

Methodology Article

An Engineered Assessment System to Manage Demand Reduction Initiatives

Alejandro Hernandez*, Nathanael Achor, Courtney Franks, William Gillogly, Randall Groller, William Hatch, Nicholas Ulmer

Systems Engineering, Naval Postgraduate School, Monterey, United States

Abstract

The Joint Warfighting Concept is a framework for how the United States will fight in the future security landscape. To successfully carry out these new concepts, the military services must find ways to lessen the logistics burden at the strategic, operational, and tactical levels. Only by reducing the demands on its current and planned sustainment systems can the United States continue to be a dominant force on the world stage. However, defense agencies such as the Logistics Functional Capability Board lack a quantitative, credible, repeatable process to effectively assess and manage demand reduction initiatives. This paper is based on work from a student/faculty team that created an assessment system for demand reduction initiatives. Discussion highlights the systems engineering techniques that were used in the effort, which includes but is not limited to stakeholder analysis, functional analysis, morphological analysis, and value modeling. The blended qualitative and quantitative methods focused on user and stakeholder needs to create a process system to evaluate technologically disparate, multicriteria systems. The team expects that the resultant assessments system's applicability to a range of demand reduction initiatives would be of interest to organizations that must prioritize technology proposals, as well as perform trade-off analysis. Additionally, the approach to create the assessment system has the flexibility to adapt to changes in the stakeholders' requirements from the reduction initiatives, as well as the ongoing evolution of the warfighting concepts.

Keywords

Demand Reduction, Value Modeling, Functional Analysis, Complex System, Assessment, Systems Analysis, Systems Engineering

1. Introduction

The Department of Defense (DoD) has shifted its focus on “near-peer threats.” This change necessitates new sustainment requirements, prompting investments in advanced technologies and processes. Additionally, the DoD has issued a directive to all military service to seek initiatives to reduce demand on the sustainment system [1]. This directive generated technological, procedural, as well as personnel-related

proposals.

A change in how the U.S. conducts war requires modifications in sustainment operations, specifically overseas. The 20 years of continual combat have resulted in a less capable sustainment force that will significantly hinder and possibly cause the failure of large-scale military operations [2]. The DoD envisions successful demand reduction initiatives (DRI)

*Corresponding author: ahernand@nps.edu (Alejandro Hernandez)

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that will enable freedom of maneuver (FoM) and the ability of U.S. forces to increase operational tempo, reach, and endurance [3]. To reduce the logistical burden in the spectrum and levels of military operations, DoD is considering a range of DRIs [1]. Consequently, the Logistics Functional Capability Board (LOG FCB) continues to grow a pipeline of new initiatives. However, LOG FCB lacks a quantitative, credible, and repeatable process to effectively evaluate and prioritize dissimilar DRIs.

A team comprised of students and faculty addressed the LOG FCB concerns through a series of case studies of DRI cases [4]. This paper is a synopsis of that research effort. Additionally, the study offers extensions that enable LOG FCB to adopt the assessment system for future evaluation challenges.

The primary objective of this research project is to develop the DRI Assessment System (DAS), a process system, which can manage proposed DRI through assessment, comparison, and prioritization for investment based on the JWC. In achieving this main objective, the research team also addressed the following:

1. Identify measurable attributes common to different DRIs.
2. Construct value models to score attributes of different DRIs on a common scale.
3. Conduct a comparative analysis of prioritized DRI with and without DAS.
4. Draft a DAS User's Manual.

Additionally, the team had to consider to which DRIs that

DAS could be applied, as well as the stakeholders' value system that could, at times, not align with the JWC needs. The team's systematic approach to development was critical for remaining unbiased in the final version of DAS.

1.1. Scope and Data

The scope of this study is bound by the availability of data to guide development of the system. In this case, the "data" are the proposed DRIs that are mature enough in the development process to allow the team to analyze relevant information about the DRIs. The team considered DRIs that were available in the period, October 2021 – June 2022 (Figure 1). The complexity of each system required a systems engineering approach to analyze the appropriate elements of each system [5]. The LOG FCB's projects ranged from the Rapid Expeditionary Ice Construction (REIC), an additive manufacturing system that utilizes ice, snow, and a lightweight cellulose instead of concrete, to mobile nuclear power plants (MNPP).

Another challenging consideration for developing an assessment system was the need to accommodate each Service's priorities along with the JWC mandates. Therefore, the researchers examined the DRIs in context of the operational environment for the next five years. To meet the project sponsor's goal, the team delivered results in time for the Joint Staff J-4 and LOG FCB chair to apply during fiscal year 2023 reviews.

