Competing Theater Strategies of Additive Complexity in the Iran War: Joint All-Domain Operations (JADO) vs. Mosaic Warfare

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1 Abstract

The 2026 Iranian War represents the first large-scale combat between two competing, untested 21st-century theater strategies. Joint All-Domain Operations (JADO) for the United States(US) and mosaic warfare for Iran. These competing theater strategies both represent campaigns of additive complexity, in which additional accumulations of complexity are wielded to overwhelm and collapse the opponent's capacity to fight. Instead of past wars where operations were conducted separately in individual domains (air, sea, or land) representing single layers (operations to sense, command, or strike), additive complexity campaigns are fought simultaneously across all domains (air, sea, land, cyber, and space) in all three layers of sense, command, and strike. Both JADO and mosaic warfare take different approaches to this as a multi-domain, multi-layer (MDML) conflict. This case study, substantively developed as the war unfolded in the first few days, attempts to capture and represent both theater strategies using qualitative systems thinking modeling with causal loop diagrams (CLD). From this model, five scenarios were forecasted as dynamic hypotheses, representing hoped-for, feared, and actual potential pathways for the conflict. These models and forecasts represent a general class of problems that military planners will face in future conflicts against adversaries using similar campaign strategies. An additional diplomacy model was added to simulate ceasefire negotiations and their impact on timelines for recovering, restoring, and reconstituting JADO and mosaic-warfare capabilities. Initial results and forecasts are compared against a dataset of 30,000+ munitions consumed over the conflict and available in the open source. The method demonstrates the benefit of 'hasty modeling' – a potential analytical technique for maintaining sophisticated forecasting ability in network-degraded or denied environments where scarce data, high ambiguity, and time urgency occur, without access to computational resources or communications links.

2 Introduction

The Iran War of 2026, a major combat operation between the United States (US) and its allies and Iran and its Axis of Resistance allies, lasted 38 days from February 28th through April 7th of 2026, when a ceasefire was declared. During that time, over a dozen state and non-state actors competed over a battlespace stretching from the Indian Ocean in the east to Cyprus in the west, Azerbaijan in the north, and Yemen to the south. Belligerents conducted thousands of kinetic strikes delivered by rockets, ballistic missiles, drones, and loitering munitions across multiple domains of air, sea, and land with engagement ranges as close as dozens of meters to thousands of kilometers. Space and cyber non-kinetic operations accompanied these strikes, shaping conditions and enabling operations. Each operation rapidly combined multiple layers of sensing, command and control, and effects with a rapid cycle of observe-orient-decide-act (OODA) loop. Over 15 countries were involved in or targeted by kinetic strikes. And though the ceasefire may have ended major combat operations across much of the theater, it has yet to bring peace. Sustained conflict between Israel and Hezbollah on the western flank of the theater provides a backdrop to intermittent strikes by both the US and Iran to enforce a blockade and closure of the Strait of Hormuz, causing global ramifications for the supply of vital resources, energy costs, and overall economic conditions.

The war highlights the first contest between two competing multi-domain, multi-layer (MDML) large-scale combat operations (LSCO) theater strategies: US Joint All-Domain Operations (JADO) doctrine and Iran's mosaic warfare doctrine.

Though every war is specific in its contingencies, the Iranian War represents a first-of-its-kind instance of a general class of problems that state actors may face in future conventional conflicts involving additive complexity or MDML LSCO.

The purpose of this paper is to present a first-of-its-kind paradigm system model for the general class of problems in campaigns of additive complexity. The primary audience consists of military planners, analysts, and policy stakeholders. The goal is to better understand what happened when JADO and mosaic warfare competed, why it happened, and what lessons can be learned for future engagements. Sources for terms and their meanings are current US military definitions[1] and doctrine[2]. Acronyms are presented in military standard form: first written in full and then referred to by the acronym. In addition to the lessons learned, the case study demonstrates the utility of systems thinking to enable analysts to create 'hasty' non-computational complex system analysis and forecasting for future operational planners that may take place in network degraded or denied environment where access to computer simulations or AI may be limited or too risky to access. The final audience is those seeking to better understand this new form of conflict and its impact on friends, families, communities, and the economy.

The boundary of the study is defined using a geographic, temporal, and population-slicing approach described below. The article examines the time period of MDML LSCO, from February 28th through April 7th, and, in some cases, a few weeks later. Subsequent diplomatic negotiations to secure a ceasefire are modeled, but only from the limited standpoint of how they might restart or pause MDML LSCO again. Beyond this work's scope are the strategic considerations for any participant in pursuing past or current conflicts, including nuclear proliferation, containment, and the utility of uprisings for regime change. For the latter, the author has developed a different paradigm system model of conflict between state and non-state actors elsewhere [3], [4].

The case study begins with a detailed problem description of campaigns of additive complexity and the different theater strategies the combatants can take in MDML LSCO. Next, a system paradigm, hastily modeled within the first 36hours of war as a causal loop diagram (CLD), is unfolded to explore key interacting feedback loops within the selected boundaries. The model led to five forecasts, all developed in the first 36 hours, of which the one forecast 'most likely' at the time was shared. The remaining are provided in the supplementary, which also preserves public postings and the timeline of forecast development as they occurred. A section on deliberate data collection from Open-Source Intelligence and Publicly Available Information (OSINT & PAI). From this, the actual results of the warfare are compared with the dynamic hypothesis, and seven key lessons are discussed, comparing the forecast with actual behavior. These lessons on contested campaigns of additive complexity aren't just limited to the US versus Iran. Still, anywhere JADO and mosaic warfare doctrines may compete, including in future conflicts with China.

3 Detailed Problem Description

Many problems begin when a war starts. The problem this paper focuses on is how to model and forecast two untested theater strategies of additive complexity competing with one another as they occur. For a fuller treatment of MDML LSCO operations and the lead-up to the outbreak of war, please see the supplementary material.

A theater strategy is a commander's organizing "construct" of how to combine instruments of national power to achieve "national strategic objectives[1, p. 216]." Additive complexity campaigns are a kind of theater strategy targeting multiple types of the opponent's targets, each requiring some level of organizational complexity to respond. When the targeted complexity exceeds the available organizational complexity, a threshold effect occurs, and the system collapses to a simpler level. This causes a degradation of organizational complexity, meaning the next targeted level of complexity falls into an ever-growing gap. As the gap compounds in reinforcing feedback, cascading failures result in either the "outright collapse" or "seriously impaired responses" by an opponent[5].

Both mosaic warfare and JADO are theater strategies embracing additive complexity campaigns to achieve the national strategic objective. For the US, this was, at the start of hostilities, the collapse of the Iranian regime so that the people could take over the government, leading to the elimination of the Iranian nuclear weapons threat[6]. The Iranian national strategic objective, articulated in its mosaic warfare doctrine, was to ensure the survival of its current government by absorbing offensive attacks on its own territory while maintaining regime security against future uprisings, and imposing high costs through retaliation across a 'mosaic' of regional targets to force the US to de-escalate quickly [7, pp. 19–21].

The US JADO theater strategy is a multi-domain and multi-layer doctrine (MDML). JADO envisions all the domains of battlespace air, sea, land, space, and cyber[8] integrated across three layers. First, a sensing layer of intelligence, surveillance, reconnaissance, and analysis (ISR) "to understand the enemy", subsumed into a command-and-control layer that directs an "effects layer, which includes kinetic, non-kinetic, and information operations[9]." Iran's theater strategy, originally developed in 2005[10, p. 22], shares similar characteristics and began as "mosaic defense (defa e mozaik)[11]." Over time, this would evolve into a doctrine of mosaic warfare that decentralized command and control (C2) of military capabilities to survive early-phase decapitation strikes. Local commanders, acting on preestablished doctrine, would then activate their own and proxy force capabilities to respond and retaliate, inflicting "pain on the adversary" through combinations of kinetic barrages, cyberattacks, and terrorism to dissuade them from aggression or to de-escalate quickly[7, pp. 19–21]. Closing the Strait of Hormuz would also disrupt global energy supplies and increase pressures[10, p. 22]. This represents most of the same multi-domain approach as JADO (air, sea, land, cyber) but adds unconventional while removing space. Also, while JADO is mainly, though not exclusively, counterforce (e.g., aimed at instruments of national power), mosaic warfare is countervalue (e.g., aimed at civilian targets and infrastructure).

The multi-layer approach in both theater strategies is a current framework for a concept developed in the 1960's: the observation-orientation-decision-action (OODA) loop [12], [12]. Pioneered in aerial dogfighting between two pilots, OODA loops now interact with thousands of ground, air, maritime, and space-based sensors, directing kinetic operations across these domains, as parsimoniously depicted in a JADO concept image in Figure 1 [13, p. 1].

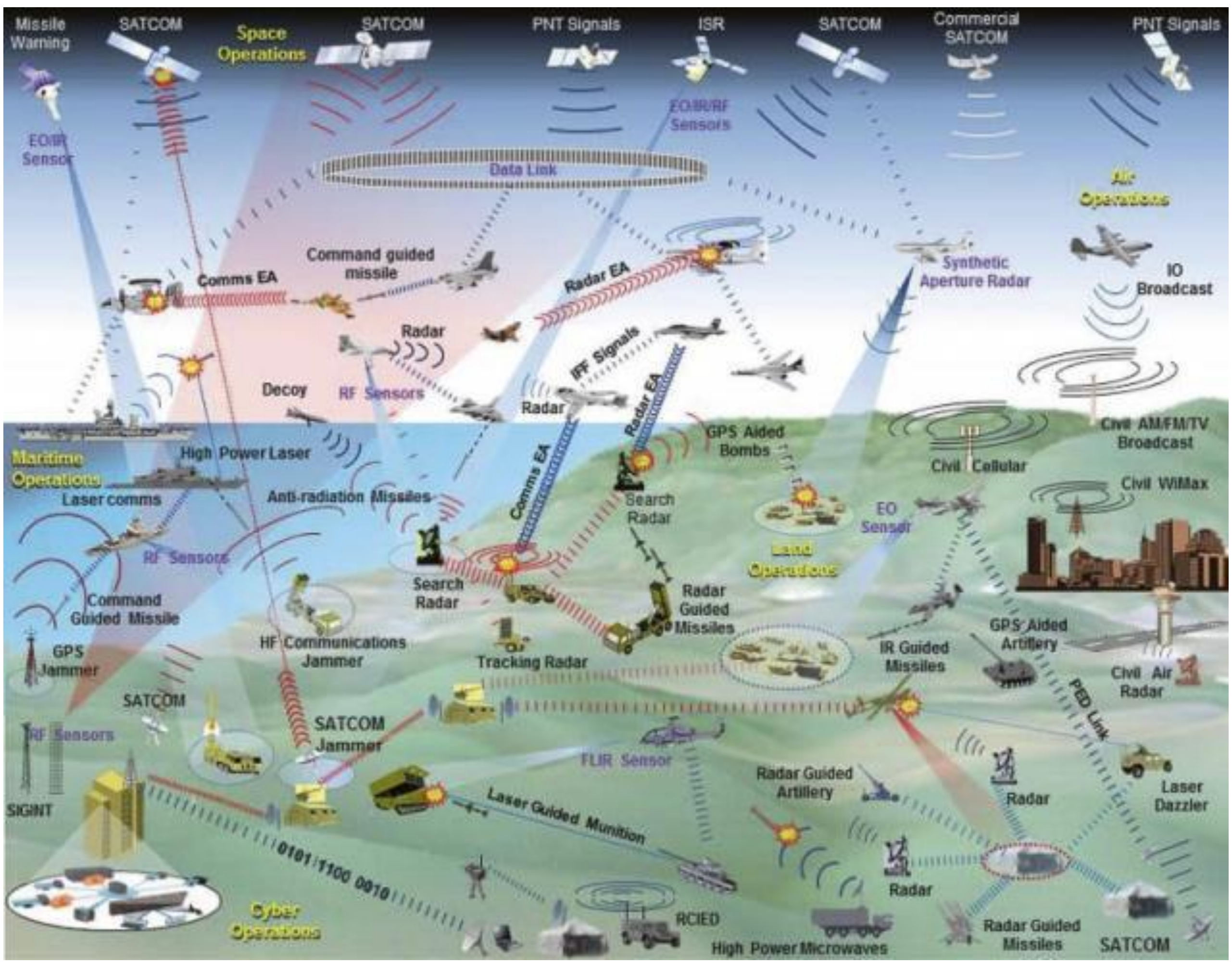

Figure 1: Depiction of Joint All Domain Operations (JADO) Concept

Figure 1 is both busy and static at the same time. But each depicted interaction is an offensive or defensive OODA loop, frozen at a moment in time like a frame in a film.

4 Hasty Methods: Modeling a JADO vs. Mosaic Warfare System Paradigm & Initial Forecasts (3,485)

In this work, the author leveraged CLD in a 'hasty modeling' effort in the first 36hours after the outbreak of war. A CLD identifies positive and negative feedback loops leveraging a well-established library of system archetypes [14], [15], [16], [17]. This allows 'hasty' assembly of pre-existing structures with known reference modes[18]. As a blueprint for future computational efforts, qualitative CLD can aid in developing future quantitative system dynamics computer simulations to capture causal feedback loops in continuous time using calculus [19]. CLD modeling also solves a key problem in evaluating theater strategies in real time – the potential degraded or denied environments where computational resources are low or unavailable, data is scarce, and high ambiguity prevails [20, p. 10]. For further information on the pros and cons of hasty qualitative modeling such as this within the field of system dynamics readers can reference the so-called "quality debates" beginning in 2007 on whether useful models and forecasts[21] can be obtained from scarce data and the value of exploratory versus calibrated models [22], [23], [24], [25], [26], [27].

In this effort, hasty modeling of a JADO vs. mosaic warfare system paradigm led to five forecasted scenarios in the first 36 hours from the start of the war, with refined dynamic hypothesis reference modes in the first five days. These results were developed into a full paper and submitted just 18 days after the war began (see supplementary materials for preserved online posts). To achieve this 'hasty analysis', a simplified form of slicing complex problems [27] and the so-called standard method for developing qualitative models [28] were leveraged. The geographic slice was limited to the active combat theater of 15 countries, and the time slice began with H-Hour, the start of operations, and continued through the first ceasefire. As this was a 'hasty method,' many sacrifices were made, even in the standard method, to deliver a working model in < 36 hours (see supplementary for more detail on slicing choices and modeling limitations).

Throughout this section, "objectives" refers to both the doctrinal JADO and mosaic warfare objectives, as well as leadership statements on military objectives. As these shifted over time, the objectives referred to here were those issued within the first 36 hours (for the hasty modeling of the system paradigm) or clarified on March 2nd, for the scenario forecasts built from the system paradigm.

4.1 JADO vs. Mosaic Theater Strategies System Paradigm

The system paradigm model unfolds across seven phases of conflict described below. The model anchors two phenomena, capturing the essence of the competing theater strategies of counterforce (JADO) and countervalue (mosaic warfare), as shown in Figure 3.

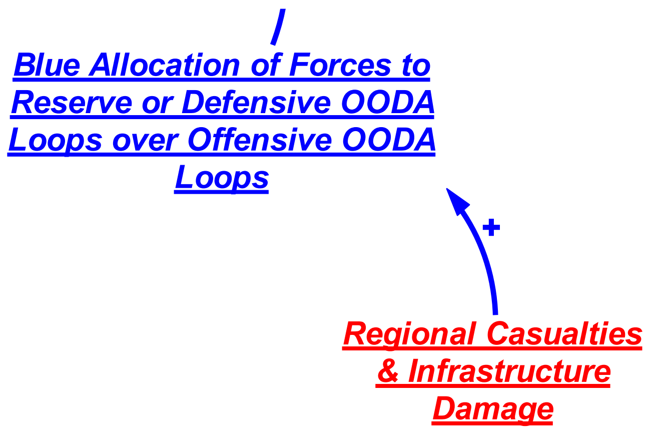

Figure 2: Two Key Phenomena of the Model

To achieve its counterforce strategy, Blue allocates forces to Offensive OODA Loops that attack Red's command and control (C2) and conduct interdiction and close air support against Red's military targets to suppress uprisings and insurgencies. Red's mosaic warfare strategy is to absorb these attacks while imposing enough countervalue costs in regional casualties and infrastructure damage to force a shift in the allocation of Blue forces away from offense to defense or reserves. Allocation is not an all-or-nothing, binary switch, but a gradient of relative priority between the two. The oscillation between these two phenomena, counterforce and countervalue, sets the pace for the phases that follow.

4.2 PHASE I: Offensive CounterAir by Blue in Red Territory

The initial Blue Phase of JADO consists of Offensive CounterAir Operations protecting friendly aircraft while destroying enemy aircraft and conducting suppression of enemy air defenses (SAED) missions [2, p. 4]. Establishing air superiority is a negative feedback loop in Figure 3 that seeks the Blue Desired Level of Air Superiority. At this phase, offensive OODA loop operations are heavier than defensive OODA loop actions.

