



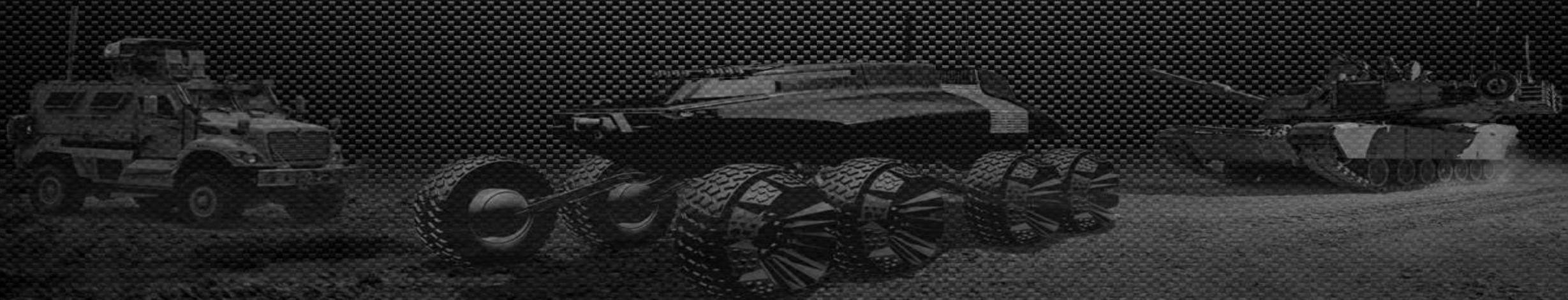
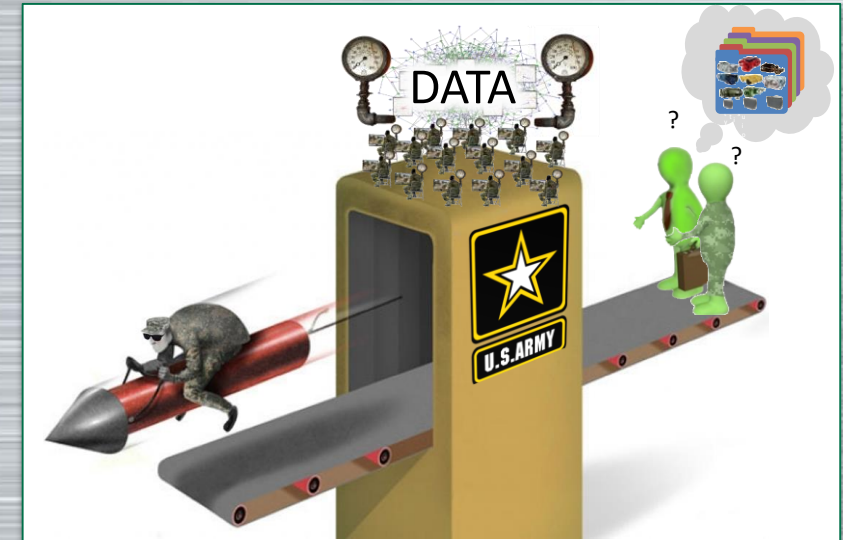
The Soldier and the Scientist: A Learning Singularity

Mad Scientist Learning in 2050

8 August 2018

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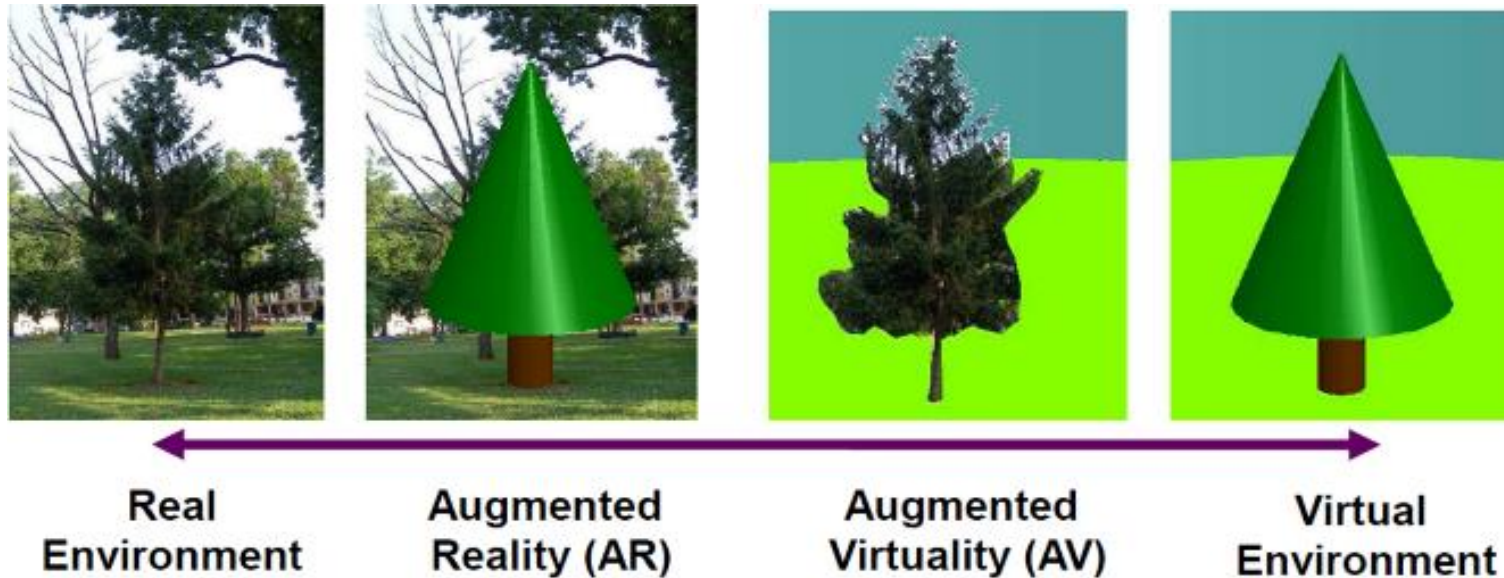
Somewhat Dystopian World in 2050



