



4th Annual SMI

# Future Armoured Vehicles Weapon Systems

London - 6 June 2019

## Extended Realities

A Training & Simulation  
Perspective on VR, AR &  
Related Technologies in  
Armoured Warfare

Andy Fawkes



**Human Factors  
and Training  
Always Last?**

- **Training Requirements**
- **A Little About Training and Simulation Technology**
- **Extended Realities?**
- **A VR Land Training Pilot**
- **Thinking about Recruits**
- **Joining the Army**

## **Presentation Overview**

# Training Requirements

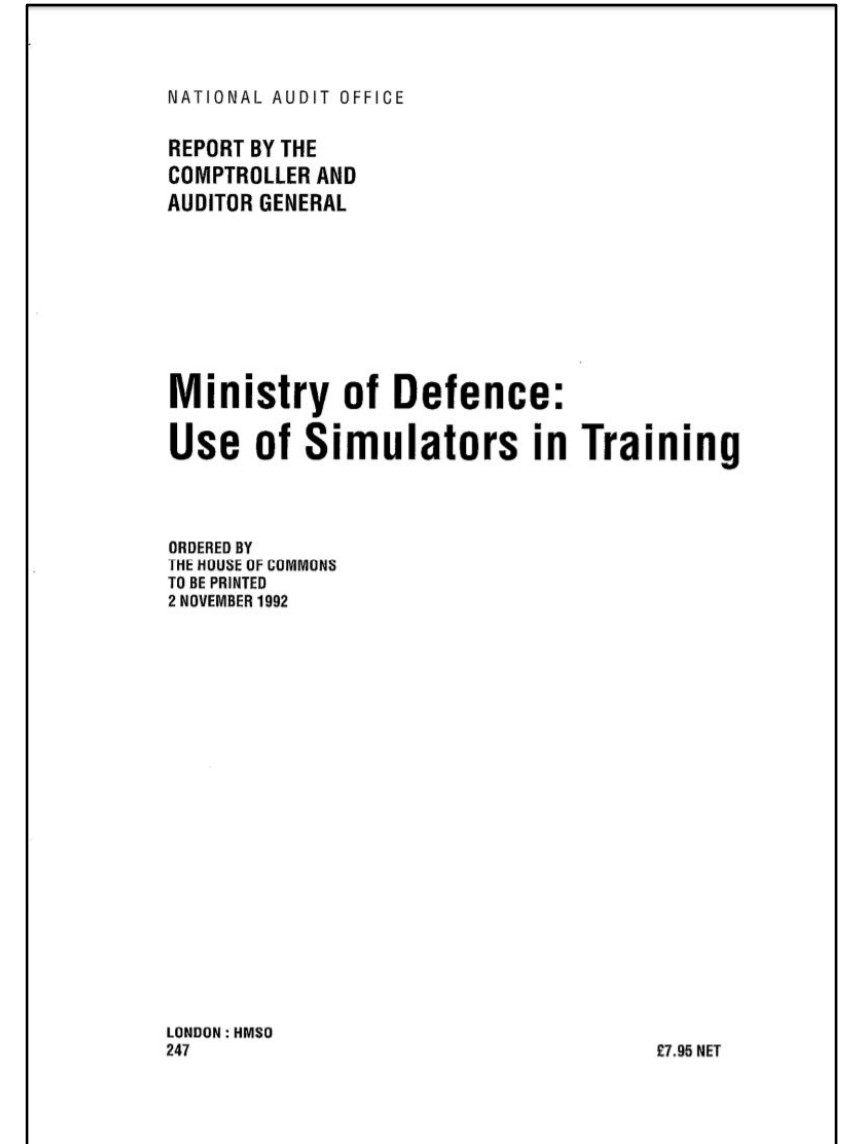
# Getting the Requirement Right

## Driver Training

- “Simulators at the Driving and Maintenance School at the Royal Armoured Corps Training School, Bovington were introduced to reduce demand on parent equipment (principally tanks and armoured fighting vehicles) and to save on running costs. **The simulator was introduced without the benefit of a clear definition of training requirements**, and subsequent research has shown that **more than four hours training on the simulator at a time leads to diminishing training benefit.**”

## Gunnery Training

- “A Gunnery Training System Simulator was introduced to teach firing drills for tanks. The simulator has several disadvantages, **including a very high workload for the instructor** in setting up and monitoring scenarios; relative unreliability; poor representation of targets and inaccuracy in aiming compared to the parent equipments.”



# Value for Money? - US GAO Aug 2016 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                                                            | 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**

# The UK Army Context (2017)

- The nature of war remains constant: it is **visceral, violent, characterised by friction that makes the simplest things difficult, and its outcomes are more often determined by the effects on people's minds than by physical effects**, and it is always about politics
- The **battlefield is increasingly decentralised** with a premium placed on the talent of junior leaders within land forces, and their ability to understand the strategic context
- The **manoeuvrist** approach is our fighting doctrine, focused on the enemy – but the pervasiveness of information demands that manoeuvre has to take account of a broader audience than simply the 'enemy'
- This requires **Integrated Action**



Ministry  
of Defence

Joint Doctrine Publication 0-20

UK Land Power



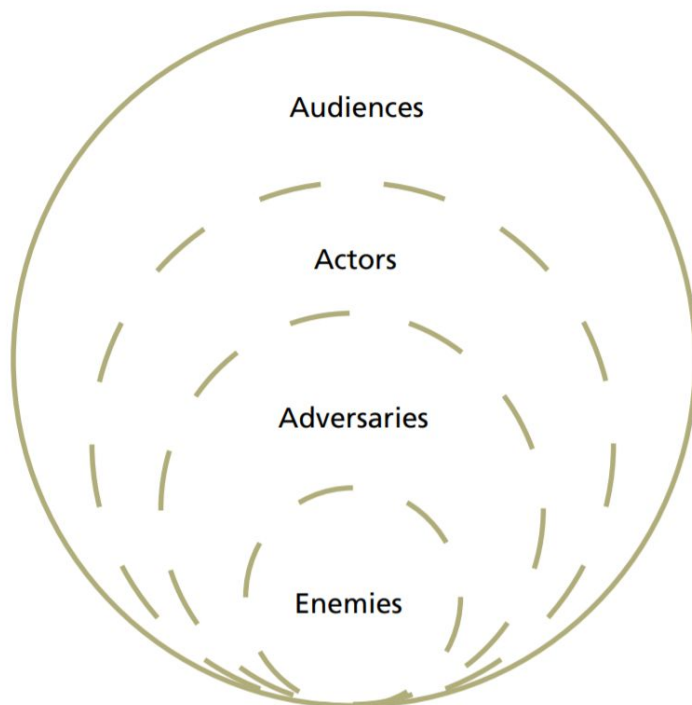
Development, Concepts and Doctrine Centre

# Integrated Action (2016)



A unifying doctrine that requires commanders to:

1. to identify the desired outcome
2. to consider all the audiences relevant to attaining the outcome
3. to analyse the effects required on the relevant audience and then
4. to determine the best mix of capabilities, from soft through to hard power, to achieve the outcome



**Audience.** All the groups and individual people whose perception and interpretation of events and subsequent behaviour contribute to the success or otherwise of military action