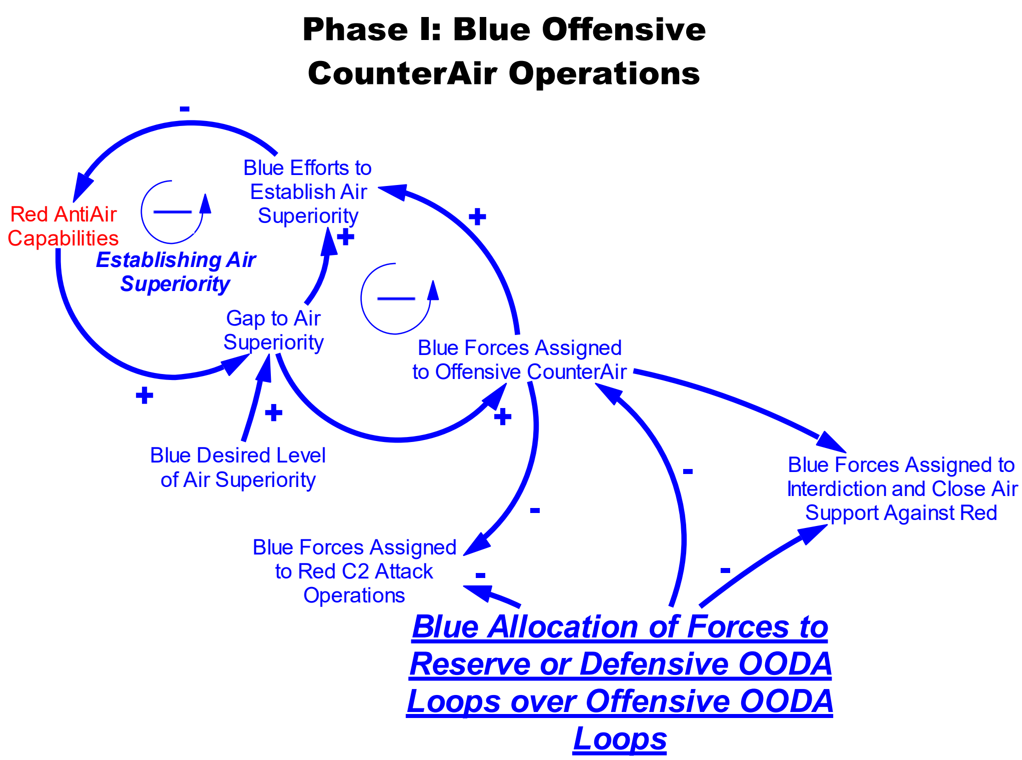

Figure 3: CLD at Phase I

As air superiority is reached, Blue Forces assigned to Offensive CounterAir can shift to offensive operations against Red in Phase II below.

4.3 Phase II:

Phase II is a single-phase split into two large simultaneous actions presented separately for clarity.

4.3.1 Phase II-A Blue Decapitation Strikes on Red C2

Using standoff munitions in parallel with Phase I or aircraft, as soon as it is safe to do so, JADO targets Red's command and control (C2) capabilities. These strikes add additive complexity by eliminating both civilian (e.g., Supreme Leader Khamenei) leadership and also severing operational command and control of Iran's military forces, including the Iranian Revolutionary Guard Corps (IRGC) and the Basiji.

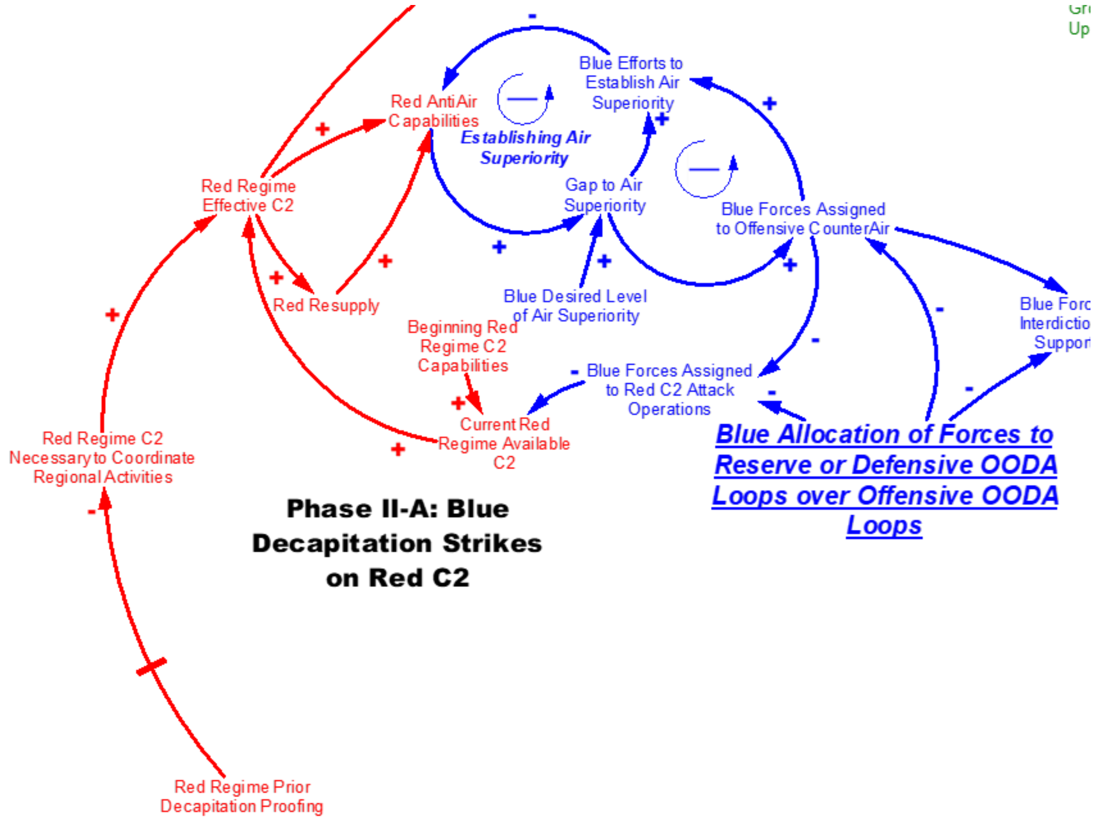

Figure 4: Phase II-A Decapitation Strikes against Red C2

However, Red's mosaic warfare doctrine is developed to 'proof' the regime against such strikes.

4.3.2 Phase II-B: Blue Interdiction and Close Air Support to Uprisings & Separatist Movements against Red

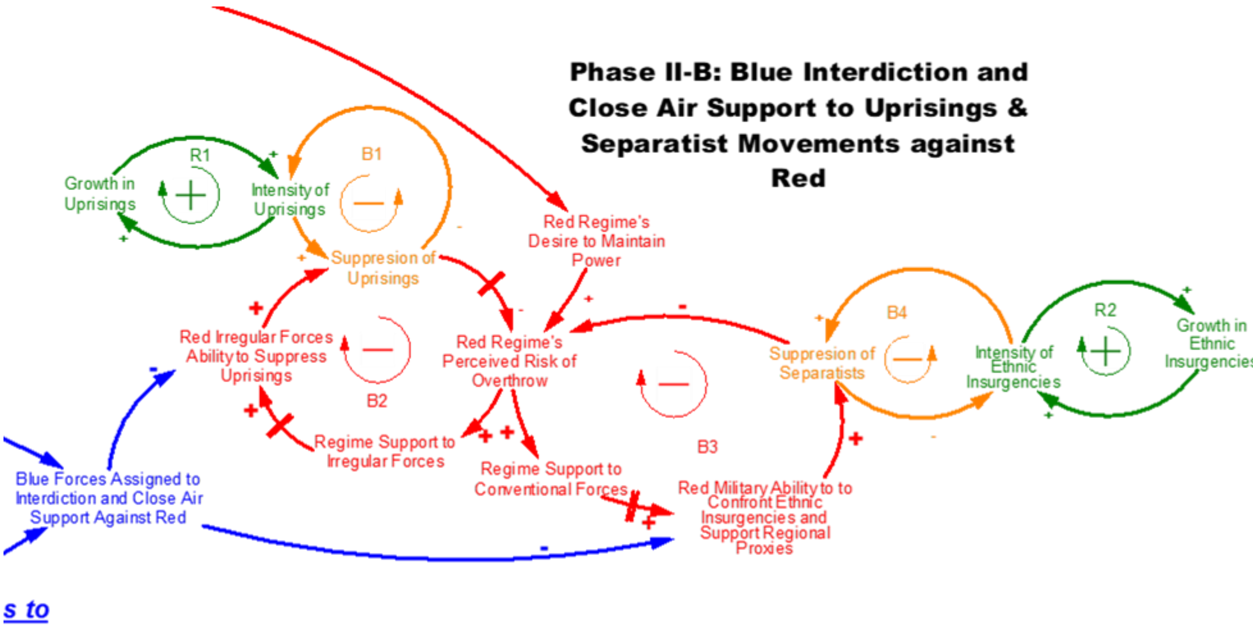

Figure 5: Phase II-B Interdiction and Close Air Support to Uprisings & Insurgencies against Red

To achieve regime change, popular uprisings and ethnic insurgencies must rise to a point where they legitimately threaten the Red's hold on power. As either or both of these grow, they can benefit from exponential feedback as people realize the weakness of a regime. Aware of this risk, regimes invest in internal forces to suppress the risk [7, pp. 19–22], represented as a double-fronted growth and investment archetype [16, pp. 73–86], [15, pp. 16–18] in Figure 5. These archetypes consist of each of the 'growth' positive loops capable of exponential growth, in green, damped by two sequential negative feedback loops, one in amber and one in Red. The two archetypes anchor on the red loops to the Red regime's perceived risk of overthrow. As the Iranian regime's perception of internal risk grows, its investment in suppressive Basij and IRGC increases (red), which can then conduct more suppressive actions (amber) against the growth of popular uprisings and insurgencies (green). This is an example of 2nd- and 3rd-order effects (see supplementary for more details).

4.4 Phase III: Red Counters with Regional Barrages

Mosaic warfare, however, is designed with US air dominance in mind. Instead of attempting to contest air superiority over their own territory, Red activates retaliatory regional barrages in Phase III, as shown in Figure 6.

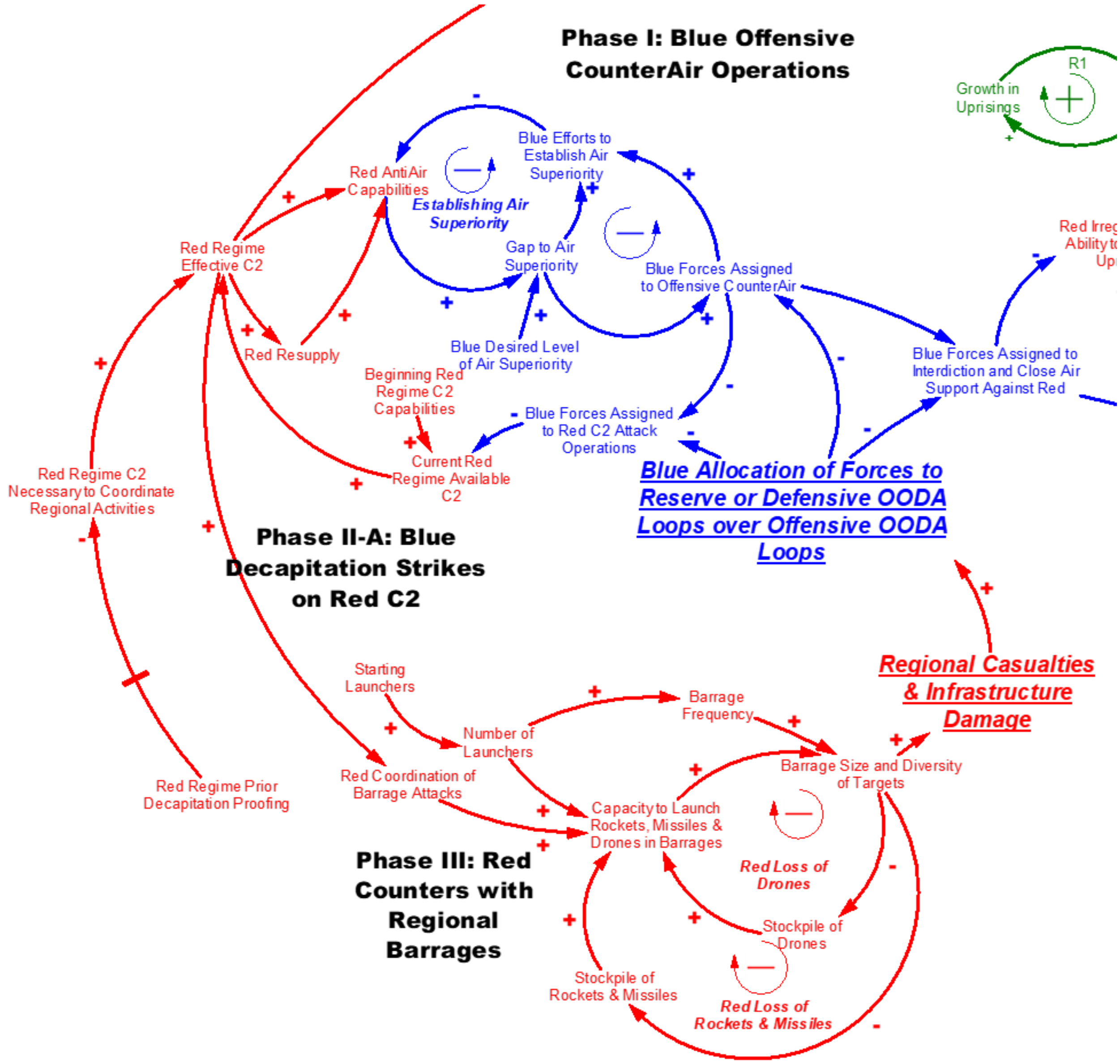

Figure 6: Phase III - Red Counters with Regional Barrages

Red regional barrages of rockets, missiles, and unmanned aerial vehicles (UAVs) not only target Blue military platforms (counterforce) but also regional civilian and infrastructure targets (countervalue). Barrage intensity and frequency are determined by the available launchers and starting inventory of munitions, minus losses. Red's additive complexity strategy is to use these barrages to shift Blue from offensive to defensive OODA Loops (see supplementary for additional details) as described in Phase IV below.

4.5 Phase IV: Blue Reallocates Airpower to Interception & Launcher Hunting

As Red regional barrages hit targets, or the threat of regional barrages remains high, Blue must reallocate its forces from offensive to defensive OODA loop operations, or reserves, as depicted in Figure 7.

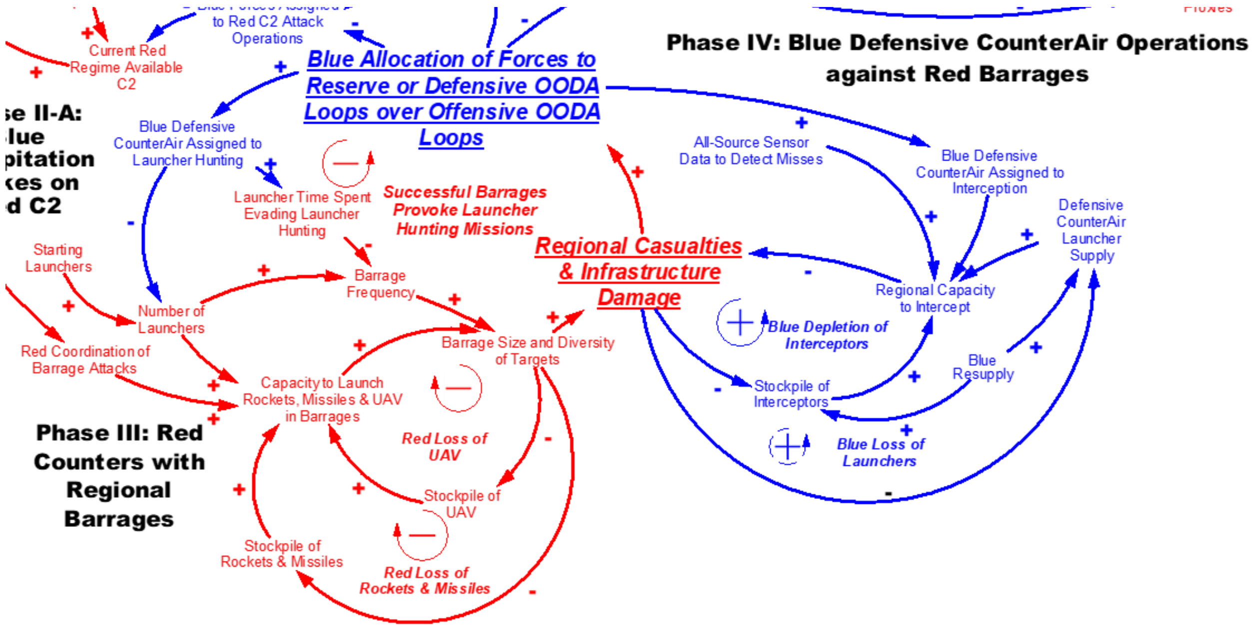

Figure 7: Blue Reallocates Airpower to Interception & Launcher Hunting

Phase IV represents true JADO MDML operations, requiring coordination of all activities to both absorb Red barrages and reduce Red barrage capability [4, pp. 31–33]. In Figure 7, this is simplified into defensive counterair operations: "interceptions" and "launcher hunting". The former includes all efforts to intercept barrages once launched. At the same time, the latter involves forces designed to hunt down the launchers firing barrages as well as the arsenals storing munitions. This is also a contest in inventory management, where aligning the optimal munitions use case depicted in the crosswalks is key. JADO's exquisite munitions can reliably destroy whatever they are aimed at. Still, mosaic warfare's cheaper munitions may overwhelm available interception and launcher-hunting capabilities.