- Most technologies available globally
- ROI negative for “widget” S&T investments
- Unknown enemy / no homefield advantage
- Individual platforms not important
 - Swarms of deadly hobby drones
 - Best AI wins

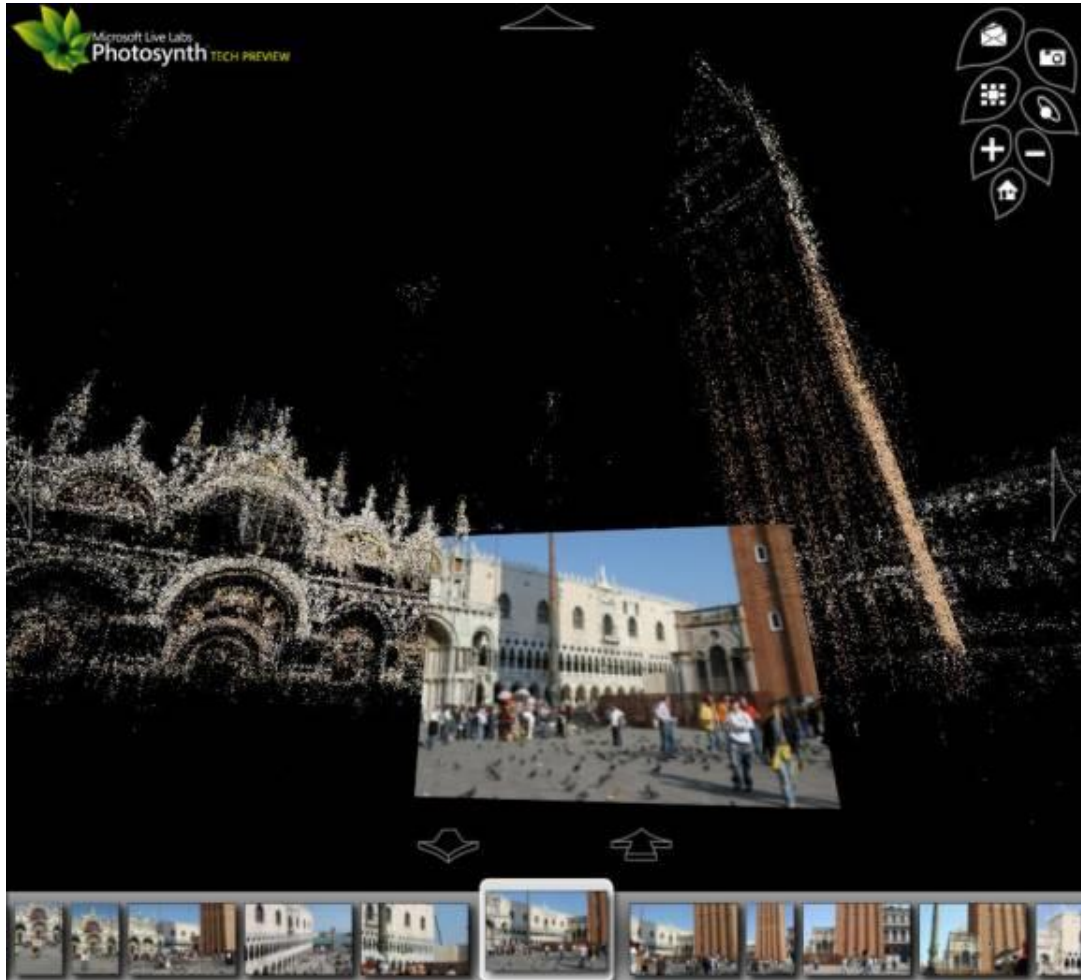
Somewhat Dystopian World in 2050

- Reality and Virtual Reality are blurring and ubiquitous

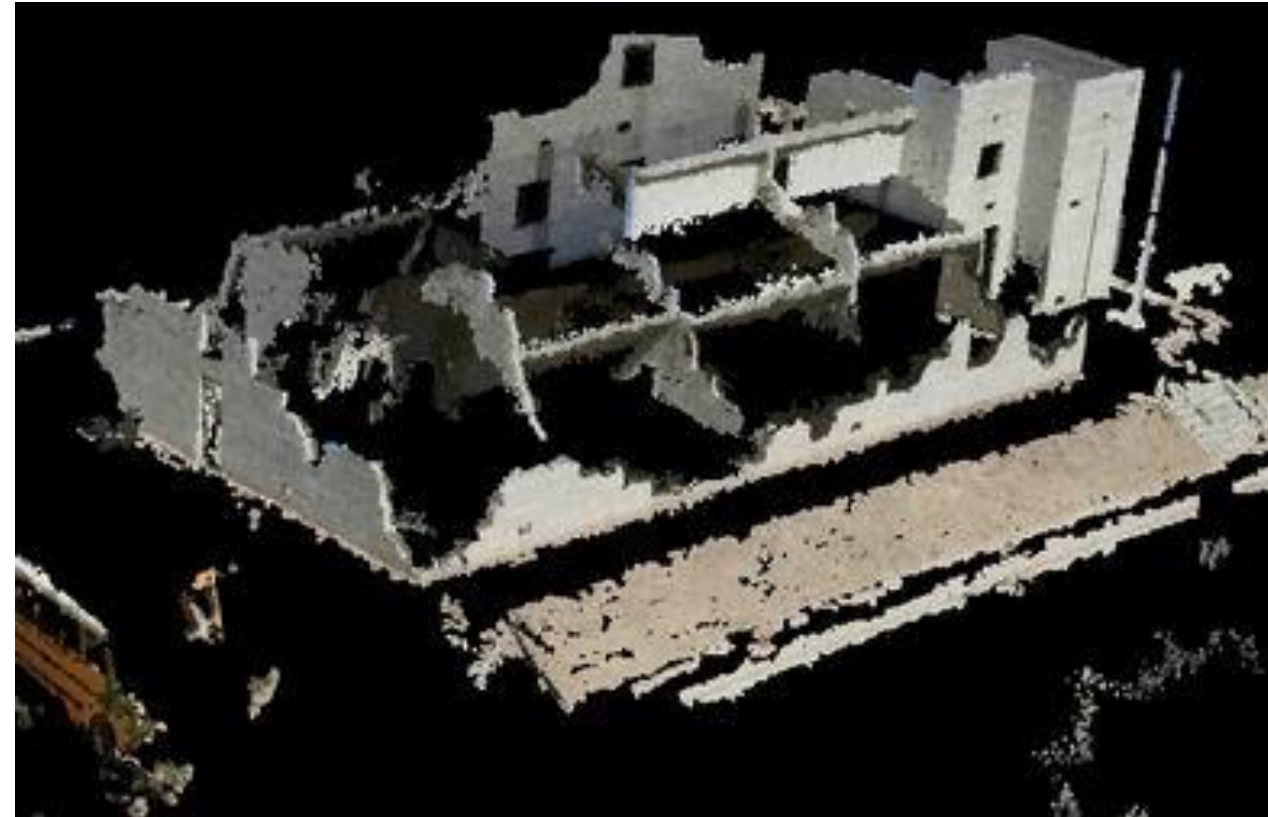


Reality into the Pure Virtual

Microsoft Photosynth



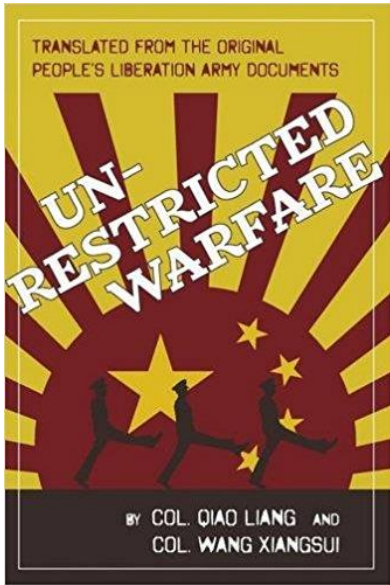
SPAWAR 3d from motion



Pure Virtual into Reality



