

SHORT COURSE ON WARGAMING

Heavily derived from Matt Caffrey's "On Wargaming"

G. Darl Lewis

5 January 2023

Tech Note

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AFRL

Short Course on Wargaming

Heavily derived from Matt Caffrey's *On Wargaming*

G. Darl Lewis, Ph.D.

Wargaming and Analysis Principal Investigator

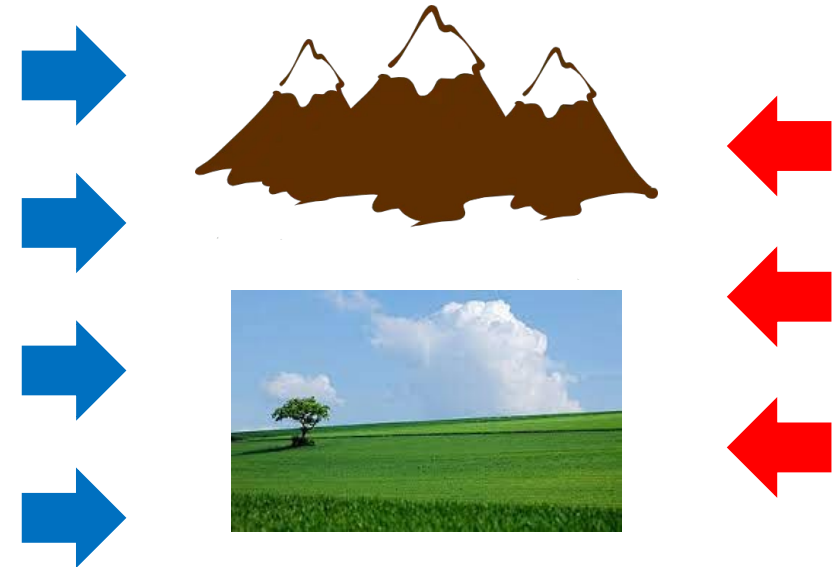
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Colonel Blotto

Scenario:

- Colonel Blotto (B) must defend his state against an invader (R)
- He can allocate four available platoons however he desires to defend two avenues of attack—the mountain pass (M) and the plain (P)
- The invader allocates three platoons to attack Blotto however she desires
- The invader wins a battle if she allocates more platoons to that location than Blotto
- The invader wins the territory if he penetrates Blotto's defenses at any point

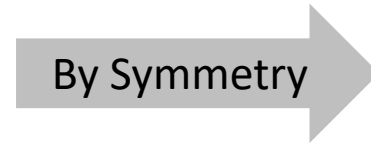
What is your strategy?



Colonel Blotto Continued

- For each pair of strategies, $\sigma_i = \{n_m, n_p\} : n_m + n_p = N_i$, the following payoffs accrue to R (with B losing the same value)
 - For any pair of strategies, at least one player has an incentive to deviate—There is **NO PURE STRATEGY EQUILIBRIUM**

B\R	3,0	0,3	2,1	1,2
4,0	0	1	1	1
0,4	1	0	1	1
3,1	0	1	0	1
1,3	1	0	1	0
2,2	1	1	0	0



B\R	3,0	2,1
4,0	0.5	1
3,1	0.5	0.5
2,2	1	0

- Look for an equilibrium in **MIXED STRATEGIES**
 - As there are several mirrored strategies, we can simplify the matrix to a 2x3 games by symmetry
 - We can already see an equilibrium for a pair of *classes* of strategy in which B plays {3,1} and {1,3} with equal probability while R plays {3,0} and {0,3} with equal probability
 - There is an additional equilibrium that has B playing {3,1} and {1,3} with equal probability while R plays {3,0}, {0,3}, {2,1} and {1,2} with equal probability



Colonel Blotto Continued

Expected payoffs of symmetric subgames:

B	R	R Payoff
4,0	2,1	1
4,0	1,2	1
0,4	2,1	1
0,4	1,2	1
Expected R Payoff		1

B	R	R Payoff
4,0	3,0	0
4,0	0,3	1
0,4	3,0	1
0,4	0,3	0
Expected R Payoff		0.5

B	R	R Payoff
2,2	3,0	1
2,2	0,3	1
Expected R Payoff		1

B	R	R Payoff
2,2	2,1	0
2,2	1,2	0
Expected R Payoff		0

B	R	R Payoff
3,1	2,1	0
3,1	1,2	1
1,3	2,1	1
1,3	1,2	0
Expected R Payoff		0.5

B	R	R Payoff
3,1	3,0	0
3,1	0,3	1
1,3	3,0	1
1,3	0,3	0
Expected R Payoff		0.5

B\R	3,0	2,1
4,0	0.5	1
3,1	0.5	0.5
2,2	1	0

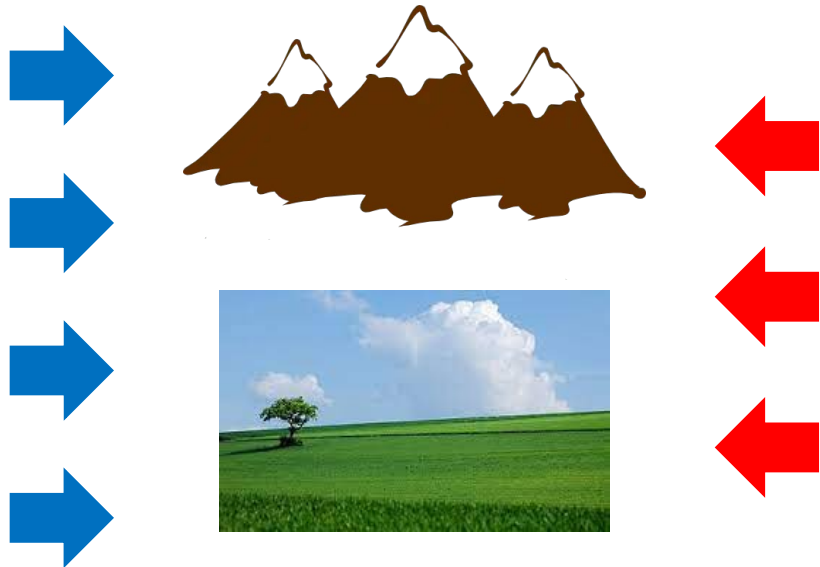


Colonel Blotto Continued

- Assume R plays a {3,0} strategy with probability, $0 \leq r \leq 1$, and a {2,1} strategy with probability, $1 - r$
- Assume B plays a {4,0} strategy with probability, $0 \leq p \leq 1$, a {3,1} strategy with probability, $0 \leq q \leq 1 - p$, and {2,2} with probability, $1 - p - q$
- The R payoffs, conditional on strategy, are now:
 - {3,0}: $0.5p + 0.5q + 1(1 - p - q) = 1 - 0.5p - 0.5q$
 - {2,1}: $1p + 0.5q + 0(1 - p - q) = p + 0.5q$
- R is indifferent between the two classes of strategies if $p = \frac{2}{3}(1 - q)$
- The B payoffs, conditional on strategy, are now:
 - {4,0}: $-0.5r + (-1)(1 - r) = 0.5r - 1$
 - {3,1}: $-0.5r + (-0.5)(1 - r) = -0.5$
 - {2,2}: $-1r + 0(1 - r) = -r$
- If $r = 1$, B is indifferent between {4,0} and {3,1} and strictly prefers each of those over {2,2}
 - This implies $1 - p - q = 0 \rightarrow p = 1 - q = \frac{2}{3}(1 - q) \rightarrow q = 1$. This is our “pure” strategy.
- If $r \neq 1$, B is strictly better-off choosing {3,1} or (possibly) {2,2}
 - B is indifferent between {3,1} and {2,2} if $r = 0.5$
 - This implies $p = 0 = \frac{2}{3}(1 - q) \rightarrow q = 1$. So the second equilibrium has B playing {3,1} and {1,3} with equal probability while R plays {3,0}, {0,3}, {2,1} and {1,2} with equal probability

		r	1-r
	B\R	3,0	2,1
p	4,0	0.5	1
q	3,1	0.5	0.5
1-p-q	2,2	1	0

Colonel Blotto Continued



- “War is very simple, but in war the simplest things become very difficult” - Clausewitz
- What did we learn from this game?
 - How should we allocate resources?
 - Can underdogs win? How?
 - Which strategies are the most successful?
 - How will the enemy respond to us?
- What are the limitations of this game?
 - How realistic is the scenario?
 - How realistic are the capabilities?
 - Did the game have the right information?
 - Did the players behave realistically?



Agenda

Ice-Breaker

Colonel Blotto

Introduction

Definitions, Value, Skillsets

History Of Wargaming

Generations, Goals

Wargaming Typology

LVCM Wargames, Operational Levels, Objectives

Wargame Administration

Personnel, Processes, Authorities

Futures Wargaming

Concept and Scenario Development, Adjudication

Bringing It Together

Rethinking Skillsets, Improvements, Other Considerations



Purpose

- Provide information on the nature & scope of wargaming so recipients can better:
 - Understand senior leaders' use of wargaming
 - Apply wargaming within their organizations
 - Supervise the wargame work of subordinates
- Why do we wargame?

Wargaming saves: Time—Money—Lives	It is required by: <ul style="list-style-type: none">• DOD Policy• Joint Doctrine• Service Direction
It provides an edge over adversaries: <ul style="list-style-type: none">• Better Strategists• Better Strategies• Enable faster, more effective and longer-enduring innovations	IT'S FUN



What is a Wargame?

- Definitions of *Wargame*:
 - A simulation, by whatever means, of a military operation involving two or more opposing forces, using rules, data, and procedures designed to depict an actual or assumed real life situation. *DoD Dictionary of Military Terms*
 - (1) A simulated battle or campaign to test military concepts or use. Conducted in conference by officers acting as opposing staffs. (2) A two-sided umpired training maneuver with actual elements of armed forces participating. *Webster's Dictionary*
 - A warfare model or simulation in which the flow of events shapes, and is shaped by, decisions made by a human player or players during the course of those events. *Dr. Peter P. Perla, Center for Naval Analyses*
 - A simulation game depicting armed conflict. *Matt Caffrey*

***Wargaming is art as much as it is science, and the requirements & descriptions described are flexible
—Use your own expert judgement—***



Wargame Examples

US Military Wargaming:

- **RIMPAC:** World's largest coalition naval exercise
- **Unified Quest, Futures Game, Expeditionary Warrior, &c.:** Title X wargames focused on developing the future capabilities of the US military, typically joint activities and often in coalition
- **Red Flag, Green Flag, &c.:** Service and joint exercises designed to provide operators the experience of combat in the safety of a training environment
- **Northern Edge, Valiant Shield:** Joint COCOM/MAJCOM exercises focused on improving combat readiness and exploring integration of near-term technology
- **GLOMO, LDLW, &c.:** MAJCOM wargames focused on improving the next generation of S&T investment
- **ACE/DEUCE:** Mission-level virtual wargames at AFRL/RD focused on next-gen Directed Energy

