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Optimizing Multi-Domain Operations at the Brigade Combat Team Level

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Abstract: History has shown that those unable to adapt to the future are forced to remain in the past. The United States Army is successful because of its ability to learn from past mistakes, strength as a nation, and the American spirit. Russia and China, near-peer threats of the United States, are constantly improving their capabilities, and in order to maintain the Army's military superiority it must continue to modernize and adapt to the future. Multi-Domain Operations is the future of warfare. The utilization of integrated assets across all domains towards the collective creation and exploitation of enemy vulnerabilities is necessary to achieve future victory. Wars are fought and won by soldiers on the frontlines, and the brigade combat team (BCT) is the largest mobile unit in the United States Army in which these frontline soldiers operate. The BCT's MDO capabilities will determine the future success of the United States Army.

Keywords: Multi-Domain, Operations, Modeling, Strategy

1. Introduction and Background

World influence is the ability to shape the conditions and course of the world; it constantly shifts between countries as influence ebbs and flows. The ability to influence the world comes from factors such as economic stability, increased military capabilities, and internal conflicts. Countries are competing to become a hegemon, a singular country with an overwhelming amount of influence to gain security and stability. This status can be achieved through military superiority, political control, or a combination thereof. The United States is in direct competition with near-peer countries (such as Russia and China) that have similar capabilities. These near-peer threats continue to rapidly develop their technological and military capabilities as they compete with the United States for world influence. In response, the United States Army has adopted a new operational concept: Multi-Domain Operations (MDO). Under Multi-Domain Operations, the Army seeks to deter enemies and effectively respond to attacks within any of the five domains: land, air, sea, space, and cyberspace. The world today is "not defined by battles but by persistent competition that cycles through varying rates in and out of armed conflict" (Townsend, 2018). The advantage of competition comes from the sustained effort of "executing integrated operations and campaigning" (Townsend, 2018). The Army will continue integrating Multi-Domain Operations to maintain superiority in competition, but should competition transition into conflict, the Army will "penetrate and dis-integrate enemy anti-access and area denial systems" (U.S. Army TRADOC, 2018) so that the enemy's freedom of maneuver will be reduced enough to allow the securing of "strategic objectives" (U.S. Army TRADOC, 2018) which enables a "return to competition" (U.S. Army TRADOC, 2018). The intent behind MDO enables the Army to establish a presence with Calibrated Force Posture, utilize assets through Multi-Domain Formations, and integrate fires among other assets through convergence (U.S. Army TRADOC, 2018).

To analyze a specific mission set of Multi-Domain Operations, an offensive mission was selected that uses field artillery assets to destroy enemy anti-access and area denial (A2/AD) assets to enable operational and tactical maneuver. Battlefield commanders need to make decisions that best accomplish their mission given the resources and the time that are at their disposal, so we created two alternatives that represent. The Systems Decision Process (Parnell, 2013) and its four steps: Problem Definition, Solution Design, Decision Making, and Solution Implementation was implemented to approach this problem.

2. Methodology

2.1 Problem Definition

The Systems Decision Process starts with an analysis of the problem. To narrow the problem's scope, a DSRP (Distinction, System, Relationship, Perspective) diagram (Figure 1) was created. In essence, the DSRP diagram identifies what system is being assessed, what network the system belongs to, the system's status within the network, and from what perspective the system is being analyzed. This problem is focused on an Army Brigade Combat Team's mission to destroy enemy A2/AD assets. This mission is nested within MDO at Division, Corps, and Army levels of the military.