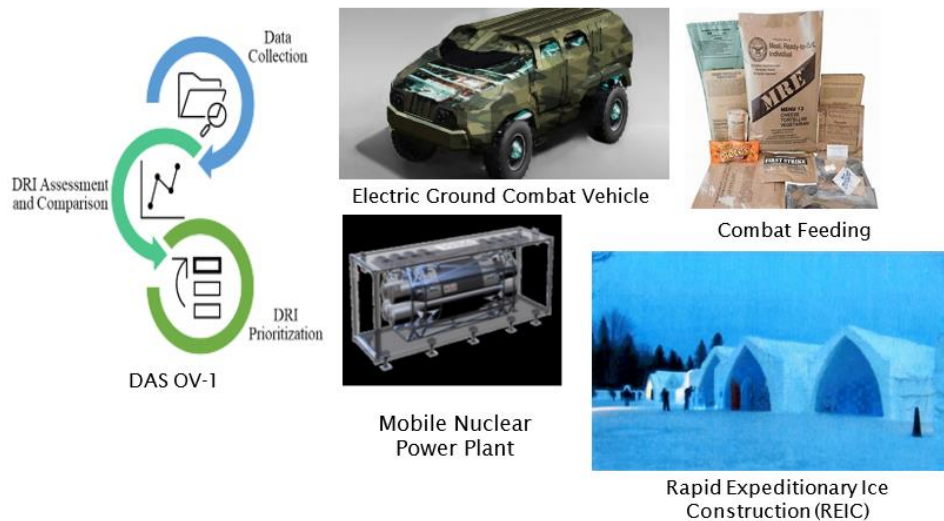


Figure 1. Known Initiatives for DAS Development.

This research creates an assessment system that can produce a prioritized list of DRIs to inform the LOG FCB Chair's decisions. The development of DAS offers the user with the means to identify relevant DRI data as input for the value models. In prioritizing the initiatives that reduce demands on

the sustainment structure, LOG FCB expects that the long-term benefit to the warfighter will be an increase in operational reach, lessening of logistical complications during missions in contested environments, while saving time, money and lives. The results of this work will allow the end

user to refine the DAS for implementation to future initiatives.

1.2. Overview of the Study Approach

The systems engineering vee-model was used to design and

develop the DAS (Figure 2). This process has five key areas of discussion: (1) problem definition, (2) system requirements, (3) functional decomposition, (4) design and development, and (5) verification [6].

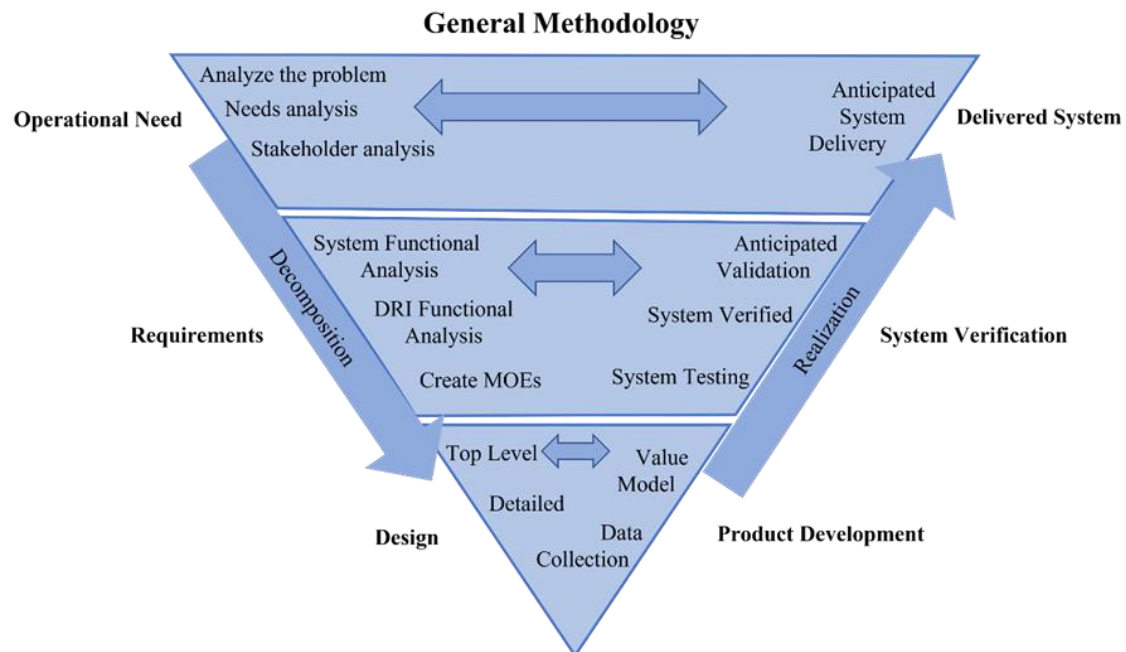


Figure 2. Das Development Process. Adapted from [6].

The steps on the left-hand side of the vee-model are fundamental to the systems engineering process. Different techniques may be used at each step. For instance, the problem definition can be developed with cause-and-effect diagrams, i.e., an Ishikawa diagram. Interviews or surveys are instrumental for stakeholder analysis to define overarching system requirements and user objectives. Conceptual designs are created through different means such as analogous systems, general morphological analysis, or synectics. This paper describes the techniques that the development team used.