**Actors.** A group or person that takes action or directly exerts influence

**Adversary.** A group or person that seeks to prevent us from achieving our objectives

**Enemy.** A group or person that seeks to defeat us through armed lethal means



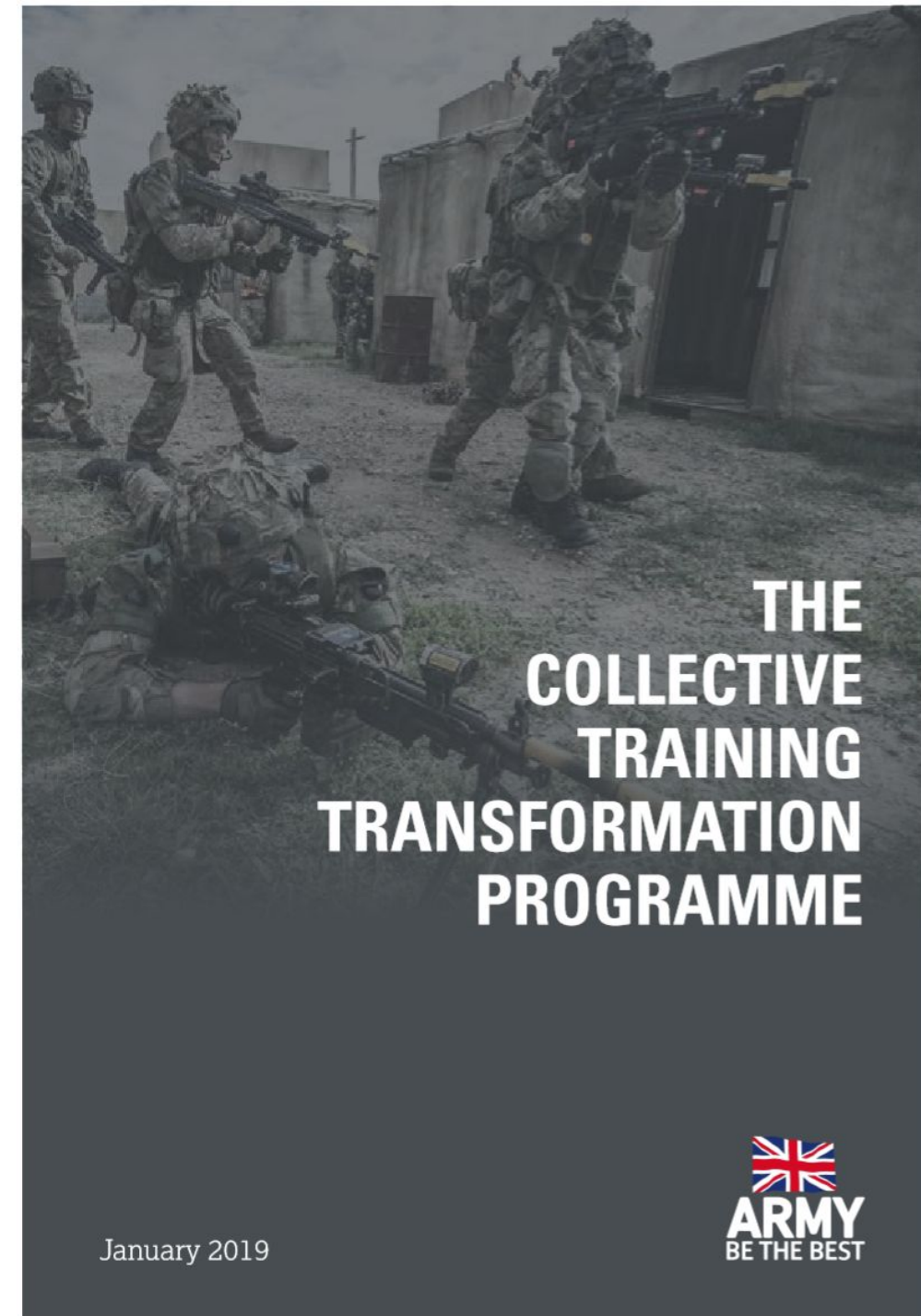
# Principles of Training

- Is a function of command
- Is a continuous and progressive process
- Must be challenging and interesting
- Must be realistic
- Must have an aim and objectives
- Training methods must be continuously reviewed for effectiveness
- Must reflect operational doctrine
- Must be permissive of error
- Must be appropriately safe
- Must be exploited



# Collective Training Transformation Programme (CTTP)

- From now to 2025, CTTP seeks collective training that is more challenging and conducted in more dynamic and complex environments (physical, virtual and cognitive) to ensure its formations and units are ready for a future operating environment that has increasing emphasis on urban operations and information manoeuvre
- Collective Training will become surrogate warfare; driving adaptation, generating combat ethos, empowering commanders, and delivering tactical innovation
- It will be measurable, enabled by simulation and technology, and form part of an assured and responsive lessons loop and wider Warfare Development process
- The British Army will train in regions of the world that cement our Joint and International partnerships, reassure our friends and deter potential adversaries



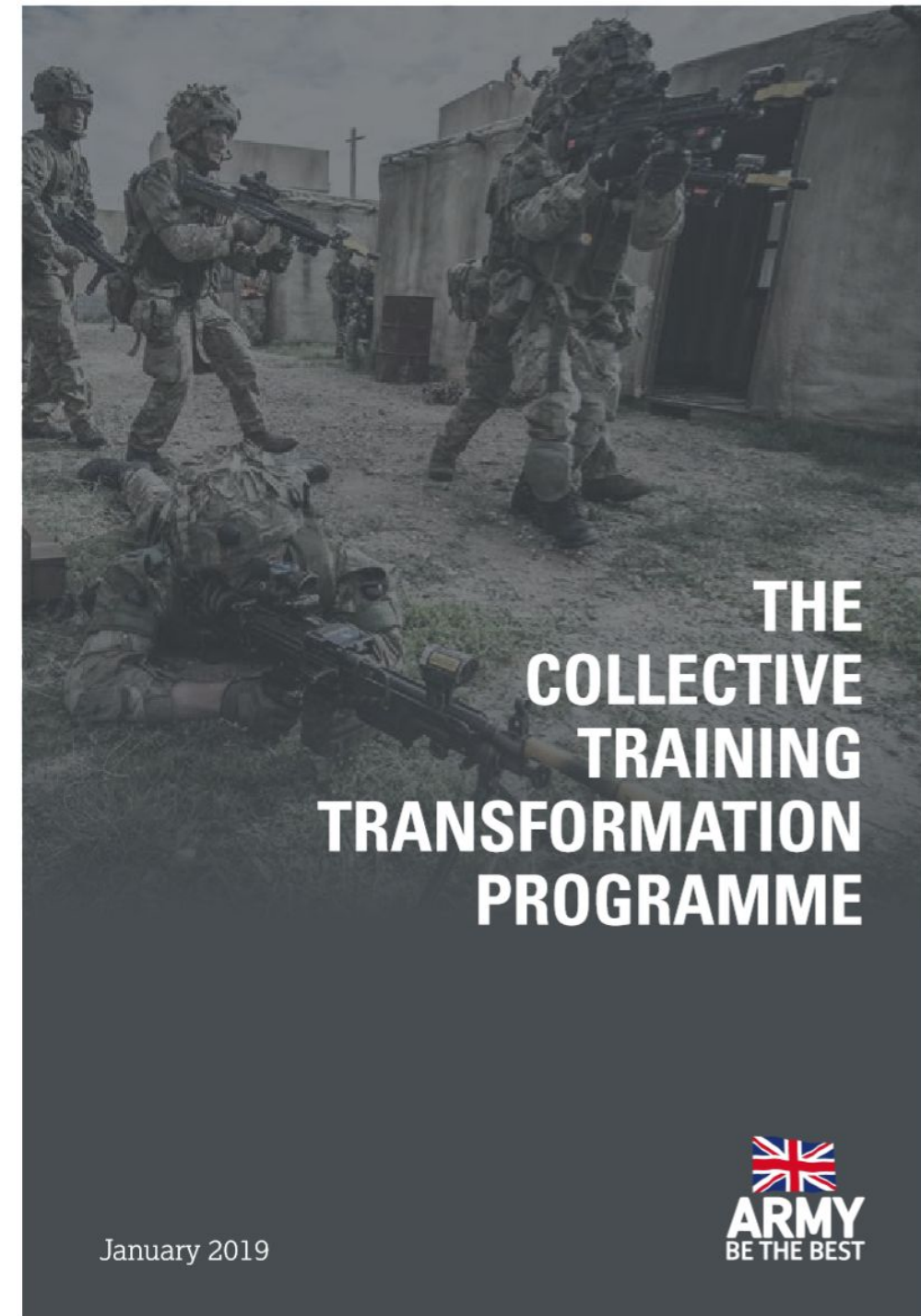
## THE COLLECTIVE TRAINING TRANSFORMATION PROGRAMME

January 2019



# Collective Training Transformation Programme (CTTP)

- The CTTP is developing a **Future Collective Training System (FCTS)** which includes the aim by 2023 to deploy high fidelity simulation across all Army locations increasing its access to Regular and Reserve units
- **Pilot studies** have been initiated to inform the development of the FCTS, including an investigation of Virtual Reality (VR) technology



THE  
COLLECTIVE  
TRAINING  
TRANSFORMATION  
PROGRAMME

January 2019



# CTTP's Future Collective Training System (FCTS)

- Training will be progressive with the greatest focus on the Combined Arms Sub Unit within a BG context
- There will be **greater use of virtual training** and a **paradigm shift to 'virtual before live'**, where live training is used to consolidate and confirm skills learned in a virtual environment
- All **training will be instrumented**, recorded, analysed and exploited
- Synthetics and instrumentation systems will routinely be **held and operated at unit level**
- The complexity of the contemporary operating environment will be represented by a Synthetic Operating Environment (SOE) which is **coherent across the live, virtual and constructive environments**
- Urban complexity will be provided through a combination of individual and collective virtual, alongside the current built estate and that of our allies



# US Army Synthetic Training Environment (STE)

- IOC of 2023 and FOC 2029
- Building a **single synthetic environment** that can handle virtual/gaming and constructive
- Incorporate the US Army's **one-world terrain** project which maps the entire globe, both geographically and socio-politically
- Deliver **training to the point of need**
- Create artificial intelligence to **reduce the need for human role players** in exercises and offer intelligent enemy forces
- Utilize **big data** for analytics and visualization

