



From SIMNET to the Metaverse

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Why is it taking so long?

Andy Fawkes | IT2EC | Rotterdam | 25 April 2023



**From SIMNET to the
Metaverse**

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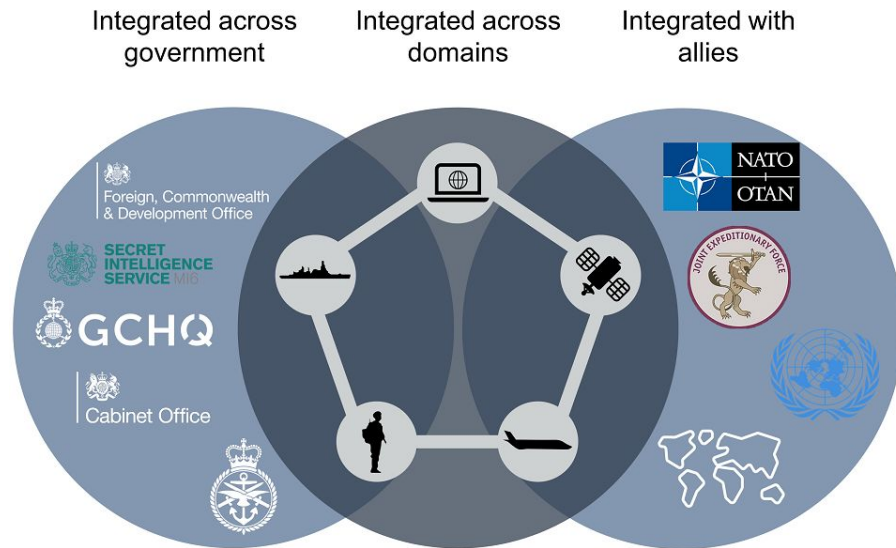
Why is it taking so long?

Outline

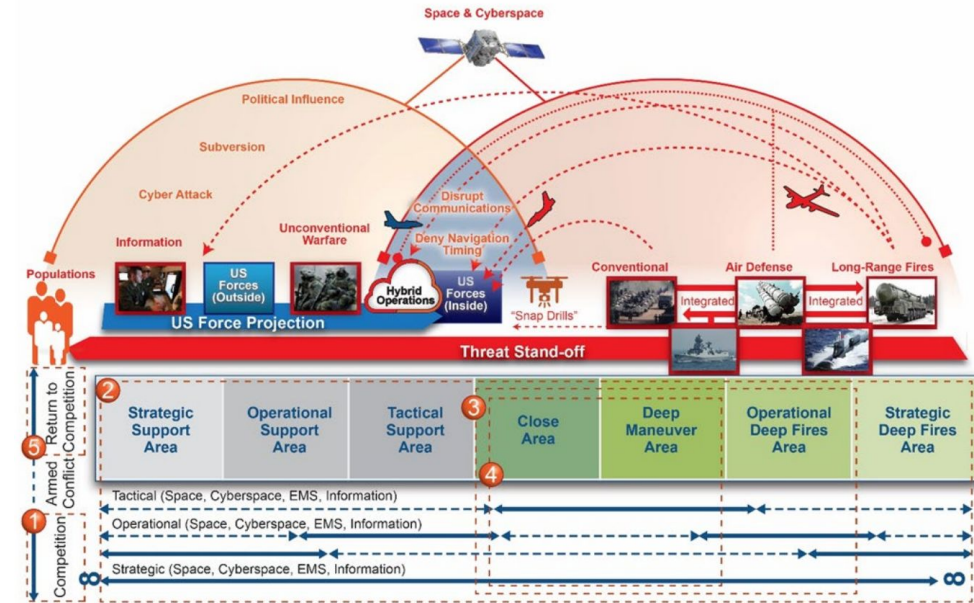
- **The Requirement**
- **SIMNET & beyond**
- **The Military Metaverse**
- **Why is it taking so long and what might we do better?**

The Requirement

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



UK Multi-Domain Integration Guidance - Jan 22



The U.S. Army in Multi-Domain Operations 2028 - Feb 21

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

SIMNET & Beyond

USAF Capt Jack Thorpe's White Paper (1978)