The team followed the general process of the vee-model. When necessary, the team modified the techniques to accommodate the nature of the problem. For instance, the Ishikawa diagram [7] is a cause-and-effect tool for a team to come to consensus on the problem to be addressed and the situation surrounding the problem. However, the team used the Ishikawa diagram for stakeholder analysis, a systems engineering approach to elicit the stakeholders' requirements. Traditionally, stakeholder analysis is performed through a relatively regimented process. Formal interviews and questionnaires are common instruments. Because the issue is complex, the team opted for the Ishikawa diagram, which provided a more in-depth discussion with the stakeholder in the development

of the diagram.

2. Preliminary Analysis for Das Development

Stakeholder Analysis through the Ishikawa or Fishbone Diagram

An Ishikawa diagram [7] identified five major factors that contributed to the overall problem, the inability to compare and prioritize sustainment focused DRIs (Figure 3). The "head" of the fish is on the right side of the diagram, and each fin is the cause of the problem.

1. Shift in warfare to focus on near-peer competitors,
2. New needs of the force associated with the JWC,
3. Range of disparate, dissimilar DRIs,
4. Absence of an assessment system for initiatives traditionally unrelated to sustainment, and
5. Lack of an approach to compare disparate initiatives.

These factors mapped onto the required capabilities that the eventual DAS must possess. The following sections show the trace of these causal factors into the design for the DAS.

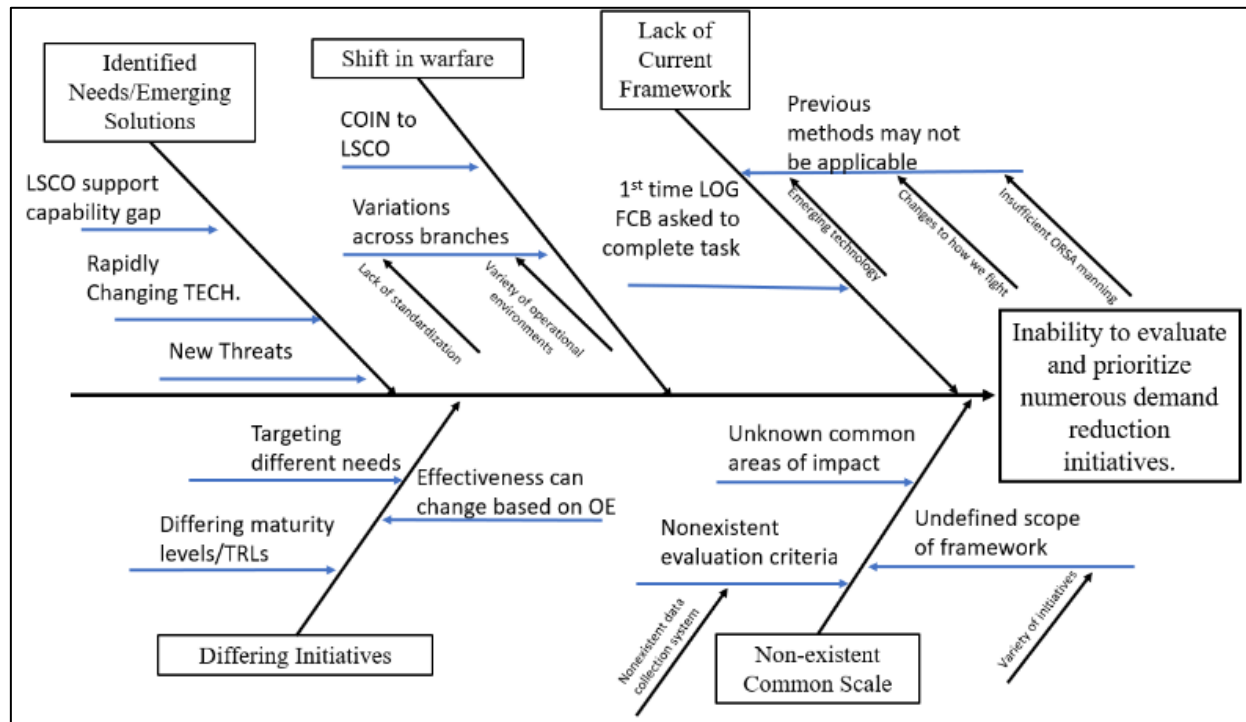


Figure 3. The Cause-and-Effect Diagram for DAS Development. Adapted from [4, 7].

2.1. Hierarchical Objectives and System Level Requirements Analysis

These activities enabled development of a high-level system requirements hierarchy. A needs analysis established the baseline for system level requirements against which other design configurations were evaluated. The Joint Staff, J-4 Analysis Branch is the primary stakeholder for this project and the end user for the DAS tool. The main purpose for DAS is to prioritize DRIs. A stakeholder analysis provided the background for determining end-user needs and capabil-

ity gaps. From these conversations with the stakeholder, the team defined system level requirements to support system functional analysis and design.