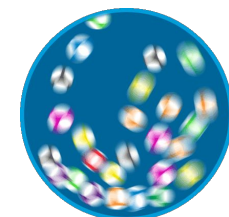
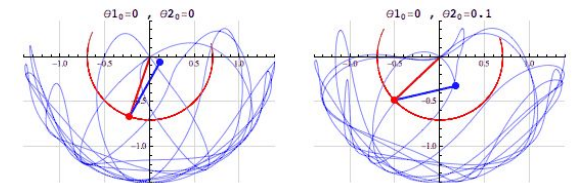
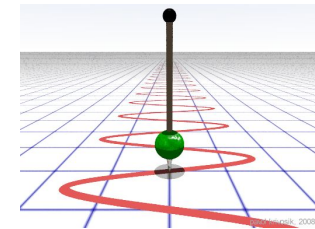
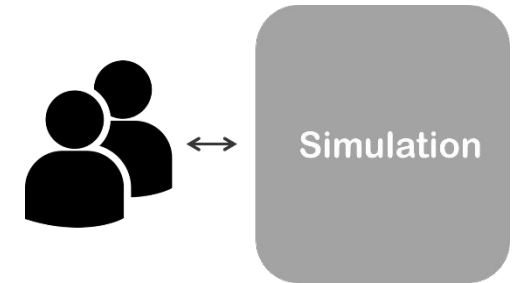
# Other Drivers



# A Little About Training and Simulation Technology

# What is Simulation?

- Humans Inside or Outside
- Runs in Real or Non-Real Time
- Some Systems have Order
- Some Systems are Chaotic
- Some are Random



# Why Use Simulation in Training?



# Simulation Now - Land, Sea, Air, Anywhere

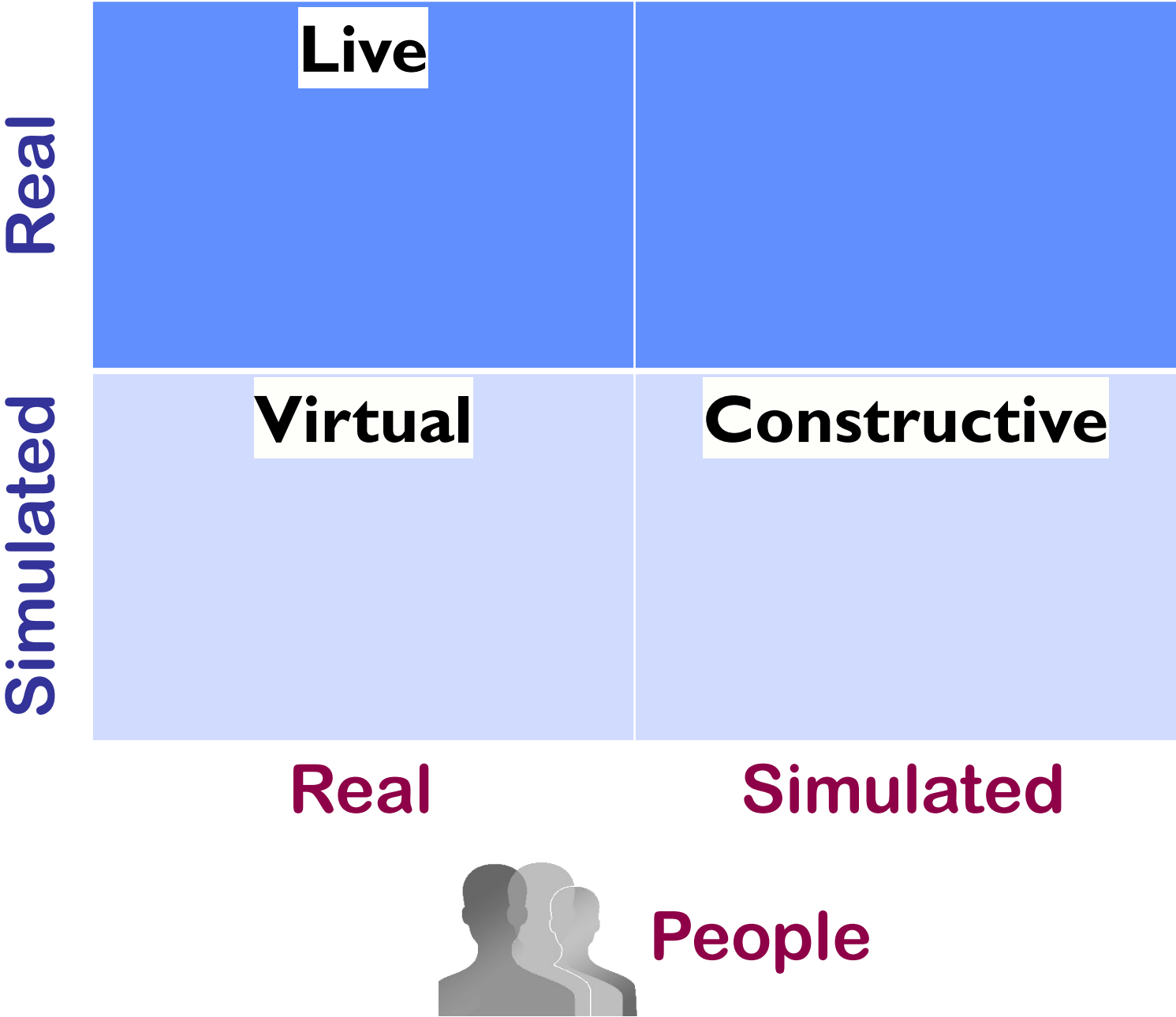
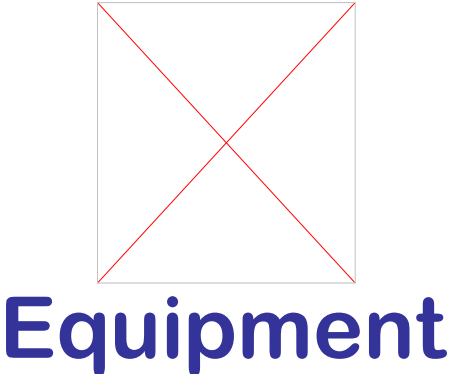


# US Army STE (Synthetic Training Environment)

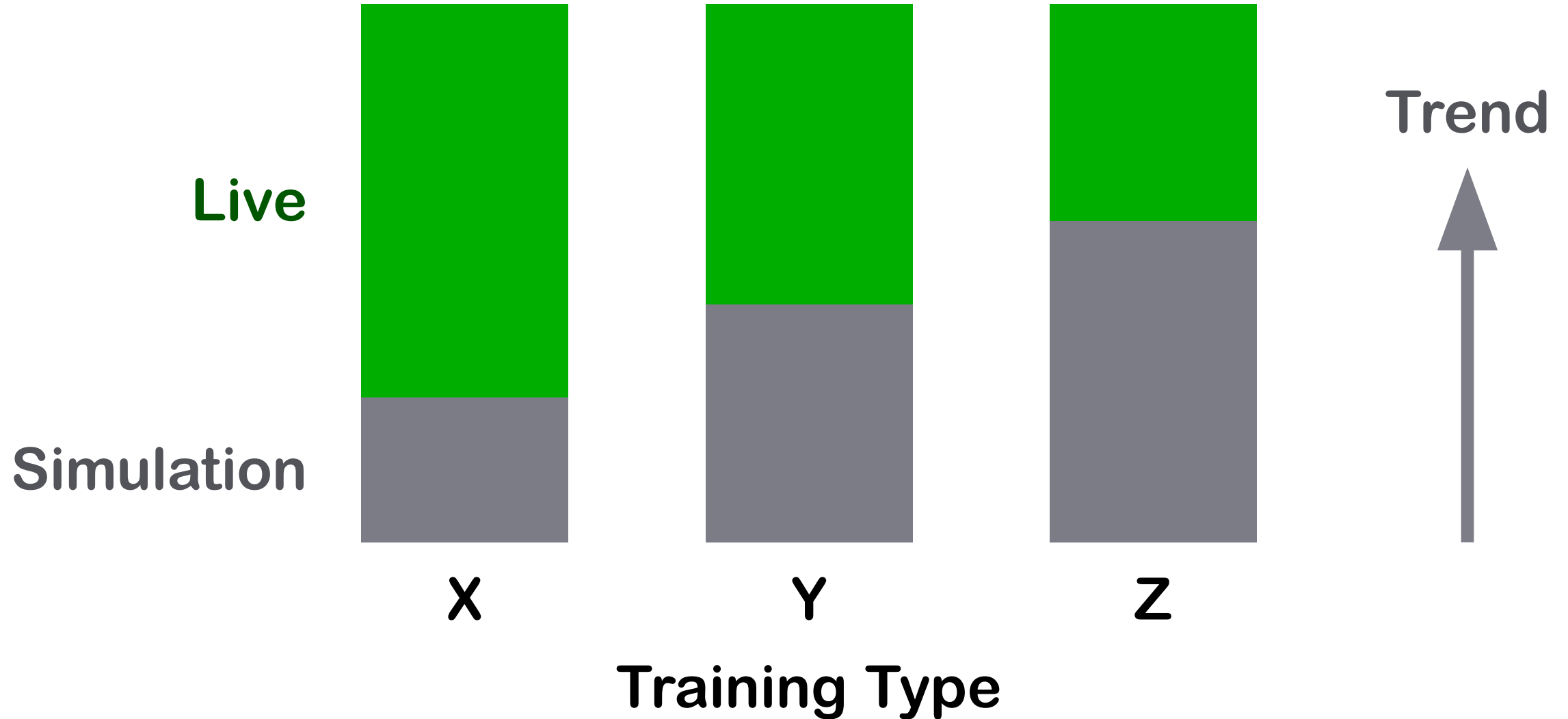
## One World Simulation, AI-Driven Entities



