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EW, Air Combat Training/LVC, Unmanned Systems,
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Live – Virtual – Constructive (LVC) Training

What Is It?
Why Does the LIVE Component Remain Critical?
What Challenges Are Faced in a Multinational Environment?

My Background – Why Am I Talking About This?

Flew much of career, but with limited simulators and open air threat emitters

My Background – Why Am I Talking About This?

If you recall my presentation in Sweden in 2019 THIS is what I trained against ….

Training systems when I started flying reconnaissance in late 1983 were NOT exactly robust

- One approved route to/on range due to airspace restrictions (EM, physical, etc)
- Two threats
  - SA-2 (both freqs)
  - SA-3
- Halfway through training the SA-2 freq #2 goes down for maintenance

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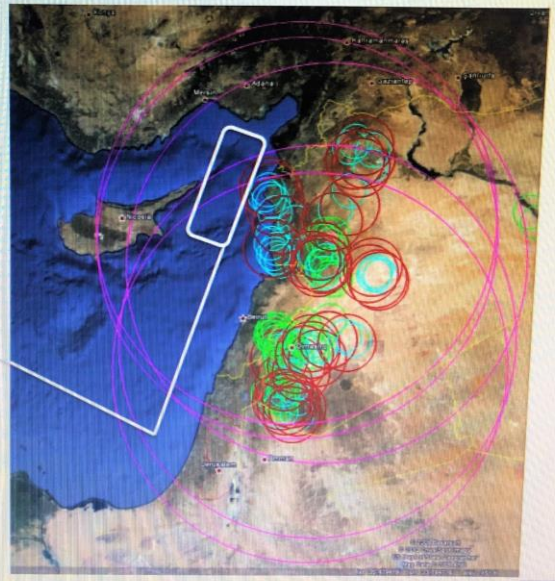
My Background – Why Am I Talking About This?

And THIS is what I faced on my first deployment just months later….

My first DEPLOYMENT was in early 1984 – providing targeting for Battleship fire in support of US Marines in Beirut

- Threat laydown shown is SAM only – fighters provided additional threats!
- Threats at the time that could (potentially) reach me included
  - SA-2
  - SA-3
  - And the "deathstar of the day" the SA-5



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My Background – Why Am I Talking About This?

Again, was I prepared?

Better than nothing, but limited prep for combat on first deployment!

My Background – Why Am I Talking About This?

Last Air Force assignment (early 2000s) was V&V and operational certification of aircraft simulators which INCLUDED distributed training – the earliest stages of LVC

Since then worked in industry on very advanced EW systems, aircraft, ACMI, and advanced threat simulators

And since 2019 I have been consulting on ACT advancements, LVC, and range modernization with several allied nations

LVC – What is it?

LVC – What is it?

What are the total number of definitions of LVC?

d

LVC – What is it?

How many people are here today?

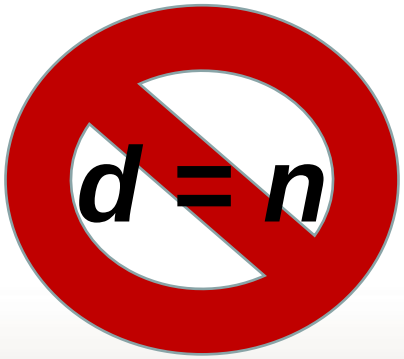
n

LVC – What is it?

$$d = n\ ?$$

LVC – What is it?

But experience has PROVEN that each person has MORE than one definition



LVC – What is it?

But experience has PROVEN that each person has MORE than one definition

THEREFORE ….

LVC – What is it?

d = n (~16.5411355609)*

(+/- 14)

(Hey… I'm an aviator with a communications degree…)

LVC – What is it?

MOST will be aligned conceptually, but when you come to SPECIFICS there are as many (or more) definitions as there are definition holders!

SO …..

Since this is MY presentation I'll share with you

MY definition

LVC – What is it?