Another result from the needs analysis is an understanding of how the stakeholder expects the system to behave. These non-functional requirements are the basis of constructing an objectives hierarchy. This systems engineering technique created a tree of the customer's needs. The structure of the tree led to development of metrics for evaluation (Figure 4). Metrics identification is a critical step for value modeling that will comparative analysis of dissimilar DRIs on a common scale.

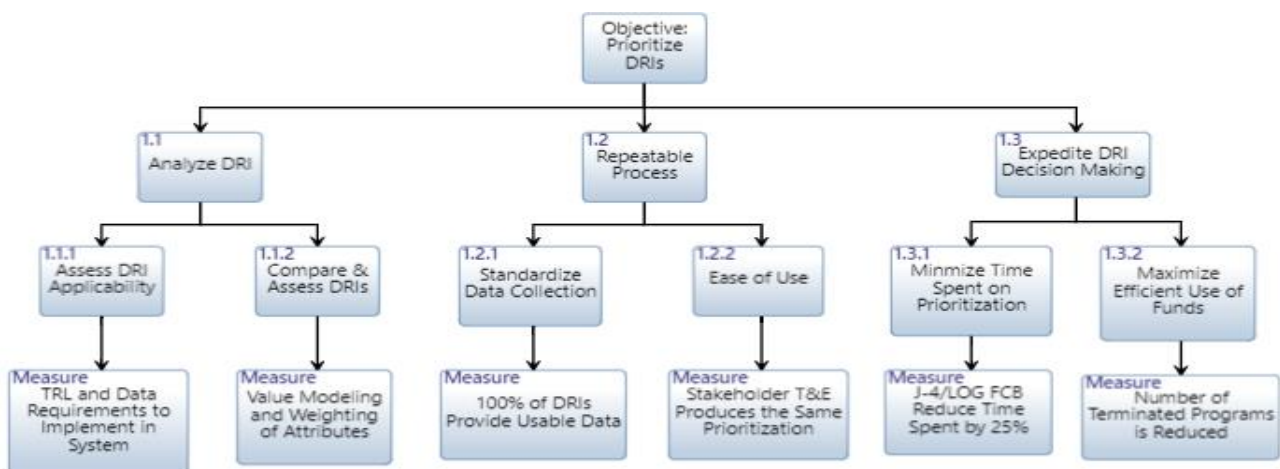


Figure 4. Stakeholder Objectives Hierarchy for the DAS [4].

2.2. Functional Analysis

The system level requirements led the team to develop an understanding of what DAS must do to achieve its overarching purpose. This section explains 1) the function of each component in the system, 2) the necessary physical methods for the component to achieve the function, and 3) how components complement each other in the fully functioning system. The team's key areas of work to build DAS included collecting accurate and usable data, identifying how to analyze that data, and frequent communication with the stakeholders to verify that DAS construction was in accordance

with where LOG FCB envisioned it would be applied.

Functional analysis of the DAS began with the identification of the overarching purpose for the system. This critical step resulted in determining specific functions that the system must perform. The essence of this analysis is to ask the question, "What must the system do to achieve its overarching purpose?" The primary purpose for DAS is to Prioritize Disparate Initiatives (1.0) at the top of the functional tree. The three sub-functions are: 1.1 Gather Data, 1.2 Identify DRI Attributes, and 1.3 Rank DRIs. The three sub-functions were further broken down into their most basic functions as depicted in Table 1.

Table 1. DAS Functional Analysis Requirements [4].

Composition level	Function/subfunction	Requirements
1.0	Prioritize Disparate Initiatives	The DAS shall provide a repeatable process resulting in prioritized DRIs.
1.1	Gather Data	The DAS shall gather data from DRI sponsors.
1.1.1	Standardize Data	The DAS shall standardize data received from DRI sponsors.
1.1.2	Identify Measurable Data	The DAS shall provide instruction on applicable quantitative or qualitative data.
1.2	Identify DRI Attributes	The DAS shall provide and/or identify DRI attributes.
1.2.1	Identify Metrics	The DAS shall implement appropriate quantitative and/or qualitative metrics for assessment.
1.2.1.1	Link Data to Metrics	The DAS shall provide metrics specific to each attribute.
1.2.1.2	Normalize Metric Data	That DAS shall include a scaling of attributes to assess all DRIs evenly, in a repeatable manner.
1.2.2	Narrow Attributes that only effect Operational Needs	The DAS shall eliminate non-technology DRIs and out-of-scope attributes.
1.3	Rank DRIs	The DAS shall provide a prioritization of DRIs.
1.3.1	Conduct AoA	The DAS shall conduct AoA to enable the assessment and comparison of DRIs.
1.3.2	Compare DRIs	The DAS shall compare DRIs.