4.6 Phase V: Red Counters by Activating Proxies

As Blue defensive counterair operations attempt to absorb regional barrages fired by Red, Phase IV progresses to Phase V when Red activates its regional proxies to conduct attacks of their own, as depicted in Figure 8.

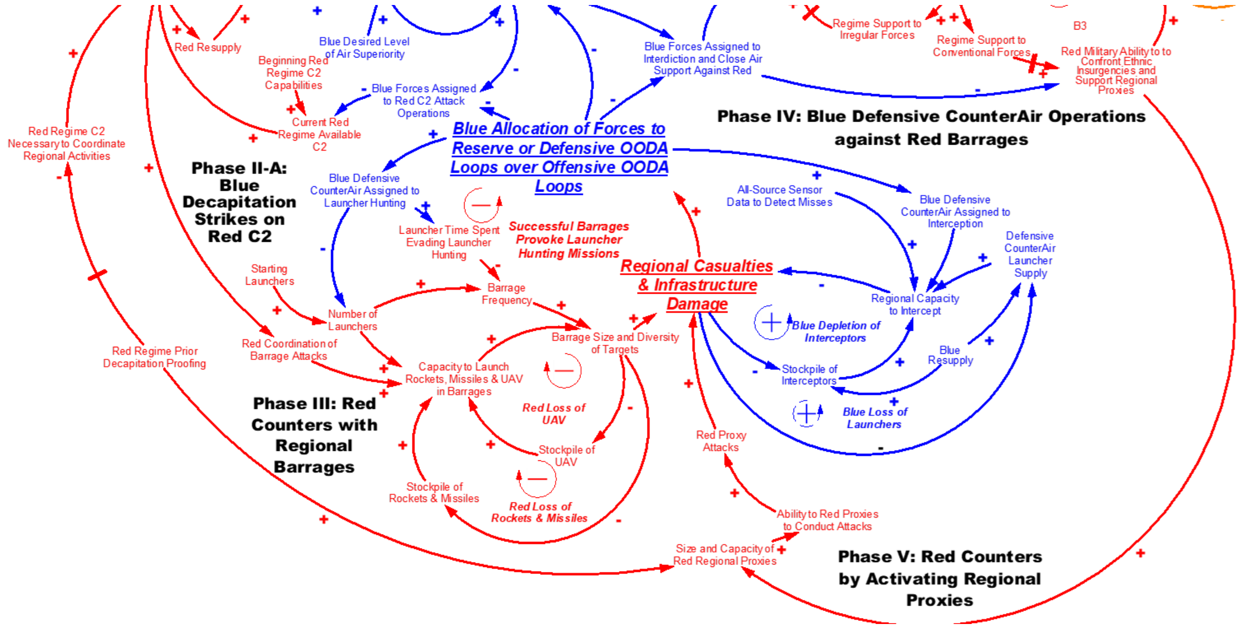

Figure 8: Phase V - Red Counters by Activating Proxies

The main axis of Red barrage fires and Blue defensive counterair operations runs east-west across the theater, from the interior and coastlines of Iran across the Persian Gulf towards GCC targets, or as far afield as Türkiye, Israel, and Azerbaijan. However, Iran's three proxies are positioned on the 'flanks' of this theater: Hezbollah in Lebanon, attacking south into Israel. Houthis in Yemeni attacking east into the Gulf of Oman, north towards the GCC, northwest towards Israel, or west into the Strait of Mandeb and Red Sea. And Shia-aligned Popular Mobilization Fronts (PMF) are opening new internal axes of conflict in Iraq by targeting US military installations supporting Blue forces. Activating regional proxies advances mosaic warfare's accumulation of additive complexity on Blue's ability to manage defensive counterair operations.

4.7 Phase VI: Blue Defensive CounterAir Against Red Proxies

In Phase VI, as regional proxy barrages impose their own countervalue costs on civilian and regional infrastructure, Blue must draw more forces away from offensive OODA loop operations inside Iran to defensive OODA loop operations in the broader regional theater, as shown in Figure 9.

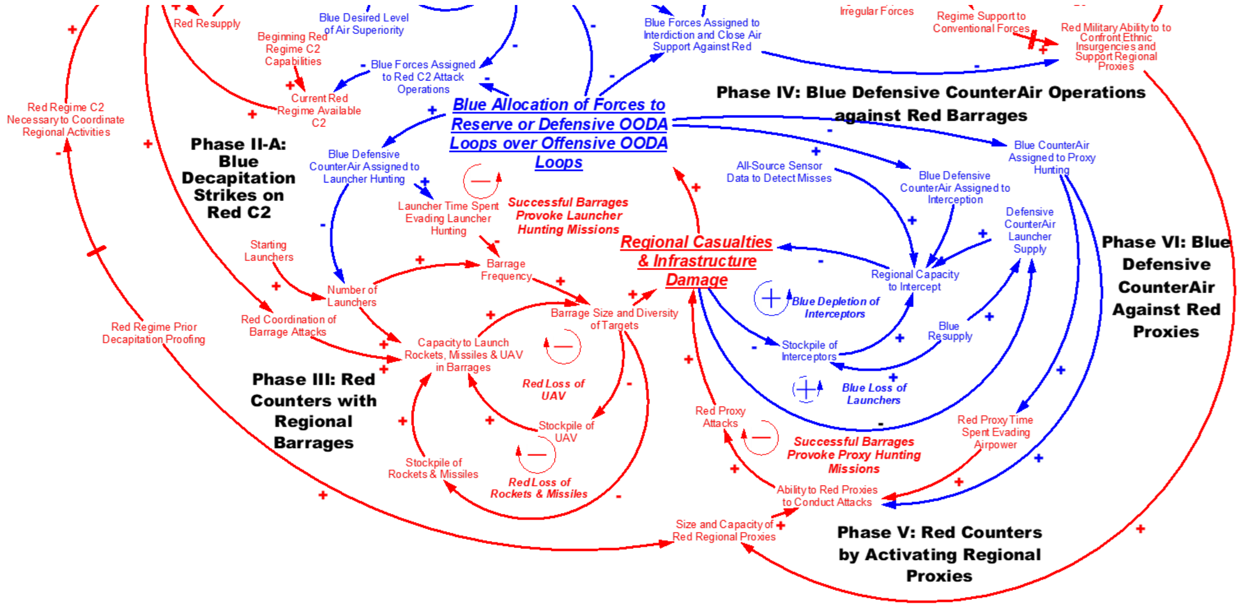

Figure 9: Phase VI - Blue Defensive CounterAir Operations Against Red Proxies

Phase VI represents a very high state of additive complexity between JADO and mosaic warfare theater strategies, with both sides 'putting everything on the table' depicted in Figure 10.

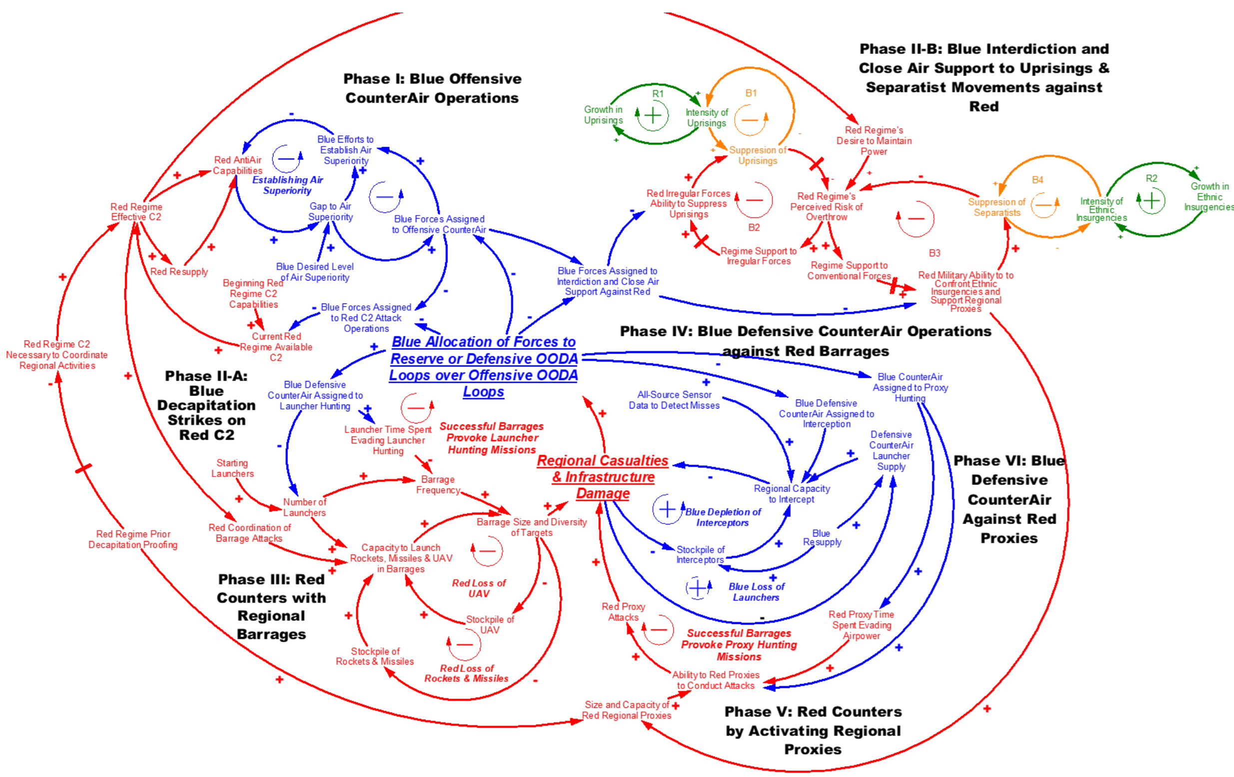

Figure 10: Complete JADO v. Mosaic Warfare System Paradigm

The additive complexity for Blue is managing simultaneous offensive and defensive OODA loop operations; carrying the battle to Red through counterforce strikes while limiting regional countervalue damage to its allies. For Red, the additive complexity challenge is to sustain countervalue retaliatory operations across both barrages and proxy attacks, drawing sufficient Blue forces away from offensive OODA loop operations within its own territory while imposing enough costs to force a negotiated settlement.

4.8 Phase VII: Collapse of Complexity

Campaigns of additive complexity, taken to their limits, result in system-state collapse in one form or another. If Red's mosaic warfare prevails at Phase VI, a Blue partial or complete collapse of operations might lead Blue to seek a ceasefire, leaving the Red regime intact with sufficient internal capacity to quell uprisings and insurgencies while reconstituting its expended capabilities. A pre-Phase I state. And damage to Blue allies in the region may be extensive. If Blue's JADO theater strategy prevails at Phase VI, Red's ability to conduct barrages and proxy attacks collapses, and the system evolves into a simpler Phase VII depicted in Figure 11 below.

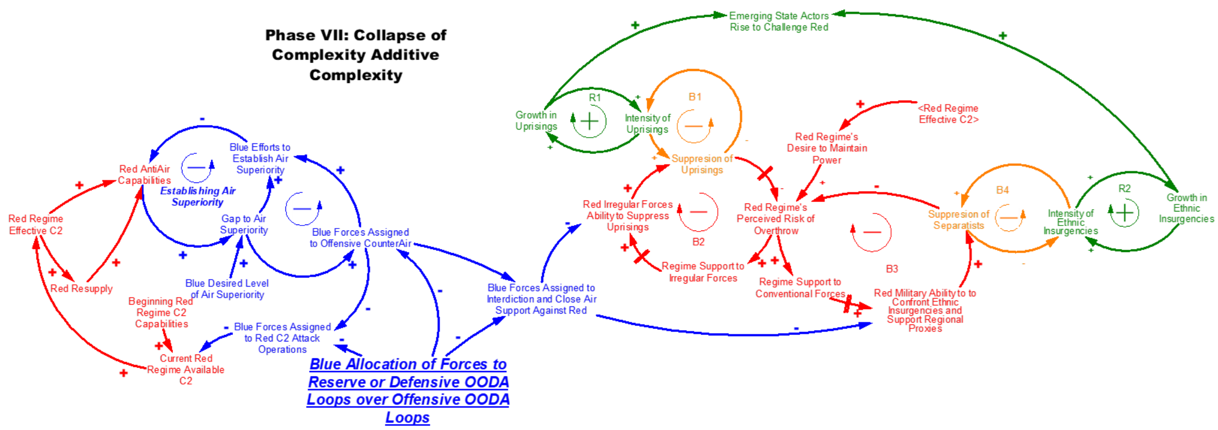

Figure 11: Phase VII - Collapse of Complexity

In Figure 11, Red's ability to conduct mosaic warfare has collapsed. All of Blue's forces and reserves can be dedicated to offensive OODA loop operations, split between offensive counterair, attacks on Red's C2, and ever-increasing interdiction and close air support strikes against security institutions that maintain regime control, enabling uprisings and insurgencies to topple the government.

In previous LSCO wars, such as the Gulf War I in 1991, the Kosovo intervention in 1999, and the Iraqi Invasion in 2003, US forces were able to move through Phases I-VI within hours or days, arriving at Phase VII and maintaining those as long as necessary to either collapse the regime or set the conditions for ground operations. In the Iran War, Phase VII does not have to collapse the regime itself, but create conditions for a popular uprising or ethnic insurgency to become an emerging-state actor, where different dynamics and a different model are more useful for understanding the progression of conflict from there [3], [4].

4.9 Scenario 5 Forecast– Revised Actual by Blue Force Rated Most Likely

The JADO vs. mosaic warfare system paradigm lends itself to a variety of scenario forecasts, which can be presented as dynamic hypotheses. Five scenarios were forecast with probabilities on March 1st[29] and revised to reflect updated objectives on March 4th[30], though the probabilities didn't change:

> "1) A complete collapse of the regime under Phase VII attacks or even earlier decapitation strikes or calls for ‘surrender’ of the IRGC. Very unlikely. (See HOPED Slide)
> 2) Iran counter-punches exceed regional and US/Israeli interceptor capabilities, domestic appetite for another forever war, and pressure on the Blue Forces (US and Israel) to disengage with the Iranian regime intact. Don't think it's probable. (See FEARED Slide)
> 3) The US and Israel coalition exhausts Iranian counter-punches and succeeds in sparking popular uprisings and ethnic insurgencies. These result in emerging-state actor dynamics that topple, or at least tangle, the Iranian regime, significantly reducing its power and projection capability for years to come. Probable, if grim, scenario. (See ACTUAL 28 FEB Goal Slide)
> 4) The US and Israel coalition exhausts Iranian counter-punches but fails to spark popular uprisings or ethnic insurgencies after several months. This is a likely scenario.
> 5) The sides break off combat operations suddenly under the auspices of a ceasefire and negotiation. This is the most likely scenario, but only after the end of this week and since 02 MAR is now tied to the revised objective of reducing Iranian barrage capability. (See ACTUAL 02 MAR Revised Goals Slide)"

The dynamic hypotheses were posted on March 5th[31]. All texts, probabilities, and dynamic hypotheses except for scenario 4 are included in the supplementary. Scenario 4 already had dynamic hypotheses from previous work [3], [4]. In the standard method of system dynamics, multiple scenarios of hoped, feared, and actual reference modes are presented on a single dynamic hypothesis [28], each as one reference mode. Timelines are notional without specification of units of time. In this hasty approach, the x-axis timeline is notionally denominated in quasi-logarithmic hours, days, and weeks across the phases, and the alignment of those to phases varies between scenarios. Each chart only contains one scenario, and each scenario consists of eight component reference mode forecasts charted to more richly forecast potential behaviors across the progression of JADO v. mosaic warfare phases described above, as shown for Scenario 5 Figure 12 below.