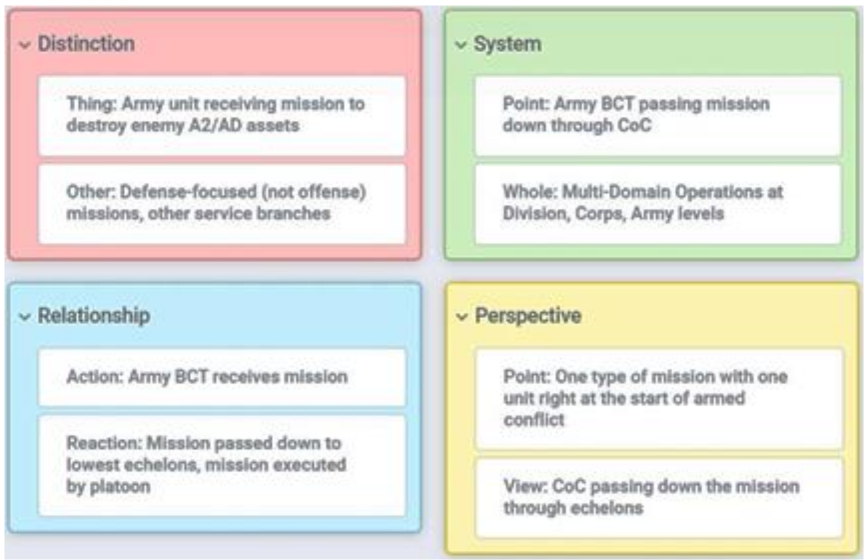

Figure 1. DSRP Diagram

With the problem's scope narrowed, a more holistic understanding of MDO in Brigade Combat Teams [BCT] was accomplished through interviews. COL Christopher J. Byrd (FORSCOM G6) and COL Jabari Miller (3rd ABCT Commander, 1st Armored Division) were interviewed as subject matter experts on BCTs. From these interviews, Finding, Conclusion, and Recommendation (FCR) matrices were created, an example of which can be found in Appendix A. FCR Matrices summarize findings from interviews as well as draw conclusions and make recommendations. Afterward, a Functional Hierarchy (Figure 2) was created of an MDO Fire Mission that outlined a fundamental objective, which could be accomplished through its functions. Within the functions are a few "maximize" or "minimize" objectives, which can be quantitatively measured through value measures. Each value measure has units and a statement indicating whether less or more is better, which helped formulate the value functions. Creating this functional hierarchy breaks down the task of accomplishing an MDO Fire Mission into distinct parts that can be assessed through objectives and measured.

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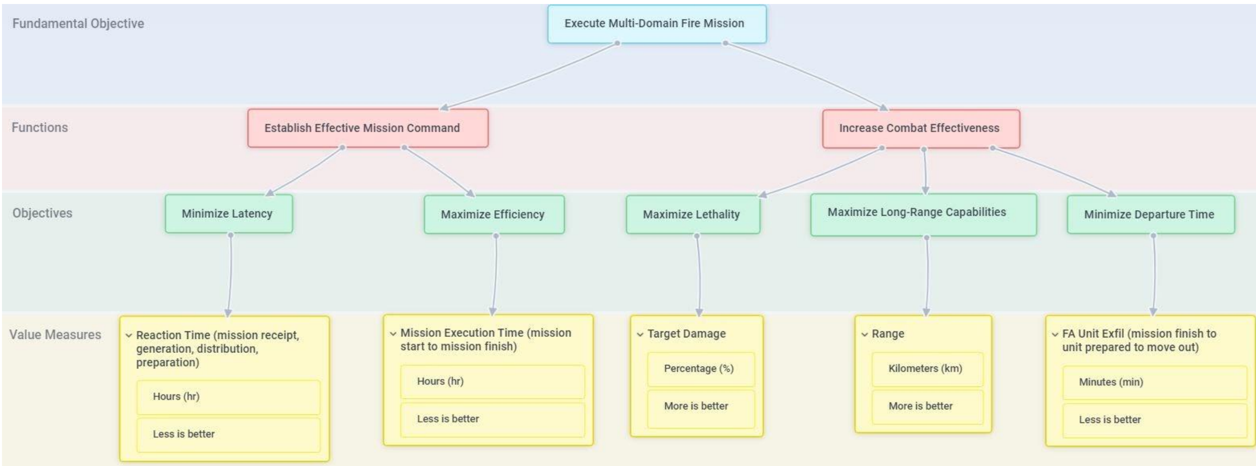

Figure 2. Functional Hierarchy

The problem definition phase concluded with value modeling, in which value measures were identified and assigned weights with a swing weight matrix (Appendix B). This matrix considered the variability in each measure's range as well as their importance relative to the problem being solved. Value functions (Appendix B) and global weights (dividing each assigned swing weight by the sum of the swing weights) were created to produce the final value scores of each alternative in the Decision Making phase. Weights and values were assigned for each value function by identifying needs and regulations from Army doctrine, as well as ideal situations given by the interviewees.