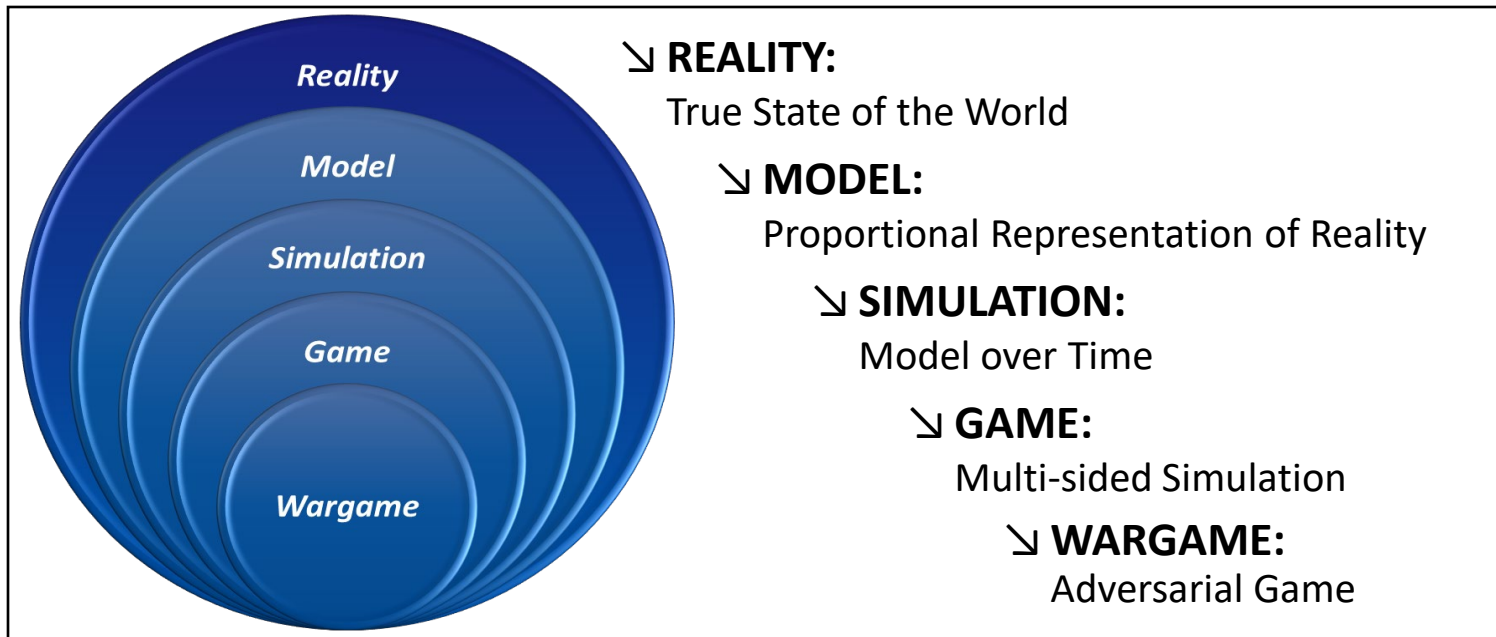
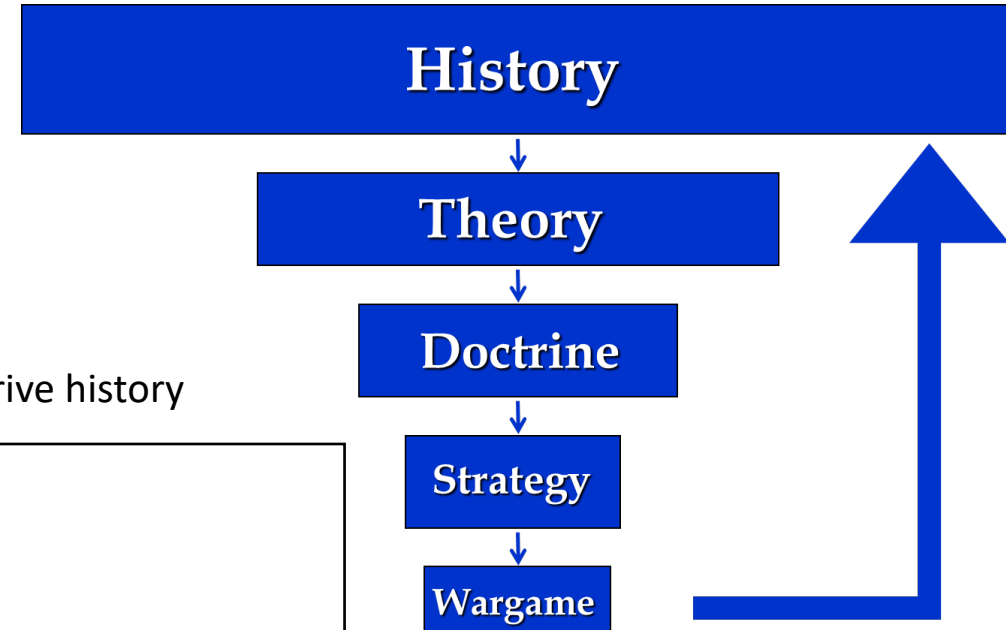
Additional Examples:

- Medieval jousting tournaments: Live wargames used to develop skills with weapons of the era
- Chess, Risk, Go, &c: Tabletop games used to develop strategic thinking toward recreation and war
- Football, Boxing, &c.: Modern live combat simulations develop strategy & fighting skills

Where do Wargames Fit?

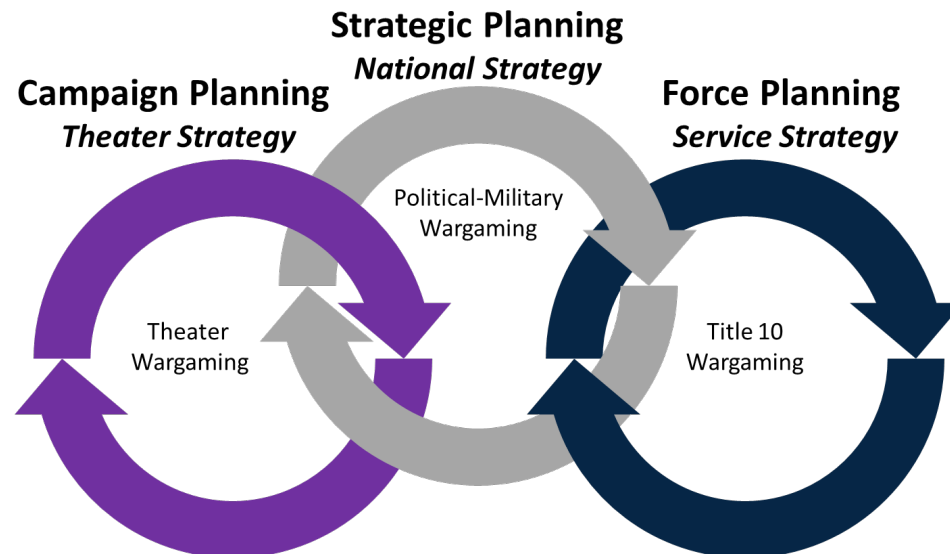
Strategy Cycle

- Wars inform History, which in turn informs Theory, Doctrine, Strategy, and Future Wars
- Wargames do the same—at much lower cost
 - Influence interpretations of history, as well as wars that drive history



Wargame Applications

- Remember ACE:
 - **Anticipate:** Wargames provide insights into the impact of emerging threats & opportunities.
 - **Communicate:** Wargames clarify. For example, they demonstrate the utility of military concepts to operators and needs of operators to concept developers.
 - **Educate:** Wargames help participants to better understand military operations, hence anticipate how Command may have greatest impact, i.e., wargames develop strategists.



Prescriptive Caution

This is not a prescriptive guide—wargames are flexible tools that should be designed and used in the manner that most befits the needs of the specific organization



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Historical Support



***"...nothing that happened ... was a surprise,
– absolutely nothing except the Kamikaze..."***

- Fleet Admiral Chester Nimitz



Internal Look – why we moved fast

- Gen Schwarzkopf, Cmdr CENTCOM

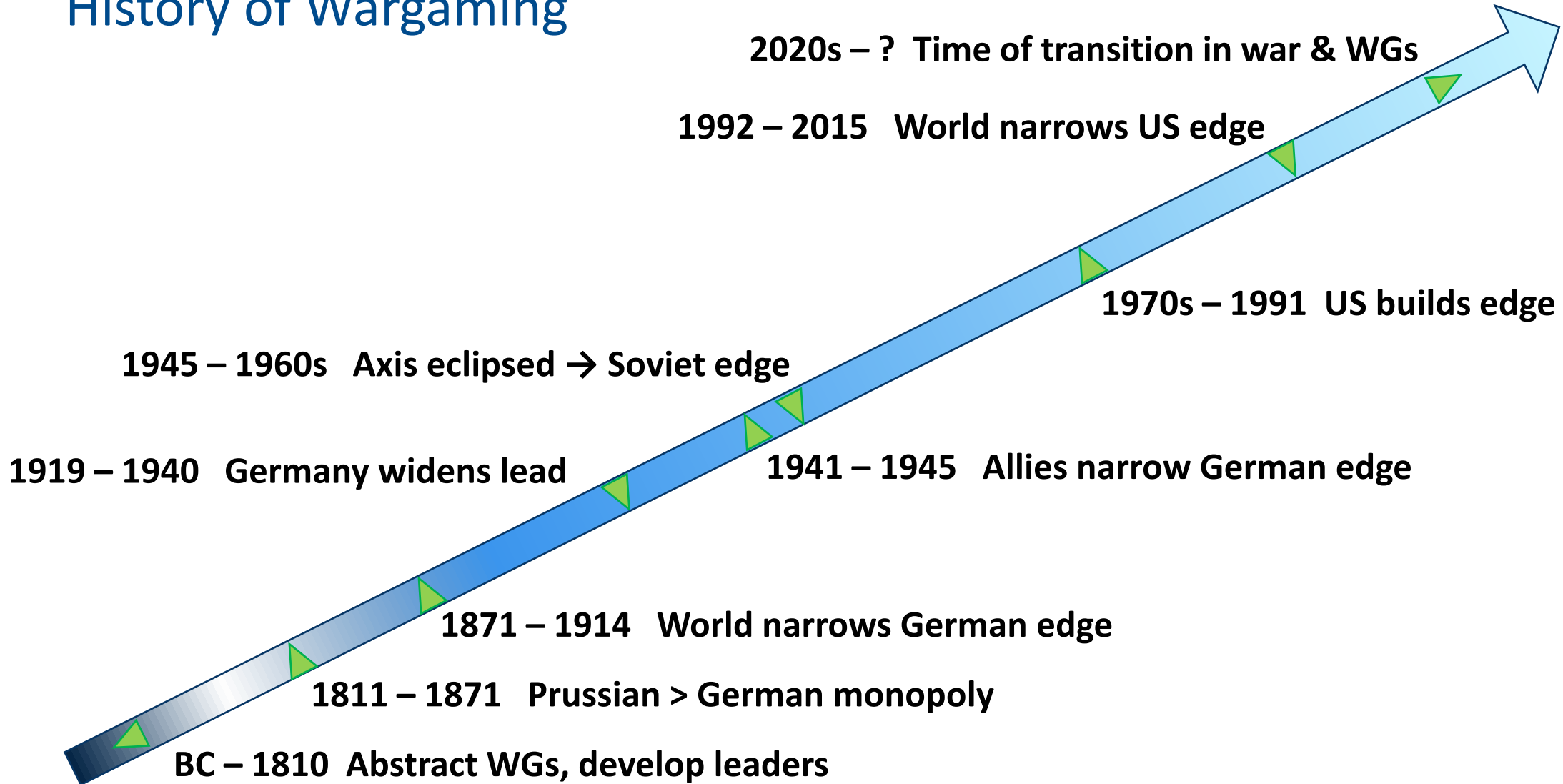


"This is not (exactly) the enemy we wargamed against."