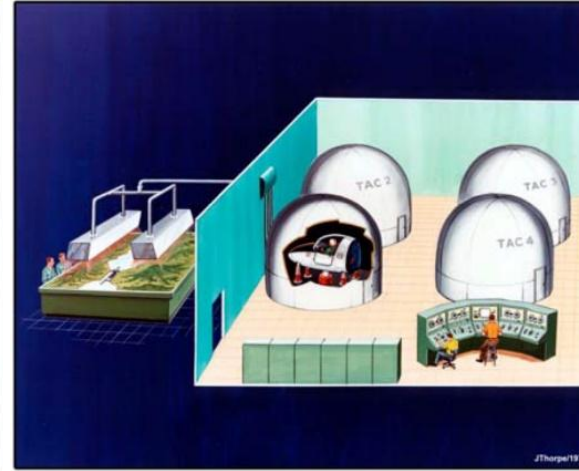
1

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

DARPA
(Cybernetics
Technology
Office)

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J. Dextor
Fletcher

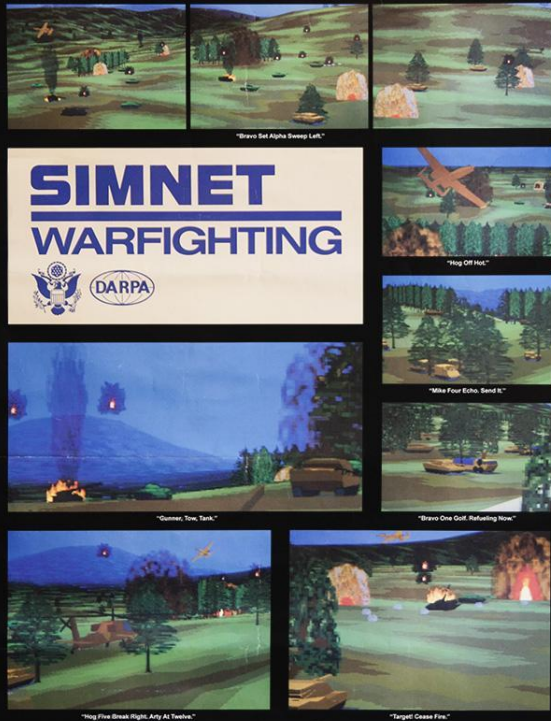
(1977-1980)

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**

SIMNET (SIMulator NETworking)

1983-1990



- **Cost** was a driving factor of the **SIMNET** programme and hence the degree of fidelity that could be provided.
- **Only the controls and displays necessary to train for the task and to allow tactical team training involving many soldiers were provided.**
- Part of the design process was the so-called “**60% Solution**” whereby prototypes were rapidly fabricated so that soldiers could see and touch and provide feedback and this led to rapid iterations of design, manifested as cheap foam core and plywood mock-ups.
- **SIMNET** marked a shift in simulator design from an engineering or physical reproduction approach to manipulating "brain state" and relying more on human factors analysis.
- Incrementally developed over the 1983-1990 period, **SIMNET** became a network of 260 simulators at 11 sites in the **USA** and **Europe** including tank and aircraft simulators and was made operational by the **US Army** in **January 1990**.