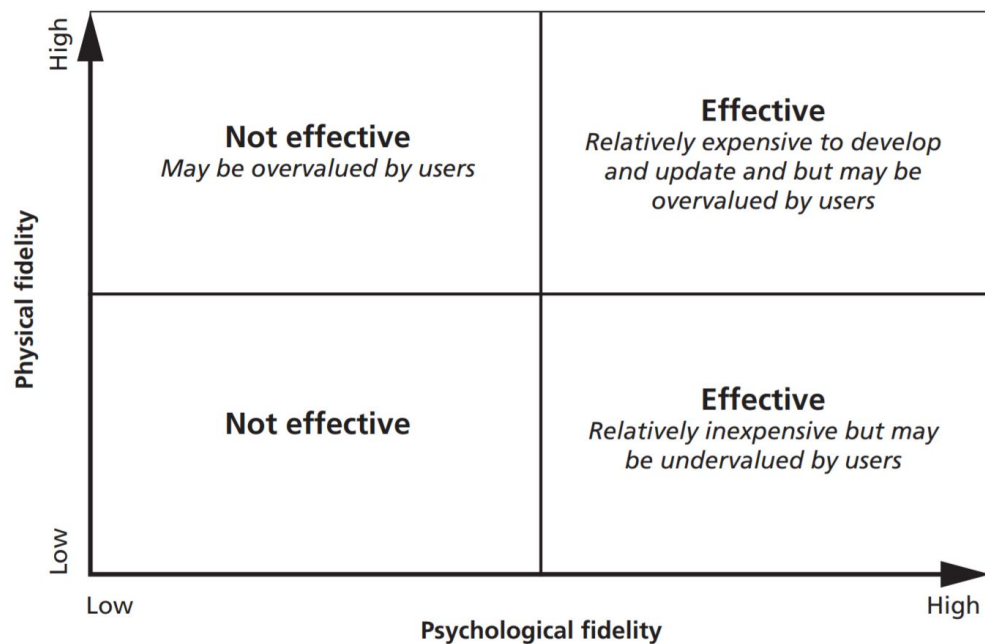
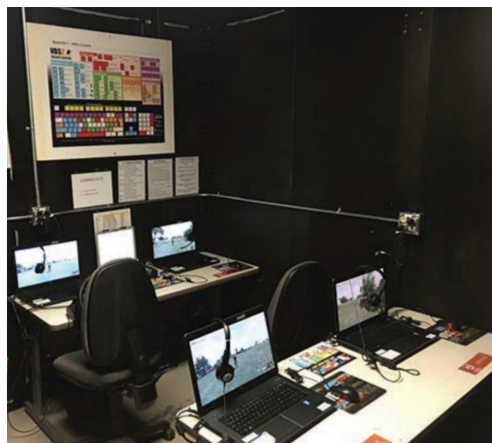
# Simulation Categories (LVC)



# Live & Simulation Based Training



# High Physical Fidelity?



## 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



# Maintaining Proficiency

How do we stay proficient?

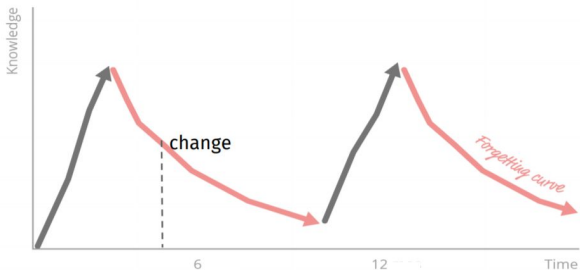
repetitive tasks?



on the job



How do we stay proficient?



How do we stay proficient?

non-repetitive tasks?

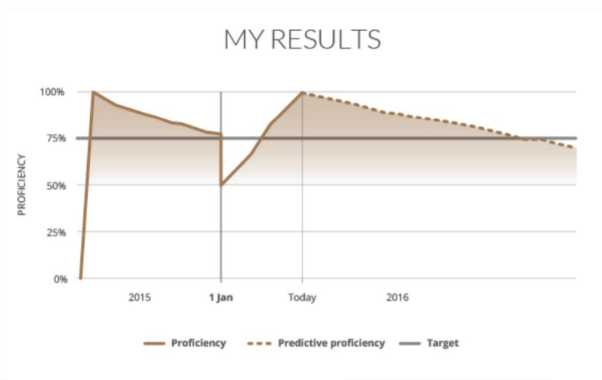


yearly recurrent exam  
simulator

....