- Lt Gen Wallace, V Corps CC



History of Wargaming



Pre-1810

The earliest wargames arrived with the beginning of civilization:

- Toys—miniature swords, bows, &c.
- Boardgames—Go, Chess, Checkers
- Tournaments—Gladiatorial fights, Jousts, Olympics
- Terrain Maps—Frederick the Great of Prussia



Napoleon overcame these with a few advantages of his own:

Personal genius, meritocracy, and a willing population



Napoleon to the The Great War: Prussian Dominance

To overcome Napoleon, Prussia developed a dominant wargaming culture:

- Terrain tables and maps
- Umpired games
- Incomplete information
- Realistic representation and capes
- Wargaming societies
- Professional Military Education
- Adversarial gaming
- With Prussian success came imitators:



***Baron Leopold von Reisswitz,
Prussian war councilor at Breslau
Improved by Georg von Reisswitz***

***Helmuth von Moltke
Prussian Army Chief of Staff***

Moltke came to recognize the implications of competitors—*Keep the Peace!*

- *But continue to improve—Wargames for different operational levels and expanded realism*
- *Yet command influence also bears its head—Kaiser Wilhelm II*



Interwar Years and WWII:

- Germany returns to its roots under Gen. Hans von Seeckt and later Gen. Erich von Manstein,
 - Treaty of Versailles limits German capability and resources
 - Optimize wargaming at the appropriate level—and to the appropriate resources—for all soldiers
 - Respond to new technology with tactical innovation
 - Take failure seriously
- Allied focus on refighting the last war—ignoring the tactical impact of new technology
- American indifference and emphasis on non-military concerns
 - When exercises did occur under strained budgets, they struggled to interpret to use and adjudicate novel technology
 - However, there were bright spots, especially with the USN and USMC
- Soviet gaming survives, evolving large scale one-move wargames
 - Standout adversarial performance by Georgy Zhukov with implications for command decisions in WWII
- Japan uses intensive wargaming in the build-up to war, but separates political and military wargaming—with major consequences
- During the war: Rise of Operations Research—Game Theory—yields an allied edge



Cold Wargaming

- US expectation of peace through nuclear deterrence vs. Soviet ambition
 - USSR takes the lead—and opens their schools to allied nations (except China)
 - But computers and mobilization of the scientific community plant the seeds of Western renewal
- 1950s:
 - Return of US wargaming based on post-war debriefs of German military
 - Rise of joint wargaming in the US
 - Popular gaming and other nonmilitary wargames
- 1960s:
 - Robert McNamara: Effective defense at a cost the United States can sustain over the long-haul w/ OR and wargaming
 - ARPA (DARPA) and RAND: Depict all the political, psychological, and economic ramifications of war, incl. insurgency
 - ARPANET
- 1970s onward:
 - Top Gun and Red Flag
 - Increasing integration of virtual combat
 - Rise of China—and adoption of Western wargaming



Modern Wargaming

- With the collapse of the Soviet Union, America stood as the world's lone superpower by the 1990s—and so too in wargaming
 - Reemphasis on Joint wargaming
 - Expanded focus on wargaming within Professional Military Education
 - Widespread adoption of virtual environments
 - Diversification on granularity, cost, and rigor
 - Deliberate and Crisis Planning
 - Increased sharing with partners and allies
- Title X wargaming: Renewed focus on the future
- **Meanwhile, massive US success in Iraq caught the eye of China—and jump-started a massive wargaming modernization effort, including the adoption of computer wargaming techniques**

2020s and beyond: Expanded mission sets, expanded tools, expanded outcomes....



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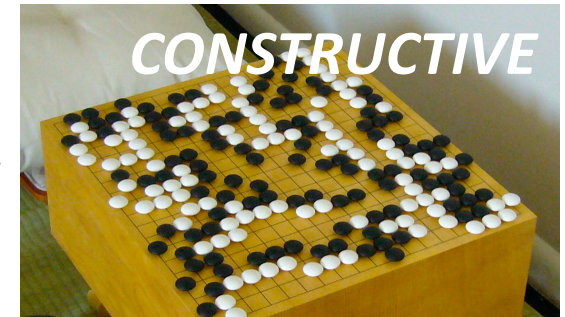
Rethinking Skillsets, Improvements, Other Considerations

Live, Virtual, Constructive, and Mathematical Games

		Player 2			
		B\R	3,0	0,3	2,1
Player 1	4,0	MATHEMATICAL			
	0,4				
	3,1	0	1	0	1
	1,3	1	0	1	0
	2,2	1	1	0	0

MATHEMATICAL games use letters and numbers to represent the participants. A single individual with pen and paper—or a computer—can (attempt to) solve the game—find the equilibrium behavior analytically.

Forces are represented by some symbol in *CONSTRUCTIVE* games—a chess piece, a cardboard square, glowing pixels on a monitor. The level of abstraction may vary greatly—think Go or Axis and Allies

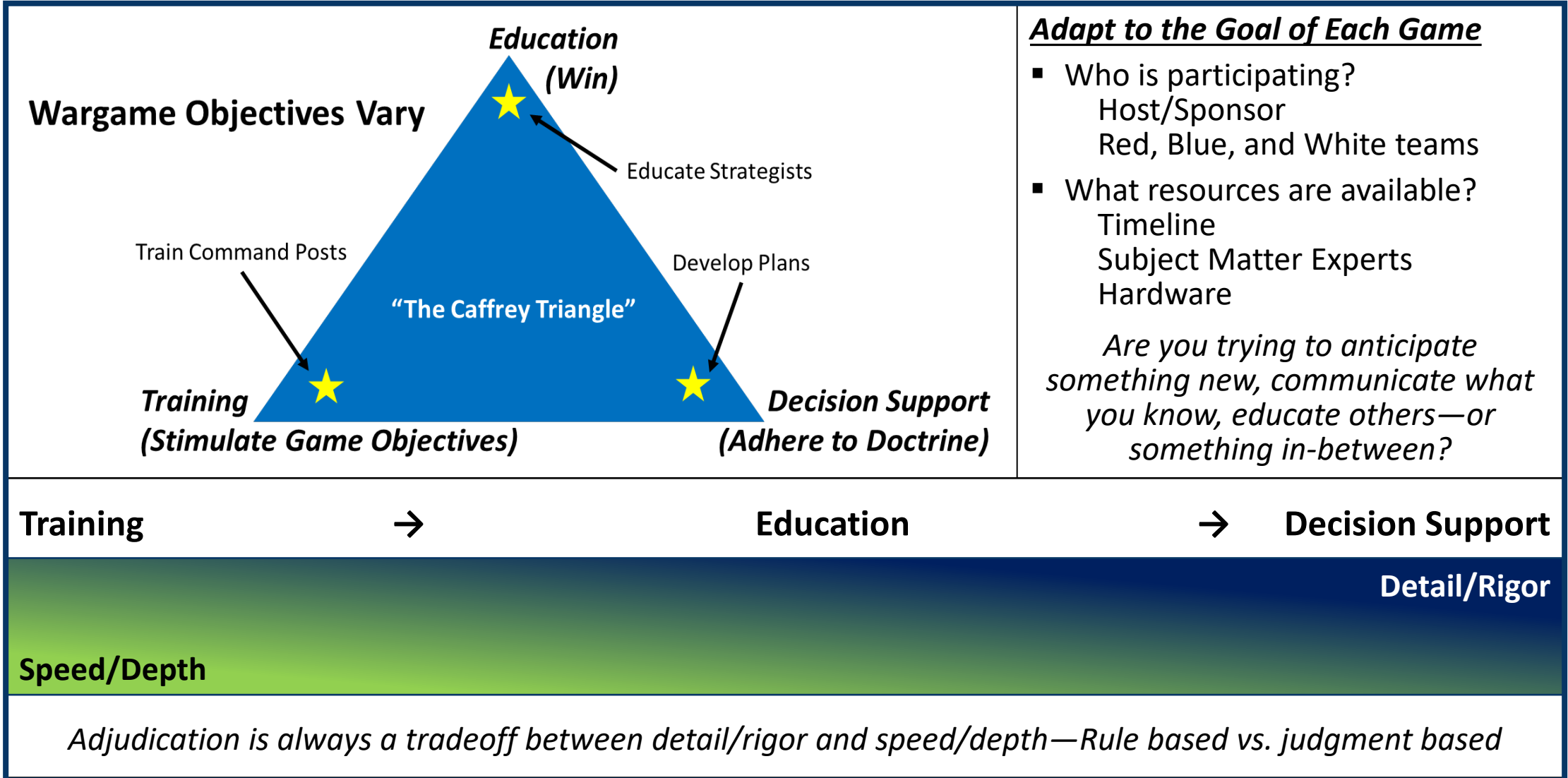


VIRTUAL is the newest form; in it, combatants use electronic simulators. From inside the simulators, they all look out on the same virtual battle space. They can see other friendly forces—and their adversaries

Everything from medieval jousts to modern Red Flag exercises are *LIVE* wargames because actual forces engage in (simulated) combat. Even some potentially lethal activities are sometimes included—e.g., Roman gladiatorial combat.