**SIMNET MI
Tank
Simulator
1986**

-

**Targeted
Fidelity**



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



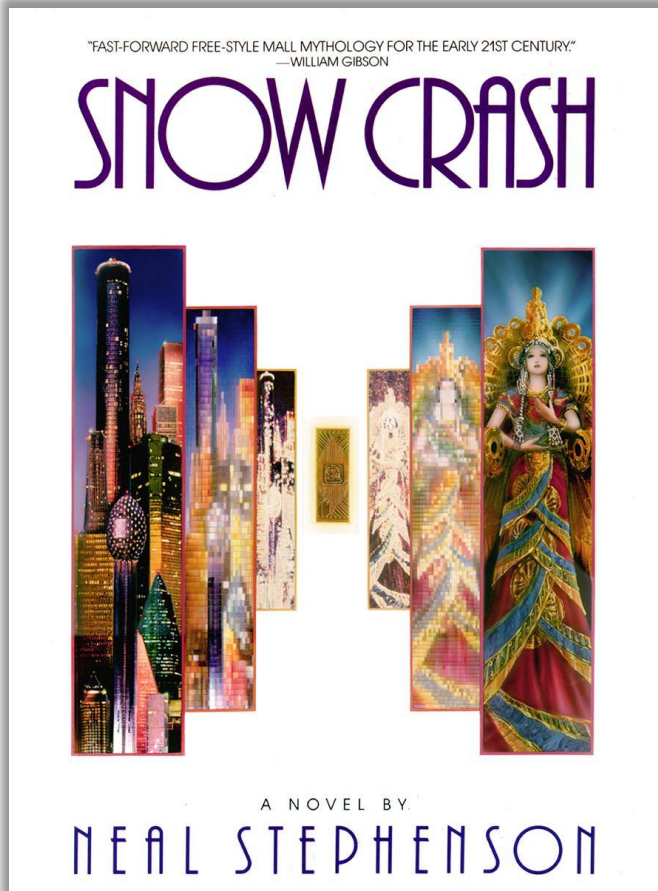
“Network simulation is a technology that elevates and strengthens the collective problem-solving abilities of human beings.

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 war fighting 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.”

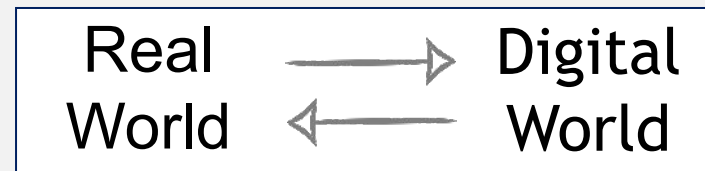
Also in 1992 ...



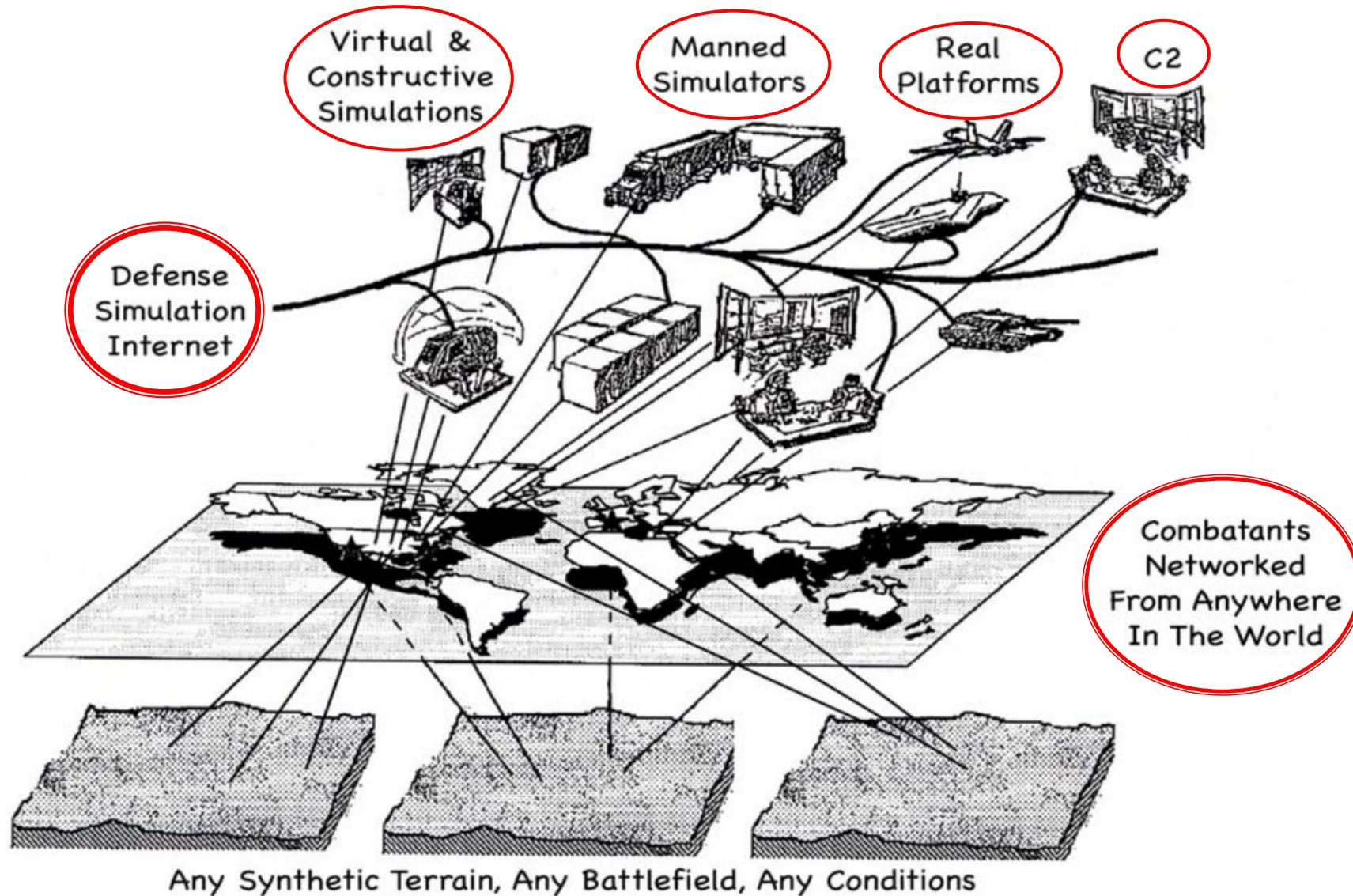
**Neal Stephenson creates the word
“Metaverse”**