Somewhat Dystopian World in 2050



China

National Defense
Strategy

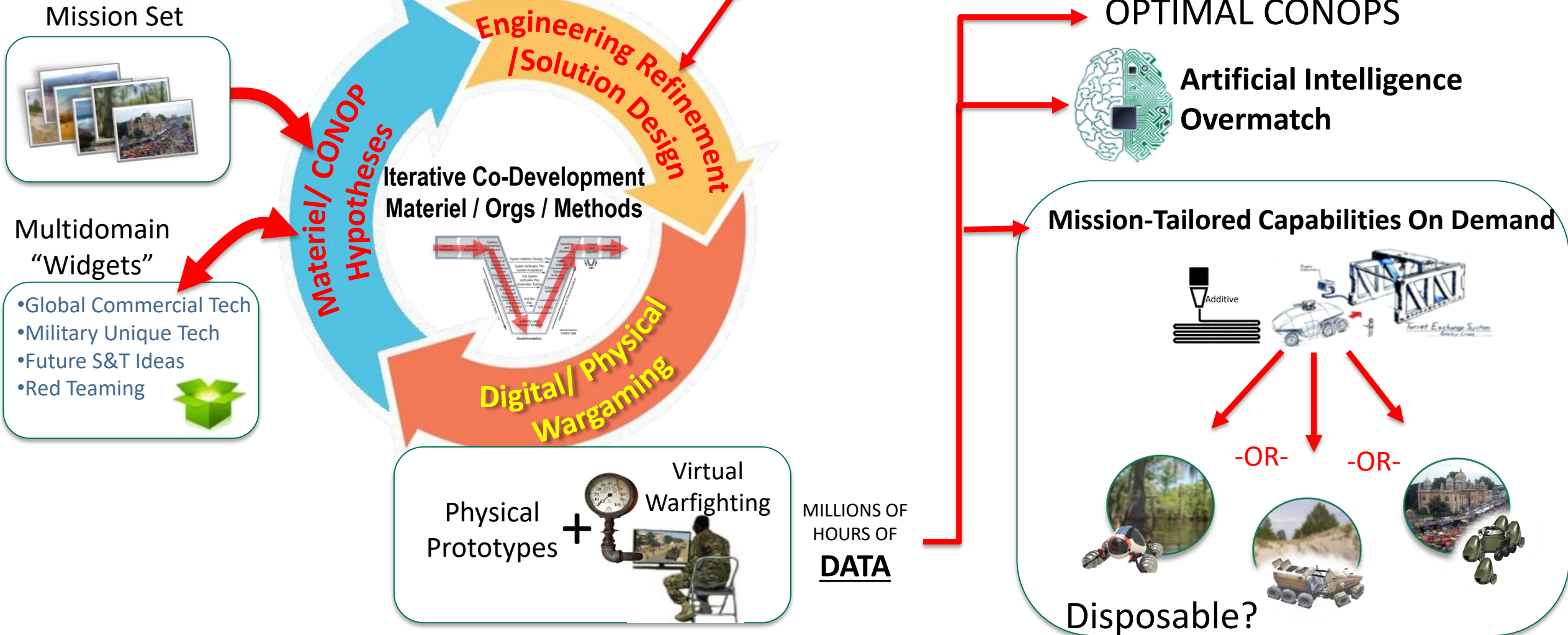
“Proposing a new concept of weapons does not require relying on the springboard of new technology, it just demands lucid and incisive thinking. However, this is not a strong point of the Americans, who are slaves to technology in their thinking”

“Customizing weapons systems to tactics which are still being explored and studied is like preparing food for a great banquet without knowing who is coming, where the slightest error can lead one far astray”