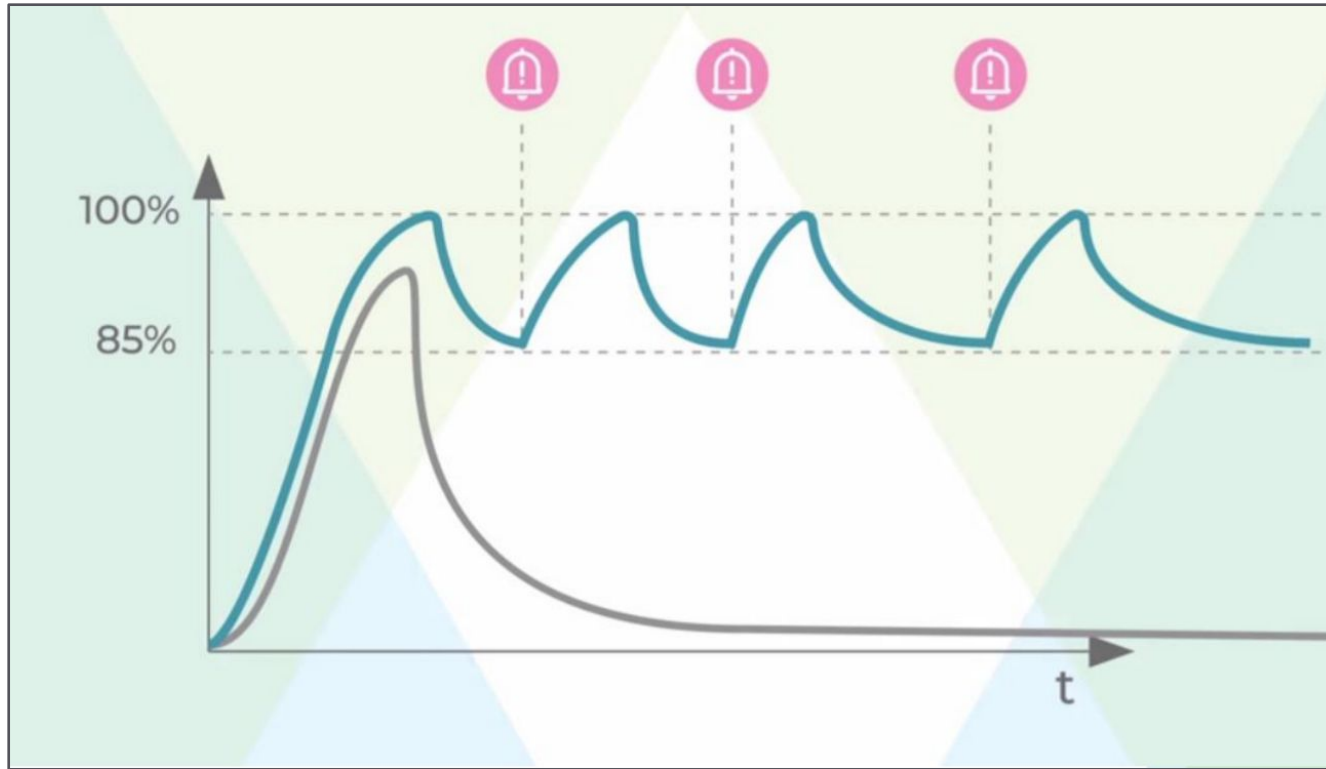


Manage change



drillster learning with you

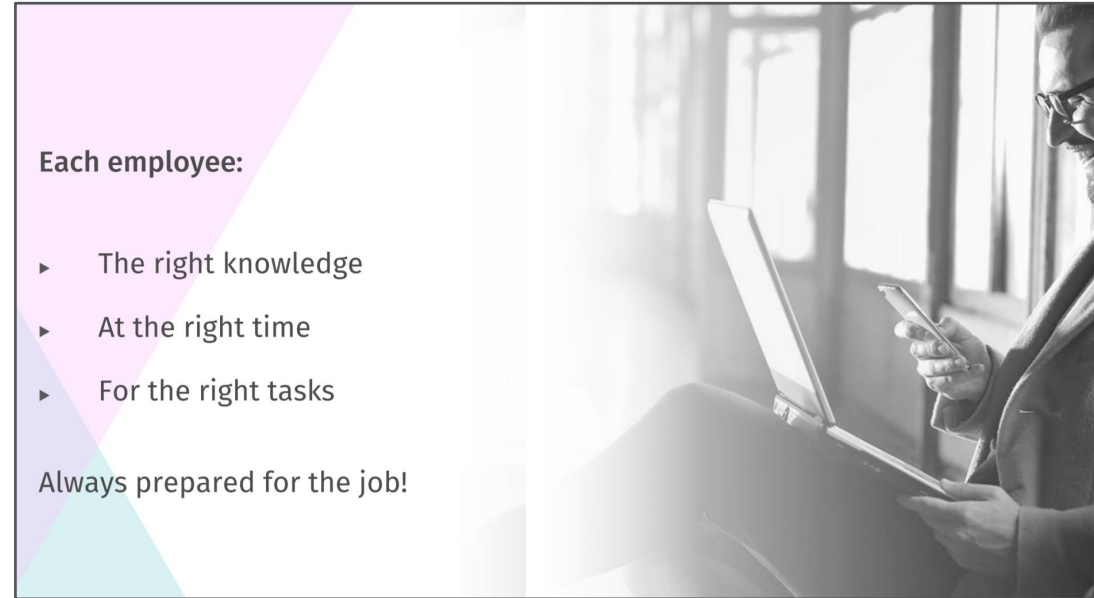
# Maintaining Proficiency



Each employee:

- ▶ The right knowledge
- ▶ At the right time
- ▶ For the right tasks

Always prepared for the job!



# SISO/US Army – ENGTAM Group

(Exploration of Next Generation Technology Applications to Modeling and Simulation)

- **Gaming Technology**
  - The games-derivative simulation software is already used in many areas of training and is extending into the image generator and mission rehearsal spaces.
- **Virtual Reality**
  - VR may find its way into a number of new applications in the military training space where immersion and physical space are significant or limiting factors.
- **Augmented Reality**
  - AR may become increasingly more prevalent in training as the technology becomes more robust and most probably making its way into the operational space too.
- **Cloud and Streaming**
  - Future simulation and other training and education services may be streamed across the enterprise over a private secure cloud and network.
- **Wearables/IoT**
  - In the military domain it will be possible to monitor and interact with all military people and equipment with value in both training and operations.
- **Big Data and Data Analytics**
  - The ability to monitor, record and learn from training data will be enhanced.
- **Artificial Intelligence**
  - AI will impact on operations but also training through improved AI in simulations and intelligent tutoring.

# Additional Realities

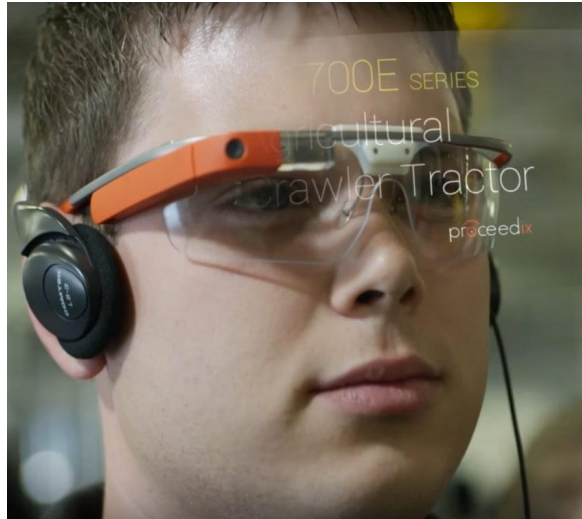
**Reality**

**The real world**



**Augmented Reality**

**Information layered over vision**



**Mixed Reality**

**Blend of real & digital information to enhance reality**



**Virtual Reality**

**Fully virtual world**



# Extended Realities?

# Philco Headset - 1961

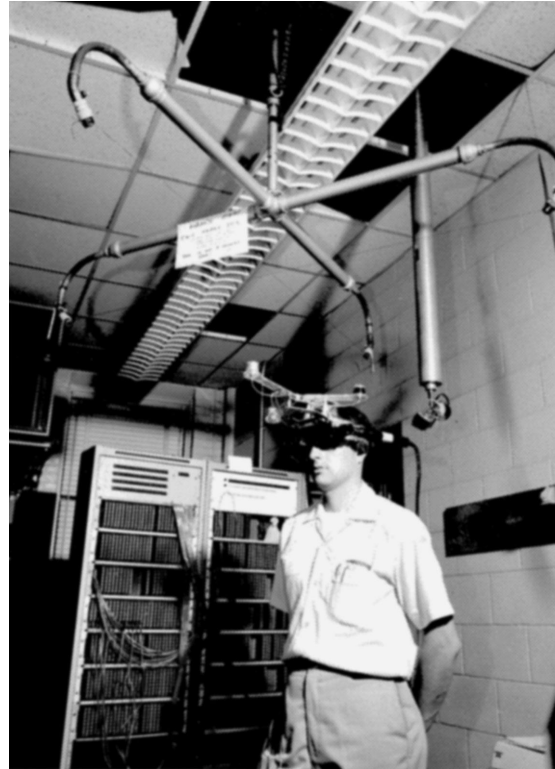
- The first motion tracking Head-Mounted Display (HMD)
- Built-in video screens for each eye and a head-tracking system
- Developed for the military to allow them to remotely look at hazardous situations
- A remote camera imitated the head movements so the user could look around the setting



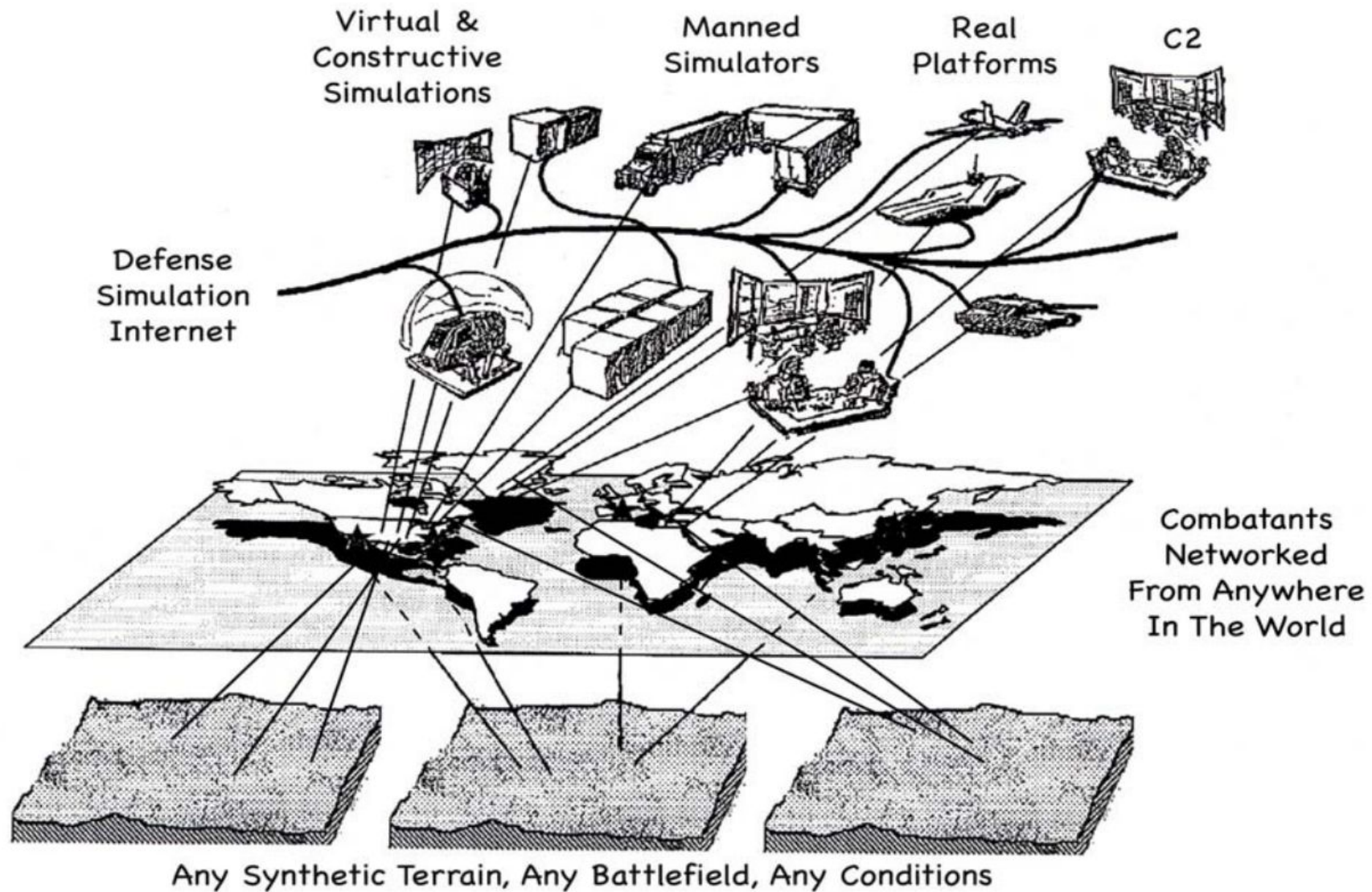
# The Sword of Damocles (VR) - 1968

## Ivan Sutherland - University of Utah

- The first VR HMD
- Connected to a computer rather than a camera
- Displayed a simple 3D virtual wire-frame shape, changing as the user moved their head