**a portmanteau of "meta" (beyond) and
“universe”**

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



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



US Synthetic Theater of War (STOW)

- Running from 1992 to the late 90s, the **STOW** exercises help to develop further the **SIMNET** concept and technologies and also introduced allies such as the **UK**, but no permanent capability was left behind.

Distributed Mission Operations (DMO)

- Initially developed by the **USAF** in the early 2000s, it is a distributed network of geographically separated systems to simulate a distributed air combat training environment. Although it has joint capabilities it is not clear to what extent they are used by other services.

US Joint National Training Capability (JNTC)

- **JNTC** was designed to provide an integrated, cross-agency training and education platform and in operation from 2009 to 2016, but appears now to be an approval body rather than a training capability.

US Army Synthetic Training Environment (STE)

- The **US Army Synthetic Training Environment (STE)** is a virtual training environment designed to simulate a variety of battlefield environments and a platform for commanders to design and conduct joint exercises.

Exercise Viking

- This Swedish-led exercise is designed to prepare civilians, military and police together for deployment to a peace or crisis response mission area.

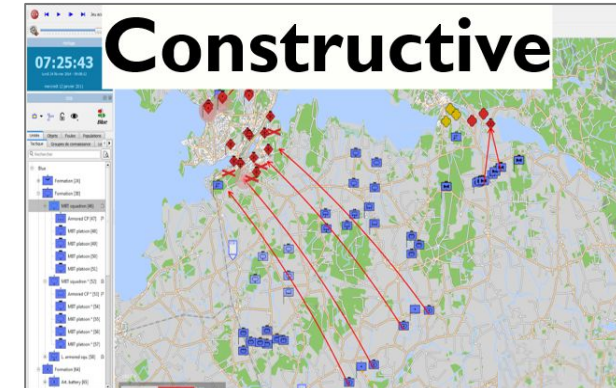
NATO Education and Training Network (NETN)

- Instigated in 2006, **NETN** aims to deliver a persistent, distributed and joint training capability but it is not clear if persistent capabilities have been deployed.