Table 1 shows the decomposition of the DAS's required functions and detailed subfunctions in the first two columns. They match the objectives tree from the stakeholder analysis (Figure 4). The right-hand side of the table explains the system requirement that addresses one or more functions. Following this process ensured that the system requirements were traceable to the original needs of the stakeholder. These systems engineering steps were the basis for developing the DAS. Of note, functional decomposition is a critical activity in the DAS. The research team next mapped functions in Table 1 to potential physical forms that would perform each function.

2.3. Function-to-Component Mapping and the Morphological Box

The team researched and identified a variety of physical

forms to achieve the functions in Table 1. The left-hand column in Table 2 is a list of functions that DAS must perform. The right-hand columns are component options to achieve the function. For instance, options to "Gather Data" are questionnaires and interviews. Therefore, to generate one instance of a conceptual design, the engineer selects one option from each row, as shown in the green shaded boxes in Table 2.

The team reviewed all feasible instantiations and, for demonstration purposes in this study, chose a reasonable system (shaded in green) that would be able to perform all the identified system functions. While the research sponsor agreed to this specific design, the team recommends an in-depth analysis of alternatives to reduce the options to a manageable subset of feasible conceptual designs.

As an additional trace, the team developed a physical decomposition of DAS to connect the chosen forms from Table 2 to

the function(s) that the component would perform. The idea for this hierarchical tree is to ensure that each function that the DAS must perform is addressed by a specific component. For instance, the value modeling process of DAS served to normalize the data,

while functional analysis determined metrics linked to the attributes. The following sections illustrate the application of the conceptual design outlined in Table 2.

Table 2. System Functions Traceability Matrix [4].

FUNCTIONS	SUB-FUNCTIONS	FORM OPTIONS			
Gather Data	<i>Standardize Data</i>	Questionnaires	Interviews	Standard Format of DRI Proposal	
	<i>Identify Measurable Data</i>				
Identify DRI Attributes	<i>Identify Metrics</i>	DRI Functional Analysis			
	<i>Link Data in Metrics</i>				
	<i>Normalize Data</i>	Value Modeling Tool	Measures Development	Historical Data	
	<i>Narrow Attributes</i>	Attribute Comparison Tool			
Rank DRI	<i>Conduct AoA</i>	KVA Tool	Total Value Tool	Multi-Objective Optimization Framework	
	Compare DRIs	Total Value Ranking Tool	Cost Reduction Estimate	Cost-Benefit Analysis	Modeling and Simulation

3. Developing the DAS

3.1. Gather Data and Identify DRI Attributes

A critical step in creating the DAS involved establishing the common attributes of any DRI proposal that LOG FCB would expect to assess. The team used the set of known proposals from the set of initial DRIs from LOG FCB as the basis for establishing the core attributes of a DRI. A functional analysis of the DRIs provided identified the functions that the DRI is to

serve if implemented. These functions are listed on the left-hand side of Table 3. The following columns are the specific DRIs. An “X” marked in the box associated the function with the DRI. This visual provided the team with an understanding of the common functions across the different DRIs.

This functional analysis traced the JWC areas that each DRI impacted. Stakeholders also determined that two of the functions in Table 3 are unlikely to be considered as core functions in future DRI proposals. Therefore, they were removed. The next step for the team was to construct appropriate measures to evaluate the degree that each function is achieved.

Table 3. Comparison of Functions to DRIs [4].

	DRIs									
	STAMP	MNPP	CF	REIC	APM	TaCV-E	MAFFs	MPBR	BLS	UCA
Reduce Weight	X	X	X	X	X	X	X	X	X	
Reduce Volume	X	X	X	X	X	X	X	X	X	
Reduce Fuel Consumption	X	X	X	X	X	X	X	X	X	X

	DRIs									
	STAMP	MNPP	CF	REIC	APM	TaCV-E	MAFFs	MPBR	BLS	UCA
Reduce Resupply Platforms	X	X	X	X	X	X	X	X	X	
Reduce Costs	X	X	X	X	X	X	X	X	X	X
Reduce Manhours	X	X			X	X	X	X	X	X
Increase Availability	X	X			X	X	X			X
Reduce Augmented Power Sources	X	X				X				
Reduce Storage							X	X	X	
Reduce Heat Signature	X	X		X		X				
Reduce Noise	X	X				X				X

The team first compared the attributes to their effect on maneuverability as being the most critical during operations according to the JWC and Joint Concept of Contested Logistics. Related to maneuverability, other operational factors against which the DRI attributes were compared are speed, reach, endurance, and flexibility [2]. These final operational factors became the basis for selecting the subset of DRI functions. Using a rating scale of low (1), medium (3), and high (5) with regard to operational impact, the team scored the DRI functions (Table 4).

Table 4. Top Functions Based on Impact on Operations [4].