# 1980s SIMNET Distributed Simulation Concept



# SIMNET Tank Engagement (late 80s)



**Early 1990s**

**US Navy Virtual  
Environment for  
Submarine Ship Handling  
and Piloting Training  
(VESUB)**

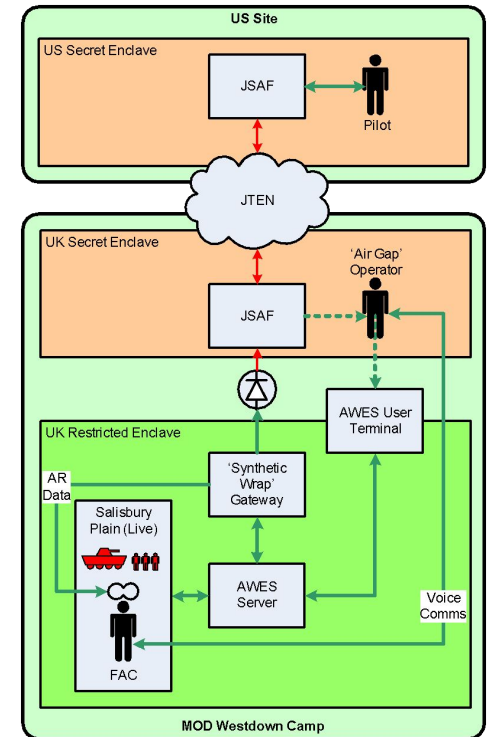


# UK Combined Arms Tactical Trainer (CATT) - 2002



# US/UK Augmented Reality – 2008

- US Pilot in Flight Simulator
- Transatlantic Connection
- UK Soldier on Salisbury Plain
- Soldier with Augmented Reality Sight
- Virtual Bombs landing on Real Terrain



Source: JTEN use case latest Final - SISO Discussion Forums

# UK Parachute Training - VR in Use (RAF Brize Norton - 2011)



# Oculus Rift DK1 2014

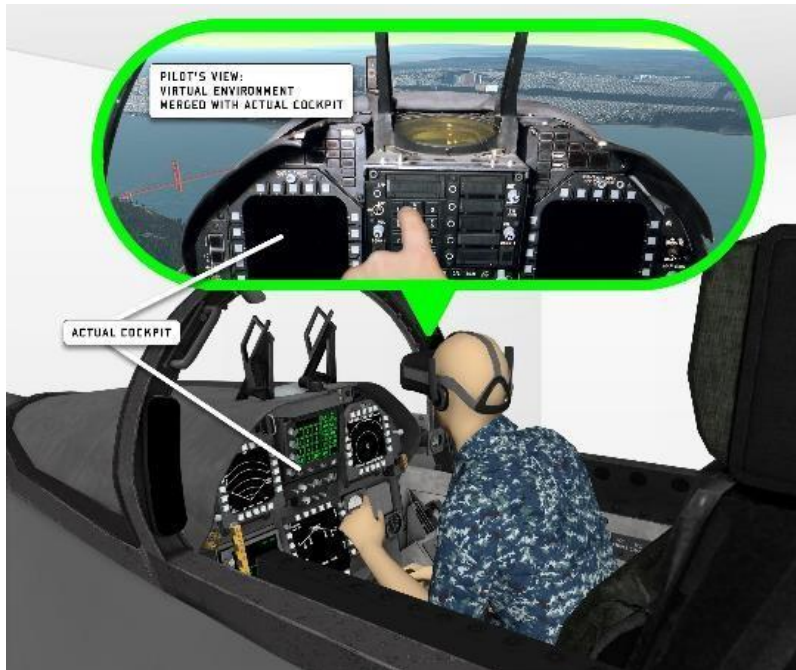
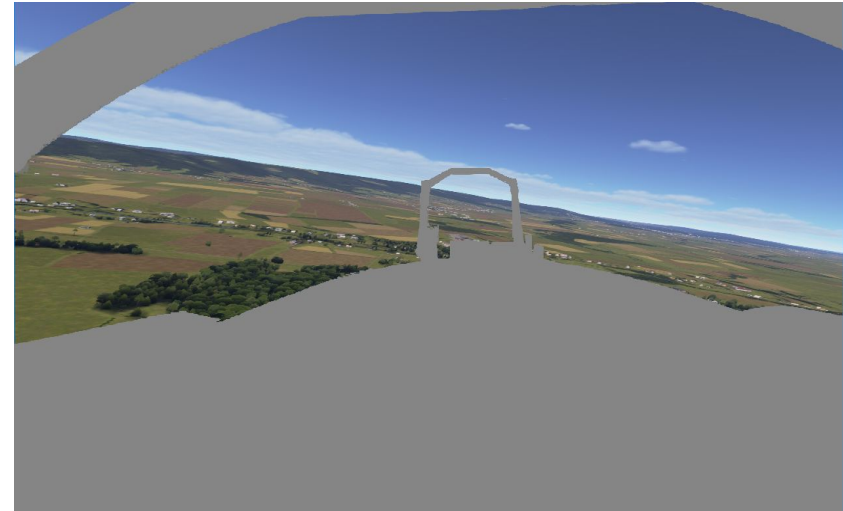


# Close Air Solutions (UK)

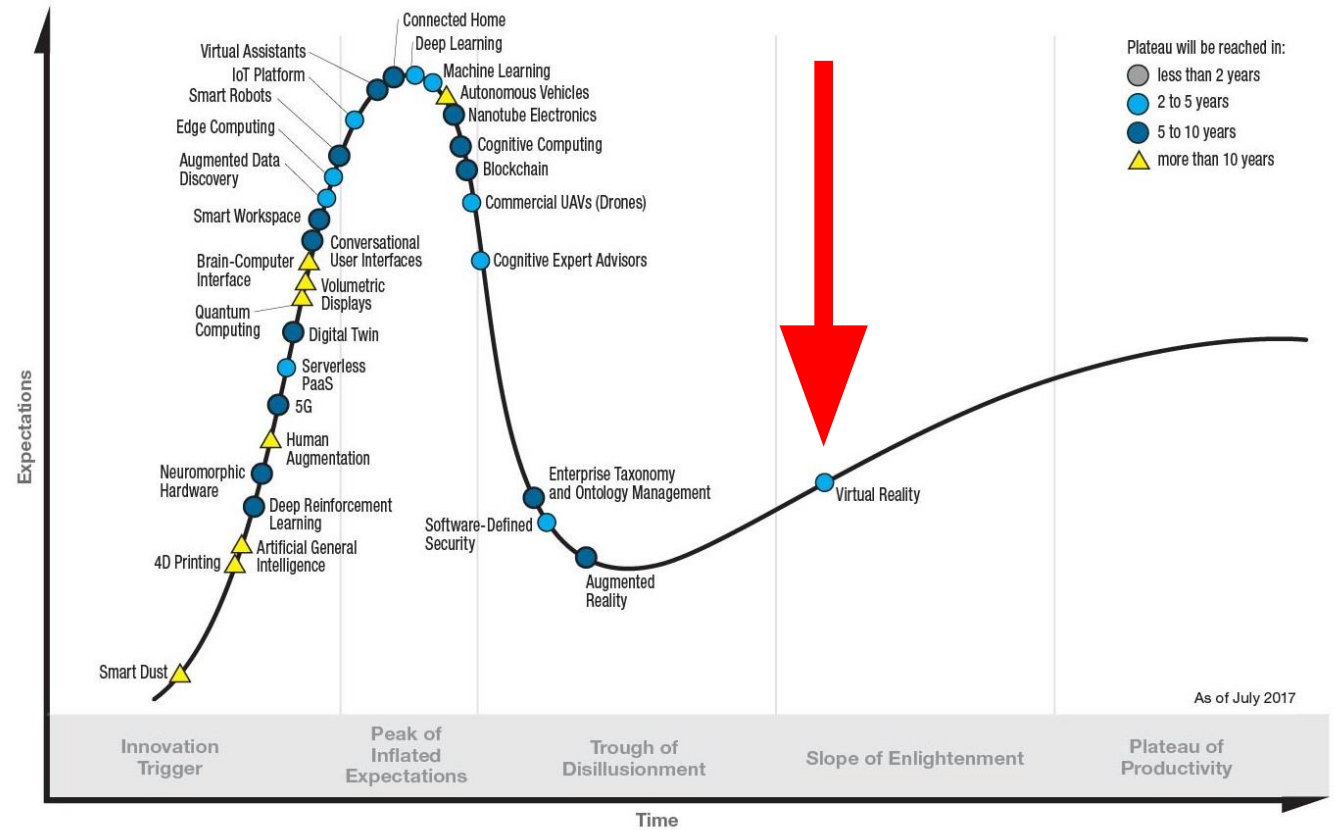
## Real + Virtual - Hyper Real Immersion – 2018