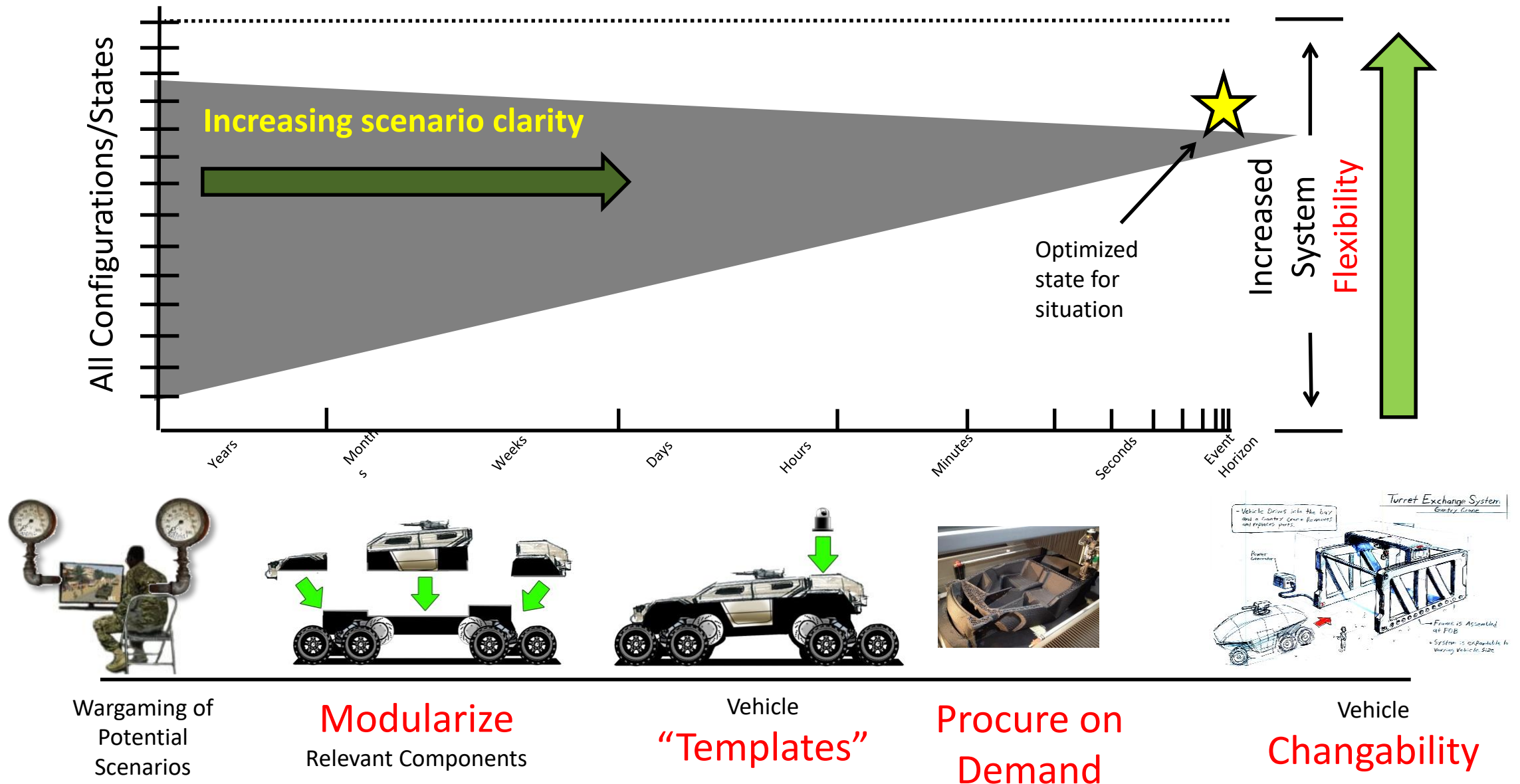
“Success no longer goes to the country that develops a new fighting technology first, but rather to the one that better integrates it and adapts its way of fighting....” -

Robtopian Vision: Continuous Windows of Advantage

OUTPUT



Modularity / Changability vs Learning in Time



Prototyping is the Shorthand of Innovation



- Build to learn – now beats later
- Good prototype worth a thousand pictures
- The whole point is to get feedback - data beats opinions
- Minimum viable prototype
- Prototypes don't have to be physical
- Google principle: Innovation, not instant perfection



Physical Prototyping
(Minimal refights, deep physics)

Digital Warfighting

(Lots of mission space/ data, lesser physics)

Magazine Racing: Where you pull out the specs and never run the race.
OPINION BASED

Camaro SS 2010

Engine: 6.2 Liter LS3
Power (SAE): 426 BHP @ 5900 RPM
Torque: 420 ft-lb @ 4600 RPM
Weight: 3,860 lbs