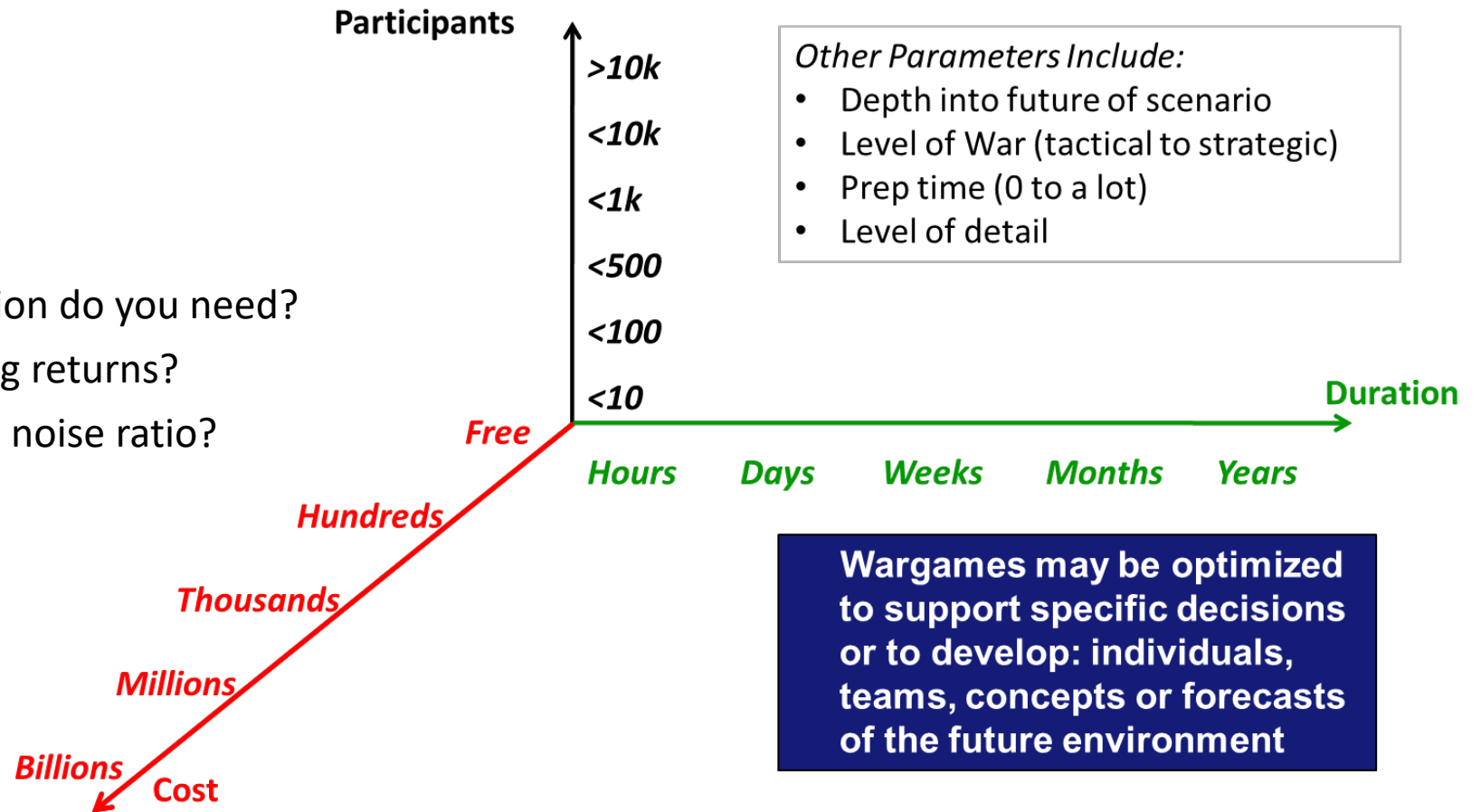
The Caffrey Triangle—Tailoring to Specific Needs





Scale of the Game

- What resources are available?
 - Time
 - Money
 - Facilities
- What is your goal?
 - How much information do you need?
 - Are there diminishing returns?
 - What is the signal to noise ratio?



Key Wargame Insights



Wargames can inform our understanding of (non-exhaustive):

- The quality of our own training
- Likely enemy responses to our tactics and strategy
- Optimal investment strategies and force posture
- Training requirements
- When not to fight

Can we distinguish Wargames from Modeling and Simulation, Exercises?

- Wargames are typically small-N (or single data points), M&S provides large-N capability
 - But M&S offers limited reactive capability, real-time creativity
- Wargames can elicit insights in unexpected directions, compared to static exercise tactics
 - But exercises provide more predictability and control
- ***But all are on the same spectrum, and inform each other***



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Wargame Personnel

Position	Role	Potential Duties
Executive	Oversight/Direction	<ul style="list-style-type: none">• Act on insights• Integrate WG effort
Supervisor	Lead & Manage	<ul style="list-style-type: none">• Set goals and provide resources• Lead & Manage execution• Endorse insights confidence level
Planner	Consume WG Insights	<ul style="list-style-type: none">• Provide “collection requests”• Appropriately incorporate insights
Practitioner	Produce WG Insights	<ul style="list-style-type: none">• Serve as SME on wargaming• Recommend most effective & efficient way of meeting WG goals• Prep for wargames• Analyze & report in wargames• Estimate confidence in insights
Participant	Effective Participation	<ul style="list-style-type: none">• Prep for wargames• Participate in wargames• Assist in analysis & reporting



The Wargame Process



- **Anticipate:** Executive, Supervisor
- **Plan:** Supervisor, Planner, Practitioner
- **Execute:** Supervisor, Planner, Practitioner, Participant
- **Analyze:** Supervisor, Practitioner
- **Document:** Supervisor, Practitioner
- **Communicate:** Executive, Supervisor, Practitioner
- **Act:** Executive, Supervisor





All roles participate at every stage—ebbing and flowing with demand

Supervisor, Planner, Practitioner, and Participant

Game Control

Analysis  **Adjudication** 

Friendly Forces  **White** **WG** **Blue** **Red** **Opposing Forces** 

Thinking in your Role

- Easy
 - Learn history & culture
 - Learn geography, economy, trade
- Hard
 - Learn objectives, doctrine
 - Assess likely influences
- Hardest
 - Learn planning, training methods
 - Learn perception of adversary
- Impossible?
 - Anticipate timing and nature of changes in strategy

Applies to all involved

Anticipate

- The Executive anticipates:
 - The right questions
 - The right personnel
 - The right path to a solution
 - The right action
- Works closely with supervisors to ensure that the game accomplishes the goals
- Acts on the results of the wargame
 - Makes decisions incorporating the game output
 - Ensures the right lessons are learned across the bigger picture
 - Anticipates the next questions
- *Must remain neutral—Do not exert command influence to force the desired outcomes*





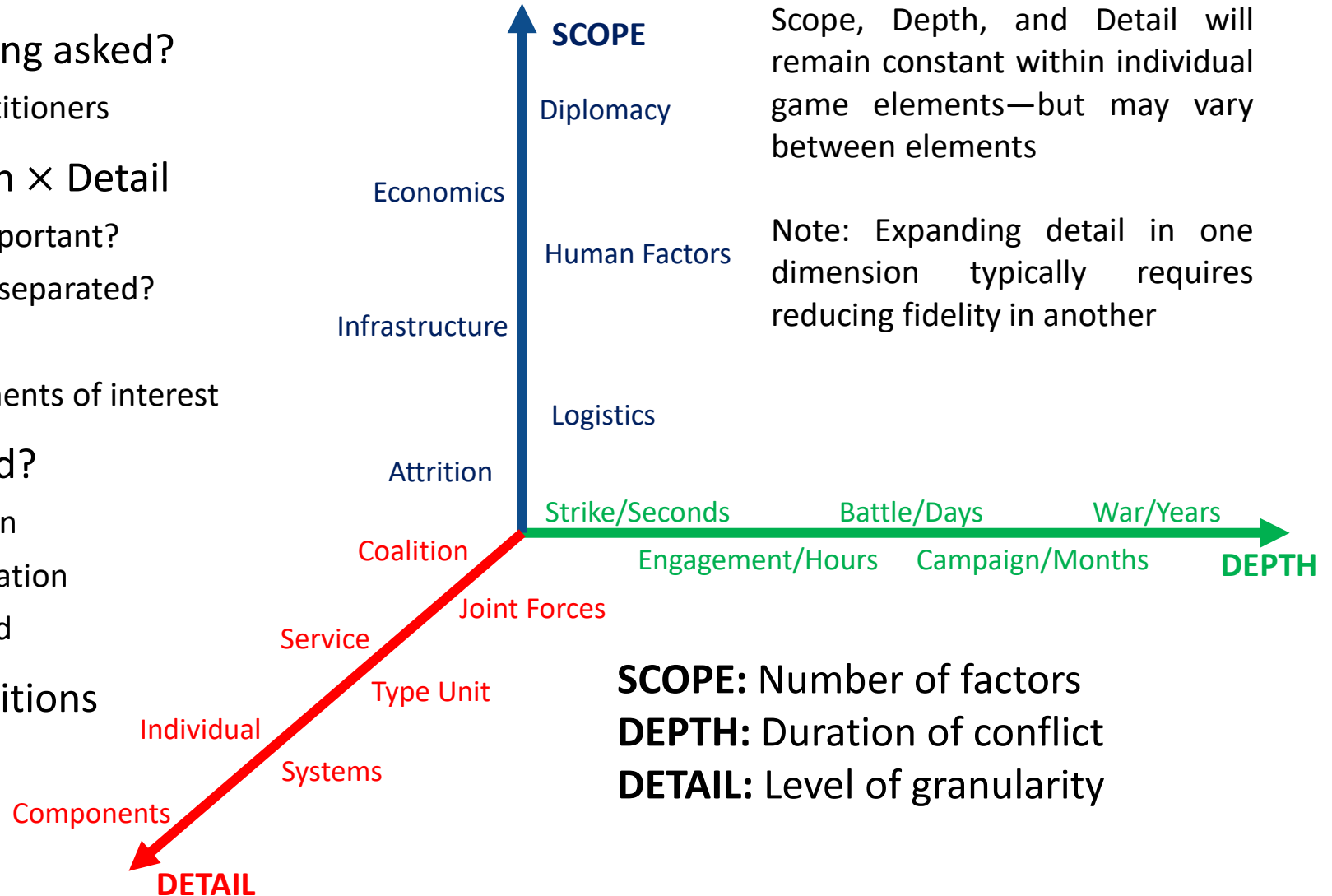
Wargame Control

- The Supervisor is the key decision-making authority within the wargame—The buck stops here
 - Understands the overall goals of the Executive—Not just the objectives of the wargame
 - Serves as the Executive’s eyes and ears throughout the day-to-day wargaming process
 - Shepherds the wargame to completion
- Works with all participants in the wargame as a team member to translate goals into action
 - Identifies and assigns personnel and resources
 - Fills gaps as needed
 - Verifies plans are appropriate and feasible
 - Endorses insights are accurate and supportable
- The Control Team also includes:
 - Facilitators/Game Control: Guide and administer execution; maintain schedule, track objectives, support players
 - Adjudicators: Identify outcomes based on player behavior, predetermined rules, and expert judgement
 - Analysts: Extract the impact and lessons learned as a result of the wargame
 - Planners and programmers: Prepare the flow of the game,, including automation, and generate needed information



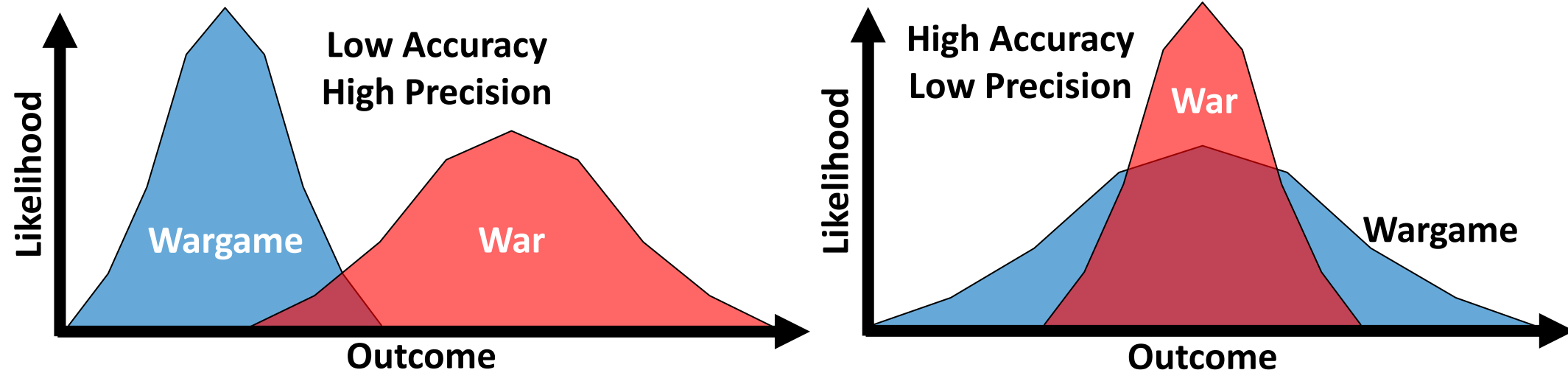
Plan—Scope the Game

- What are the questions being asked?
 - Advise supervisors and practitioners
- Resources \propto Scope \times Depth \times Detail
 - Which dimension is most important?
 - Can multiple dimensions be separated?
 - Do analogs already exist?
 - Signal to noise ratio for elements of interest
- What information is needed?
 - Request the right information
 - Incorporate the right information
 - Generate data where needed
- Establish sound initial conditions