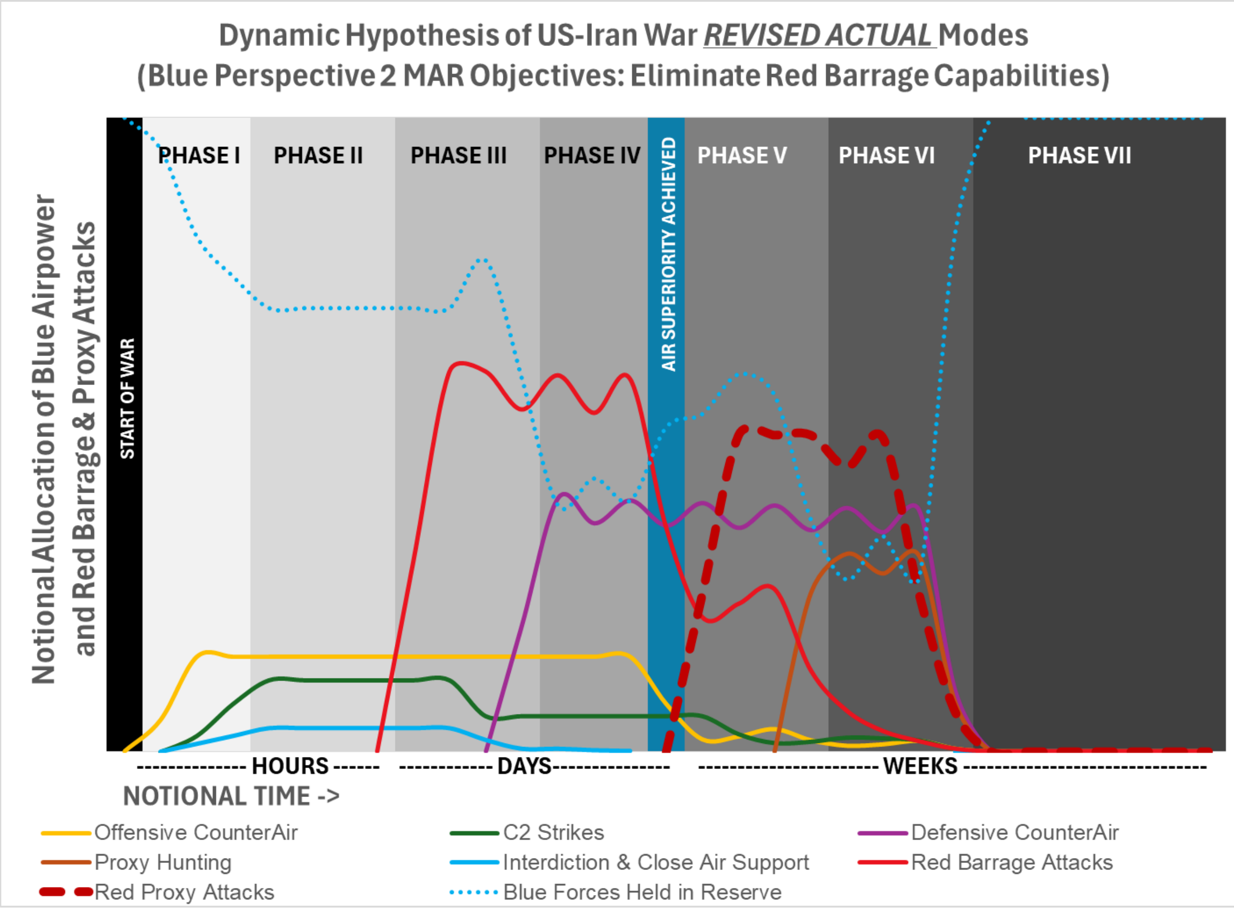

Figure 12: Scenario 5 - Revised Actual by Blue Force Rated Most Likely

Scenario 5 is similar to scenarios 3 except that the goal is no longer regime change, but the elimination of barrage capability. The opening JADO theater strategy emphasizes offensive counterair and C2 strike OODA loops early on to achieve first air superiority, and then air supremacy before shifting to Phase VII interdiction & close air support strikes against regime supports similar to past historical US conflicts. Instead, however, Blue forces shift to defensive counterair OODA loop operations responding to Red barrages beginning after the first day. They must further refocus as proxy attacks begin near the end of the first week. Throughout this period, Red is conducting countervalue cost-imposition strikes on civilian infrastructure and closing key shipping lanes. Once barrages are sufficiently reduced and enough time has passed for both sides to save face, ceasefire negotiations begin, leading to the rapid end of the conflict after a few weeks without ever progressing into Phase VII.

4.10 Diplomacy is War by Other Means Paradigm

On March 12th, based on the above analysis, I forecast that the war would last at least 40-43 days, and a ceasefire would occur no earlier than 9-12 APR 2026[32]. However, the original paradigm model created on March 1st lacked an endogenous structure to implement a ceasefire that halted military activities. An additional structure was created and shared on April 1st, repeating the March 12th forecast [33].

The 'diplomacy is war by other means' paradigm rests atop the JADO vs. mosaic warfare paradigm and is depicted fully in Figure 13.

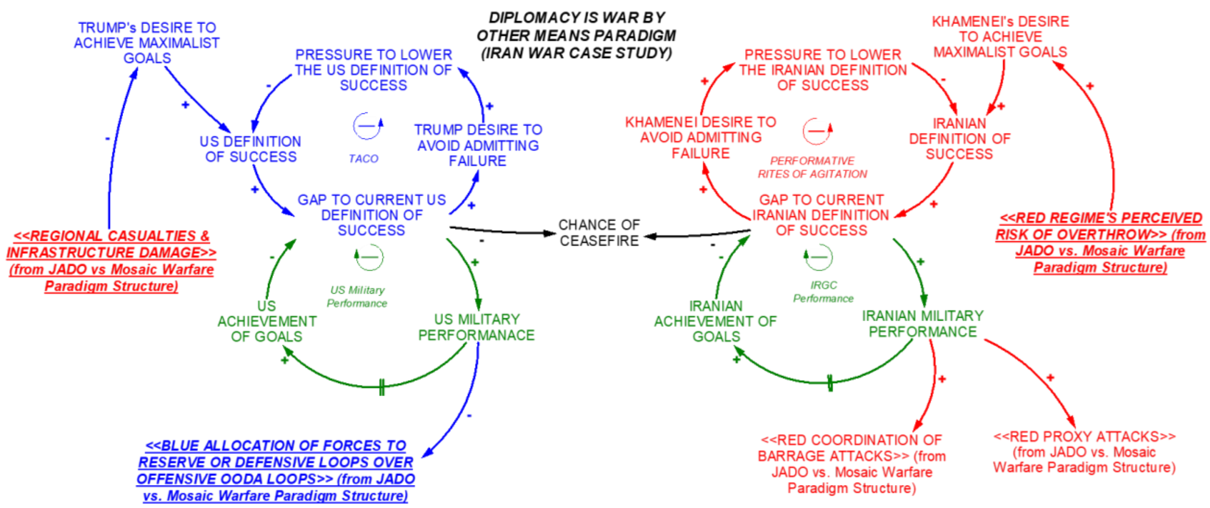

Figure 13: Diplomacy is War by Other Means Paradigm

The paradigm leverages an eroding or drifting goals archetype[15, pp. 6–8], [16, pp. 61–73] (see supplementary for more on this archetype). Reference modes of this paradigm for the US are depicted in Figure 14 and are notionally similar to Iranian. Goals for either party begin in the 'maximalist' zone of the upper left, where the chance of a ceasefire is the lowest. As the drifting goal's structure kicks in, the chance for a ceasefire increases. As the chance of a ceasefire increases, the system decreases the 'foot on the gas' of military performance. For Blue, this is shifting offensive OODA loop actions against Iran to defensive or denial, such as blockading Iranian ports. And for Red, this is reducing barrage attacks while maintaining closure of the Strait of Hormuz. Proxy fights may also abate, as they did in Iraq, or continue as they did in Lebanon.

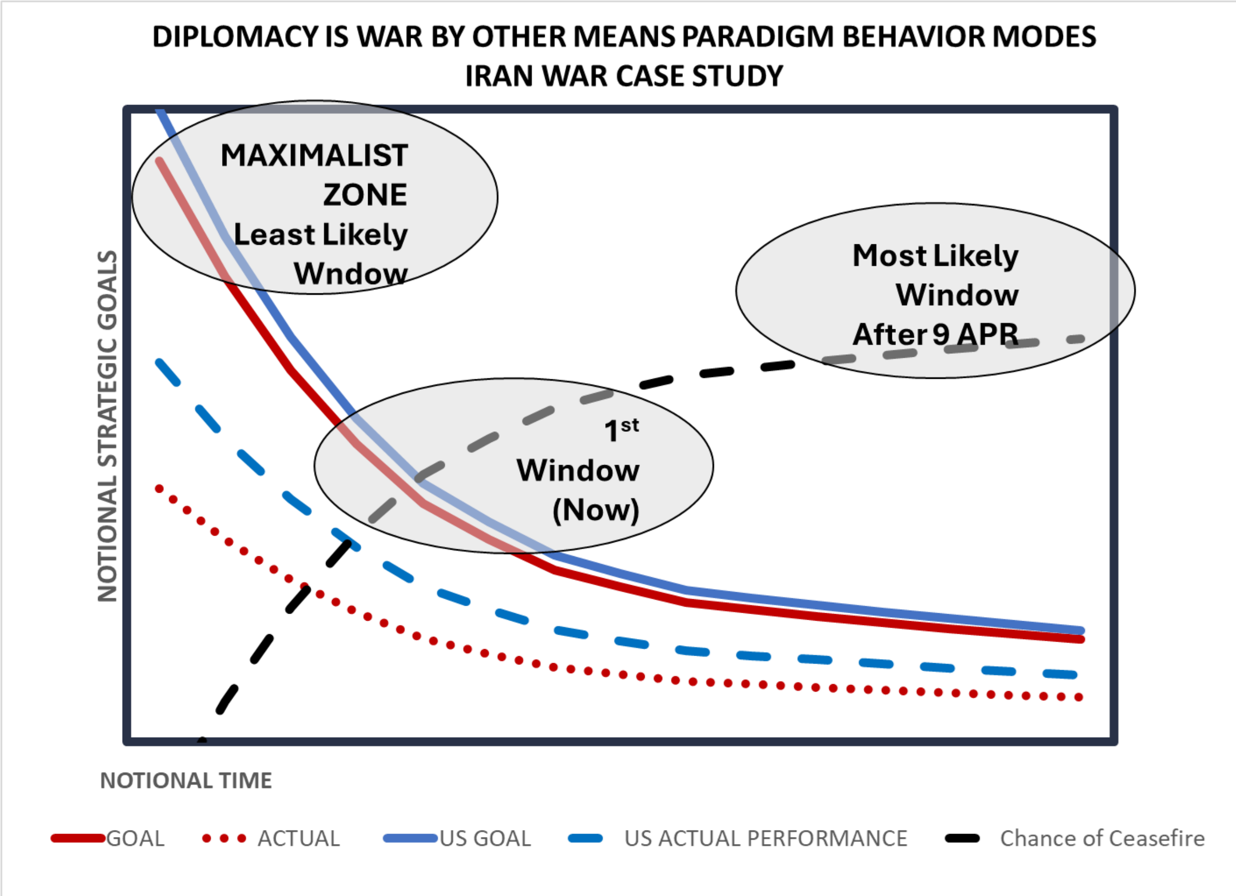

Figure 14: Abstracted Forecast of Windows for Ceasefire 1 APR 2026

At some point, the 'reduced definitions of success' of both Iran and the US intersect in the first window with the chance of a ceasefire. As the chances increase and the reduced goals continue to erode, the window for a most likely ceasefire widens.

5 Deliberate Methods for Evaluation of Forecasts (380)

To determine the accuracy of hasty method forecasts, traditional data collection occurred after MDML LSCO had ended OSINT & PAI. A dataset of over 30,000 munitions and platforms consumed was collected from OSINT & PAI secondary sources (see supplementary for full notes and sourcing and data collection). Over 70 munition and platform types were located across seven different crosswalks similar to Figure 15, which focuses on exquisite counter-barrage munitions used by Blue forces.

BLUE MUNITIONS & PLATFORMS USED AGAINST RED BY CATEGORY (PHASE IV EXQUISITE)					Optimal	Available	Less than Ideal	PHASE I BLUE OFFENSIVE COUNTERAIR		PHASE II- BLUE DECAP, INTERDICT & CAS	PHASE IV DEFENSIVE COUNTERAIR AGAINST RED BARRAGES			
Country	**Category**	**Type**	**Munition or Platform**	**Launch Domain**	**Target Domain**	**Range**	**Per Munition/Asset Cost Estimate**	**Ground, Sea, or Both**	**Air Targets**	**Ground, Sea, or Both**	**Rocket**	**Drones & Loitering Munitions**	**Cruise Missile**	**Ballistic Missile**
US	Exquisite	Anti-Ballistic Missle	SM-3	Sea	Air	1,200km	$ 12,000,000		X			X	X	X
US	Exquisite	Anti-Ballistic Missle	SM-6	Sea	Air	500km	$ 4,900,000					X	X	X
GCC	Exquisite	Anti-Ballistic Missle	Partner Operated THAAD	Ground	Air	200km	$ 12,600,000					X	X	X
US	Exquisite	Anti-Ballistic Missle	US THAAD	Ground	Air	200km	$ 12,600,000					X	X	X
Israel	Exquisite	Anti-Ballistic Missle	David's Sling	Ground	Air	180km	$ 700,000		X		X	X	X	X
US	Exquisite	Anti-Ballistic Missle	US Pac-3 Patriot	Ground	Air	160km	$ 4,000,000		X		X	X	X	X
GCC	Exquisite	Anti-Ballistic Missle	Saudi Pac-3 Patriot	Ground	Air	160km	$ 4,000,000		X		X	X	X	X
GCC	Exquisite	Anti-Ballistic Missle	Gulf Partner Pac-3 Patriot	Ground	Air	160km	$ 4,000,000		X		X	X	X	X
Israel	Exquisite	Anti-Ballistic Missle	Arrow 2/ Arrowe 3	Ground	Air	150km	$ 3,000,000					X	X	X
France	Exquisite	Anti-Ballistic Missle	French Rafael MICA	Air	Air	80km	$ 2,500,000		X			X		
Qatar	Exquisite	Anti-Ballistic Missle	Aster	Ground	Air	30km	$ 2,000,000		X		X	X	X	X
Israel	Exquisite	Missile	Python/Derby Derivative (SEAD)	Air	Air	20km	$ 750,000		X			X	X	X

Figure 15: Allied Exquisite Counter-Barrage Munitions Crosswalk

Crosswalks like Figure 15 further reveal the additive complexity of JADO and mosaic warfare, as depicted statically in Figure 1. Each munition or platform has a launch domain and one or more target domains. It is designed to be used during a specific phase of the MDML LSCO paradigm (see below). Since not all use cases are optimal for a given munition, red, amber, and green indicate the optimal, available, or less-than-ideal use case. See the supplementary for all seven crosswalks.

In Figure 16, a comparison is made between the total allied munition and platform usage rates contained in the article data sets with those publicly announced by the US and Israel at key timing phases.

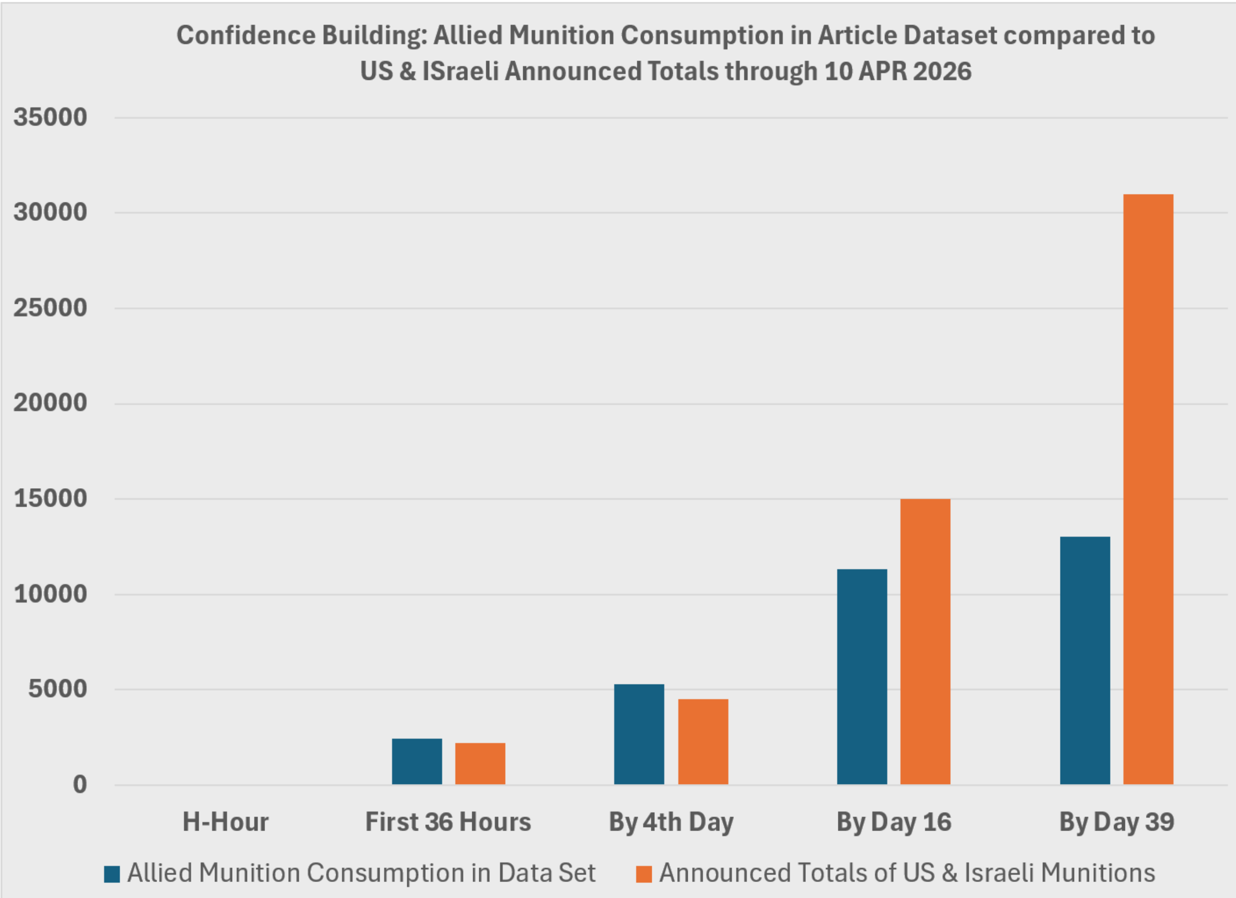

Figure 16: Comparison between Article Data Set Total Allied Munitions & Platforms vs. US & Israeli announced Totals

5.1 Determining Forecast Accuracy

Four of the forecasted eight reference modes in each scenario were compared against observed rates in the data set. Blue ground vs. air targeted strikes (based on munition type used and consumed) and Red and Proxy barrages (based on daily reporting and summary analysis). Mean Absolute Error (MAE) and Mean Absolute Squared Error (MASE) were evaluated, all denominated in munitions. Thiel's U_1 and U_2 forecasting accuracy analyses were performed, each of which is dimensionless[34, pp. 874–880]. The overall results and specific results on Scenario #5 are provided in Table 1 & Table 2. (See supplementary for all forecast accuracy measures.)