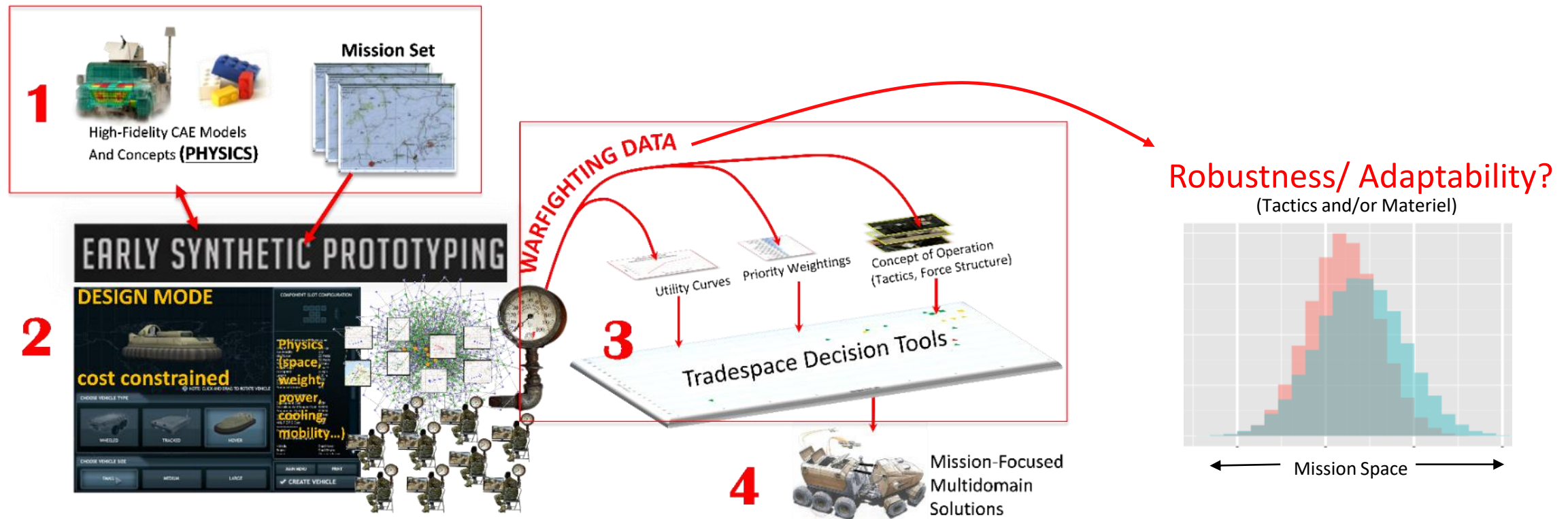
Mustang GT 2011

Engine: 5.0L V8
Power (SAE): 412 hp @ 6,500 rpm
Torque: 390 ft-lb @ 4,000 rpm
Weight: 3,605



Early Synthetic Prototyping (Operation Overmatch)

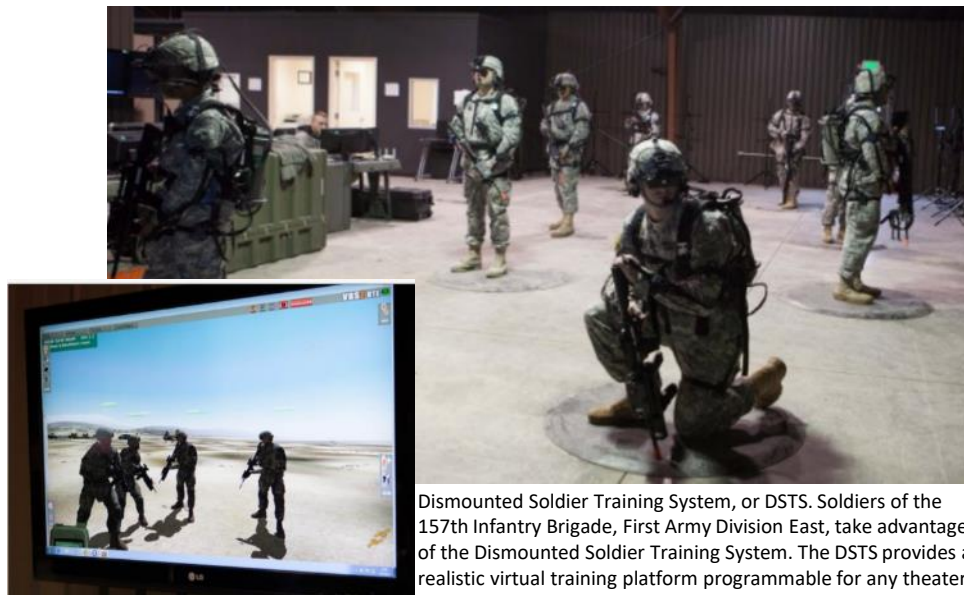
- TRADOC/RDECOM using gaming for acquisitions – not training
- Physics-based and crowdsourced
- First alpha out now Operation Overmatch, first person shooter
- Technical challenge in data mining 12 million hours of play / year



Exploiting Virtual Reality / Augmented Reality

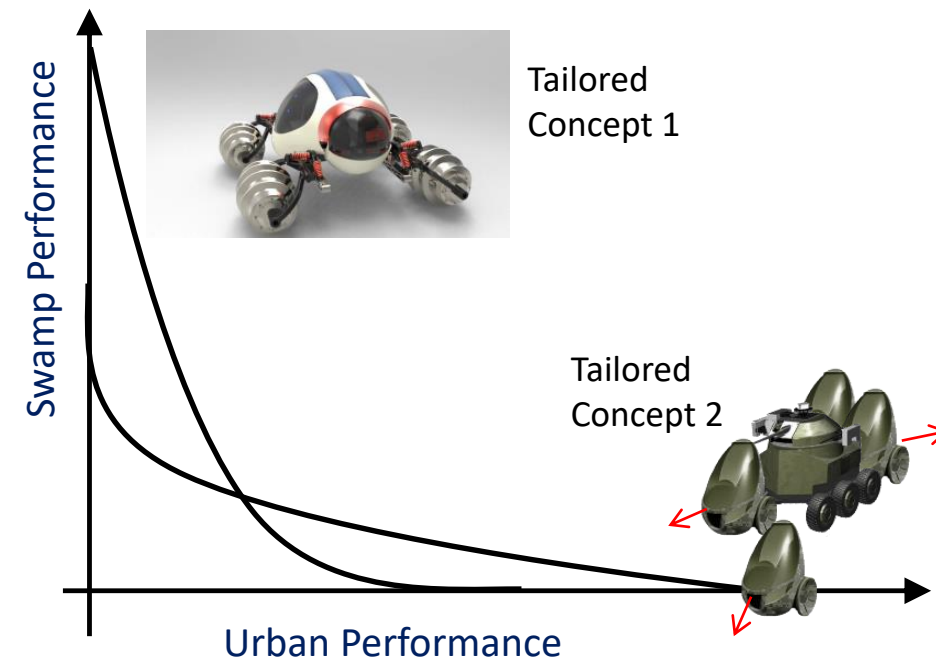
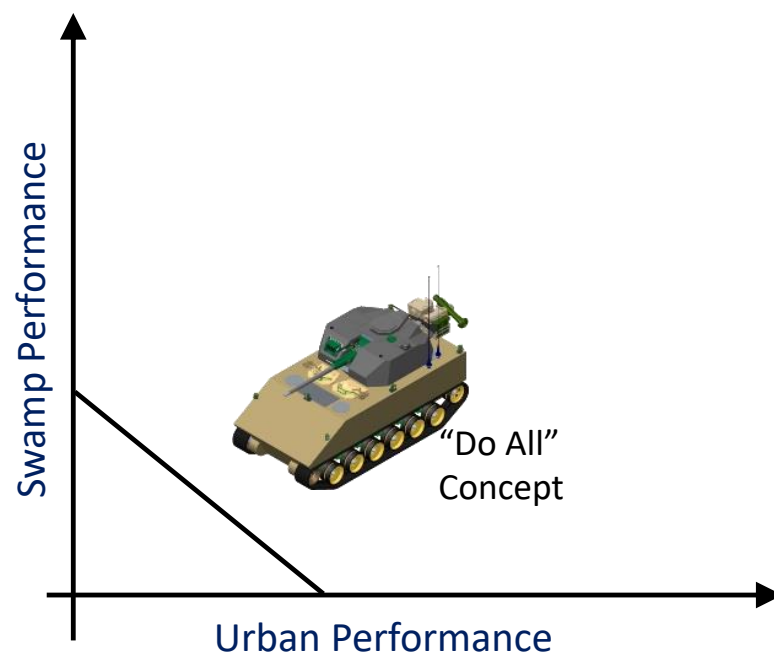