The Military Metaverse

Military Metaverse



**Computing
Hardware**

Software

**Networking
& Security**

**Human-Co
mputing
Interfaces**

**Data &
Digital
Twins**

**AI, Data &
Analytics**

**Automation
& Robotics**

It's Bringing Everything Together that Matters Most

Metaverse v Military Metaverse Features Mapping

Matthew Ball	Jon Radoff	Lik-Hang Lee et al	Newzoo	Roblox	Microsoft	Nvidia		Military Metaverse
Hardware		Network	Gateways - Centralised	Identity	Mesh & HoloLens	Omniverse Apps		Discovery
Networking	Experience	Edge/Cloud	Gateways - Decentralised	Friends	Azure AI & Autonomous Systems	Omniverse Platform		User Interfaces & Immersion
Compute	Discovery	Artificial Intelligence	Avatar & Identity	Immersive	Power Platform	Artificial Intelligence		Robotics/Sensors/IoT
Virtual Platforms	Creator Economy	Computer Vision	User Interfaces & Immersion	Low Friction	Azure Analytics	Graphics		Data & Digital Twins
Interchange Tools and Standards	Spatial Computing	Blockchain	Economy	Variety	Azure Maps	Compute		Virtual Economy
Payments	De-centralization	Robotics/IoT	Social	Anywhere	Azure Digital Twins	RTX GPU		Content, Services, & Assets
Metaverse Content, Services, & Assets	Human Interface	User Interactivity	Cloud, Scalability & Hosting	Economy	Azure IoT			AI & Computer Vision
User Behaviours	Infrastructure	Extended Reality	Play-to-Earn/Collect	Civility	Physical World			Interchange Tools & Standards
		Avatar	Visualisation & Digital Twin					Network
		Content Creation	Artificial Intelligence					Edge/Cloud
		Virtual Economy	Decentralised Infrastructure					Security, Privacy & Culture
		Social Acceptability	Adtech					Procurement
		Security & Privacy	Connectivity					
		Trust & Acceptability						

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.

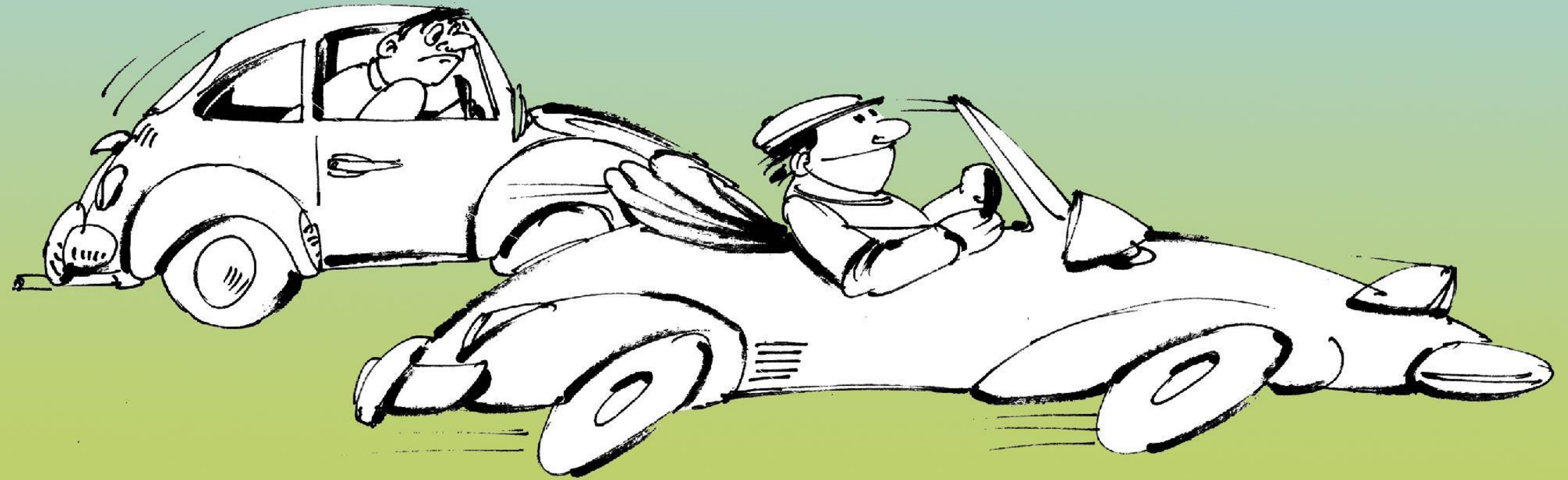
The real world is three-dimensional, and increasingly the digital world will be too.



Wake Up!



Everyone is Doing Networked LVC Now



A Military Metaverse?



“Persistent secure networked interoperable live, virtual and constructive simulations, synchronized with multi-domain operational systems and enterprise-wide digital twins of equipments, platforms, infrastructure, and personnel and the wider human and natural world.”