		Speed	Reach	Endurance	Flexibility	Score
DRI Attributes	Reduce Volume	med (3)	high (5)	high (5)	high (5)	18
	Increase Availability	high (5)	med (3)	high (5)	high (5)	18
	Reduce Weight	high (5)	med (3)	med (3)	high (5)	16
	Reduce Resupply Platforms	med (3)	med (3)	high (5)	high (5)	16
	Reduce Manhours	high (5)	low (1)	high (5)	high (5)	16
	Reduce Fuel Consumption	low (1)	high (5)	high (5)	med (3)	14
	Reduce Storage	med (3)	low (1)	low (1)	high (5)	10
	Reduce Augmented Power Sources	low (1)	low (1)	low (1)	high (5)	8
	Reduce Costs	N/A	low (1)	med (3)	med (3)	7
		high	5			
		med	3			
		low	1			

The right most column suggests that “Reduce Storage,” “Reduce Augmented Power Sources,” and “Reduce Costs” should be removed as core functions. The primary stakeholders agreed with the team.

The team administered a questionnaire to the DRI developers as a second method to reduce the functions to a manageable subset. A major item in the questionnaire was the availability of relevant data to evaluate the function. From this

review, the team determined that the functions shaded in yellow, “Reduce Resupply Platforms” and “Increase Availability,” were unlikely to produce usable data for the DAS. Additionally, if the team could not determine or found the claim not credible regarding the function’s impact, the response was discarded. The primary stakeholder agreed that these two functions were not significant for assessing DRIs. The final four common functions provide clarity into how to

assess DRIs. See Table 5. Within each definition is a unit of measurement. These measures are the attributes that will be used to assess different DRIs.

Table 5. Final Four Common DRI Functions and Associated Measures [4].

DRI FUNCTION	MEASURES DEFINITION OF SELECTED ATTRIBUTES
Reduce Volume	The amount of space occupied by a three-dimensional object as measured in cubic units. Does not include volume of fuel.
Reduce Fuel Consumption	The amount of fuel the engine of a system burns each hour in gallons, or the amount of fuel no longer required to transport.
Reduce Weight	The amount that an object weighs as measured in pounds (lbs.). Does not include weight of fuel.
Reduce Manhours	The number of hours required for military and civilian personnel that are required, authorized, and potentially available to train, operate, maintain, and support the system. (1 FTE = 40-hour work week)

3.2. Rank DRIs Through Value Modeling

The next component of DAS to develop is a process to Rank DRIs. The team used a value modeling approach [7-9]. Developing a value function for DAS required LOG FCB leaders and staff to map each measurable attribute to a common scale for level of “goodness,” where goodness is the ability of the DRI to achieve an objective or function [9]. A common value scale provided a reasonable, repeatable method to aggregate dissimilar units of measure to assess different DRIs. The team selected a value scale that ranged from 1 to 20, with one being the stakeholder’s lowest perceived value of the DRI if it were to achieve the reduction it claimed. If an attribute did not appear in the DRI, that attribute had zero value.

3.3. Value Modeling of Attributes

Developing relevant metrics is an important step in value modeling. The team performed studies from industry and DoD to identify useful metrics for this study. The results led to organizations that rated product lines in terms of the attributes in Table 5. The team reviewed studies from and about companies such as Ford, Amazon, Tesla, Dell, and the DoD that were intended to improve efficiency and business practices. Highlights from these studies are listed below and informed the team on the appropriate data to collect and relate to the value scale [4].

1. Ford Motor Company switched its automobile body from steel to aluminum, which was projected to reduce fuel consumption by 2% and other changes, such as engine options, to further reduce fuel consumption by

5–29% [10].

2. The new United States Postal Service truck designed by Oshkosh will reduce fuel consumption by 5% [11].
3. The U.S. Army’s Improved Turbine Engine has a goal of reducing fuel consumption by 25% [12].
4. The U.S. Army’s goal in research of waste-to-energy was to displace 85% of Jet Propellant-8 [12].
5. The U.S. Army’s efficient power train program aimed to develop engines with a 15–20% reduction in fuel consumption [12].
6. A microgrid test in Afghanistan had a 17% fuel-consumption reduction [12].
7. The U.S. Marine Corps studied a new ship-to-shore connector that had 11% better fuel efficiency [12].
8. A Bradley replacement engine was predicted to reduce fuel consumption by 50% [12].
9. A generator for the U.S. Army increased fuel efficiency by 21% [13].
10. Utilizing the under armor auxiliary power unit (UAAPU) on the Abrams M1A2 SEPv3 battle tank, provided a 78% reduction in fuel consumption when running the main engine at idle [14].

The average reduction from the studies was 28% with a standard deviation of 0.27, which the team used to develop the end points of the measure. To normalize the comparisons, the team used the daily fuel consumption that a 5,000-person camp would require in a desert climate. This amount was 16,880 gallons of fuel [15]. Therefore, the percentage of reduced fuel consumption was based on 16,880 gallons.