- Soldiers must accrue [SOF-like] experience at a much faster rate over a wide range of operations so they can adapt and innovate.
- Per [Head Strong: How Psychology is Revolutionizing War](#):
Broad learning exposures allow experts to build huge pattern recognition ability to modify/ act quickly.
- In complex world there won't be a "right way" for most situations
(unpredictability is also an advantage)
- **Army will learn from students in Complex World**



Dismounted Soldier Training System, or DSTS. Soldiers of the 157th Infantry Brigade, First Army Division East, take advantage of the Dismounted Soldier Training System. The DSTS provides a realistic virtual training platform programmable for any theater of operations while mitigating risk.

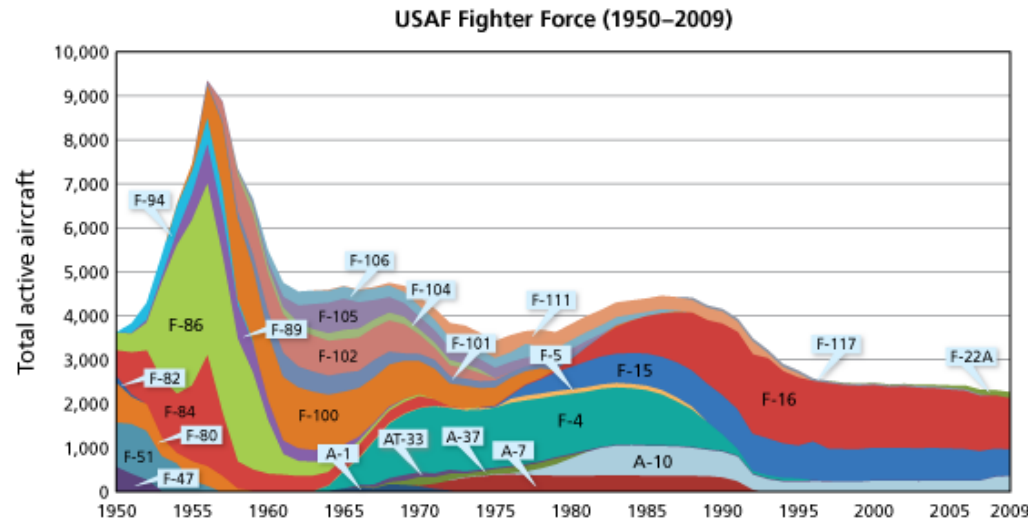
Tailoring for System Combat Utility



Disrupting Enemy Learning / Strategic OODA Loops



- DoD should embrace a strategy of options and diversity
 - Create more capability options across a wider, more diverse portfolio
 - Develop a true high-low mix of capabilities
- Between 1950 and 1960 the U.S. Air Force employed 14 different fighter jets, three times as many as today



We have just over 60 F-117s, but the world must react to those F-117s just as if we had many hundreds ... Our problem, though, is the F-117s operate in a fairly constrained, well known altitude and speed block ... Our answer must be an F-118 and an F-119

--Colonel John Warden

Disposable? DARPA AVM XC2V



Idea to vehicle in 4 months



“Maybe we did not do the same development that [the contractor] did, to make sure the strut on the vehicle lasts a million miles. But if it saves a life, and it lasts for a whole conflict, haven’t we done a better thing?”

-- Jay Rogers, Local Motors

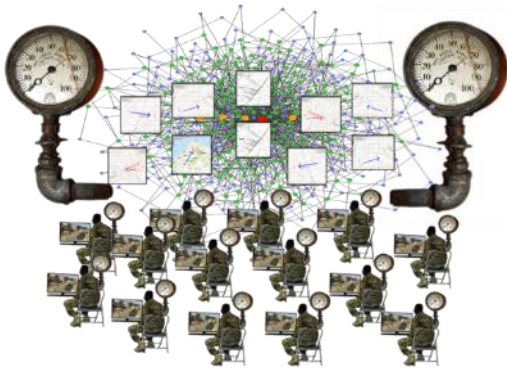
“Not only could this change the way the government uses your tax dollars—think about it, **instead of having a 10-year lead time** to develop a piece of equipment, if we were able to collapse the pace of which that manufacturing takes place, that **would save taxpayers billions of dollars**—but it also could get technology out to the theater faster, which could save lives. “

--President Barack Obama 2011



Learning from Game Analytics

Virtual Physics-Based Gaming Environment

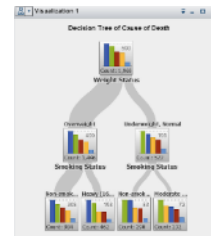
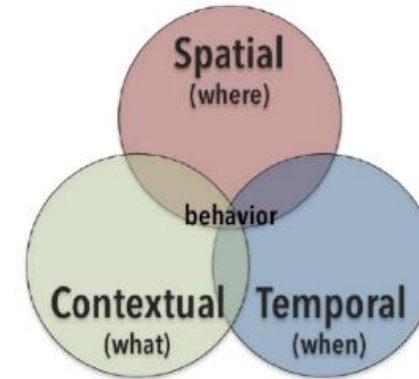