Table 1: Scenarios 1-5 No. of Four Reference Modes Evaluated per Scenario that were Useful, Wrong but Useful, or Wrong

Thiel's Forecast Statistic Used	Measures	Meaning	Assessment of Hasty Forecast	Scn #1	Scn #2	Scn #3	Scn #5
U_1 Decomposition of MASE	>0.80 of U_1 from U^c	Correct outcome, trend, and cycles but incorrect phasing	Wrong, but Useful	1	2	1	1
	>0.80 of U_1 from ($U^c + U^s$)	Correct outcome, trend, cycles and phasing but point-to-point data is inaccurate	Wrong, but Useful	0	0	0	2
	>0.50 of U_1 from U^s Investigate to determine (A), (B), or (C)	(A) Correct outcome, trend, cycles, and phasing but amplitude fluctuation is inaccurate	Wrong, but Useful	0	0	0	1
		(B) Incorrect outcome, trend, cycles, and phasing -missing key cycles	Wrong	1	1	1	0
		(C) Incorrect outcome correlation wrong	Wrong	0	0	0	0
	>0.5 of U_1 from U^m	Bias in model parameter means outcome, trend, cycles, and phasing are correct, but values are consistently off by the same amount	Wrong but Useful	1	0	0	0
	U_1 mixed across U^m U^s U^c	Outcome, trend, cycles, phasing may all be incorrect	Wrong	1	1	3	0
U_2 Naïve Forecasting	U_2<1.0	Better than Guessing	Useful	3	1	0	1
	U_2>1.0	Worse than Guessing	Wrong	1	3	4	3

Table 2: Scenario 5 Specific Forecasting Accuracy Findings

Scenario (Probability) →	Scenario 5 Blue Actual Revised Objectives as of 04 MAR (Most Likely)			
Phenomena Compared →	Blue Ground Strikes	Blue Air Strikes	Iranian Barrages	Hezbollah Barrages
Observed	10,306	7,962	5,886	1,268
Forecast	3,502	3,651	4,383	3,004
MAE	451	369	331	126
MASE	759,273	289,230	171,581	33,756
Thiel's Forecasting Accuracy U_1				
MSE due to Bias (U^m)	0.22	**0.24**	0.05	0.35
MSE due to Unequal Variation U^s)	**0.25**	**0.46**	0.02	**0.55**
MSE due to Covariation (U^c)	**0.58**	**0.35**	**0.93**	0.12
$U^m + U^s + U^c$	***1.0***	***1.0***	***1.0***	***1.0***
Thiel's Forecasting Accuracy U_2				
Better than Naïve <1.0	**1.04**	**.73**	**1.00**	**1.22**

Some limitations regarding forecast accuracy measurements in analyzing theater strategies. Forecast errors cannot distinguish between an incorrect forecast behavior in a scenario that ultimately still happened and a forecast made to encompass a fundamentally flawed plan. For example, Scenario 3 was based on a stated objective of regime change requiring a forecast to extend into Phase VII and remain there. This never happened, and as a result Scenario 3 was the worst-performing scenario of all four evaluated, as it contained many cycles of behavior that never occurred. Likewise, three of the four components of Scenario 5 registered no better than naïve forecasting (U_2). But Scenario 5 was still the Scenario that actually occurred. Part of this is likely because naïve forecasting measurement (U_2) struggles with complicated phasing and cyclicality, which is why measurements of those specific elements (U_1) are also included, in which Scenario 5 performed best. Ultimately, the hasty forecasts were notional and illustrative; deliberate data collection was limited to OSINT & PAI estimates, so the rules are made up and the points don't matter beyond illustrating lessons that may be useful even if wrong.

6 Lessons Learned: Forecast vs. Actual Results and Key Findings (2,248)

The paper was submitted to the conference on the 18th of March and approved on the 15th of May 2026. At the time of revision, in late June 2026, there has been time to collect data, compare forecasts, and identify seven key lessons learned from the case study. The scope of analysis is limited to munition and platform consumption data from 28 FEB to 10 MAY, covering both MDML LSCO through the ceasefire on 7 APR and several weeks of post-cessation activity. Although both sides continued kinetic strikes during the ceasefire, there has been no return to MDML LSCO, creating an operational pause long enough to put any resumption into a different conflict and use these results for the case study.

6.1 Key Lesson #1: Dynamic Hypothesis Scenario #5 compared vs. Actual Results

The key lesson from the case study is that neither JADO nor mosaic warfare theater strategies of additive complexity achieved an early and decisive system collapse of the other (Scenario #1 & #2), and the hasty methods used on March 1st successfully forecast this (Scenario #5). The intensity of the two theater strategies in competition pushed both sides towards a ceasefire, which was achieved on April 7th rather than April 9th as forecast[35]. In Figure 17, Iranian and Hezbollah barrage attacks are compared with Scenario #5 forecasts, with the x-axis segmented into hours, days, and then weeks. A similar comparison of JADO munition and platform consumption, actual vs. forecast, is presented in Figure 18; however, OSINT & PAI limitations make the data less discrete. For JADO, the four kinetic pathways of strikes are aggregated into two domains of potential targets. Ground targets for offensive counterair, C2 Strikes, interdiction, and close air support. Air targets for defensive counterair, mostly counter-barrage interceptions.

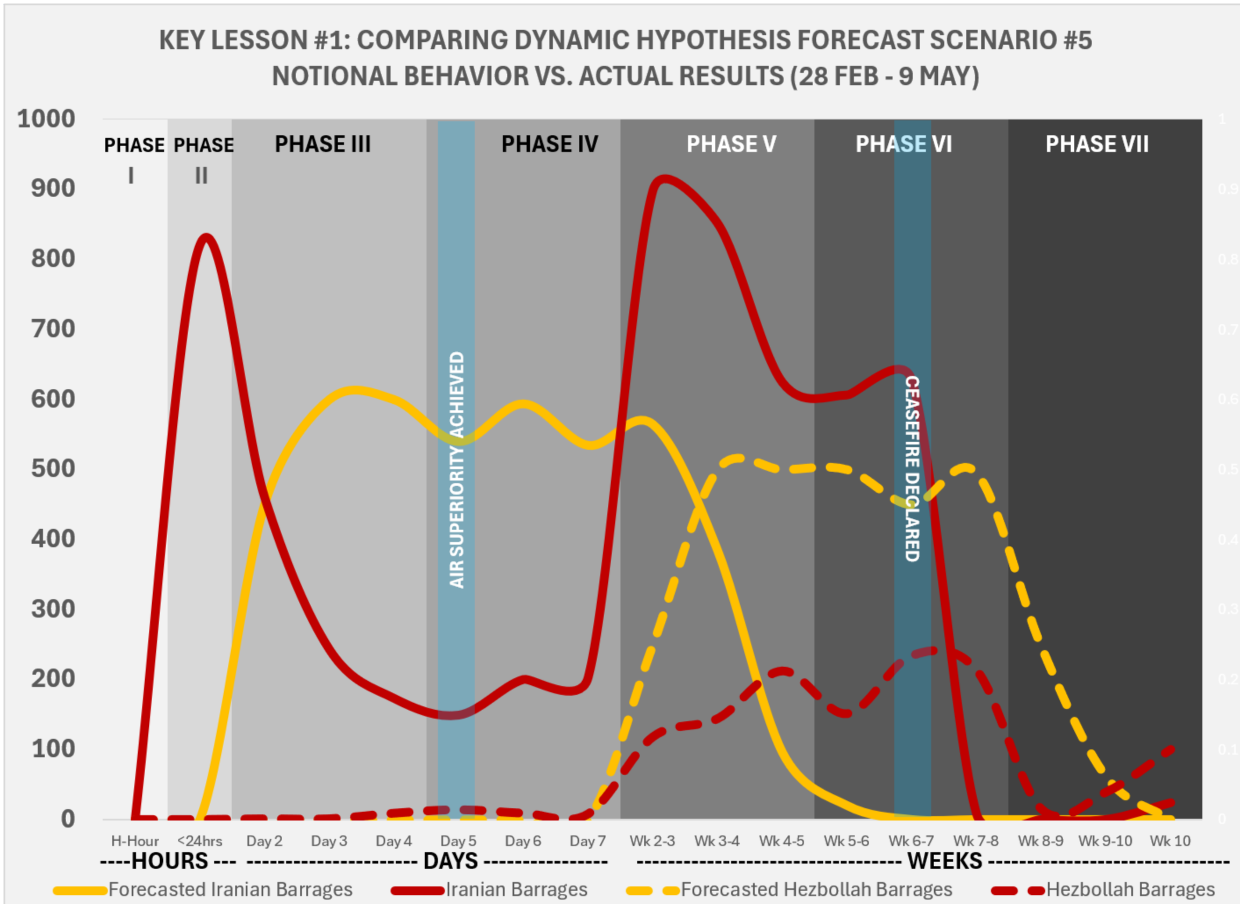

Figure 17: Comparing Actual Iranian & Hezbollah Barrage levels vs. Notional Forecasts in Scenario #5

One main difference between the forecast and observed was the speed and intensity with which Red activated its Phase III (Iran) and Phase V (proxy) countervalue retaliatory barrages in Figure 17. In the Scenario #5 forecast. Rather than taking a day, Iran's barrages activated within hours of H-Hour, sending ballistic missiles, cruise missiles, and UAV loitering munitions across GCC targets and into Israel, Jordan, Türkiye, and Azerbaijan. Iran's regional proxies also activated faster. Both Iraqi PMF[36] and Hezbollah[37] forces were conducting attacks on their respective flanks of the theater within a day instead of a week, though the Houthis never substantively activated[38]. And despite occurring sooner, Red proxy barrages by Hezbollah were much lower than forecast, accumulating in volume only as time progressed [51, p. 1], perhaps indicating they were caught by surprise by the initial H-Hour Blue strikes.

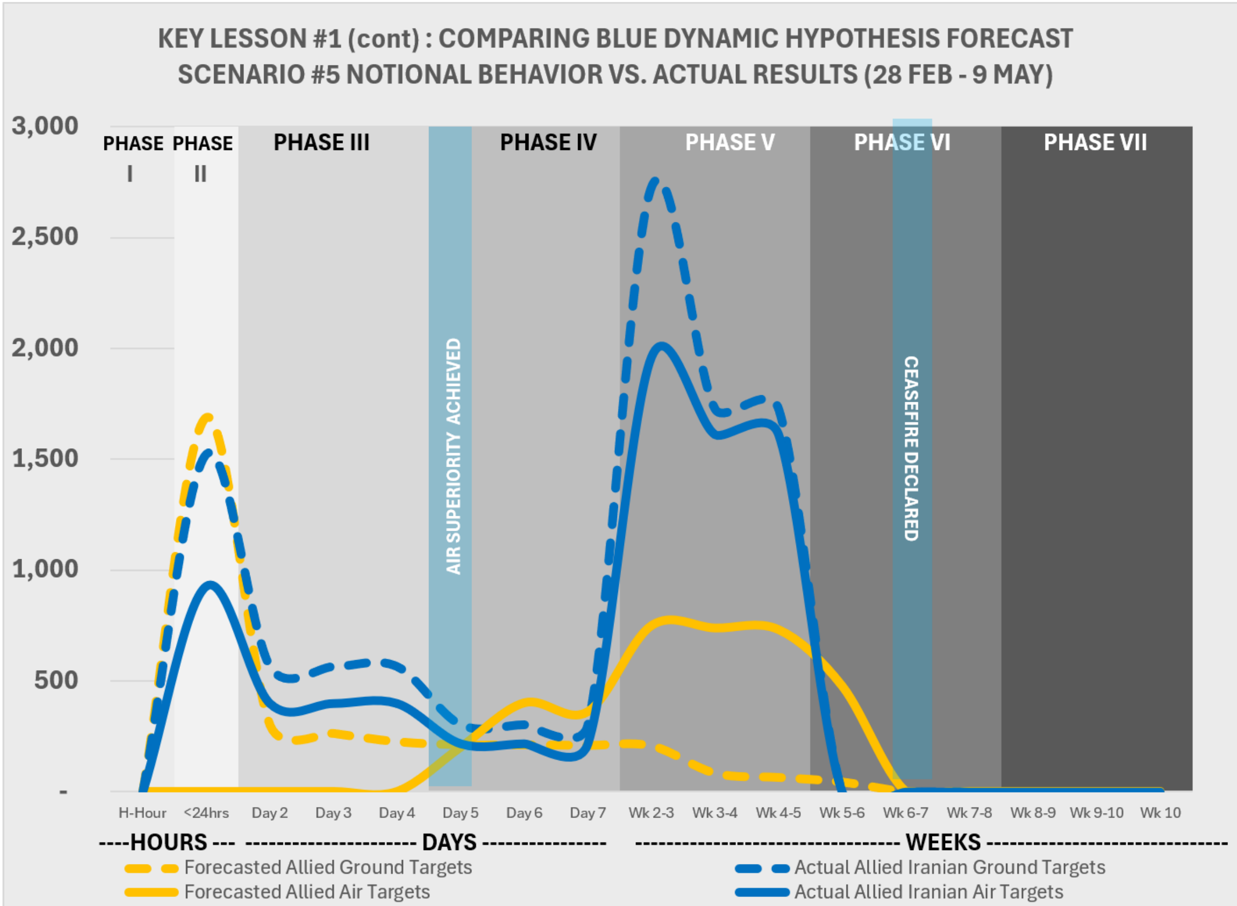

Figure 18: Comparing Actual Allied Air and Ground Targets vs Notional Forecasts in Scenario #5

Red's intensity and speed of barrages forced Blue to shift resources from offensive to defensive OODA loops, as predicted by the structure and observed in the data of Figure 18, which compares observed air target strikes with forecasts. However, JADO defensive counter-air operations (interceptions and launcher hunting) absorbed most attacks, even as the intensity and frequency of Iranian barrages decreased under launcher hunting. Even so, the barrage Iran and its Hezbollah delivered through mosaic warfare still succeeded in imposing countervalue costs on Blue. Given its global economic implications, the sustained closure of the Strait of Hormuz is the greatest source of additional complexity. The vital waterway carried an average of 105.5 ships and ~4M metric tons of cargo on February 27th. It had dropped to 6.9 ships and barely over 200k metric tons by May 24th [39]. From the very first 36 hours, Iran targeted expensive, hard-to-defend large facilities, such as key GCC oil infrastructure and artificial intelligence (AI) data centers [40], [41]. A month later, Iran issued a general warning against US technology and defense companies [42] and a specific threat to target and destroy the $30B Stargate AI data center in the UAE [43]. A ceasefire came just days later.

The need to shift Blue's offensive OODA loop forces to defensive OODA loop activities may have delayed the achievement of air superiority, which was achieved later in the war than forecast. And air supremacy was never achieved as in previous wars, causing the US to lose to destruction or damage at least 42 aircraft [39].

Combining the shift of Blue from offensive to defensive OODA loop activities and the inability to gain air supremacy thwarted Blue's Phase VIII hopes to replicate past wars where unrestricted air bombings could spark uprisings and ethnic insurgencies. Plans to coordinate and equip a cross-border Kurdish ethnic insurgency from Iraq[44] resulted in inaction, accusations, and denials around alleged missing weapons[45]. Mahmoud Ahmadinejad's interest in replacing the decapitated regime fizzled after an Israeli air strike on the house he was imprisoned in, injuring the former President[46], who was not seen publicly again until the former Supreme Leader's funeral months later [47]. Blue did manage some Phase VII interdiction strikes, hitting 73% of specific Basij or IRGC internal security units, headquarters, and communications targets in Tehran (33 out of 45)[48]. But this was no Phase VII shock-and-awe sustained campaign, as seen in either the Gulf War I or the Iraqi Invasion.