Live

– Training in real aircraft with real or training weapons

- Pilot in real plane, performing formation training with other pilots in real planes

Virtual

– Real person in a virtual environment

- Pilots performing formation training, each wingman a pilot in their own simulator

Constructive

– Most often combined with Virtual, adds computer generated forces, etc

- Pilot performing formation training in simulator and wingmen are computer generated

LVC – Benefits

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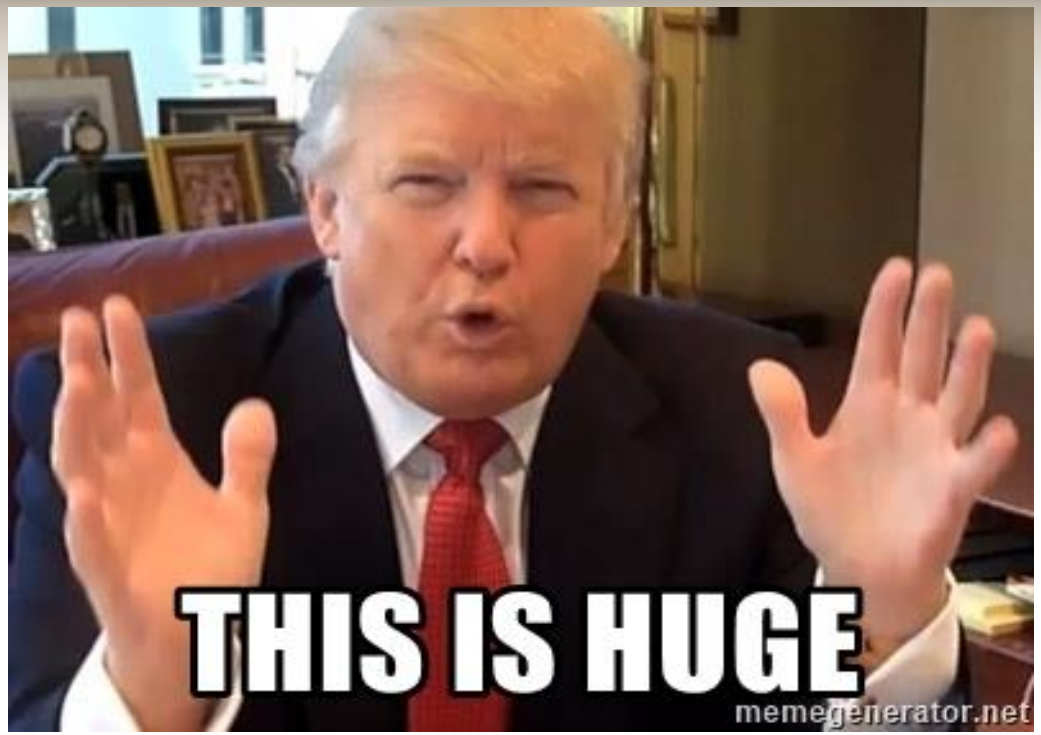

LVC – Benefits

Decreased costs in displacement of people and equipment, fuel, and ammunition

Increased safety

Flexibility to produce multitudes of scenarios, in any type of environment in any weather – day or night

Larger exercises with a **larger variety of players** – friend and foe

Security – training without revealing TTPs or capabilities in open air

LVC – EW Specific Benefits Are ALSO Many and Include:

Threat density (after all, who can afford a whole range full of $5-10M legacy threat emitters)

Complex / 5th gen threats (again, who can afford a range full of $20-25M 5th gen threat emitters … ONCE they're developed) PLUS many advanced threats have such long ranges that training areas can't support live fly

Flexibility – mobile threats that can actually easily and quickly relocate

Security – protecting against adversary knowledge of our intelligence AND of our TTPS to counter the threats

LVC – Why Does the Live Component Remain Critical?

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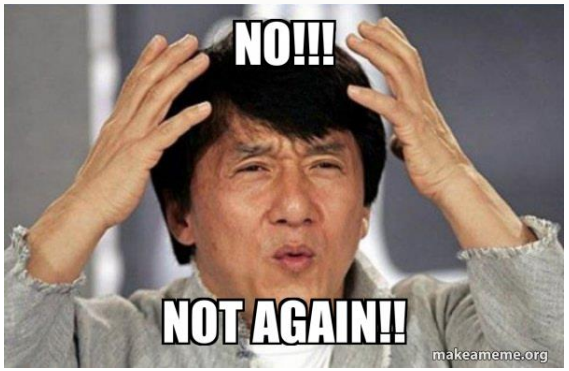
No matter HOW real the simulation there still exists the subconscious “video game” mentality

LVC – Why Does the Live Component Remain Critical?

