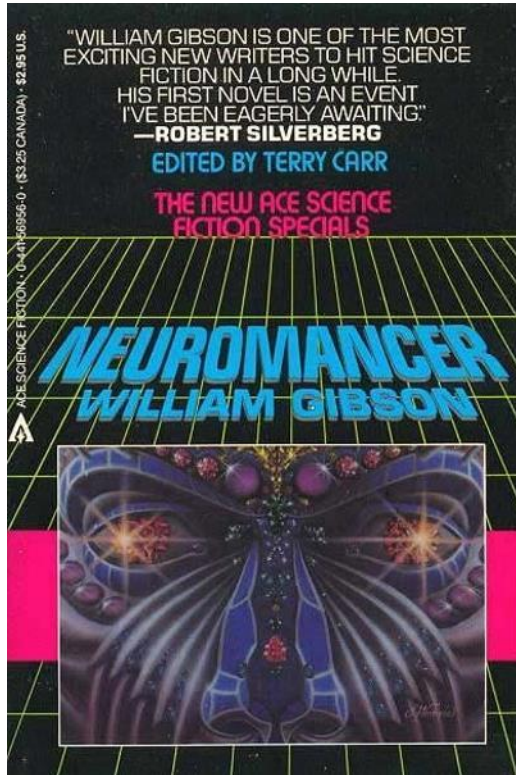
“Spatial Computing”

...

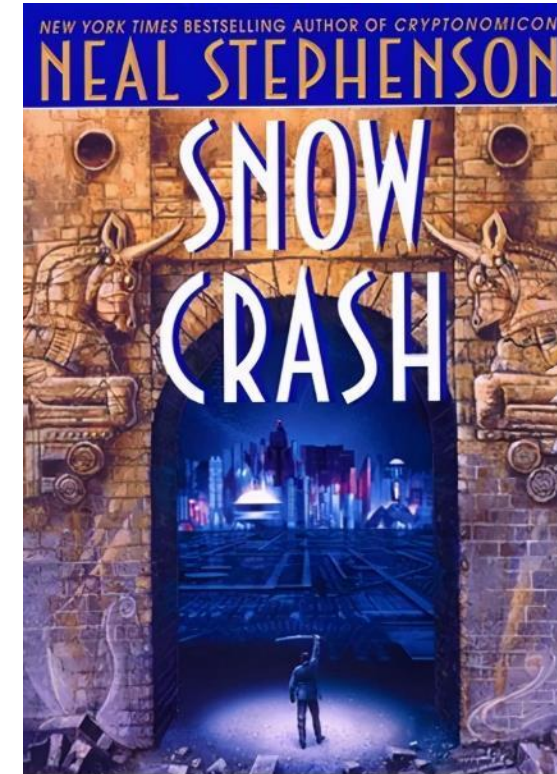
Metaverse?



It's All Science Fiction



1984 – Created by Gibson, the word “**Cyberspace**” is popularised and “*had no real semantic meaning*” a “*mass consensual hallucination*” in computer networks



1992 – Stephenson creates the word “**Metaverse**” a portmanteau of “meta” (meaning beyond) and “universe”

“... a computer-generated universe ...”

Physical World	→	Digital World
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Some Contemporary Metaverse Descriptions ...

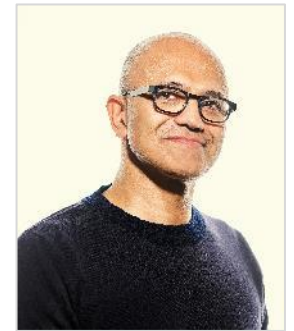
“The metaverse is a seamless convergence of our physical and digital lives, creating a unified, virtual community where we can work, play, relax, transact and socialize.’

J.P.Morgan

“Opportunities in the metaverse” 2022

“The metaverse enables us to embed computing into the real world and to embed the real world into computing ...”

Satya Nadella, CEO Microsoft, Microsoft Ignite Nov 2021



A Defence Perspective on the Metaverse

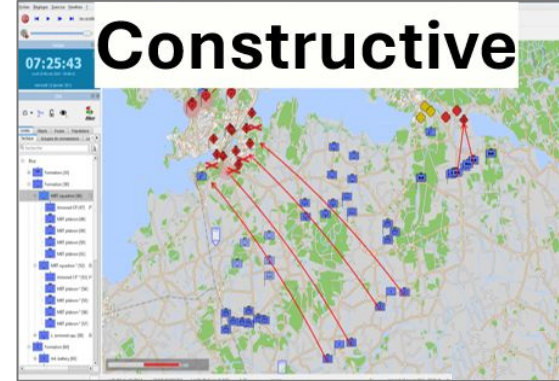
For defence, the metaverse signifies a **convergence of technologies and cultures,**

representing the next evolution of computing, a trend from 2D to 3D interaction and immersion between **humans, machines and the digital world.**

The real world is three-dimensional, and increasingly the digital world will be too.



Military Metaverse



Defence Digital Backbone

Computing
Hardware

Software

Networking
& Security

Human-Co
mputing
Interfaces

Data &
Digital
Twins

AI, Data &
Analytics

Automation
& Robotics

It's Bringing Everything Together that Matters the
Most

MILITARY METAVERSE CONOPS 2035

aka
**Persistent
Secure
Networked
Distributed
LVC Simulation**



Converging Domains



NATO Allied Command Transformation Strategic Foresight Analysis 2023



- Within two decades, an overwhelming majority of the population will have access to the internet and mobile devices, along with virtually a limitless amount of information, while **the distinction between the physical and virtual dimensions will decrease.**
- Infinite alternative worlds may emerge in the virtual dimension, unbounded by physical limitations, and eventually the **convergence of physical and non-physical (virtual) realities** fused into metaverses will further increase variations of realities and perceptions. The expansion of competition from the physical to virtual and cognitive dimensions significantly impacts the continuum and character of conflict...



Dual-Domain?

The convergence of virtual and physical spaces

Virtual infiltration could precede physical entry

A dual-domain approach allows for the creation of new tactics, techniques, and procedures to navigate and control the multi-domain battlefield

War is Virtual Hell: Bruce Sterling Reports Back from the Electronic Battlefield 1-1-1993

The whole massive, lethal superpower infrastructure comes unfolding out of 21st-century cyberspace ...

The Reserve guys from the bowling leagues suddenly reveal themselves to be digitally assisted **Top Gun veterans** from a hundred weekend cyberspace campaigns ...



**“All but
War is
Simulation”**



**Still the
Ultimate
Simulator?**





Questions ?

Andy Fawkes
Joint Military Training & Simulation Conference
Bristol
5/6 March 2024
andy.fawkes@thinke.co.uk