6.2 Key Lesson #2: JADO is much more expensive than Mosaic Warfare

Key to campaigns of additive complexity is the cost they incur in executing their effects. JADO is a far more expensive undertaking than mosaic warfare, as shown by the estimated cumulative counts of munitions & platforms and the dollar value consumed in Figure 19.

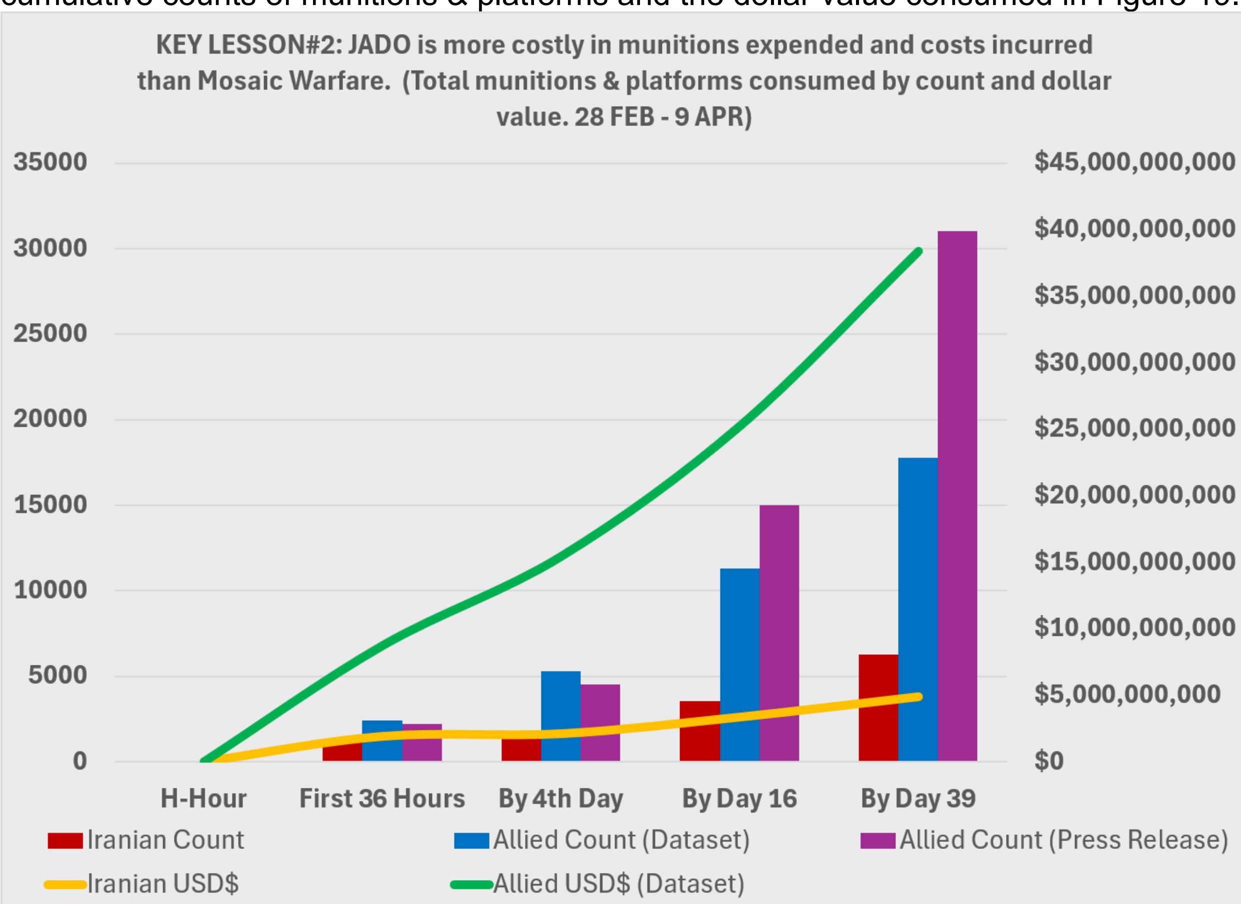

Figure 19: JADO & Mosaic Warfare munitions and platforms consumed by est. count and est. dollar value.

By day 39, in the data set assembled for the article, the US and its allies expended nearly 18,000 munitions, and platforms were damaged or destroyed, at an estimated total dollar value of $35-$40B. This cost does not include damage to US facilities not included in platforms, personnel and maintenance costs, or other expenses. This directional finding doesn't change even if allied consumption is reduced by half, as indicated in Section 5 and accounted for in the Allied Count (Press Release), which shows ~30,000 munitions consumed. Costs would be higher. Iran, on the other hand, fired just over 6,000 munitions at an estimated cost of slightly over $5B USD. Iran had more munitions to fire and would've done so had JADO's ability to rapidly maximize defensive OODA loop operations destroyed launchers on the surface or buried them, along with munition arsenals underground.

This reinforces that mosaic warfare is a conventional state-actor strategy. Non-state actors do not have the scientific and engineering expertise to design munitions themselves or the industrial capacity to produce them at scale, as either JADO or mosaic warfare requires. Non-state actors can be supplied by state actors, as Iran has supplied its proxy allies in the Axis of Resistance.

6.3 Key Lesson #3: JADO & Mosaic Warfare both front-load intensity, but this leads to rapid exhaustion and the pursuit of operational pauses.

Cumulative expenditure can create a deception that intensity is gradually increasing, but that is just accumulation. When mapped to a per-day intensity rate, both JADO and mosaic warfare are front-load as shown in Figure 19.

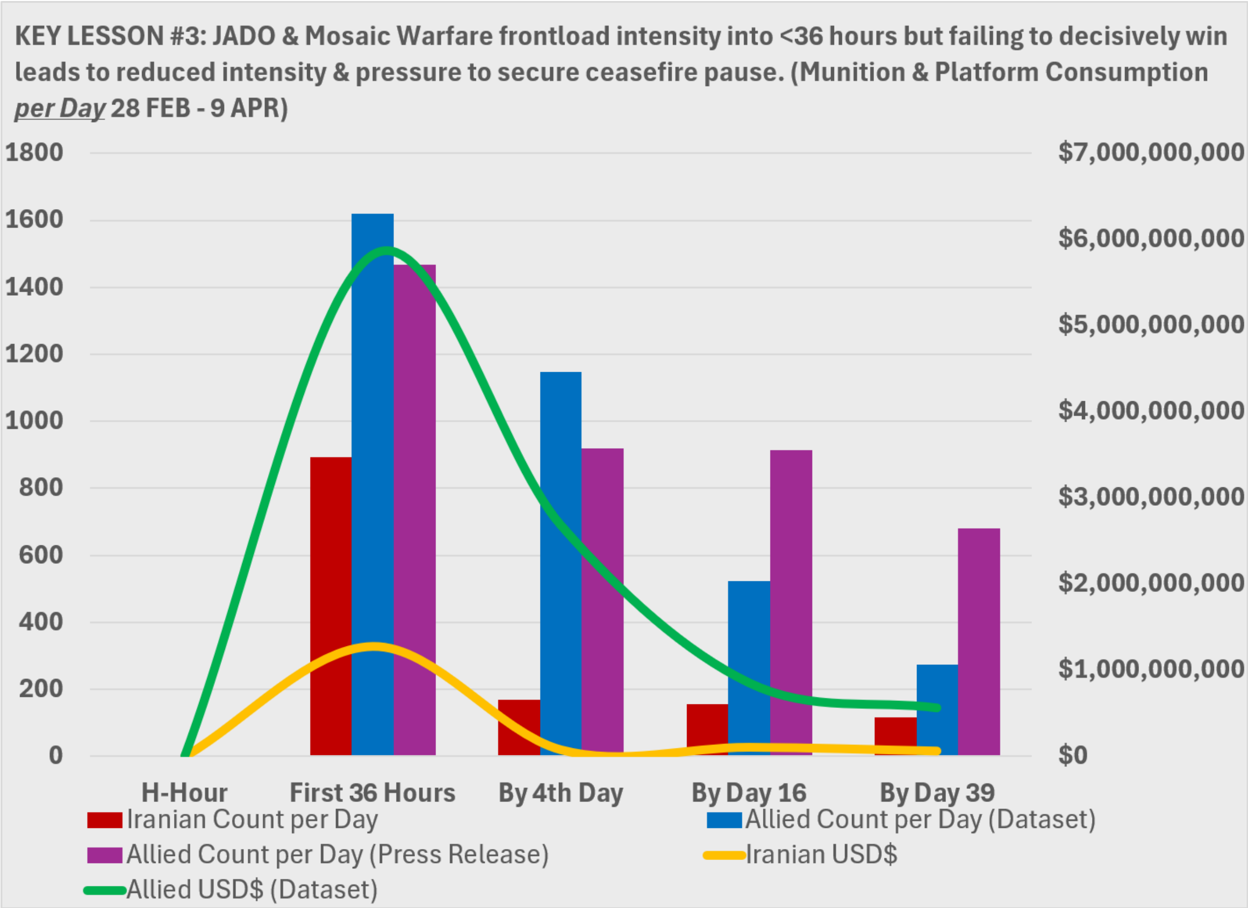

Figure 20: Per Day Intensity of Est. Munitions & Platforms Consumed and Dollar Value

Nor do the publicly announced total consumption figures, which are nearly twice as high as the article data set, alter this directional finding. The Allied Count per Day (Press Release) in Figure 19 shows that daily consumption rates started higher and declined over time at each timing stage.

6.4 Key Lesson #4: JADO fights a multi-domain battle. Mosaic warfare avoids the air domain in favor of ground operations, putting JADO's air operations mainly in a defensive counterair role.

Although JADO is an MDML doctrine, mosaic warfare didn't contest all domains. Among the two domains, Iran prioritized ground-domain targets over air-domain targets, as shown in Figure 21.

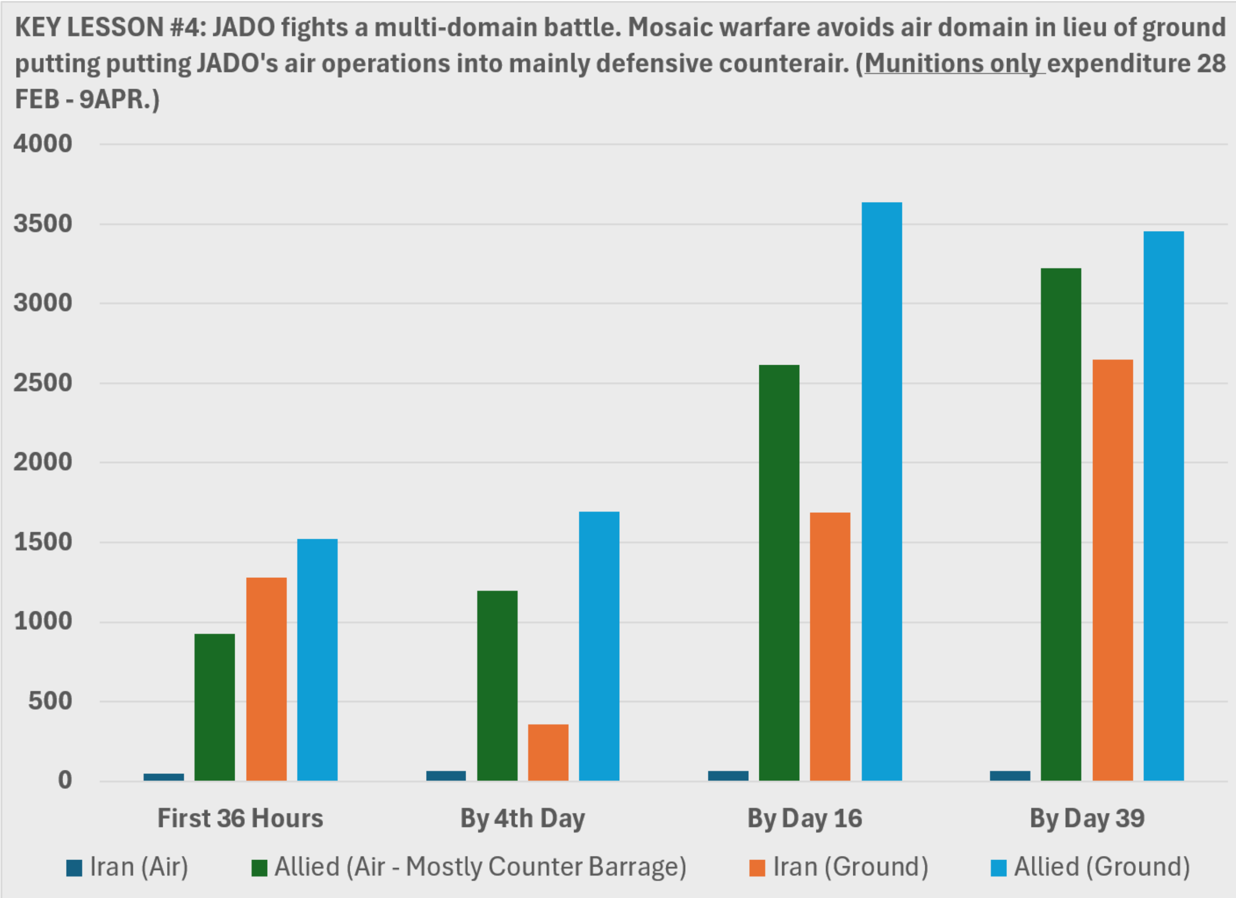

Figure 21: Munitions Expenditure by Target Domain Allied vs. Iran

This is a key aspect of competitive additive complexity. Each contested domain requires additional complexity in the overall defense design and production system. By yielding the air domain, Iran focused its limited resources on ground-domain capabilities. And although Figure 21 shows significant air domain targeting by allied forces, the vast majority of those involved used expensive, exquisite munitions as interceptors against barrages in counterair defensive operations. Note that even when accounting for the Section 5 discrepancy in total allied munitions, the directional findings remain consistent, as the vast majority of the delta is assumed to be bombs dropped on allied ground targets, which was already the dominant target domain.

6.5 Key Lesson #5: Mosaic warfare "radar hunting" prioritizes day-one strikes against exquisite radar systems to blind or degrade counter-defensive air operations despite multilayered defenses. (Per day losses of global stockpiles of exquisite radar systems 28 FEB - 9 APR.)

A surprise lesson not accounted for in the CLD was mosaic warfare's effective response to 'launcher hunting' with its own 'radar hunting.' In launcher hunting, depicted in Figure 7, JADO targets launchers and underground arsenals to reduce the intensity and frequency of barrage operations. In radar hunting, mosaic warfare targets radars to reduce counter-barrage effectiveness by damaging AN/FPS-132, AN/TYP2, and AN/TPS-59 platforms to such an extent that losses can be measured in per-day % of the global inventory of these exquisite platforms, as shown in Figure 22[49].