Wargame Accuracy and Precision

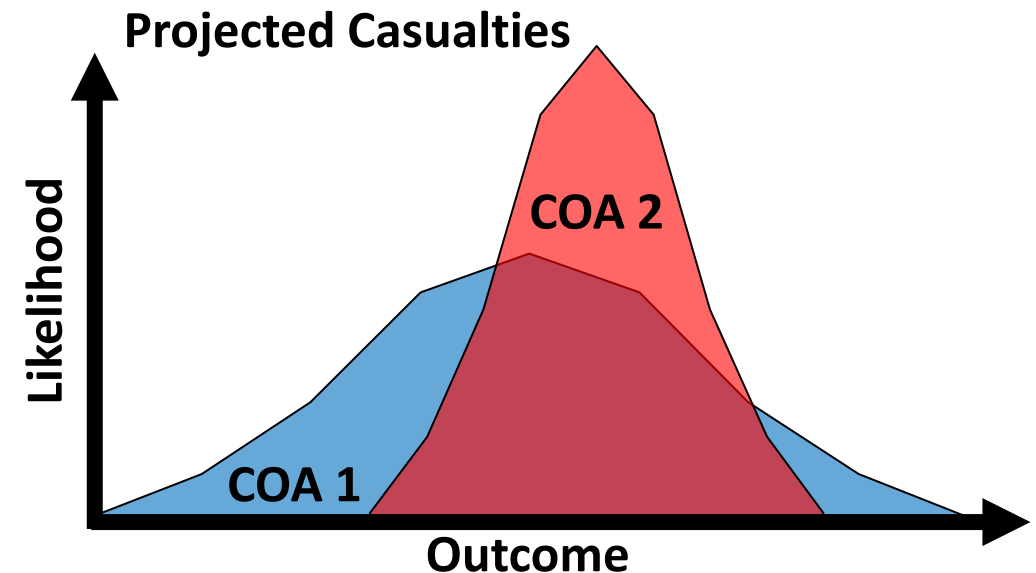
- Strive to achieve maximum *Accuracy* and *Precision* in wargames—but recognize the limitations
 - Each game is one look at a series of chance events; repeat the same scenario, and a range of outcomes will occur
 - Each war is one look at a series of chance events; many outcomes are possible, with some more likely than others
 - Accuracy & precision of the game depend on the complexity of the scenario & the effectiveness of design, execution
- Can you plan and develop a wargame that is more accurate, precise than the war itself?
 - Is your wargame still realistic if it is too precise? If the war proceeds as the wargame did, was your game accurate?
 - Perfect wargames draw from distributions that match the distribution of outcomes in war—But effective wargames may reduce uncertainty in war *and* change the expected outcome





Playing and Evaluating Accuracy and Precision

- Must also consider accuracy and precision when developing Courses of Action (COAs) as a player
 - What is the expected outcome v. the range of possible outcomes?
 - What is the likelihood that the prediction is correct?
 - What are the consequences if the prediction is wrong?
- Understand risk aversion
 - Are you willing to risk extremely negative outcomes for the chance of an extremely positive outcome?
- How do adjudicators evaluate unpredictable outcomes
 - Modern computers allow large scale Monte Carlo simulations to understand the full distribution of outcomes
 - But each simulation still only applies to one COA
- Critical to communicate uncertainty and limitations of the wargame prior to acting
 - Don't take the wrong lessons or become overconfident
 - One wargame may not capture the full consequences of a noisy COA





The Players

BLUE

- The “Good Guys”
 - Typically, we are focused on improving the performance of one side, but not always
- Challenges:
 - Innovation
 - Technology
 - Command Influence

RED

- The adversary
- Challenges:
 - Culture
 - Doctrine
 - Assets (Intelligence)
 - Command Influence
 - Resources—planning and execution

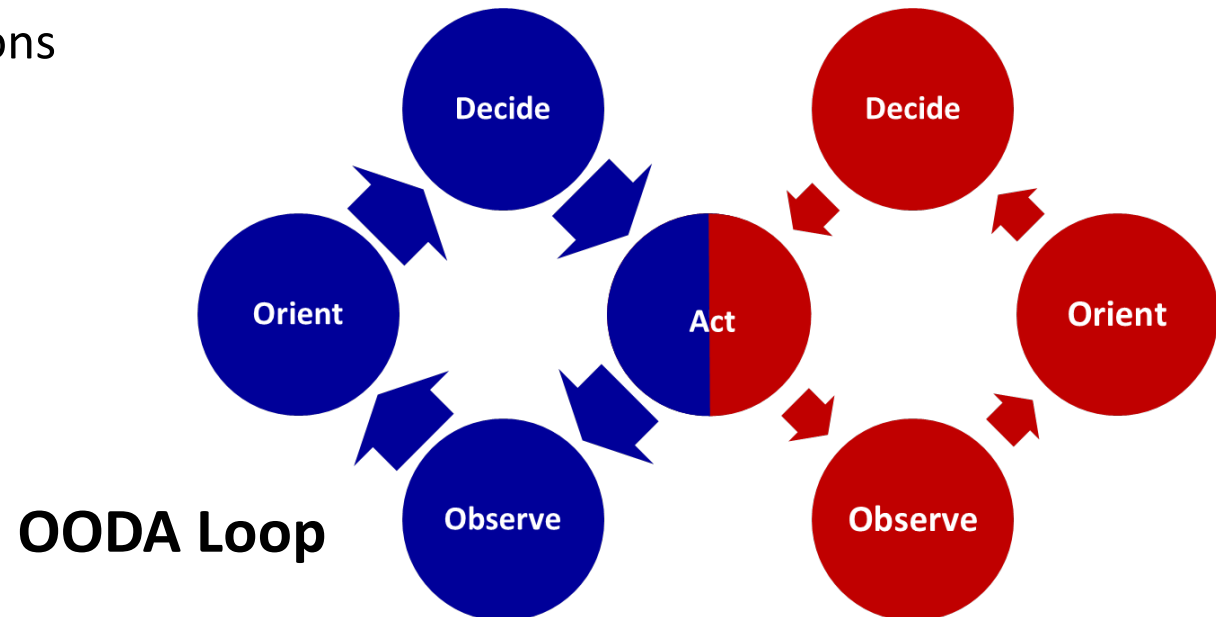
GREEN: Allies and Partners

GRAY: Neutral Parties

- Whether internal or external to the organization, players should adhere to the assignment—which will depend on the game’s goals
 - Education: Play to win
 - Decision Support: Adhere to doctrine
 - Training: Stimulate Game Objectives
- If the right information is not provided, request it
- Support Adjudicators and Analysts as needed—Clarify what was done and why

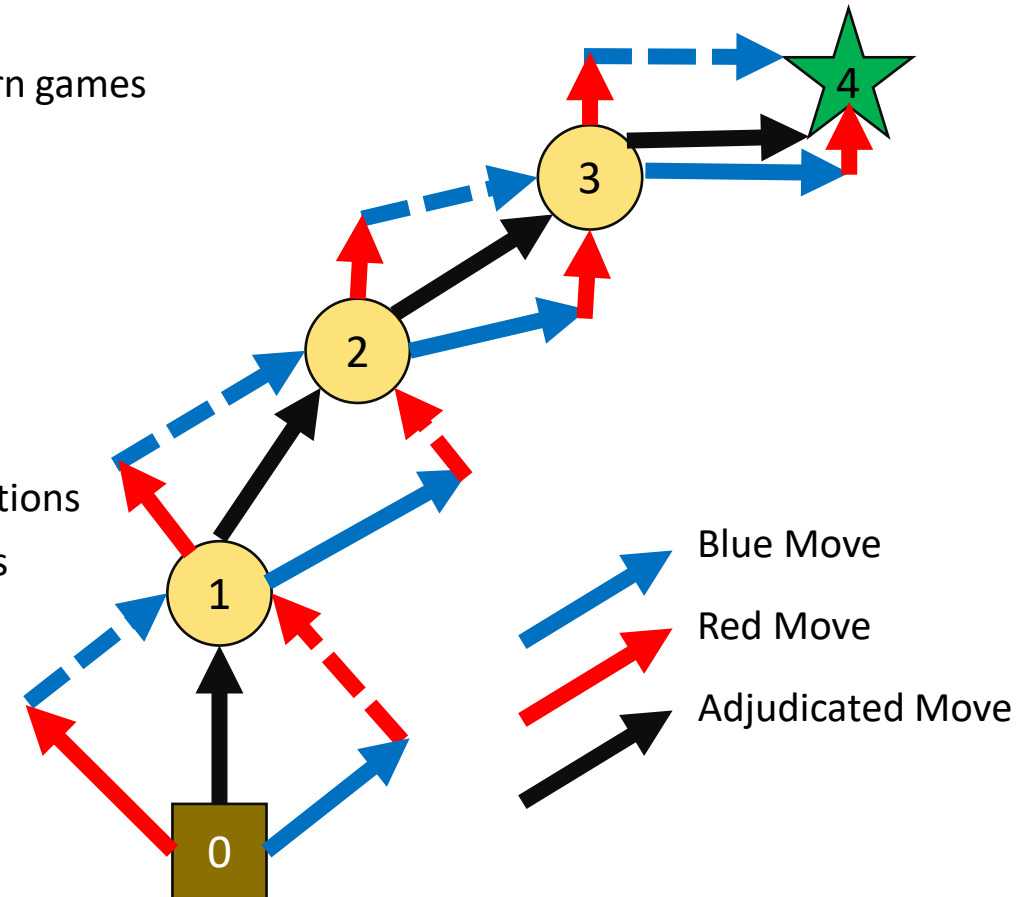
The Play

- Analyze character objectives and resources
- Learn adversary objectives and resources; work to anticipate how both may shape actions
- Develop plan to achieve objectives within resources
- Obtain needed info from provided materials when you can, submit an RFI when you must
- Develop each move with branches to respond to likely adversary moves
- Cooperate with analysis to capture lessons



Adjudication

- Once players move, *Adjudication* determines the result of each team's move, conditional on the other teams' behavior:
 - Establishes an end state--Or intermediate state in multi-turn games
 - Determines what information each team sees as a result
 - May be manual/human driven or preprogrammed
 - May or may not include Red/Blue players
 - Provides answers back to the rest of the team
- Path dependency is always a challenge
 - Obtaining specific end-states may require new initial conditions
 - Complicates definitive strategies—planning multiple moves
 - Just like reality, order of play impacts results
 - Error propagates
- Prepare to answer questions to justify decisions
 - For players: To the extent allowed by the game design
 - For executives, planners, analysis: This is critical