2.2 Solution Design

Having a more complete understanding of the problem, alternatives were created. The decision was made to pursue either a larger, more mission-effective (exquisite) system or a more cost-effective system that focuses on higher levels of quantity. The exquisite system is based on the United States Army's current approach to systems: gaining an overwhelming advantage through capabilities. The cost-effective system is based on near-peer threats, mainly Russia and China, which aims to gain an advantage through a significant quantity of systems. There is a "baseline" alternative in the project's analysis that represents the current weapon system as it is; its purpose is to be compared the performance of new systems. To maintain a broader focus in terms of overall value, a cost analysis was not run in creating these alternatives. While some of the estimates came directly from the interviews with COL Byrd and COL Miller, many of the values were estimated when assigned for each value measure in each alternative. Given that there were only two alternatives with five value measures, a screening criterion was not implemented. The screening criteria are designed to set requirements that eliminate alternatives, and the list of alternatives does not need to be narrowed with only two alternatives. The two alternatives were then compared in the Decision Making phase.

2.3 Decision Making

Applying the Additive Value Model (multiplying an alternative's value score in a particular value measure by the global weight) to calculate the total value scores of each alternative (Figure 3), it was found that the "Exquisite Systems" alternative had a higher value score than the "Cost-Effective" alternative. While the "Cost-Effective" alternative only has a slightly higher value in terms of the value measures, the lower cost for better performance indicates that the baseline alternative should be eliminated in favor of one of the two. The "Exquisite Systems" alternative has more value than the "Cost-Effective" alternative, but it will cost more time and money to implement. Both alternatives have improvements to make. Exquisite Systems need to improve in mobility to keep up with the changing battlefield conditions that come with MDO, and while Cost-Effective does enough damage to enemy A2/AD assets to neutralize them, it does not inflict enough damage to accomplish the mission on its own.

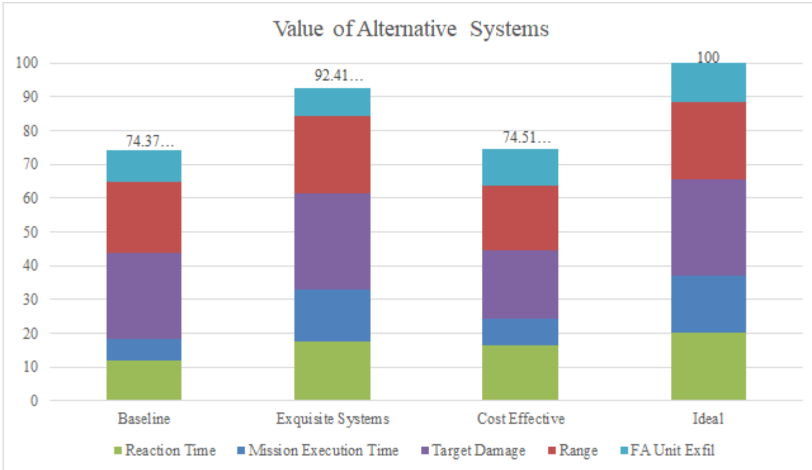

Figure 3. Alternative Total Value Scores

Either it is used in combination with other assets, or it needs to have more destructive power. The use of either of these alternatives will depend on the time and resources available to the BCT Commander. If the BCT can only allocate field artillery assets to destroy enemy A2/AD assets, Exquisite Systems would be best in accomplishing the mission. If time is short and other assets are available, Cost-Effective would better set the conditions for mission completion. Further analysis is necessary to determine which of the value measures is most sensitive to change.

2.4 Solution Implementation

The Decision Making phase determined that the Exquisite Systems were the best candidate solution to accomplish the mission of disintegrating and destroying enemy anti-access/area-denial assets. The other candidate solution, Cost-Effective Systems, does not perform as well as the Exquisite Systems. However, the lower cost enables an increase in quantity that counters the Exquisite Systems' sophisticated capabilities. The Army should continue integrating exquisite systems into its ranks while searching for ways to lower the cost of exquisite systems. This is a difficult but necessary task given the reduced budget and demands of the Army.

3. Conclusion

The Army has prioritized modernization to improve MDO capabilities in support of maintaining military superiority. Recent involvement in armed conflicts over the past few decades has given near-peers of the United States time to develop their technological and military capabilities as they compete with the United States for world influence. MDO is the future of the Army, and modernizing the Army, integrating its assets, and improving combat effectiveness are the priorities required to maintain military superiority. With an increased pressure to keep up with and surpass near-peer threats, MDO must be successfully implemented. Early implementation has already begun with new units, exercises, and allies of the United States. However, assessing the effectiveness of MDO will provide insight into military strengths and weaknesses.