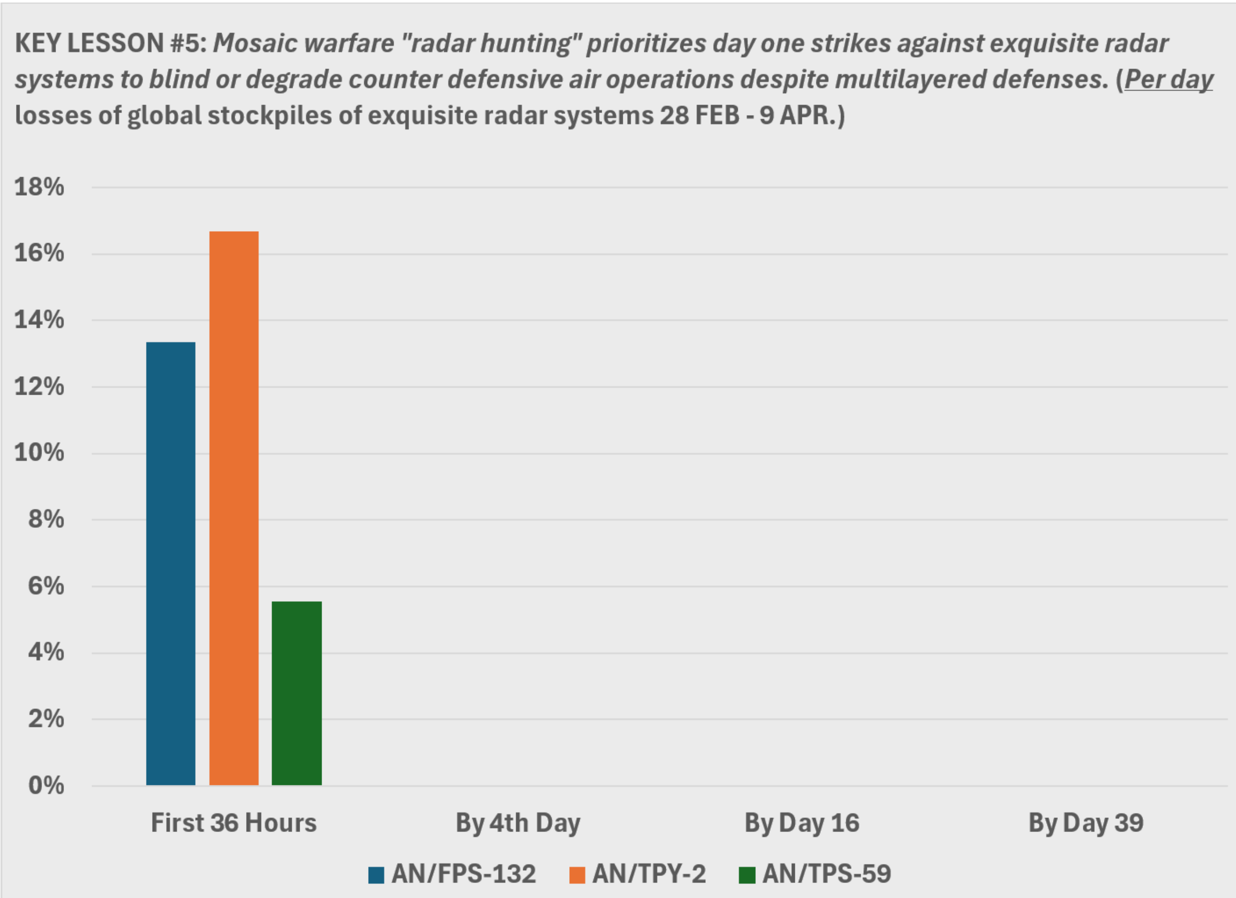

Figure 22: "Radar Hunting" - Exquisite Radar System Losses, Per Day, as a % of Global Inventory

Although targeting enemy radars is not novel to mosaic warfare, Iran's ability to penetrate the defense-in-depth layers surrounding these facilities was a surprise. Iran's targeting of all-source sensor information was not limited to exquisite radars, destroying ~24 MQ-9A Reapers and 2 MQ-4C Tritons, or 13% and 10% of the US's global inventory, respectively. Mosaic warfare's success at radar hunting requires a revision to the model paradigm, shaded in Red, depicted in Figure 23 below.

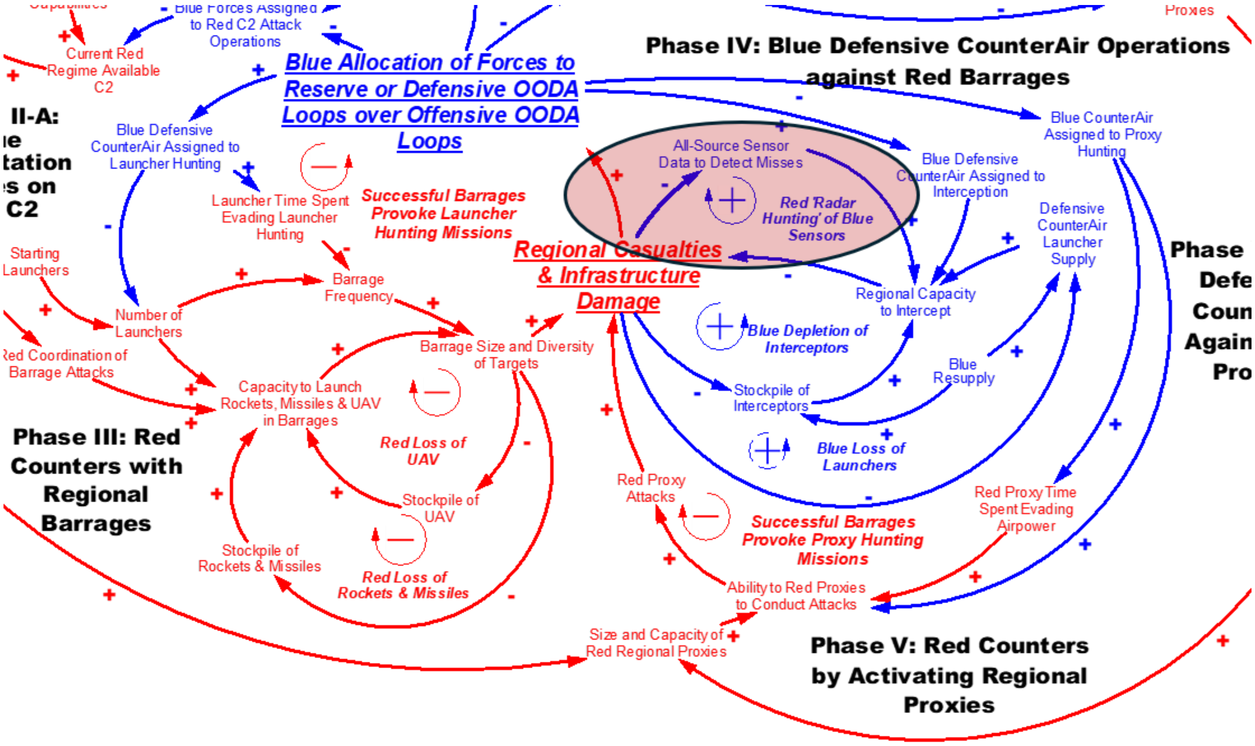

Figure 23: Addition of Radar Hunting Feedback Loop to Paradigm Structure

As regional casualties & infrastructure damage increase, radar hunting reduces all-source sensor data, reducing regional capacity to intercept, which results in more barrages that create regional casualties & infrastructure damage. This is a key positive feedback loop that, if switched, could trigger an exponential collapse more easily than losses in launchers or interceptors, as exquisite radars and ISR drones are far fewer in number.

Furthermore, 'radar hunting' creates strategic additive complexity as sensors consume exponentially more rare-earth minerals than munitions. This is demonstrated in Figure 24, which compares the gallium needs for just three damaged radar systems with over 5,000 munitions consumed in the first four days[50].

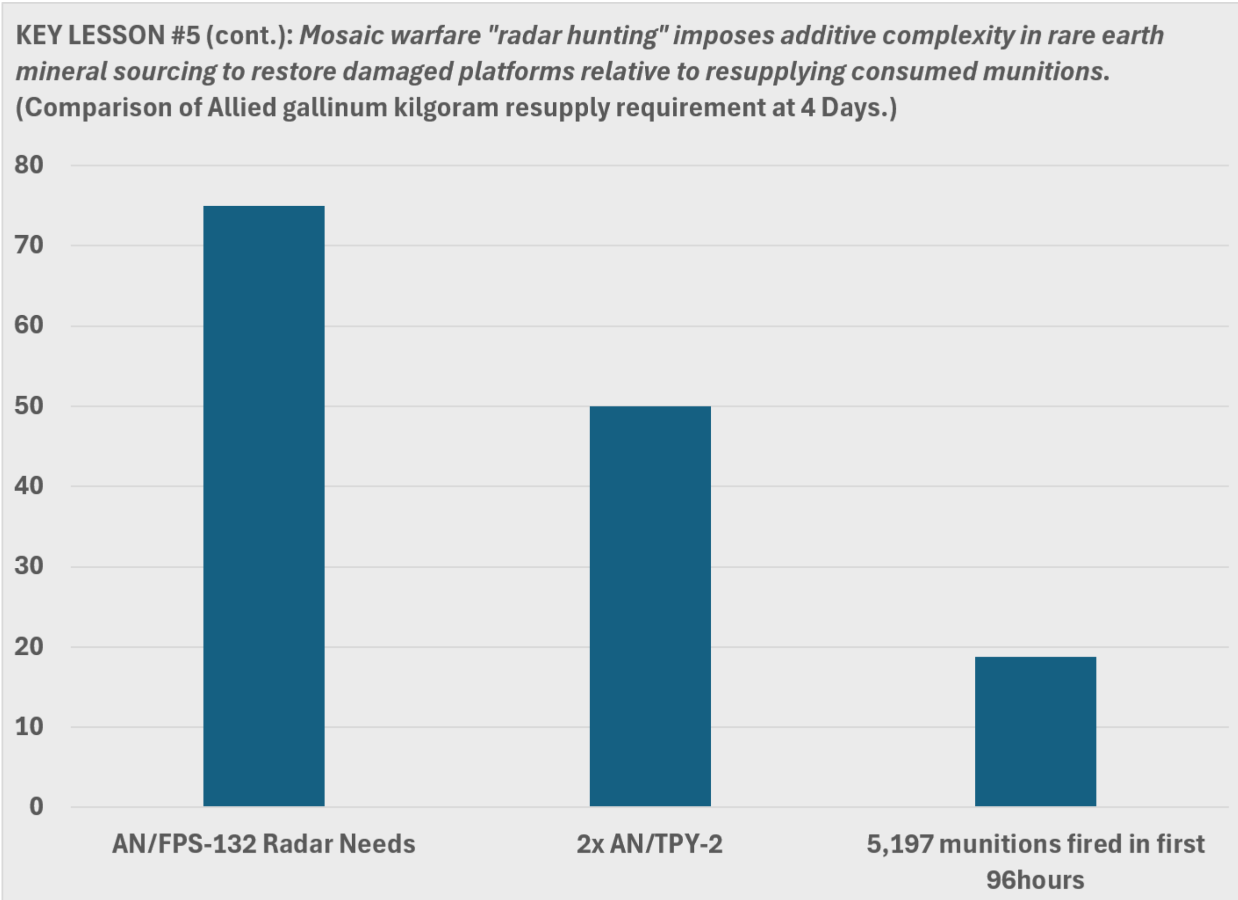

Figure 24: Comparative gallium sourcing needs for radars vs munitions after 96hours of MDML LSCO

6.6 *Key Lesson #6: Mosaic warfare loses capability faster but recovers it faster if JADO buries rather than destroys launchers and arsenals.*

Iran has located underground launchers and munition arsenals. JADO's defensive counterair operation interdiction could prioritize more strikes on a single target to destroy these facilities, or fewer strikes to bury them. Blue force chose the latter, which enabled the rapid drop in Red force barrage capacity shown in Figure 25.

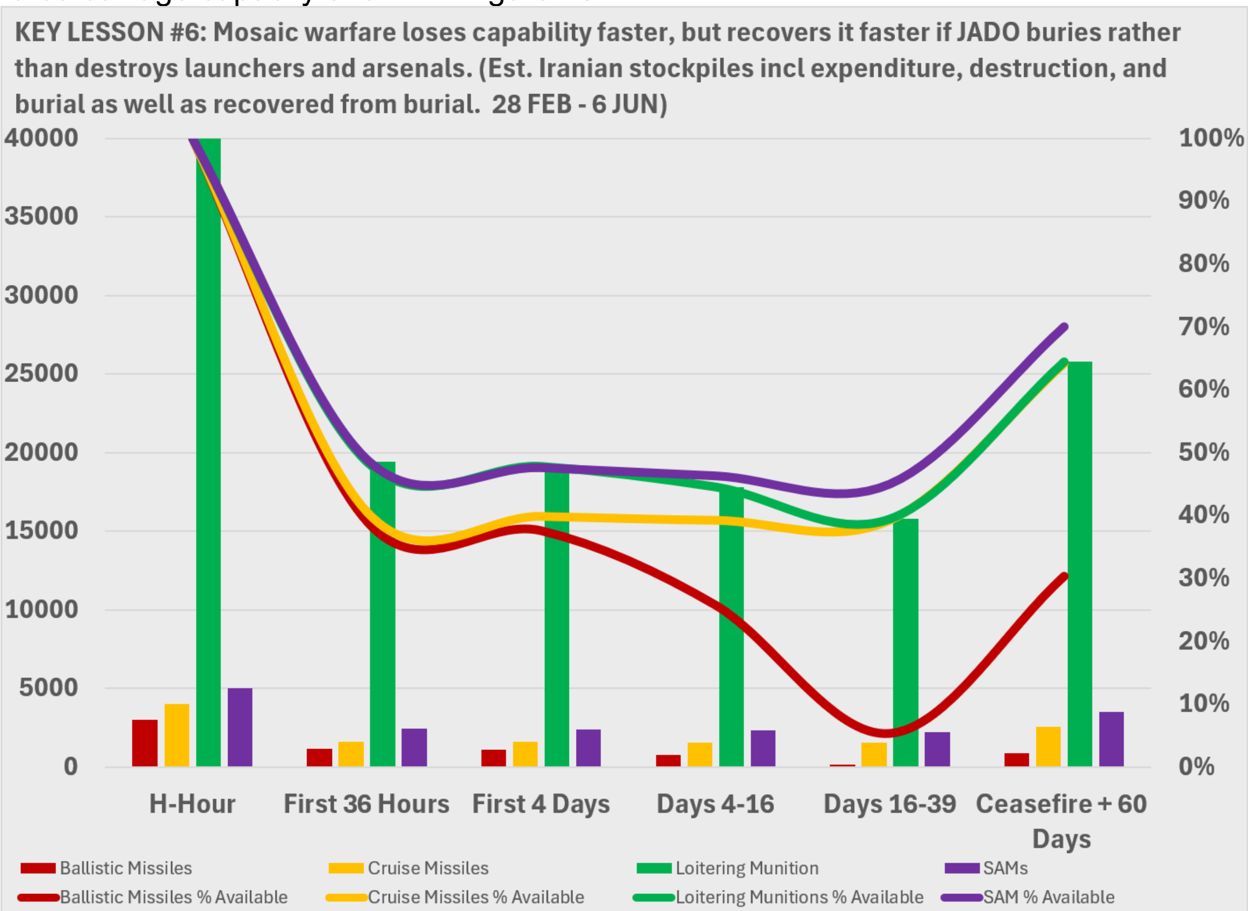

Figure 25: Iranian munitions stockpile category (count and % of starting) at each phase of the war and 60 days after ceasefire

A consequence of this choice is that Iranian barrage capacity is buried rather than destroyed. Given a sufficient operational pause, the capacity can be unburied and recovered. From a contested additive-complexity perspective, the US used scarce and exquisite munitions to gain a temporary advantage over Iran that faded faster than the window in which those munitions could be resupplied, with two implications. First, operational pauses will, on balance, favor the competitor who can more quickly recover operational capability, and this has implications for US allies, as discussed below.

6.7 *Key Lesson #7: JADO allies must be rapidly resupplied with ABM to maintain commitment during any pause periods.*

As a consequence of the above lesson, JADO allies must be resupplied or receive security guarantees from the US during operational pauses, commensurate with the risk posed by mosaic warfare's recovered barrage capability. In Figure 26, the GCC starts at a higher ABM stockpile, and the disparity only increases as Iran's ballistic missiles are either destroyed through JADO launcher hunting and burying arsenal sites. However, many of Iran's ballistic missiles are recoverable within 60 days after the ceasefire. In contrast, GCC ABMs are harder to resupply given long US lead times [51]. At an estimated 60 days after the ceasefire, with Iran unburying its ballistic missile and launcher inventory, the disparity of ABM to missiles has almost evaporated. And if Iran can restore manufacturing capability and begin building ballistic missiles again, then it will soon gain an advantage over the GCC. This dynamic may explain why some GCC partners have pressured President Trump to both maintain and expand upon the ceasefire.

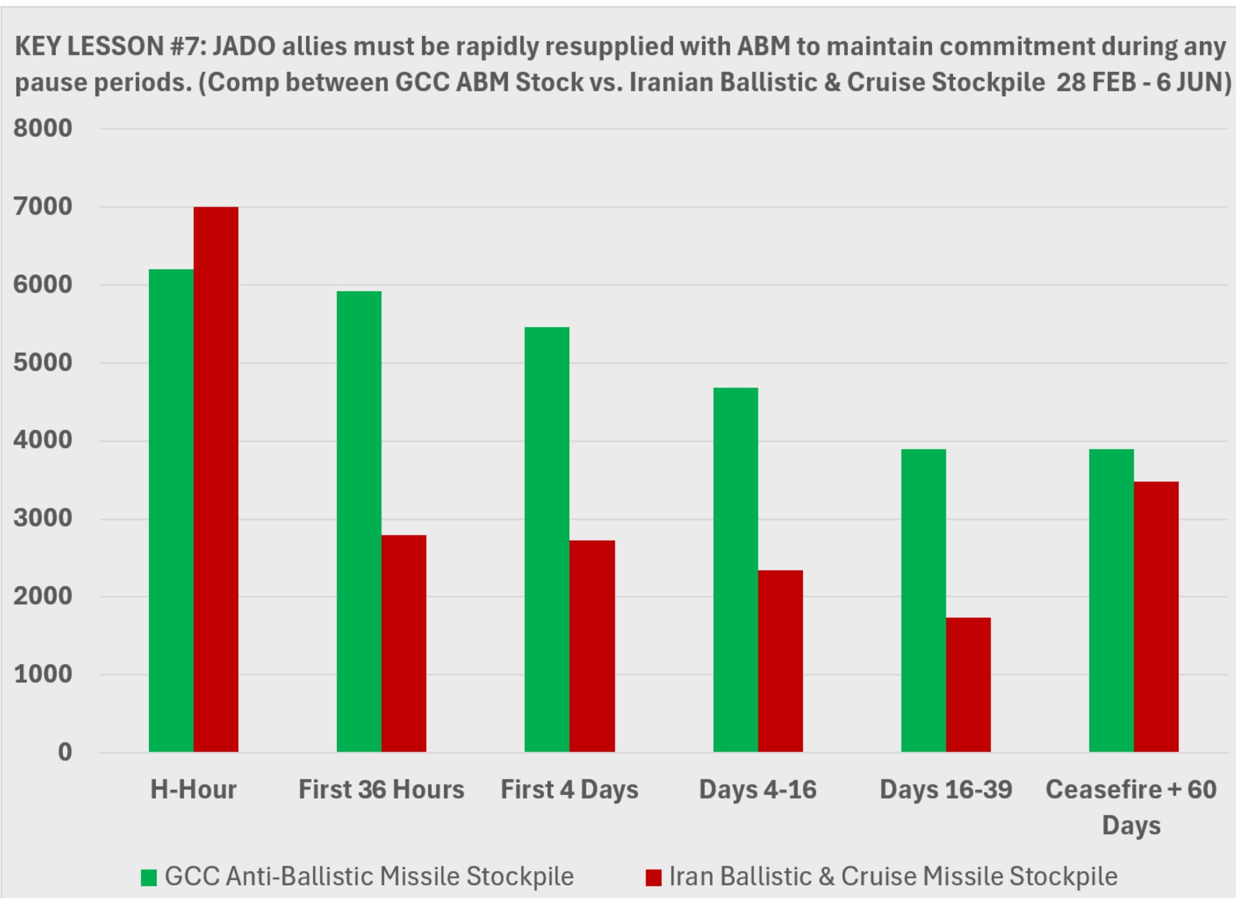

Figure 26: Gulf Cooperation Council (GCC) est. anti-Ballistic Missile (ABM) stockpiles compared to Iranian ballistic missile stocks

Applying this lesson elsewhere means JADO doctrines reliant on regional partners should strive to ensure they have adequate stocks and resupply of US exquisite munitions, or that their domestic industries are capable of creating such.