MILITARY METAVERSE

aka
**Persistent
Secure
Networked
Distributed
LVC Simulation**



SYSTEMS INTEGRATORS & SERVICE PROVIDERS

SYNTHETIC DATA & SIMREADY 3D ASSETS

DIGITAL TWINS

ROBOTICS

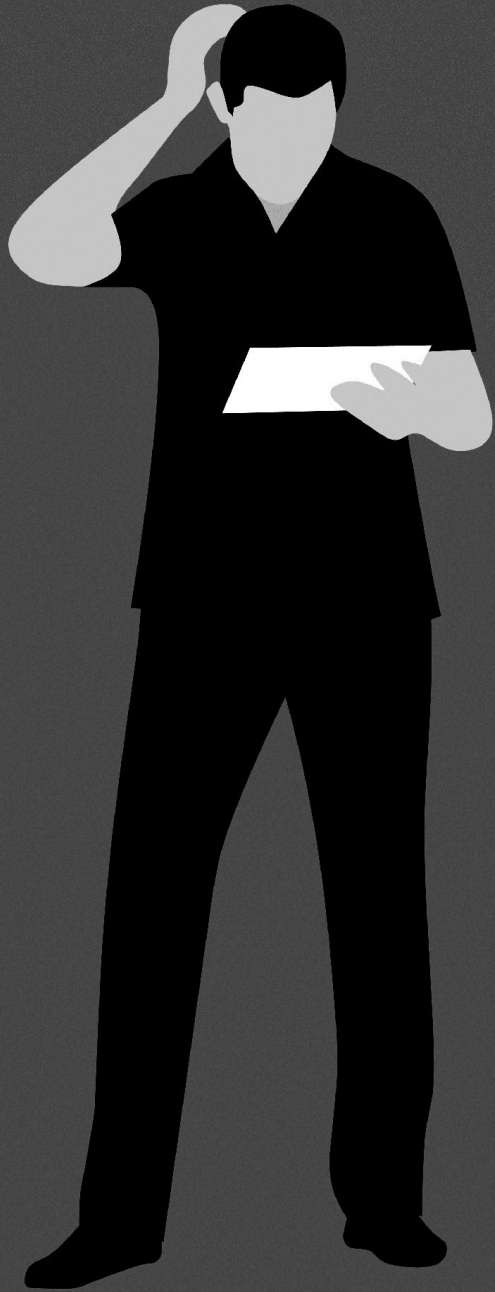
DESIGN & ENGINEERING

SENSOR MODELS

SYSTEMS MANUFACTURERS

CONTENT CREATION & RENDERING





**Why is it taking so
long and what
might we do better?**

Why is it taking so long?

- There is a need for **persistent multi-domain** distributed networked simulation.
- It has been successfully **demonstrated** technically since the 1980s.
- There has been **very rapid** digital technology advances over this period.
- Sustained effort has been applied to **simulation standards**.
- Militaries across the world have struggled to put in place **persistent** multi-domain distributed simulation infrastructure.
- With the **demand there**, and the **supply also there**, why is it taking so long?

A “Wicked Problem”?



adapted from: *Dilemmas in a General Theory of Planning*
Horst W.J. Rittel and Melvin M. Webber (*Policy Sciences*, June 1973)

“Wicked Problem” Strategies (Sanders)

Authoritative

These seek to tame wicked problems by vesting the responsibility for solving the problems in the hands of a few people.