~12 million hours of Soldier
gameplay per year

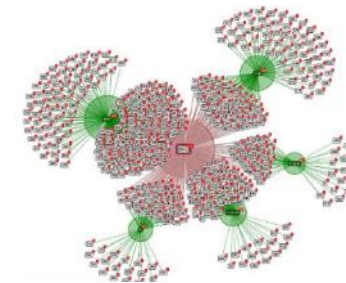
Data Mining

- What are they doing?
- Where are they doing it?
- Why they are doing it?
- How effective is this?
- Terrain versus movement choices
- What are they talking about/ when/ how often
- Optimal Force structure

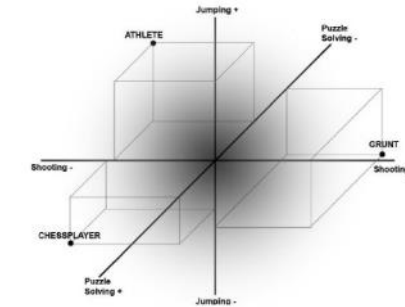
Visualization



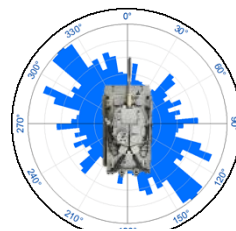
Decision Trees



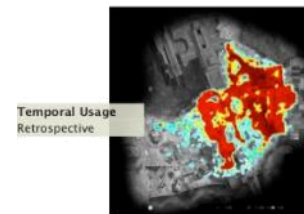
Clustering Cause of Death



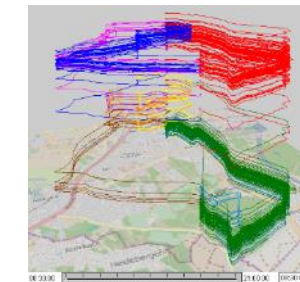
Player Personas



Engagement Sector Cardioid



Player Kills
Heat Maps



Multi-Run Movement Plots

What Might We Learn from Gaming and Sports?



- “Serious sport is war minus the shooting” – George Orwell
- Ability of a coach/players to understand behaviors wins and loses games
- Multiple cameras now allow us to create data sets of player/ball telemetry
- Brain isn’t designed to aggregate hundreds or thousands of traces, but computers can discover complex or very subtle patterns
- Data could be presented to players on the field using augmented reality
- MIT Sloan has dedicated sports/ esports conference (way beyond moneyball)

www.sloansportsconference.com february 23 - 24, 2018 | Boston



https://www.ted.com/talks/chris_kluwe_how_augmented_reality_will_change_sports_and_build_empathy



https://www.ted.com/talks/rajiv_maheswaran_the_math_behind_basketball_s_wildest_moves

Teaching the Machines



Per SCO Director, William Roper: https://www.youtube.com/watch?v=GLh_ApVVBu4

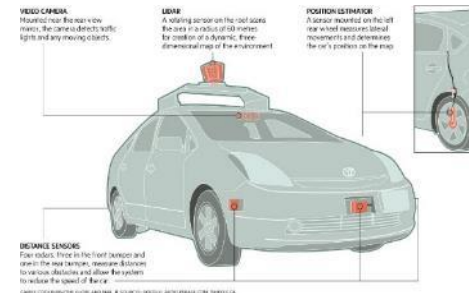
- Google, or Apple, or Amazon think people who have the most data is going to be able to train the most intelligent machine
- “Pentagon should be stockpiling all of its data from every flight, every mission, and every exercise in a way that is machine discoverable.”
- “Try to take a pentagon that is device centric—device being like fighter, bomber, submarine, or tank – and shift it to be data centric. To merely think of their systems as being data producers and the data being more important than the systems themselves.”

Per Vladimir Putin: <https://www.theverge.com/2017/9/4/16251226/russia-ai-putin-rule-the-world>

- Nation that leads in AI ‘will be the ruler of the world’
- Predicts that future wars will be fought by countries using drones. “When one party's drones are destroyed by drones of another, it will have no other choice but to surrender”

Waymo(Google) car ~1GB of sensor data / second

- 2 Petabytes of data per year (2 million GB) per car



Als without Data Useful Too



- Open AI trained on DOTA2 solely by playing itself
- The AI win stunned the gaming community, because bots are generally considered inferior to expert human players.
- Probably best combination in future is by combining human heuristics and AI self-learning.
- The trick with most AI (neural networks) is we don't know what the network is learning.

<http://money.cnn.com/2017/08/12/technology/future/elon-musk-ai-dota-2/index.html>