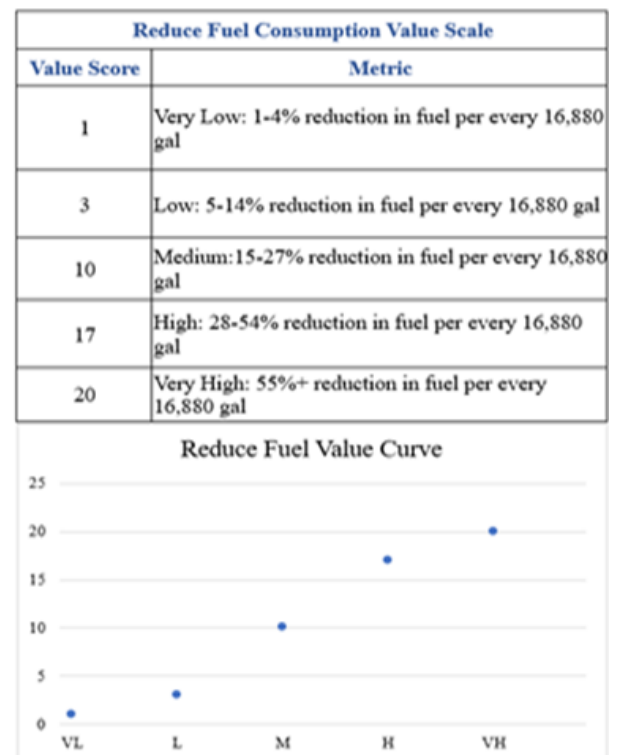


Figure 5. Attribute Value Scale and Value Curve for Fuel Consumption [4].

The team used a constructed approach to develop the value curves “Reduced Fuel Consumption.” This was an appropriate method in this initial model, given the expected difficulties in data collection. The study of these companies enabled the team to stratify data and develop a value model. Parnell and Trainor [8] provide a step-by-step description for mapping metrics to value scores. Figure 5 presents the value scale for the attribute “Reduce Fuel Consumption.” The top half of Figure 5 consists of an explanation for the meaning of specific value scores. For instance, if the DRI reduced fuel consumption by 1 to 4% per 16,880 gallons, the stakeholder considered this attribute to be low for the DRI and assigned it a score of 1. The team collaborated with the stakeholder to ensure that the value scales captured the stakeholder’s intent.

The lower half of Figure 5 is a visualization of the shape of the relationship between the attribute measure and the value scores. For “Reduce Fuel Consumption,” the categories of “Very Low through Very High” are linear or proportionally related to the value score. This same process was used for the other attributes.

3.4. Attribute Weights: Measuring Importance to Stakeholder(s)

Understanding the importance of a measure or attribute to the stakeholder is essential to DAS. The degree of importance is captured in swing weights (1–100), raw scores that when normalized is the relative weight of an attribute in context of other attributes being considered. The Parnell Matrix is a common technique to reflect swing weights as shown in Table 6 [8]. The matrix is structured in terms of importance and variance. The columns indicate the stakeholder’s view of the importance of the attribute as High, Medium, or Low. The rows of the matrix describe the range of the raw measure of the attribute. The greater ranges between minimum and maximum enable analysts to differentiate between a good and bad result more easily. For instance, when evaluating a vehicle for purchase where top speed is a desired attribute, the buyer can easily decide when one vehicle can reach 120 miles per hour (mph) and the other vehicle’s top speed is 80 mph. It would not be so straightforward a choice if the difference between top speed were 100 mph and 95 mph.

Attributes that the stakeholder views of greatest importance and having the greatest variance are placed in the top left corner of the matrix and assigned the highest swing weight. Conversely, those viewed as least important and having the least variance are placed in the bottom right corner. In collaboration with the team, representatives from the J-4 Analysis Branch assigned the swing weights as shown in Table 6.

The swing weights were normalized by summing the swing weights from each attribute and then dividing each swing weight by the total. The resulting weight is shown in Table 7, “Measured Weight.” The stakeholders verified and approved

the attributes’ measured weights to be used within the DAS.

Table 6. Swing Weight Matrix. Adapted from [4, 8].

		Importance of Metric		
		High	Medium	Low
Variance of Metric	High	100 (Fuel) 90 (Weight)	50 (Volume)	
	Medium		45 (Manhours)	
	Low			

Table 7. Normalized Attribute Weights: Measured Weights [4].