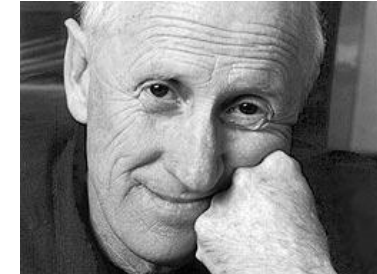
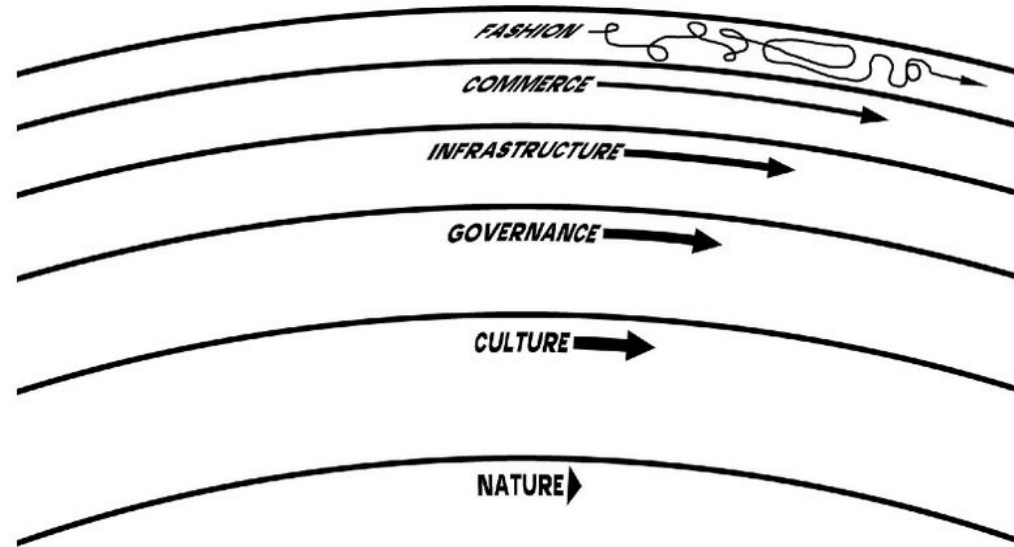
Competitive

These attempt to solve wicked problems by pitting opposing points of view against each other, requiring parties that hold these views to come up with their preferred solutions.

Collaborative

These aim to engage all stakeholders in order to find the best possible solution for all stakeholders.

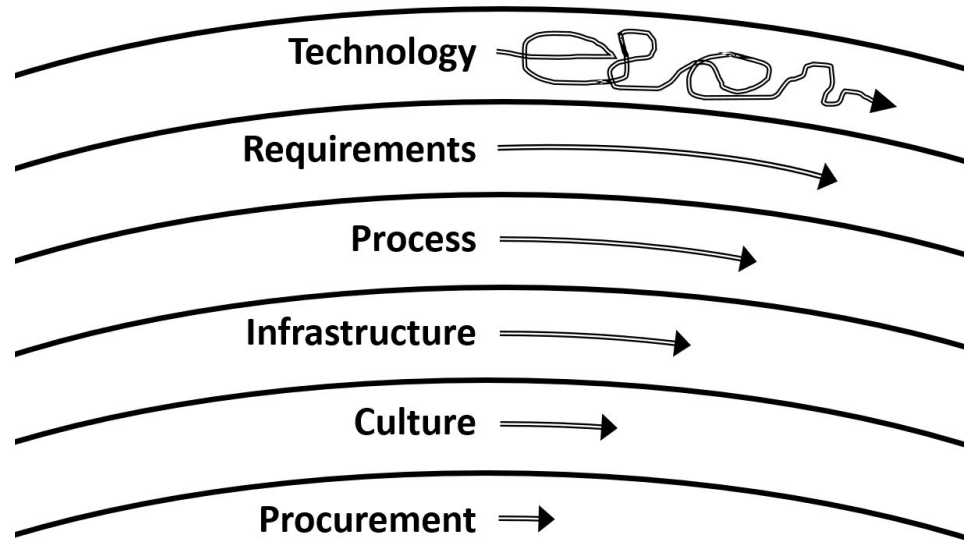
Stewart Brand's Pace Layering (as applied to Civilization) (1999)



“fast gets all our attention,
slow has all the power”

**Pace
Layering?**

Applied to Persistent Distributed Networked Simulation (?)



Way Forward?

- a) The military S&T community could be a **learning community** and build on the past, not repeat it, and continually **experiment!**
- b) The requirements for an **affordable enterprise-based persistent multi-domain distributed networked LVC simulation system** could be revisited and captured, based on the **necessary fidelity**, and flow down/across to all individual simulation projects.
- c) Metaverse technologies and approaches are developing at pace and could be considered as an **opportunity to consider M&S on an enterprise-wide basis**, including in support of training.
- d) Multi-domain networked distributed training is a “wicked problem” and could be addressed as such through both an **authoritative requirement supported by a collaborative competitive effort**.
- e) The tensions across an organisation and its relationship to technology and requirements could be **recognised and accommodated**.