<https://www.youtube.com/watch?v=I92J1UvHf6M>

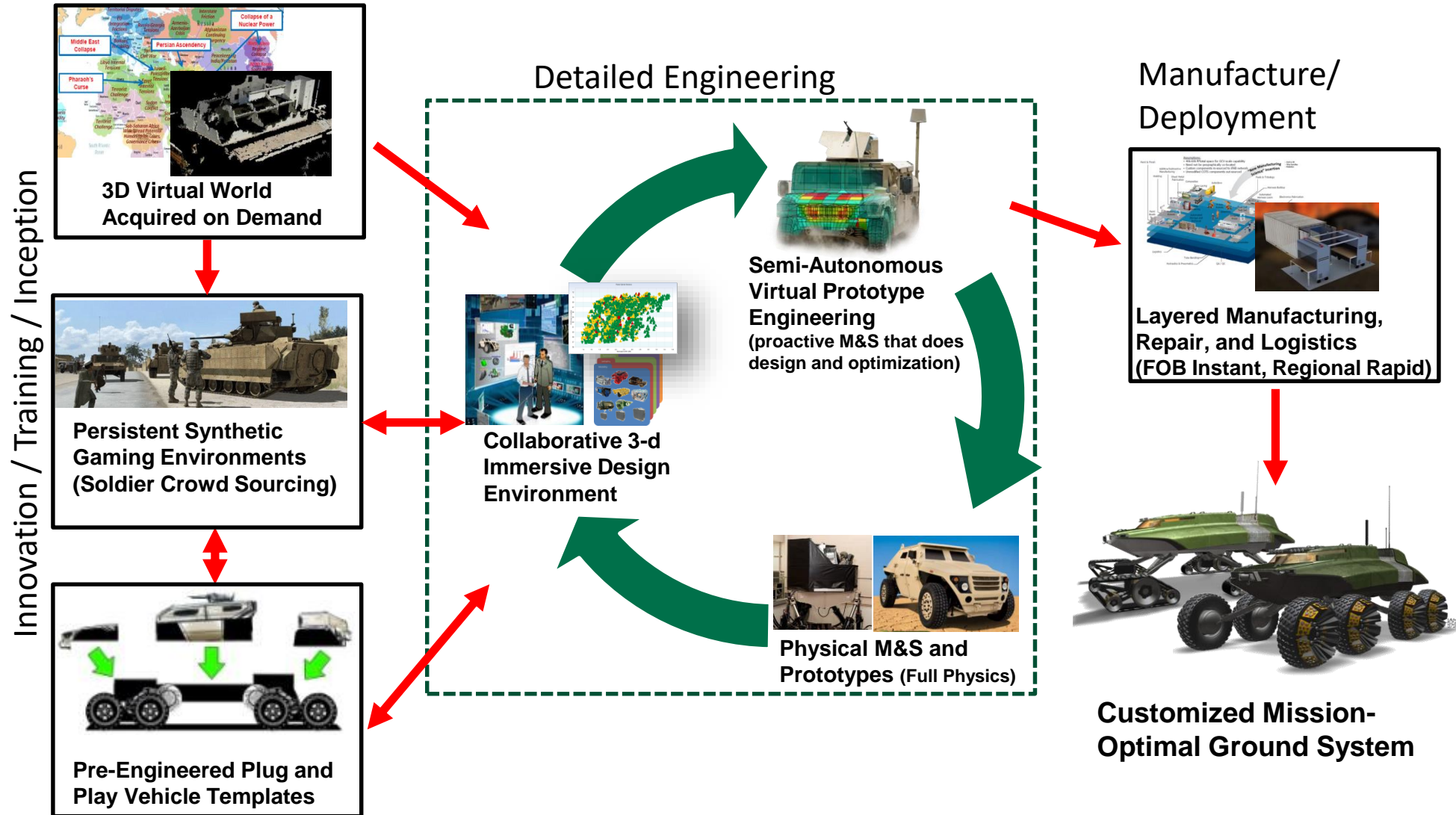




QUESTIONS



Future Investments That Could Be Made...

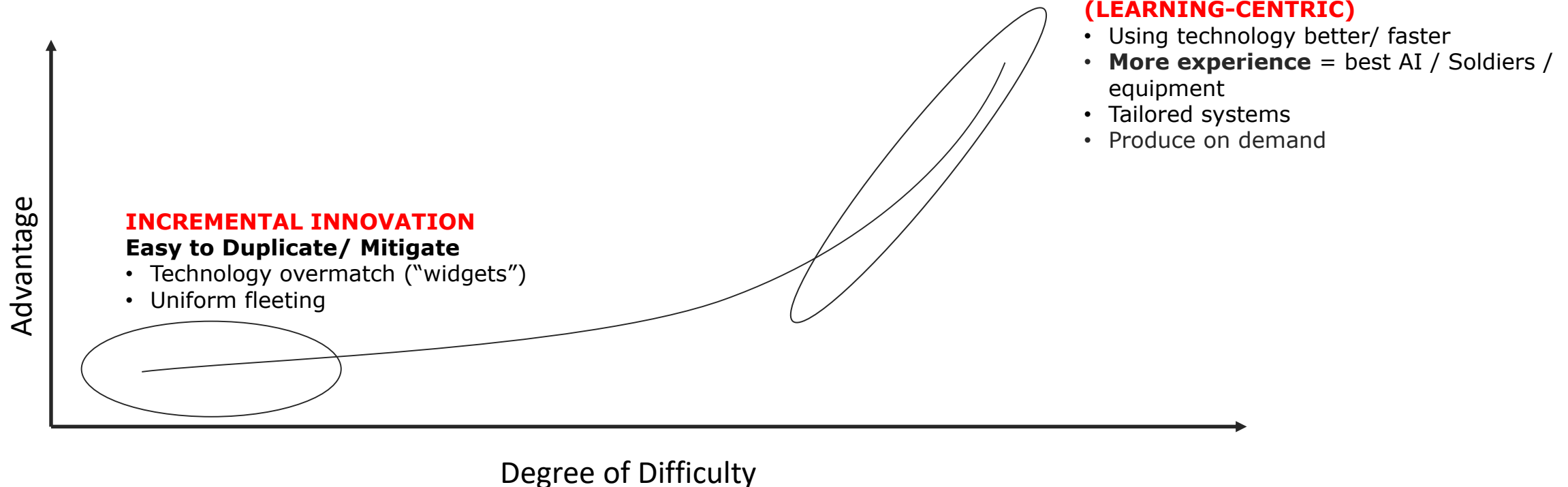


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It's all about storytelling/ physics/ immersion...



Select appropriate venues, physics, and timing



Virtual Experiment Test Plan

Video Storyboard



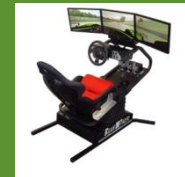
Video
<http://www.youtube.com/watch?v=JoeagekLx9c>
Feedback link
<https://www.research.net/s/technologyfortactics>

Purely Virtual @TARDEC, ESP



Higher Fidelity Experiments

Crowd Source Kiosks



Limited
Motion



Static

MITL at TARDEC



SIL



Motion

Mission Engineering treats the end-to-end mission as the system in the operational context to drive performance requirements for individual systems. An assessment framework measures progress towards mission accomplishment through test and evaluation in the mission context.

Prototype Warfare represents the paradigm shift from large fleets of common-one-size-fits-all exquisite systems to small quantities of rapidly-fielded tailored systems. Mission-tailored systems focus on specific functions, specific geographic areas, or even specific fights and are inexpensively produced and possibly disposable.