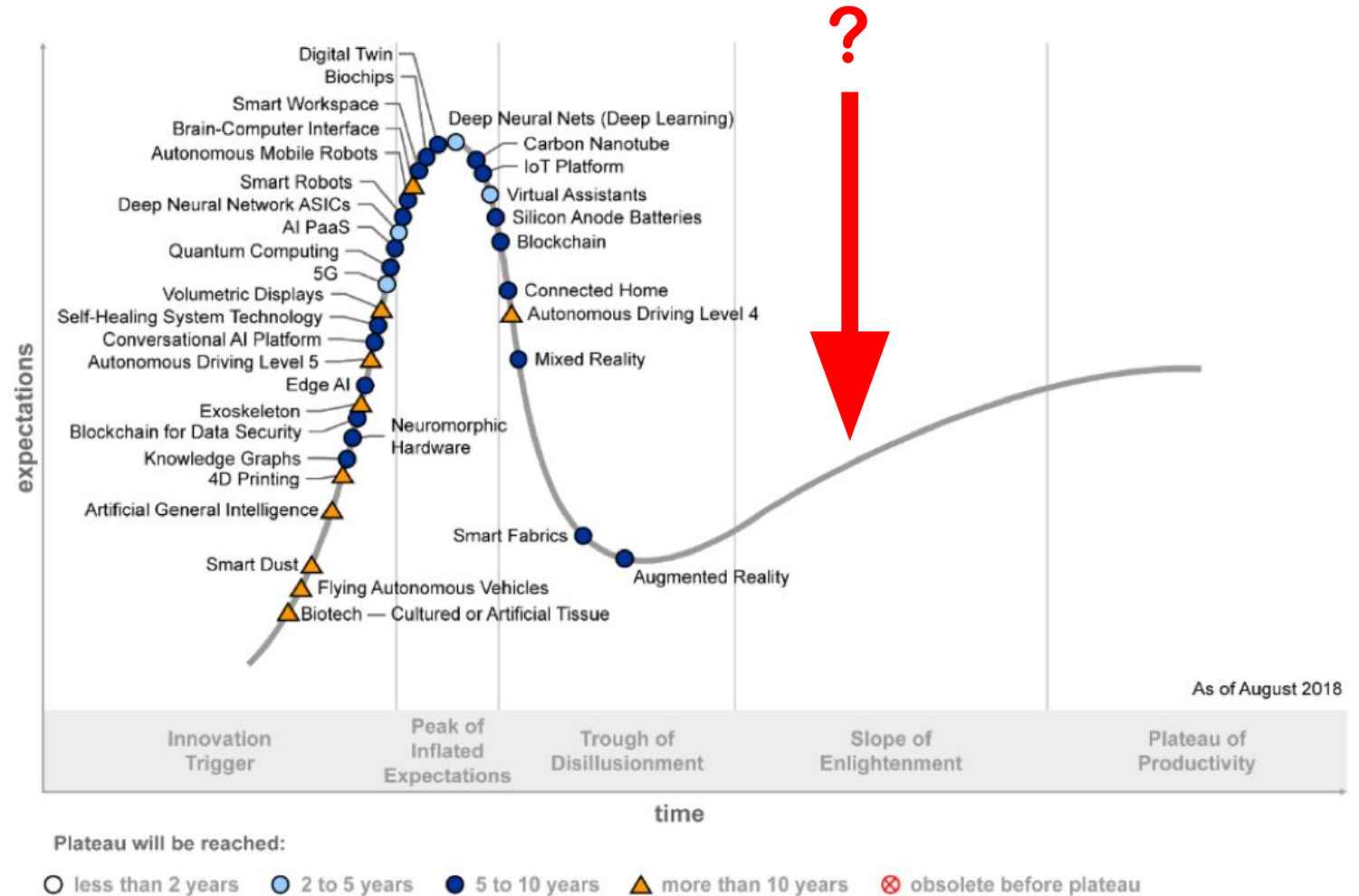
# Mixed Reality Visual System (MRVS) - 2018



# Gartner Hype Cycle 2017



# Gartner Hype Cycle 2018



As of August 2018

© 2018 Gartner, Inc.

# A VR Land Collective Training Pilot

# UK Virtual Reality in Land Training (VRLT) Pilot - 2019

The aim of the VRLT pilot is to identify the opportunities that Virtual Reality technology offers the Future Collective Training System



# VRLT Training Audience

- 3 x Warrior (3 Crew; 6 Dismounts)
- 1 x Challenger 2 (4 Crew)
- 1 x 105mm Light Gun + Fire Support Team

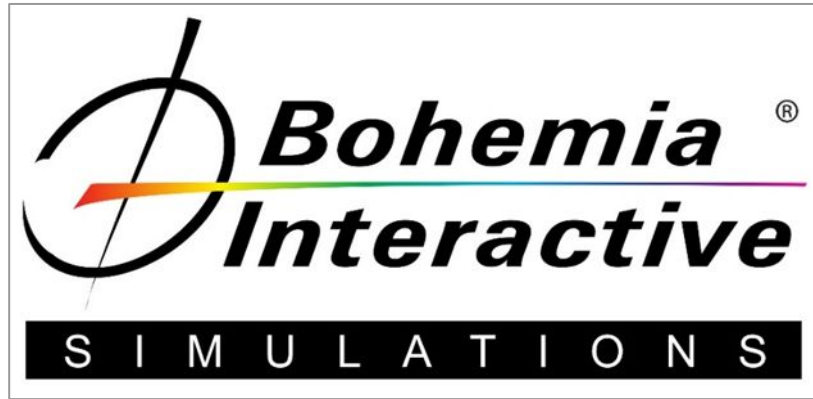


# VRLT Training Context

- Based on DATE (Decisive Action Training Environment)
- Collective Competency Objectives (CCO)
- Increasing Complexity
- Peer+ Enemy



# VRLT Contractor Team



# VRLT – The Video

**VIRTUAL REALITY  
IN LAND TRAINING**

# Some VRLT Innovations



# Some VRLT Innovations



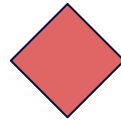
# VRLT Timeline

**Dec 18**



**Contract  
Award**

**Jan 19**

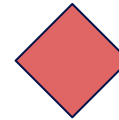


**Sprint 1**

18 Soldiers  
in VR

Oculus Rift, Vive,  
DVS/VBS3

**Feb 19**

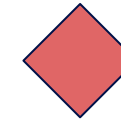


**Sprint 2**

36 Soldiers  
in VR

Oculus Rift, Haptics,  
Polystream Cloud,  
Training Data Cloud  
Capture, Unity,  
DVS/VBS3

**Mar 19**



**Sprint 3**

36 Soldiers  
in VR

OR, Vive, Mixed  
Reality, 105mm Gun  
Integration, Haptics,  
Unity, Polystream  
Cloud, Training Data  
Machine Learning,  
DVS/VBS3