Questions ?



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Next Generation Simulation

From SIMNET to the Metaverse – Why is it taking so long?

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Think Company Limited

Abstract - In 1978, US Air Force Captain Jack Thorpe proposed a network of simulators for combat planning and execution, and this concept was later developed by DARPA in the 1980s as SIMNET (SIMulator NETworking). SIMNET eventually included 260 simulators at 11 sites in the USA and Europe including tank and aircraft simulators, and connected to a real warship and command centres in the early 1990s. Today, there is renewed interest in creating multi-domain simulation capabilities, but it is unclear if any nation has succeeded in building a persistent system similar to SIMNET that integrates live, virtual, and constructive simulations across the whole defence enterprise. The trend towards the 'metaverse' may offer an opportunity for the defence sector to establish an enterprise-wide simulation infrastructure that exploits the wider trends in the metaverse and computing. This paper will examine past initiatives to build multi-domain simulation capabilities and consider the issues that may have hindered progress, and then offer a vision for the defence sector to fully realize Thorpe's 45-year-old idea through an integrated enterprise approach to networked simulation in support of all defence activities.

1 Introduction and Approach

Exploiting networked distributed simulation in support of multi-domain training has been an aspiration since the 1970s, but although it has been demonstrated many times it remains an aspiration as a truly multi-domain persistent capability. This paper aims to provide an historical perspective on this challenge drawing on open-source research, research carried out for the UK Dstl, and the author's 25 years' experience in simulation technology and application. As a complex topic, no definitive solution has been proposed, rather it is a think piece for the military simulation and training community.

2 Why multi-domain networked training?

2.1 Why networked training?

Networked simulation-based training allows multiple people, sometimes in multiple locations, to interact with each other and a simulated environment in real-time. As a capability, NATO describes it as "a persistent, distributed and joint training capability able to support training from operational to tactical level across the full spectrum of operations" [1]. This type of training enables teams and teams of teams to be immersed in a variety of scenarios in a safe and controlled environment and experience situations that they may not be able to experience in the real world. If distributed, the training requires less travel time and opens up new training opportunities with less environmental impact and with more flexibility. Further, for urgent joint or coalition training, units can practice on a networked training system before actual missions, rather than for the first time facing the enemy.

2.2 Why multi-domain?

Beyond joint and coalition training, the concept of Multi-Domain Operations [2] (MDO) or Multi-Domain Integration [3] (MDI) point to every part of defence

working as one to deliver a desired outcome. The multi-domain is important to defence for several reasons [4]: New grey zone threats that are complex, fast moving and occur frequently; the battlespace is broader and more complex than ever before with space and cyber domains increasingly prevalent; there has been an exponential explosion of data; and conflict is increasingly a competition for what people think. Ultimately, the multi-domain concept extends the range of capabilities available to decision makers, ensuring that any combination works together, and selecting the most appropriate ones to create and exploit vulnerabilities in adversaries. Supporting the training for such operations can be ideally suited to networked distributed simulation with its flexibility and cost effectiveness, but only if it is available on a timely persistent basis.

3 SIMNET and its accomplishments

3.1 SIMNET origins and convergence

Although SIMNET was a 1980s programme, its origins arose from a convergence of training challenges, people, technology, and organisational priorities in the late 1970s. In 1978, the then-Captain Jack A. Thorpe was at the Air Force Office of Scientific Research, where he authored "Future Views: Aircrew Training 1980-2000", a white paper that proposed a network of simulators for combat mission planning, rehearsal, and execution [5]. Thorpe considered affordability as a core requirement for such a system as a single simulator then would cost over \$35 million, roughly the price of two fighter aircraft [6]. He had the view that flight simulators should not be substitutes for aircraft, rather they should augment them and be used to train air-combat skills that pilots could not learn in peacetime flying and trained with simulators in large-scale battle-engagement interactions. Meanwhile, DARPA employee J. Dexter Fletcher had come to similar conclusions, but for tank gunnery training, where both live training and traditional simulators (\$18m) were high cost.

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