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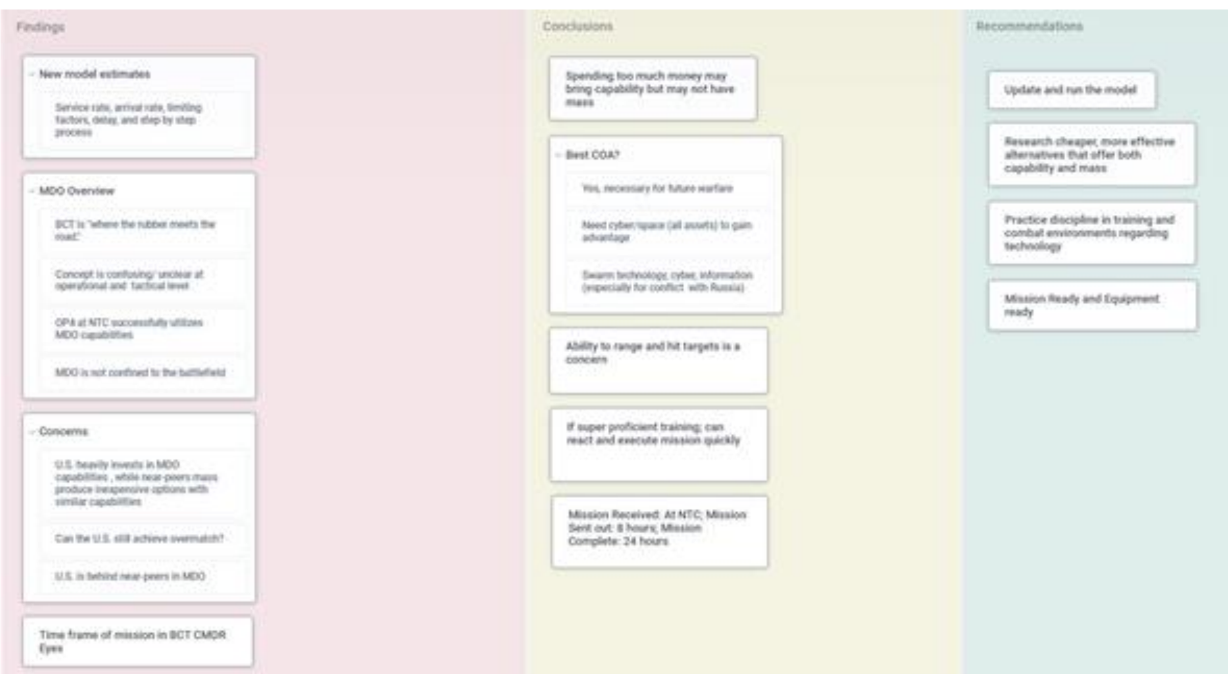
Appendix A: FCR Matrixes

Interview (COL Byrd, FORSCOM G6):

Interview (COL Miller, ABCT Commander, 1st Armored Division):



Appendix B: Value Modeling

Value Functions:

Range (km)		FA Unit Exfil (min)	
Raw Score	Value	Raw Score	Value
0	0	2	100
50	20	5	97
100	30	10	92
150	55	15	84
200	70	20	72
250	84	25	60
300	92	30	56
350	96	35	50
400	100	40	42
		45	30
		50	18
		55	5
		60	0

Reaction Time (hrs)		Mission Execution Time (hrs)	
Raw Score	Value	Raw Score	Value
3	100	0.2	100
3.5	93	0.4	97
4	82	0.6	92
4.5	70	0.8	86
5	59	1	74
5.5	48	1.5	65
6	40	2	56
6.5	29	2.5	47
7	20	3	38
7.5	12	3.5	29
8	5	4	20
8.5	0	6	14
		8	9
		10	5
		12	0

Swing Weight Matrix:

		Level of Importance of the Value Measure		
		High	Medium	Low
Variation in Measure Ranges	High	**Target Damage**	**Reaction Time**	**FA Unit Exfil**
		100	70	40
			Mission Execution Time	
			60	
	Medium			
	Low	**Range**		
		80		

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