Attributes to Reduce	Swing Weight	Measured Weight
Volume	50	0.18
Fuel Consumption	100	0.35
Manhours	45	0.16
Weight	90	0.31
Total	285	1.0

4. Results

The three major components of DAS are established processes that the J-4 Analysis Branch can apply to prioritize DRIs and make recommendations to the LOG FCB for investments. DRIs that had a total value score (TVS) close to 20 would be the likely candidates for continued support. Table 8 easily shows that MAFFS and Combat Feeding initiatives have the greatest overall value. This computation informs the decision makers on managing their investment of resources to deliver useful products to warfighters. A TVS is computed for a DRI by multiplying the DRI’s value score for each attribute by the associated measured weight, and then summing the resultant products. For instance, MNPP has a TVS of 7.37 while STAMP has a TVS of 10.96 (Table 8). Given these two choices, the J-4 would recommend STAMP ahead of MNPP. Although the two systems are different, value modeling enables comparison because the core functions and associated attribute measures are the only consideration in the assessment [4]. Table 8 shows all 10 DRIs that the J-4 provided. The total under each “Weight” column of the DRI is its TVS. In this manner, the J-4 analysts can prioritize the full set of DRIs and trace the justification for the recommendations. Should the stakeholder decide to change the weights, the process can adjust accordingly with new prioritization. As a result of this effort, the LOG FCB used this process during the 2023 financial year review.

Table 8. Application of DAS on Proposed DRIs [4].

	MAFFS			BLS		MNPP		REIC		TaCV-E	
	Weight	Value Score	Weight	Value Score	Weight	Value Score	Weight	Value Score	Weight	Value Score	Weight
Volume	0.18	14	2.52	4	0.72	4	0.72	14	2.52	14	2.52
Fuel	0.35	20	7	1	0.35	10	3.5	3	1.05	20	7
Manhours	0.16	15	2.4	10	1.6	10	1.6	5	0.8	15	2.4
Weight	0.31	14	4.34	1	0.31	5	1.55	14	4.34	14	4.34
Total	1		16.26		2.98		7.37		8.71		16.26

	UCA			STAMP		Combat Feeding		APM		MPBR	
	Weight	Value Score	Weight	Value Score	Weight	Value Score	Weight	Value Score	Weight	Value Score	Weight
Volume	0.18	0	0	4	0.72	14	2.52	4	0.72	1	0.18
Fuel	0.35	1	0.35	10	3.5	10	3.5	3	1.05	1	0.35
Manhours	0.16	5	0.8	15	2.4	15	2.4	10	1.6	5	0.8
Weight	0.31	0	0	14	4.34	20	6.2	5	1.55	1	0.31
Total	1		1.15		10.96		14.62		4.92		1.64

5. Conclusions and Recommendations

The challenges that the JWC presented to the sustainment and logistics community were numerous. Ideas to reduce demands on sustainment and logistics systems are prevalent and generate technological solutions. However, the demands that are to be reduced come in many disparate units of measures. The technologies themselves come in numerous forms. Each manufacturer claims specific performance measures to promote their product. Yet, these measures of performance are not necessarily the critical element of the solution being offered. The logistics and sustainment communities lack a means to manage the various DRIs that are offered.

This study has developed a tool to evaluate a range of DRIs. In creating this instrument, the team provides the LOG FCB with a way to manage the resources that might be invested in the proposed DRI. The application of a systems engineering approach analyzed the fundamental functions and components for an assessment system that supports quantitative comparison and prioritization of the DRIs. A key component of the DAS is a value modeling approach that can be adjusted as the logistics, sustainment, JWC, and the security require-

ments change [9]. The overall methodology remains the same.

The resultant system, DAS, was demonstrated on the set of DRIs that were mature enough to provide the necessary quantitative information. The system clearly shows the differences between the DRIs based on unbiased total value scores computed from critical measures that the primary stakeholders identified. Concepts for how the DAS is implemented in the LOG FCB process or contingency planning within the JWC framework remain to be developed.

The team encountered some obstacles during the development of DAS. Recommendations seek to remove the limitations and constraints. The most significant of these recommendations is the need to identify relevant, quantifiable, collectable measures for the reductions that the DRI proposes. LOG FCB review of proposals should include operator buy-in for the plausibility and feasibility of the DRI to be implemented in operations. Stakeholders should review the core functions and associated attribute measures that will be used for future DRI assessments. It is likely that the core set of functions will grow as more diverse DRIs are considered. It will be incumbent on LOG FCB or DAS users to develop relevant measures. The methodology that the team used can be followed by other scientists and managers who wish to compare a set of diverse systems.

Abbreviations

AoA	Analysis of Alternatives
APM	Autonomous Predictive Maintenance
BLS	Biomanufacturing of Lubricants from Seawater
CF	Combat Feeding
DAS	DRI Assessment System
DoD	Department of Defense
DRI	Demand Reduction Initiatives
FoM	Freedom of Maneuver
JWC	Joint Warfighting Concept
LOG FCB	Logistics Functional Capability Board
MAFFS	Mobile Advanced Fuel Filling Station
MNPP	Mobile Nuclear Power Plants
mph	Miles Per Hour
REIC	Rapid Expeditionary Ice Construction
STAMP	Secure Tactical Advanced Mobile Power
TaCV-E	Tactical and Combat Vehicle-Electrification
TVS	Total Value Score
UCA	Underwater Cure Adhesives

Conflicts of Interest

The authors declare no conflicts of interest.

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