Analysis Continued

- Begins before execution—at the moment the game is conceived
 - What are the measures?
 - How can I use the available data?
 - What data already exists? How does it relate?
- Is fully mapped prior to execution—but adapts as needed
 - Unanticipated results are often the best results
 - What did the players actually think?
 - What did the simulator actually do?
- Complete, but timely
 - Incomplete analysis has incomplete value
 - Quick look reports provide information within days, but with caveats
 - But first impressions are often wrong—especially those drawn during the height of execution
- Forthcoming
 - What were the limitations? The errata?
 - External validity—Accuracy and precision

Focus on game objectives,
but observe everything

Lessons aren't learned until the analysis is
complete—and communicated

Clear, Concise, and Honest—
Lives depend on it

Documentation and Communication

- If a wargame takes place, but no one knows about it, did it really happen?
- Communication is up, down, and horizontal
 - Executives must be informed of progress, limitations, results, and analysis—whether they want to or not
 - Participants, practitioners, and planners need to know the results they are seeking
 - Team members need to know what is expected of them—and what they are expecting themselves
- Documentation must be robust, timely, and well-organized
 - Need to know what happened
 - Need to know what it means
 - Need to know how to do it again—but better
- Materials should have enough detail, but not too much—
Know your audience
 - Prepare to present information differently depending on the crowd
- Begin the moment the idea pops into your head, and continue through the entire wargame, including analysis and action



Action

- What do you do with the game?—It only provides value if you act on it
 - Update plans
 - Update investments
 - Update behavior
- The executive is not the only one to act
 - Supervisors, planners, and practitioners update wargame plans and processes
 - Players update their own behavior in future wargames and in the field
- What actions should be taken?
 - Relies on communication and analysis
- Consider external validity of the game
 - What assumptions impact the results?
 - When do the lessons need to be implemented?
 - Can they be implemented unilaterally?



“The wargame provided several insights and identified the most promising concepts and force structure capabilities that the Air Force will use to influence future strategy and acquisition decisions.”

**Mark A. Welsh, III
General, USAF
Chief of Staff**



Agenda

Ice-Breaker

Colonel Blotto

Introduction

Definitions, Value, Skillsets

History Of Wargaming

Generations, Goals

Wargaming Typology

LVCM Wargames, Operational Levels, Objectives

Wargame Administration

Personnel, Processes, Authorities

Futures Wargaming

Concept and Scenario Development, Adjudication

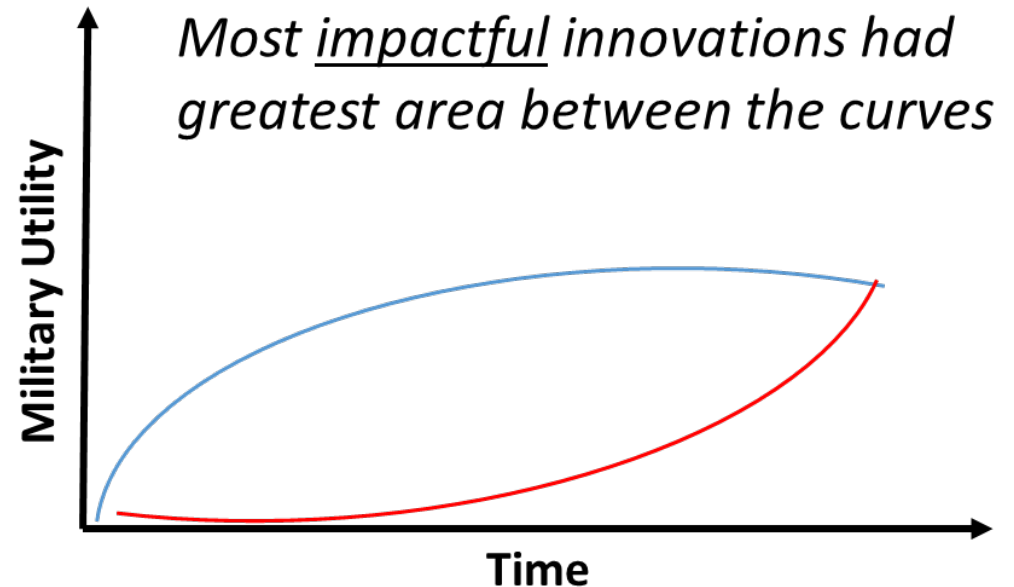
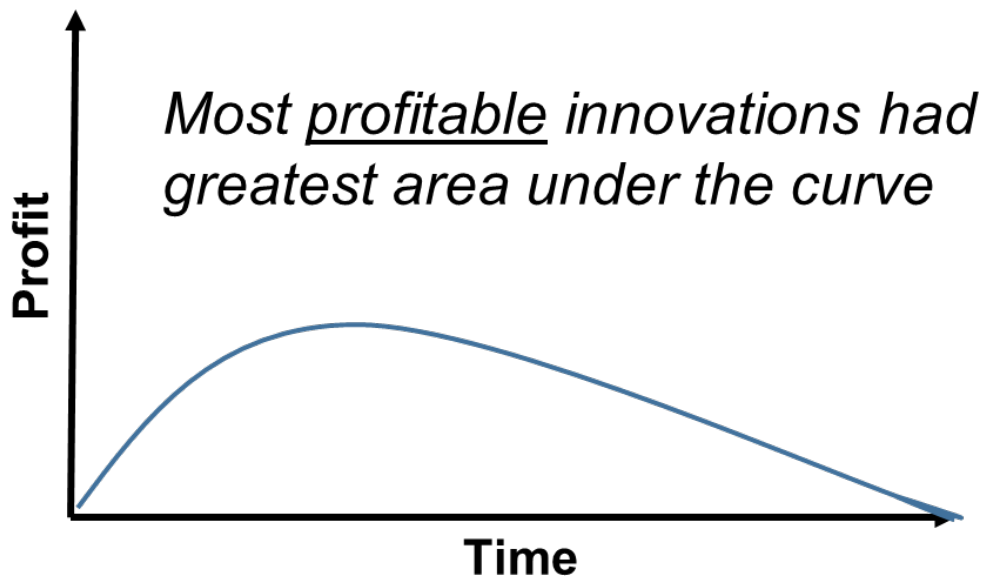
Bringing It Together

Rethinking Skillsets, Improvements, Other Considerations



Why Wargame the Future?

- The Bell Labs model—Basic science generates more *potential* innovations than resources allow
 - Need to prioritize developments
 - Life Cycle Profit \propto Magnitude of operating profit \times Duration of Profit – Cost of Innovation
- Maximizing value of innovation:
 - Maximize: magnitude of advantage, time needed for adversary to eliminate advantage
 - Minimize: time needed to reach maximum advantage, cost of innovation
 - Learn more, faster, and cheaper than the adversary





Wargaming Provides Edges

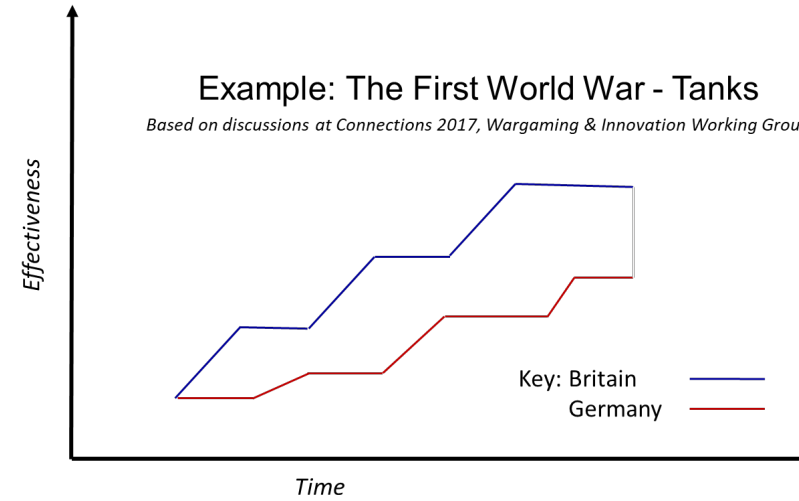
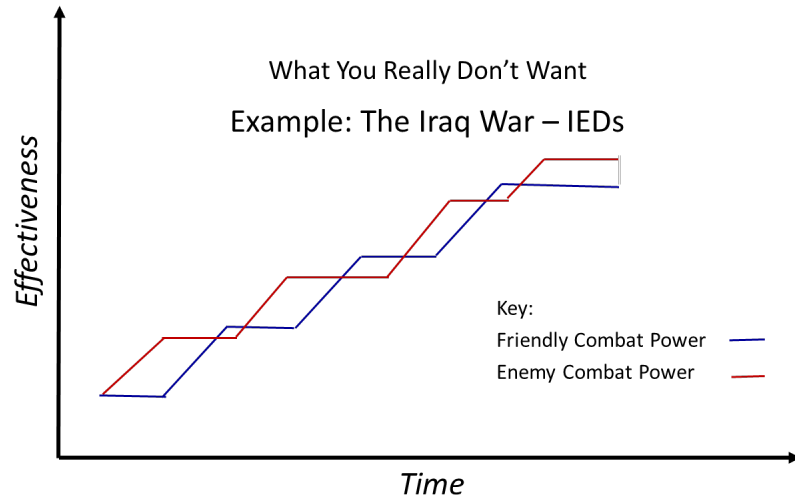
Edges are important:

- The more and stronger `edges` your side has: the shorter the war, the more certain victory
 - Superior numbers, better training, higher morale, geography, surprise, better technology
- Defeat is deadly—Even fights can be almost as bad
 - The UK won the Great War, and has not recovered
 - In Syria, the loss of life on all sides has increased with the length of conflict
 - The results in Ukraine are TBD, but not looking up
- Col Trevor Dupuy—Casualty rates consistent over ages, except for casualty spikes
- Andy Marshal & the Soviet Staff—*Military Technical Revolutions and Revolutions in Military Affairs*
- Technology, Tactics, and Organization

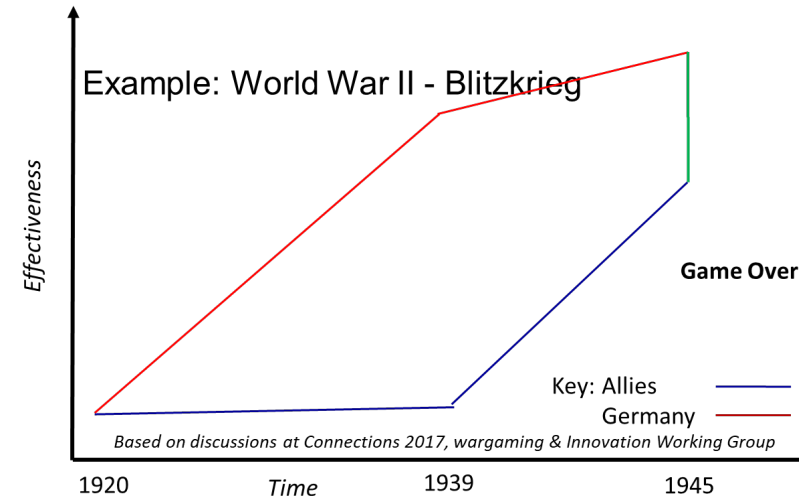
		Friendly		
		Pre-MTR/RMA	Immature	Mature
Enemy	Pre-MTR/RMA	Both at norm	F below norm E above norm	F very low E very high
	Immature	E below norm F above norm	F above norm E above norm	F below norm E above norm
	Mature	E very low F very high	E below norm F above norm	Both at norm



Historical Edges



- Effective wargaming supports the right scenarios—in the short term and the long
 - How do we explore the timeframes differently?
 - What tools are available?