("this is safe … I can always reset")



LVC – Why Does the Live Component Remain Critical?

ALMOST IMPOSSIBLE to replicate high g's, inverted flight, other maneuvers often at low level and often necessary to successfully evade a threat

LVC – Why Does the Live Component Remain Critical?

NOTHING CAN FULLY REPLACE LIVE FLY!

LVC – Challenges

LVC – Challenges

- These challenges were identified in two past LVC studies
- NOT all inclusive: they miss things like 5th gen integration, crypto, comms, etc
- And the list grows!

Type	1996 Challenges	2009 Challenges
Technical	•Interoperability •Data Description Availability •Data Security and Sensitivity •Physics-based M&S •Hardware and Software Limitations •Variable Resolution	•Interoperability •Data Discovery •Security •Representative, Composeable and Validated Models •Fault Monitoring and Persistence •Fidelity, Scale and Resolution filters
Cultural	•Acquisition Process •Incentives for M&S use •M&S workforce (Training and Access) •Acceptance of M&S	•Process Tools •Communities of Practice •Workforce Training and Collaboration •Infrastructure
Managerial	•Office of Secretary Defense Guidance •Ownership of Data and Models •VV&A •Funding Process •Use of System Model	•Governance, Standards Policies •Data & Model Mediation •VV&A •Consistent Funding •Efficient Use and Best Practices

LVC – Challenges in a Multinational Environment

But once we figure these out

this should be EASY in a multinational environment, right?

LVC – Challenges in a Multinational Environment

LVC – Challenges in a Multinational Environment

Additional challenges INCLUDE (but DEFINITELY aren't limited to):

- Equipment commonality
  - Comm
  - ACMI
- Sovereign security concerns
  - Crypto
  - TTPs
  - Intel sources/databases
- 5th and 4th gen integration
- Individual country desires

LVC – Is it Worth It?

LVC – Successes in a Multinational Environment

- There HAVE been successful multinational exercises that included some elements of LVC
  - ASTRAL KNIGHT 21 (US, Albania, Croatia, Greece, Italy, Slovenia) / ASTRAL KNIGHT 20 (US, Poland, Latvia, Lithuania, Estonia, Sweden)
  - ATLANTIC TRIDENT 21 (US, UK, France)
- Italy is standing up what promises to be a great LVC capability with their international flight training school at Decimomannu

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BUT … these are just a step on the path

to

fully integrated LVC training!

LVC – A great summary ~~stolen~~ from Frost & Sullivan

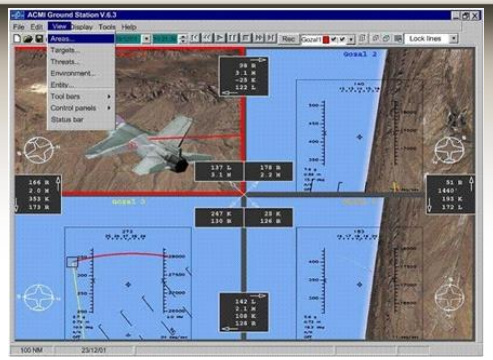
The global military training and simulation (T&S) market is witnessing **rapid transformation**, primarily driven by a shift away from traditional live methodologies towards a more blended environment

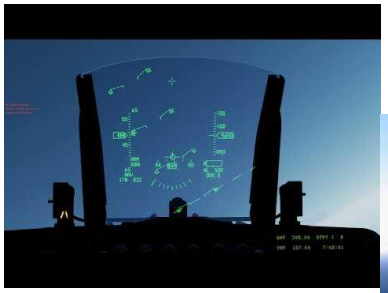
"Several Western countries have already started implementing LVC visions in T&S, facilitating the evolution of training environments through multi-phased projects involving defence and commercial industry participants"