7 Conclusion

The Iran war offers a glimpse into future large-scale conventional combat operations (LSCO) between major powers and their state adversaries. Each side deployed untested new doctrines of additive complexity: a counterforce approach of Joint All-Domain Operations (JADO) for the US and countervalue mosaic warfare for Iran. Both strategies seek to leverage the interplay between offensive and defensive observe-orient-decide-and-act (OODA) loops at scales and complexities never before seen in an effort to collapse the ability of the other side to respond.

This work began with a hasty methods system paradigm model and forecast of five potential outcomes of the war, along with the probability of each outcome, within the first 36 hours of it beginning. Since the ceasefire was announced on April 7th, deliberate data collection of over 36,000 munitions and platforms consumed, damaged, or destroyed in the conflict allowed analysis and evaluation of the hasty forecasts in more formal methods.

Seven key lessons emerged from this modeling and analysis. First, the hasty modeling and forecasts were useful, even if wrong. Of the five scenarios forecast on March 1st, the one rated most likely came to pass, and a March 12th forecast of a ceasefire occurring no earlier than April 9th was missed by only two days. Where this forecast was wrong was not in the general behavior of the conflict, but in the time delays of phasing and amplitude fluctuations. Mosaic warfare, as its doctrine sought to do, survived a devastating opening decapitation strike seeking to collapse the operational complexity of Iran's response. Instead, Iran's countervalue retaliatory barrages began much sooner, and with far higher intensity and initial success than expected. JADO, conversely, performed well in absorbing most of these retaliatory barrages across a region larger and more complex than any since World War II, even while rendering inoperable large amounts of Iranian military capability. However, even at reduced rates, mosaic warfare's barrages proved capable of shifting JADO's offensive OODA loop operations into a defensive posture. Neither theater strategy proved capable of sustaining such intense operations as the first few days. Strike intensity dropped significantly until a ceasefire occurred after 39 days, allowing an operational pause to rearm, recover, and reequip even as the conflict continued in less than full-spectrum operations.

Even though this is the first war fought between competing strategies of additive complexity, it is unlikely to be the last. Conflict between the US and its allies and Iran and its Axis of Resistance continues even as this paper is finalized for conference. As China considers its strategic options for seizing Taiwan, it may review the performance of mosaic warfare compared to JADO and which doctrine they wish to pursue. Foregoing efforts to peer-match the US 5th- and 6th-generation aircraft and carriers to instead adopt lower-cost retaliatory barrages and utilization of regional proxies to open theater flanks. Likewise, US military planners will benefit from close examination and further evolution of the JADO doctrine.

Review of JADO may also shift procurement strategies, already well underway in design and discussion, to acquire cheaper and more plentiful counter-barrage capabilities.

Bibliography

[1] *DoD Dictionary of Military and Associated Terms 2021*. Department of Defense, 2021. [Online]. Available: https://irp.fas.org/doddir/dod/dictionary.pdf

[2] "COUNTERAIR OPERATIONS," United States Air Force, Washington, D.C., Air Force Doctrine Publication 3–01, Jun. 2023. [Online]. Available: https://www.doctrine.af.mil/Portals/61/documents/AFDP_3-01/3-01-AFDP-COUNTERAIR.pdf

[3] T. Clancy, "Theory of an Emerging-State Actor: The Islamic State of Iraq and Syria (ISIS) Case †," *Systems*, vol. 6, no. 2, p. 16, May 2018, doi: 10.3390/systems6020016.

[4] T. Clancy, "Application of Emerging-State Actor Theory: Analysis of Intervention and Containment Policies †," *Systems*, vol. 6, no. 2, p. 17, May 2018, doi: 10.3390/systems6020017.

[5] T. Clancy, "InfoMullet: Principles of Unrestricted Warfare," InfoMullet. [Online]. Available: https://infomullet.com/2020/07/29/unrestrictedwarfare/

[6] "Read Trump's full statement on Iran attacks," PBS News, Washington, D.C., Feb. 28, 2026. [Online]. Available: https://www.pbs.org/newshour/world/read-trumps-full-statement-on-iran-attack

[7] J. Black, A. Lynch, K. Gustafson, D. Blagden, P. Paille', and F. Quimbre, "Multi-Domain Integration in Defence - Conceptual Approaches and Lessons from Russia, China, Iran and North Korea," RAND Europe, Santa Monica, Calif. & Cambridge, UK, RRA528-1, 2022.

[8] "Multi-Domain Operations in NATO – Explained," Allied Command Transformation. [Online]. Available: https://www.act.nato.int/article/mdo-in-nato-explained/

[9] H. Carlisle, "The Complexity of Multi-Domain Operations," in *Multi Domain Operations (JAPCC 2019)*, Essen, Germany: Joint Air Power Competence Centre, Oct. 2019. [Online]. Available: https://www.japcc.org/essays/the-complexity-of-multi-domain-operations/#top

[10] A. Saikal and D. Vestenskov, "Iran's National Security and Operational Capability," *Scandinavian Journal of Military Studies*, vol. 3, no. 1, pp. 18–30, Feb. 2020, doi: 10.31374/sjms.29.

[11] A. Nader, "How Would Iran Fight Back," Research & Commentary. [Online]. Available: https://www.rand.org/pubs/commentary/2012/10/how-would-iran-fight-back.html

[12] "Joint Publication 1-02: Dictionary of Military and Associated Terms," United States Department of Defense, JP 1-02. [Online]. Available: https://irp.fas.org/doddir/dod/jp1_02.pdf

[13] "Joint All-Domain Command and Control (JAD2C)," Congressional Research Service, Washington, D.C., IF115493.16, Jan. 2022. [Online]. Available: https://www.congress.gov/crs-product/IF11493

[14] P. M. Senge, *Appendix 2 System Archetypes : 5th Discipline*, Rev. and Updated. New York: Doubleday/Currency, 2006.

[15] W. Braun, "The Systems Archetypes," in *The Systems Modeling Workbook*, 2002, p. 26.

[16] D. H. Kim and V. Anderson, *Systems archetype basics: from story to structure*. Waltham: Pegasus Communications, 2007.
[17] T. Clancy, “Systems Thinking: Three System Archetypes Every Manager Should Know,” *IEEE Engineering Management Review*, vol. 46, no. 2, pp. 32–41, Jun. 2018, doi: 10.1109/EMR.2018.2844377.
[18] K. Saeed, “Defining a Problem or Constructing a Reference Mode,” May 1988, Accessed: Aug. 23, 2019. [Online]. Available: https://www.researchgate.net/publication/228723910_Defining_a_Problem_or_Constructing_a_Reference_Mode
[19] A. Naugle, S. Langarudi, and T. Clancy, “What is (quantitative) system dynamics modeling? Defining characteristics and the opportunities they create,” *System Dynamics Review*, p. sdr.1762, Feb. 2024, doi: 10.1002/sdr.1762.
[20] “Summary of the Joint All-Domain Command & Control (JADC2) Strategy,” Department of Defense, Arlington, VA, Mar. 2022. [Online]. Available: https://media.defense.gov/2022/Mar/17/2002958406/-1/-1/1/SUMMARY-OF-THE-JOINT-ALL-DOMAIN-COMMAND-AND-CONTROL-STRATEGY.PDF
[21] G. E. P. Box and N. R. Draper, *Response surfaces, mixtures, and ridge analyses*, 2nd ed. Hoboken, N.J: John Wiley, 2007.
[22] J. W. Forrester, “System dynamics—the next fifty years,” *Syst. Dyn. Rev.*, vol. 23, no. 2–3, pp. 359–370, 2007, doi: 10.1002/sdr.381.
[23] Y. Barlas, “Leverage points to march ‘upward from the aimless plateau,’” *Syst. Dyn. Rev.*, vol. 23, no. 4, pp. 469–473, 2007, doi: 10.1002/sdr.389.
[24] J. Homer, “The aimless plateau, revisited: why the field of system dynamics needs to establish a more coherent identity: The Aimless Plateau, Revisited,” *Syst. Dyn. Rev.*, vol. 29, no. 2, pp. 124–127, Apr. 2013, doi: 10.1002/sdr.1498.
[25] G. P. Richardson, “Building confidence in exploratory models,” *System Dynamics Review*, vol. 40, no. 4, p. e1769, Oct. 2024, doi: 10.1002/sdr.1769.
[26] T. Clancy, S. P. Langarudi, and R. Zaini, “Never the strongest: reconciling the four schools of thought in system dynamics in the debate on quality,” *System Dynamics Review*, vol. 39, no. 3, pp. 277–294, Jul. 2023, doi: 10.1002/sdr.1740.
[27] K. Saeed, “Circumscribing System Dynamics Modeling and Building Confidence in Models a Personal Perspective,” May 15, 2017, *Rochester, NY*: 3093080. doi: 10.2139/ssrn.3093080.
[28] J. Hines, “System Dynamics II: Applications of System Dynamics ‘The Standard Method.’” MIT Sloan School of Management, 2001. [Online]. Available: https://ocw.mit.edu/courses/15-875-applications-of-system-dynamics-spring-2004/27e71bdb46c79e8091158fc0fb3ebd8d_stnd_method.pdf
[29] T. Clancy, “Mega Mullet: Iran War Forecast & System Models,” The InfoMullet. [Online]. Available: https://infomullet.com/2026/03/01/mega-mullet-iran-war-forecast-system-models/
[30] T. Clancy, “Forecast Update 04 MAR,” The InfoMullet. [Online]. Available: https://infomullet.com/2026/03/04/forecast-update-04-mar/
[31] T. Clancy, “Iran War 05 MAR Forecast Update,” The InfoMullet. [Online]. Available: https://infomullet.com/2026/03/05/iran-war-05-mar-forecast-update/

[32] T. Clancy, “12 MAR Forecast Update on Iran War & Minimum Duration Forecast,” The InfoMullet. [Online]. Available: https://infomullet.com/2026/03/12/12-mar-forecast-update-on-iran-war-minimum-duration-forecast/
[33] T. Clancy, “1 APR Update: Diplomacy is War by Other Means,” The InfoMullet.
[34] J. Sterman, *Business dynamics: systems thinking and modeling for a complex world*. Boston: Irwin/McGraw-Hill, 2000.
[35] B. Mroue, J. Gambrell, and S. Magdy, “US and Iran agree to 2-week ceasefire as Trump pulls back on threats,” *AP News*, Associated Press, Apr. 07, 2026. [Online]. Available: https://apnews.com/article/iran-us-israel-trump-lebanon-april-7-2026-421ee64fdc9a5c26460df8119c7d1b3f
[36] A. GanzeveldMoore and N. Carl, “Iran Update Special Report: US and Israeli Strikes, February 28, 2026,” Institute for the Study of War. [Online]. Available: https://understandingwar.org/research/middle-east/iran-update-special-report-us-and-israeli-strikes-february-28-2026/
[37] A. Borens, B. Schmida, A. Fattah, R. Reddy, K. Campa, and A. GanzeveldMoore, “Iran Update Evening Special Report, March 1, 2026,” Institute for the Study of War. [Online]. Available: https://understandingwar.org/research/middle-east/iran-update-evening-special-report-march-1-2026/
[38] B. Toomey, “Houthis express solidarity with Iran but do not launch retaliatory attacks—yet,” Long War Journal. [Online]. Available: https://www.longwarjournal.org/archives/2026/03/houthis-express-solidarity-with-iran-but-do-not-launch-retaliatory-attacks-yet.php
[39] “IMF - Strait of Hormuz - Daily Transit Calls & Transit Trade Volume,” MacroMicroAI. [Online]. Available: https://en.macromicro.me/charts/94482/imf-strait-of-hormuz-number-of-ships-and-transit-volume
[40] D. Boffey, “‘It means missile defence on datacentres’: drone strikes raise doubts over Gulf as AI superpower,” *The Guardian*, Mar. 07, 2026. [Online]. Available: https://www.theguardian.com/world/2026/mar/07/it-means-missile-defence-on-data-centres-drone-strikes-raises-doubts-over-gulf-as-ai-superpower
[41] S. Moss, “Amazon confirms two UAE data centers hit by drone strikes, third in Bahrain damaged,” *Data Center Dynamics*, Mar. 03, 2026. [Online]. Available: https://www.datacenterdynamics.com/en/news/amazon-confirms-two-uae-data-centers-hit-by-drone-strikes-third-in-bahrain-damaged/
[42] D. Alomar and C. Sertin, “Iran Warns US Tech Firms And UAE AI Company G42 Will Be Targeted on 1 April.” [Online]. Available: https://www.wired.me/story/war-on-big-tech-iran-names-israeli-linked-us-firms-as-potential-targets
[43] S. Moss, “Iran threatens to attack OpenAI’s Stargate data center in UAE,” *Data Center Dynamics*, Apr. 07, 2026. [Online]. Available: https://www.datacenterdynamics.com/en/news/iran-threatens-to-attack-openais-stargate-data-center-in-uae-war/
[44] E. Banco, H. Pamuk, and J. Landay, “U.S., Kurds discuss potential Iran military operation, sources say,” *Reuters*, Mar. 04, 2026. [Online]. Available: https://www.reuters.com/world/asia-pacific/us-kurds-discuss-potential-iran-military-operation-sources-say-2026-03-04/

[45] O. Barin, “Iran war: Why is Trump blaming the Kurds?,” *Deutsche Welle (DW)*, May 19, 2026. [Online]. Available: https://www.dw.com/en/iran-war-us-kurds-donald-trump-iraq/a-77216394
[46] M. Mazzetti, J. E. Barnes, F. Fassihi, and Fr. Bergman, “Early War Goal Was to Install Hard-Line Former President as Iran’s Leader,” *New York Times*, May 19, 2026. [Online]. Available: https://www.nytimes.com/2026/05/19/us/politics/iran-israel-us-leader-ahmadinejad.html
[47] A. Makoii, “Ahmadinejad back from the dead at Khamenei’s funeral,” *The Telegraph*, The Telegraph, London, Jul. 06, 2026. [Online]. Available: https://www.telegraph.co.uk/world-news/2026/07/06/ahmadinejad-back-from-the-dead-khameneis-funeral/
[48] B. Rezaei *et al.*, “Iran Update Special Report, May 11, 2026,” Institute for the Study of War. [Online]. Available: https://understandingwar.org/research/middle-east/iran-update-special-report-may-11-2026/
[49] J. DiMascio and D. M. Gettinger, “U.S. Aircraft Combat Losses in Operation Epic Fury: Considerations for Congress,” Congressional Research Service, Washington, D.C., CRS Insight IN12692, May 2026. [Online]. Available: https://www.congress.gov/crs_external_products/IN/PDF/IN12692/IN12692.2.pdf
[50] M. Amoah, M. Bazilian, and J. Matisek, “Over 5,000 Munitions Shot in the First 96 Hours of the Iran War,” Foreign Policy Research Institute. [Online]. Available: https://www.fpri.org/article/2026/03/over-5000-munitions-shot-in-the-first-96-hours-of-the-iran-war/
[51] M. F. Canican and C. H. Park, “Last Rounds? Status of Key Munitions at the Iran War Ceasefire,” Centers for Strategic & International Studies. [Online]. Available: https://www.csis.org/analysis/last-rounds-status-key-munitions-iran-war-ceasefire