History of Futures Wargaming

- Leaders want both:
 - Creative, Revolutionary Concepts—wide-net, low entry cost, new thinkers, many basic ideas, low detail
 - Rock Solid, Executable, “Real” Concepts—extensive validation, experienced professionals, small numbers, high detail
- Multi-level wargaming solves this problem:

Phases	1. Concept Idea	2. System Concept	3. Concept Candidate	4. Concept Finalist
Objective:	Innovative	Feasible	Playable	Cost Effective
Filter In:	Game Objectives	Game Objectives	Game Objectives	Cost Effective
Aprox #:	100+	60-80	40-50	10-20
Format:	Quad Chart	Toolbox	Toolbox	Toolbox
Elements:	Description Advantage	Fielding Year Dev & Item Cost	Employment Red Counters Adjudication Education	Enhanced Trade Space Toolset
Filter Out:	Clear	Fieldable by Epoch	Military Effectiveness	Militarily Cost Effective
Use:	Concept Workshop	Concept Toolbox	Feeder Game	Title X Game



Designing the Right Systems: Wargaming, Modeling, Simulation, & Analysis

- Why do we take these steps?
 - Demonstrate system requirements prior to expensive prototyping
 - Can demonstrate design flaws prior to committing resources to hardware development
 - Inform the military value of novel concepts prior to investment
- Models: Help developers to understand the overall system they are building at appropriate levels of fidelity early in the design process
- Simulation: Allows developers to test modeled components in realistic environments the at low cost and low risk
- Analysis: Verifies and validates that the eventual prototype is likely to accomplish the desired goal in realistic scenarios without costly hardware investment
- Wargaming: Facilitates user insight and feedback early in the development process—when changes can still be made—while providing the possibility to identify previously unaddressed costs and benefits

All models are wrong, some are useful!

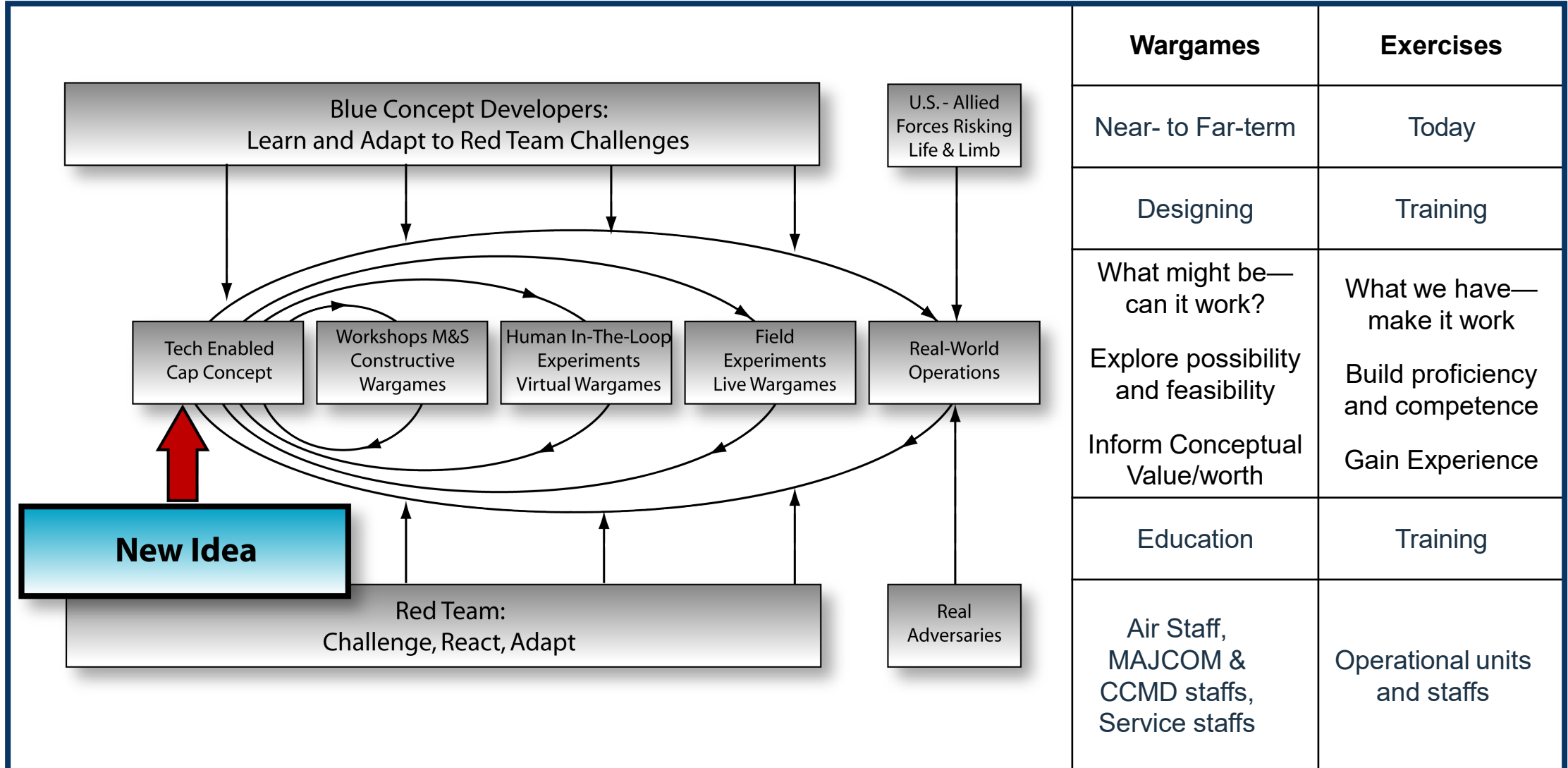
History of Futures Wargaming



- Hobbyists have long-practiced futures wargaming
 - Novelists and Hollywood have explored future wars employing novel technology: War of the Worlds, Star Wars
- Following USN in the late 1970s, USAF and USA expanded Title X series of wargames (e.g. USAF Futures Game (FG) & Unified Engagement (UE), USA Army After Next/Army Transformation Wargame) focused on future force development (15+ years out)
- AFRL Technology Seminar Games initiated in 2000 as spin-offs from FG in response to questions from Maj. Gen Norton Schwartz regarding the fieldability & capability of next-generation systems
- In 2004, AFRL Directed Energy initiated the Advanced Concept Experiment (ACE) series of wargames leveraging Virtual Flag technology
 - Likely the first use of futures wargaming focused on a virtual environment
 - Far enough in future to guide basic research investment
 - Continues today in modified form under the DEUCE moniker: Directed Energy Utility Concept Experiment



Why Wargame Novel Concepts?



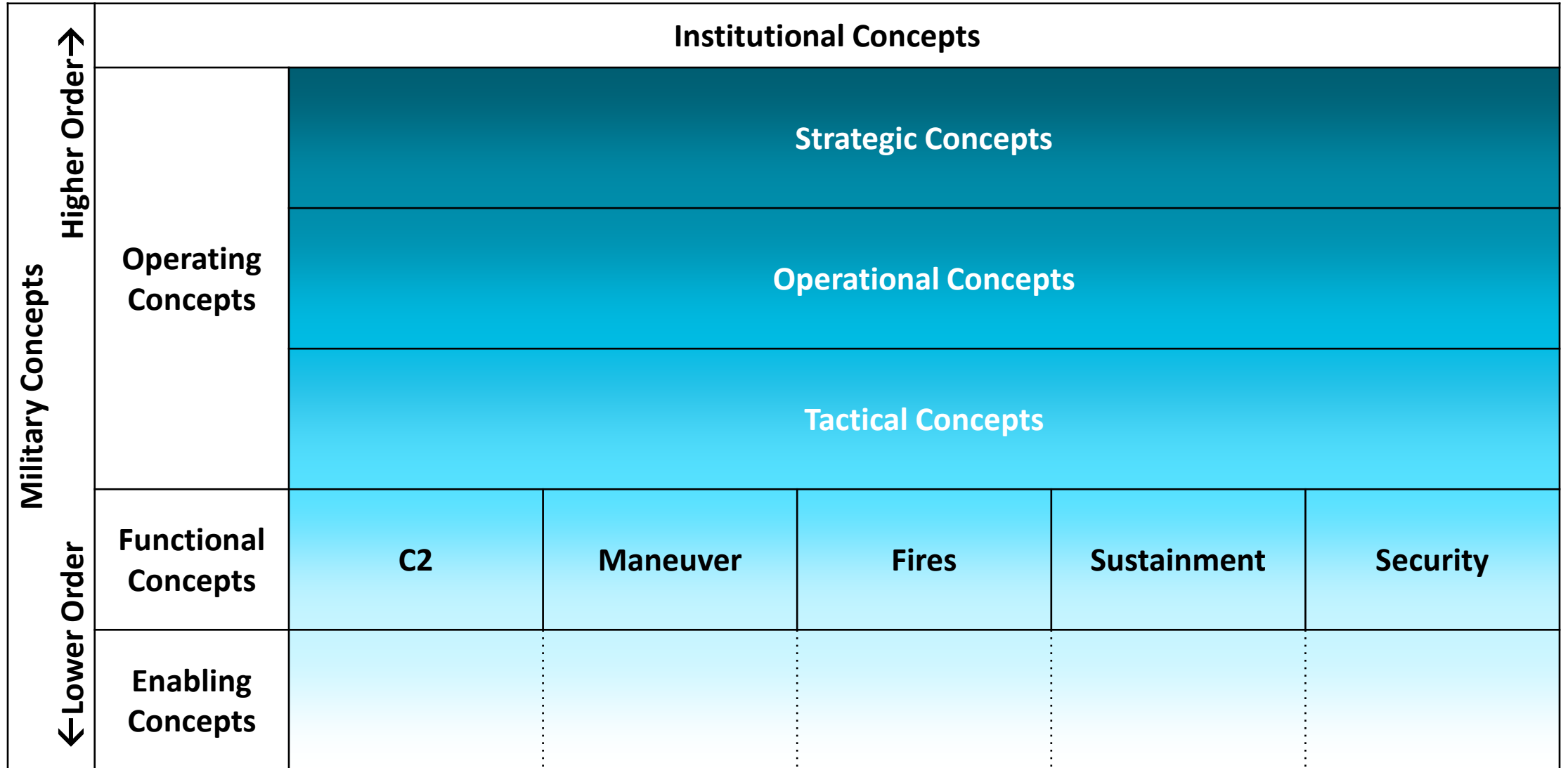


Concept Definition

- *Historical, Current, and Future* concepts are all used in wargaming
 - Historical concepts may be known in their time, or identified afterwards to characterize events—e.g., blitzkrieg and Napoleonic Logistics
 - Current and future concepts will evolve over time as they are improved or fall out of favor
- Levels of concepts:
 - **Institutional:** High-order description of the features & functioning of a military institution
 - **Operating:** Articulation in broad terms of the application of military art & science within some defined set of parameters
 - **Functional:** Description of the performance of a military field of specialization within a broader operating context
 - **Enabling:** Description of how a particular task or procedure is performed, within the context of a broader functional area, using a particular capability
- Novel concepts address new military problems or new solutions to existing military problems
 - They may be technological in nature, or they may relate to strategy & tactics, or organizational structures
 - Balance military art and science—identify the edge