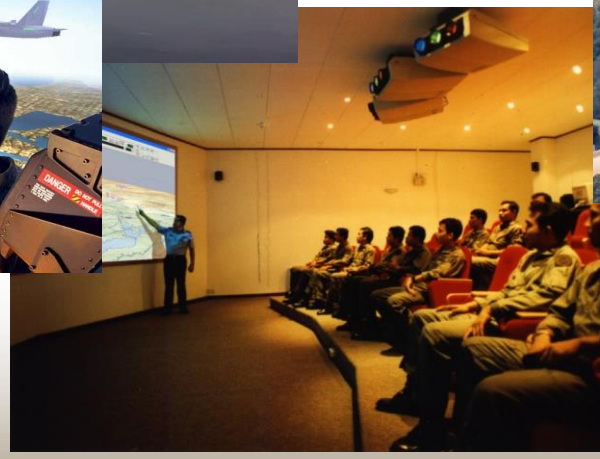
However, "integrating legacy systems with these new architectures will come with certain challenges."

(Alexander Clark, Industry Analyst, Defence at Frost & Sullivan)

Live, Virtual, Constructive Training







LVC – Summary

- Live – Virtual – Constructive training is the way of the future, and provides a wealth of benefits
  - Better simulation of advanced threats
  - Reduced flying costs
  - Better OPSEC on Tactics, Techniques and Procedures
- There HAVE been successful multinational exercises that included some elements of LVC
- Serious challenges exist in a multinational environment, including
  - Equipment and Comm Compatibility
  - Security
  - Proprietary National Interests

LVC – Summary (cont)

BUT …

We ARE on the path to fully integrated LVC training!

Live, Virtual, Constructive EW Training ….

IS IT WORTH IT?

Live, Virtual, Constructive EW Training ….

Is it worth it?

And it is incumbent on **US** as EW professionals,
both military and industry,
to **make this happen**…

Is it worth it?

Both in our own countries
And in the multinational environment!

Thank You!

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BACKUP

Blue Threats

Challenges of training with Blue Threats…

We often don't think about BLUE threats, but many countries export systems that may not always remain in friendly hands ….

Challenges of training with Blue Threats…

- The BIGGEST challenge …

Challenges of training with Blue Threats…

- Intel / technical capabilities of ones' OWN or ALLIED systems often hardest to get for developers of defensive systems and simulators!
- Reluctance to show TTPs on how to defend against Blue threats make these ideal candidates for Virtual/Constructive vs live systems (IF developers can get the right data)

Training with ACTUAL Adversary Equipment ….

SHOULD provide the best training, but…

Training with ACTUAL Adversary Equipment ….

- MOST actual systems are export models
  - Export often = reduced / different capabilities
- Often difficult to maintain
  - May or may not have operator/maintenance manuals
  - Spare parts? Hey Russia/China … have a klystron to sell us?
- TTPs may or may not be known
- GREAT training against export models, but if relied on too much could provide negative training

Cooperative Multinational Procurements

- Cooperative Multinational Procurements are a great idea!
  - Shared/reduced cost
  - Commonality of equipment
  - Commonality of comm/security backbone

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- BUT…..

Cooperative Multinational Procurements

- HUGE challenges agreeing on specs, security, cost share often lead to:
  - Dumbing down of system to lowest common demoninator
  - Costs actually growing because of “unique/special” requirements
  - Unwillingness to share intelligence data which would allow best possible system

5th Gen Threats

5th Gen Threats - Challenges

- Reproducing 5th gen threats presents a great challenge for both virtual/constructive AND live threat training systems
- Advanced radars/waveforms/algorithms difficult to capture and, more importantly reproduce
- Because of the nature of advanced AESA radars, adversaries can modify the threats more easily than before if they believe they have been compromised

5th Gen Threats - Challenges

- 5th gen threat trainers best positioned in the virtual/constructive arenas
  - Cost to physically reproduce
  - Extended range of threats usually exceeds training range airspace
  - Even more critical to conceal our knowledge of the threats and the TTPs thay may be used to counter them