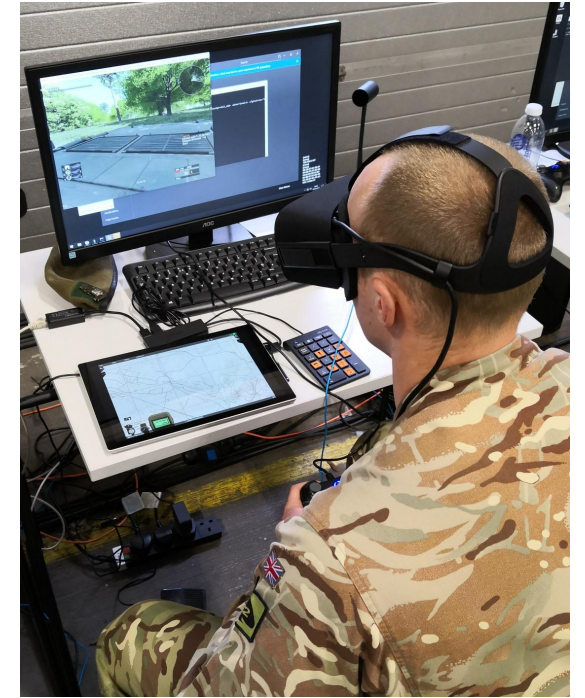
**April 19**



# VRLT Pilot Insights

- **Deployability**
  - to point of need and low physical footprint with COTS Software & Hardware
- **Flexibility**
  - to inject complexity and switch between configurations and scenarios and support individual and collective training
- **Scale and Time**
  - with ~40 users and ~100 deemed readily achievable for around 1 hour
- **Combined arms teamworking**
  - with dismounts alongside vehicles and other combined arms capabilities
- **Communication and coordination skills**
  - under pressure created through an immersive environment
- **Decision making and judgements**
  - in a high-intensity 'safe to fail' immersive 3D environment
- **Integration**
  - of federated simulations and training measurement and evaluation techniques
- **Wider utility**
  - through pre-briefing, rehearsal of concepts, briefing the plan, in-action review and after-action review

**In Virtual  
Simulation you  
look at the Virtual  
World, in VR you  
are in it**



# Thinking about Recruits

# Soldier of the Future?



- Who will they be?
- What will they do?
- Where will they be?
- How will they train?
- Will we need them?

# UK Army Age Distribution - 2018

51% ≤ 29 years old

and

85% ≤ 39

## UK REGULAR FORCES BY AGE

Full-time trained and untrained personnel, at 1 April 2018

|                    | Army<br>Service | Naval<br>Service | RAF<br>Service | All<br>services |
|--------------------|-----------------|------------------|----------------|-----------------|
| <b>Under 18-24</b> | <b>21,720</b>   | <b>7,440</b>     | <b>5,530</b>   | <b>34,710</b>   |
| Under 18           | 1,630           | 230              | 160            | 2,030           |
| 18-24              | 20,090          | 7,210            | 5,370          | 32,680          |
| <b>25-34</b>       | <b>34,770</b>   | <b>13,550</b>    | <b>13,220</b>  | <b>61,530</b>   |
| 25-29              | 19,250          | 7,540            | 6,830          | 33,610          |
| 30-34              | 15,520          | 6,010            | 6,390          | 27,920          |
| <b>35-44</b>       | <b>19,640</b>   | <b>7,490</b>     | <b>9,330</b>   | <b>36,470</b>   |
| 35-39              | 12,760          | 4,650            | 5,790          | 23,210          |
| 40-44              | 6,880           | 2,840            | 3,540          | 13,260          |
| <b>45 and over</b> | <b>4,970</b>    | <b>4,010</b>     | <b>4,860</b>   | <b>13,850</b>   |
| 45-49              | 3,270           | 2,360            | 2,790          | 8,420           |
| 50-54              | 1,510           | 1,390            | 1,740          | 4,640           |
| 55-59              | 190             | 250              | 330            | 770             |
| 60 and over        | ~               | 10               | ~              | 20              |



# “Digital Native”

generally considered a person born in the 1980s and after growing up in the digital age with day to day access to computers, games, Internet, etc.

**Broadly, 2/3<sup>rds</sup> of the Army are now Digital Natives and 95% by 2030**

# What's Next?



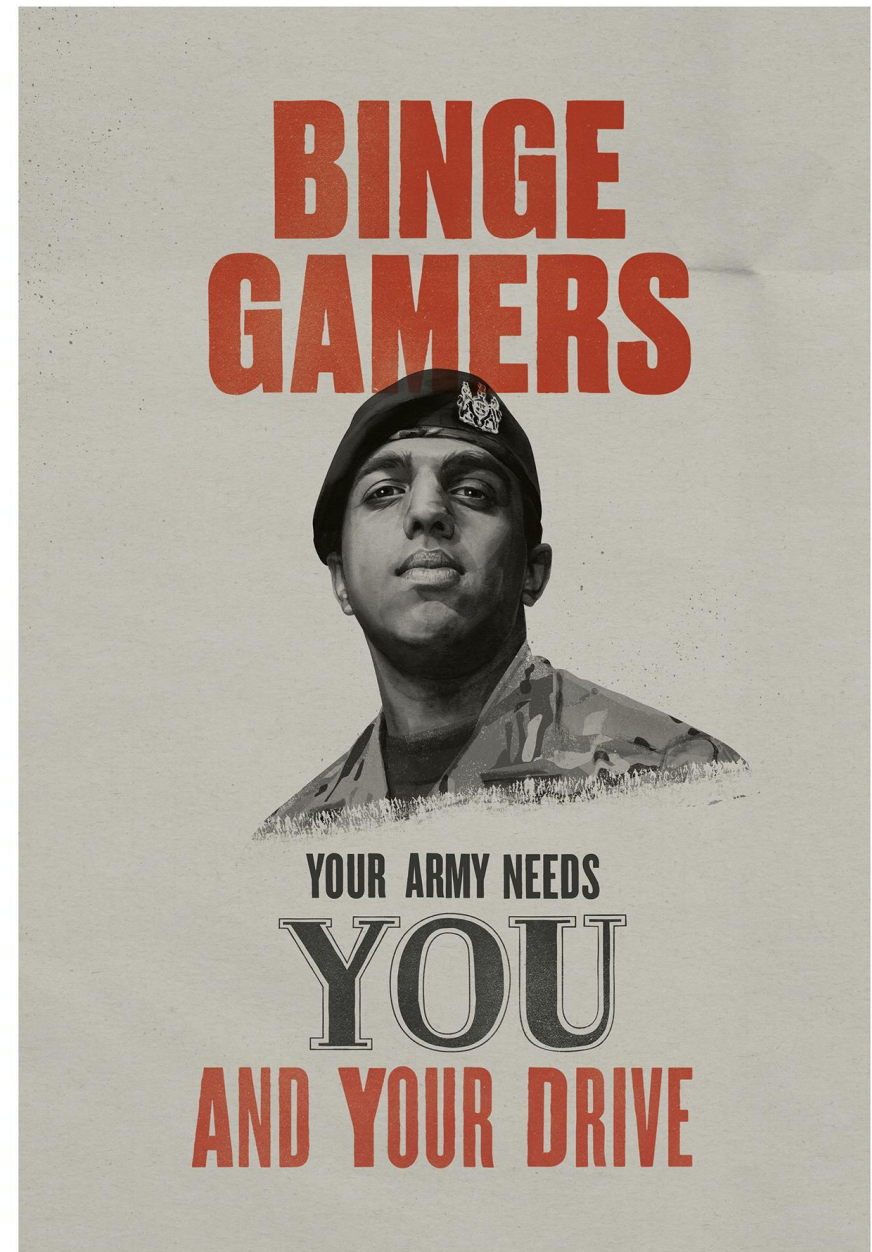
**Digital Native**



**AI Native?**

**UK Children aged 12 to  
15 spend 12.2 hours a  
week gaming in 2017**

**and 11 to 64 year-olds  
8.9 hours**



FIND WHERE YOU BELONG

SEARCH **ARMY JOBS**



# Air Chief Marshal Sir Stephen Hillier Jan 18

“teenagers playing on  
their Xbox at home  
should take their gaming  
to the next level and join  
the RAF to operate real  
drones”

MailOnline

News

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## Join the RAF for the real thing, Xbox teenagers are told: Head of the air force says young gamers should take it to the next level by operating drones

- Air Chief Marshal Sir Stephen Hillier wants more young people to join the RAF
- The service will be celebrating their 100th anniversary with events this year
- Among the major events planned is a flypast along the Mall before the Queen
- RAF chiefs hope a display of military might could provide a boost to recruitment

By LARISA BROWN FOR THE DAILY MAIL

PUBLISHED: 00:32, 12 January 2018 | UPDATED: 00:53, 12 January 2018



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Teenagers playing on their Xbox at home should take their gaming to the next level and join the RAF to operate real drones, the head of the air force said yesterday.

Air Chief Marshal Sir Stephen Hillier said the RAF's next 100 years will see a huge shift towards unmanned flying machines as he outlined plans for centenary celebrations.

# Speak to the Young

The Ally Bank logo is centered on a light gray background. It features the word "ally" in a lowercase, rounded, sans-serif font, with the "y" having a small tail. To the right of "ally" is the word "BANK." in a smaller, uppercase, sans-serif font. The entire logo is rendered in a light purple or lavender color.

**And Finally..**

# Why Join the Army? (2016)



**HOW FAR CAN DRIVING  
TAKE YOU IN THE ARMY?**  
TANK CREW



Questions?



SIMNET M1 tank simulator - 1986