Hierarchy of Concepts





Concept Development

- Novel capabilities can provide an edge in combat—these begin as novel concepts
- Concept development requires the right balance of operational knowledge, foresight of future needs, and technical expertise
 - Who meets these requirements?
 - Wargames can help develop operational knowledge. Can popular science provide the right technical knowledge?
- Approach from both directions:
 - Requirements pull—fill a gap*
 - Tech push—create a gap for the enemy*
- Concepts may succeed—accelerating development—or they may fail, stunting development
 - Wargames can filter out concepts that are not helpful to the operator with minimal investment
 - Concepts that are poorly structured and explained may wrongly-perceived to have limited value
 - Critical to write effective concepts and present them to the right audience, right wargames



Drafting Concepts

Elements of a Robust Concept:

- **Effective name:** Positive associations, descriptive yet memorable
- **Purpose of the Concept:** Lay out the intended use
- **Time Horizon, Assumptions, and Risks:** Identify the concepts dependencies
- **Description of the Problem:** Identify the military problem solved by the concept
- **Essential Description:**
 - **Definition:** Succinct, informative description
 - **Application and Integration of Military Functions:** Describe how the concept relates to existing tools, activities, capabilities, and concepts
 - **Requirements:** Describe the capabilities needed to implement the concept
 - **Spatial and Temporal Dimensions:** Describe where and when does it fits within the conflict

A robust concept will state its capabilities and goals clearly, concisely, and actionably while differentiating and orienting itself against competing concepts



Special Considerations for Technical Concepts

Initial Draft:

- **Robust name:** Positive associations, descriptive yet memorable
- **Definition:** Succinct, informative description
- **Describe capability:** Identify what the idea is intended to accomplish
- **Visualize:** Providing a diagram or schematic to visualize the idea
- **Technical Description:** Provide a scientific description of the product
- **Users:** Identify potential users of the product
- **Utility:** Describe the merit of the system to a user

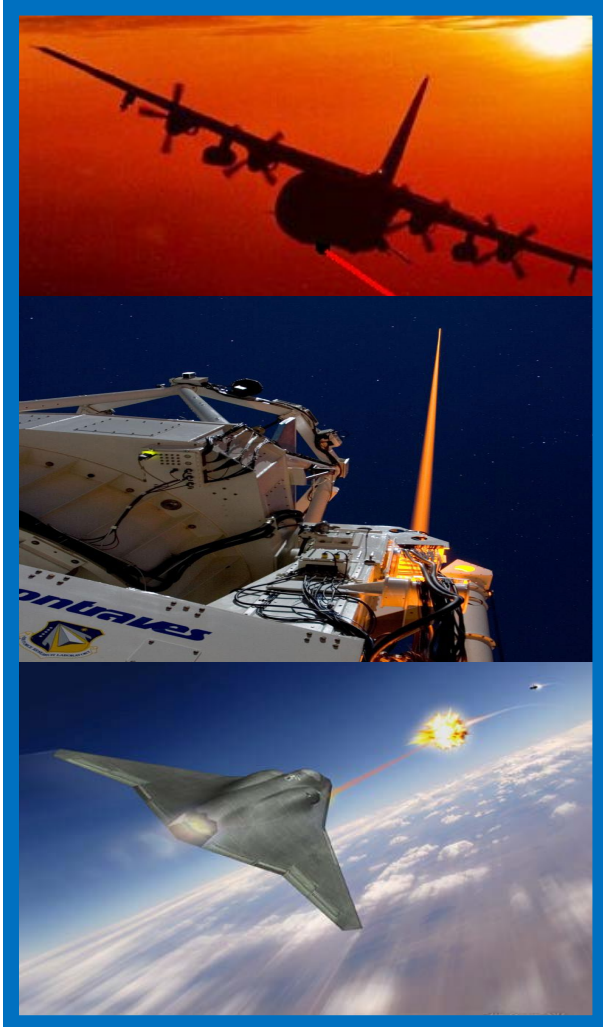


Additional Data to demonstrate value:



- **Wargame Developer:** Costs, IOC/FOC year, relative advantages over alternatives
- **Vetting/S&T Cell:** How performance will be achieved
- **Blue Players:** Operational impacts, method of employment, parameters
- **Adjudicators:** Parameters, especially performance vs. attacks, counters, & targets

Directed Energy Wargaming



- Special Considerations:
 - Spectrum management
 - SWAP
 - BDA
 - Simulation environments
 - Adjudication
 - Operational training and familiarity
- Require specialized tools
 - Most players are unfamiliar with nuances of DE
 - Does this impact the game? —It depends
 - Most virtual environments do not readily accommodate realistic DE requirements and effects
 - Impact of weather, magazine depth, damage assessment
 - How do we adapt to provide useable results?

Other Hot Topics in Wargaming

- Asymmetric/Nontraditional Combat
- Electronic Warfare, Cyber Warfare,
- Space Warfare
 - Sensor coverage
 - Kinetic interceptors
- Economic Warfare
 - How do sanctions, industrial capacity, supply chains, etc. impact warfare?
- Climate Wargaming—a rising topic of interest in wargaming
 - Are you wargaming the response, or preventing the event in the first place?
 - Highly-complex system of systems—Can wargames reach the right granularity?
 - What is the impact of individual
- Medical Wargaming—Fighting the next pandemic
 - How do we contain the next pandemic?
 - Who are the right participants?





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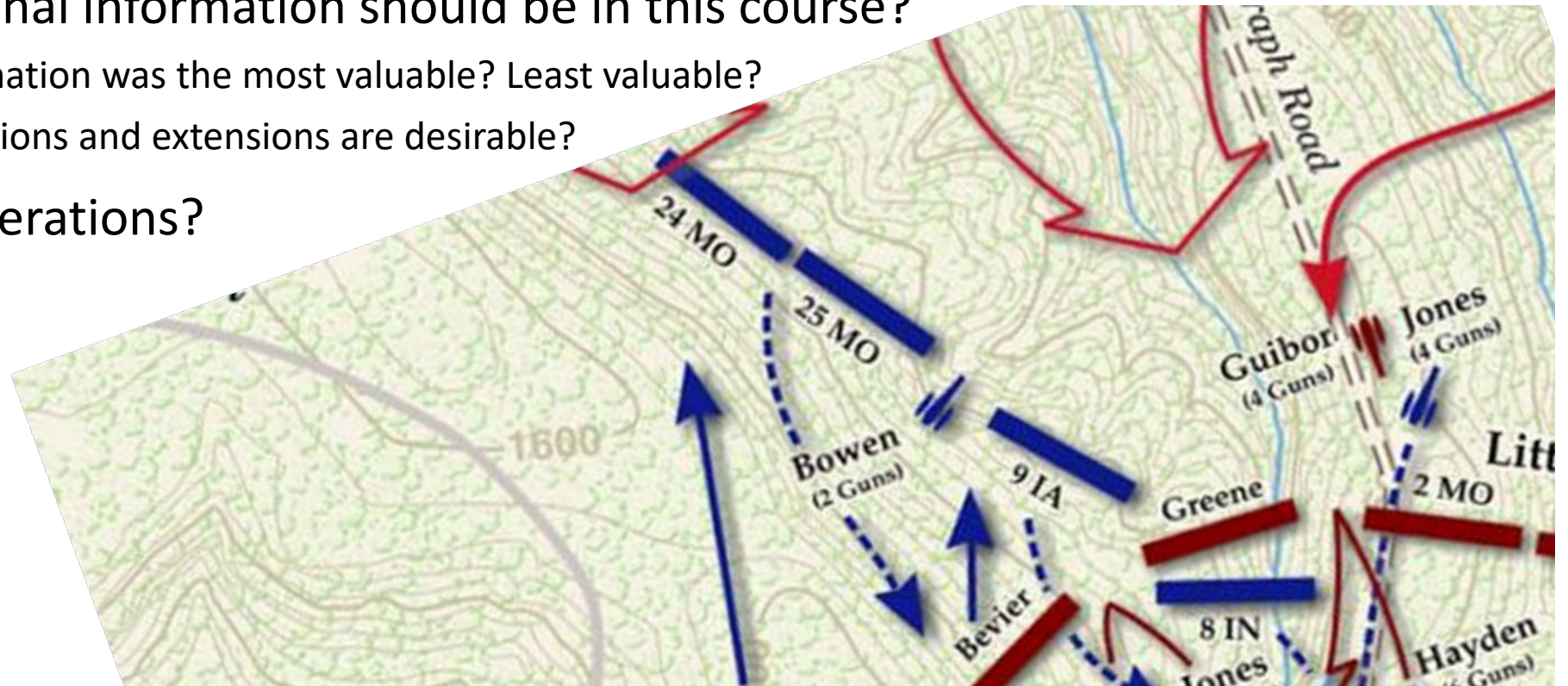
Rethinking Skillsets

- What skillsets are needed for wargaming?
 - Executive
 - Supervisor
 - Planner
 - Practitioner
 - Participant
- What additional skillsets are necessary for futures wargaming?
 - Concept Development
 - Operational Creativity
 - Technical foresight
- Do wargames have to study combat?



Next Iterations

- What additional information should be in this course?
 - What information was the most valuable? Least valuable?
 - What excursions and extensions are desirable?
- Other considerations?



Are you ready to join a wargame?



Additional Resources (Non-Exhaustive)

Courses

- AFIT: *Wargaming 101*
- MORs: *Certificate in Wargaming; Designing Tactical Games; Wargaming with Pacific Partners; Certificate in Cyber Wargaming; Gaming Cyber and Information Operations*
- Directed Energy Professional Society: Wargaming

Seminars and Conferences

- MORs: Annual Symposium; Wargaming CoP; Red Teaming CoP, Human Behavior and Performance CoP
- Connections (Professionally-Oriented Conferences)
- Georgetown University Wargaming Society
- King's College Wargaming Society
- Origins (Hobby-Oriented Conferences)

Books

- Matt Caffrey, *On Wargaming*
- Peter Perla, *The Art of Wargaming: A Guide for Professionals and Hobbyists*
- John Boyd, *A Discourse on Winning and Losing*
- NWC (Shawn Burns et al, ed.), *War Gamer's Handbook*
- CNA and NWC (Chris Weuve et al, ed.), *Wargame Pathologies*
- Robert Burks, et al., *The Craft of Wargaming: A Detailed Planning Guide for Defense Planners and Analysts*
- Graham Brown, et al., *Successful Professional Wargames: A Practitioner's Handbook*
- John Curry, et al., *The Handbook of Cyber Wargames: Wargaming the 21st Century*



QUESTIONS?