Defense Logistics Agency
Inventory Allocation and Foresting

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I. Background

The Defense Logistics Agency (DLA) is a Joint Department of Defense (DoD) agency providing logistic support to the Army, Navy, Air Force, Marine Corps, other federal agencies, and combined and allied forces with logistics, acquisition, and technical services. DLA sources sustenance , fuel and energy, uniforms, medical supplies, and construction and barrier equipment to our military, maintaining their ability to operate. DLA also supplies military spare parts, manages restoration of military equipment, provides catalogs, and production services. DLA manages almost 5 million items, fills more than 131,000 requisitions per day, and issues 10,000 contract actions per day.

DLA is committed to supporting the warfighter, emphasizing the need for agency readiness by ensuring supply chains are efficient and effective. DLA took their commitment further with a strategic transformation in 2011focusing on running a leaner, automated, and audit ready business. The realization of the strategic plan enforces the improvements by: decreasing direct material costs, decreasing operating costs, having the right size inventory, improving customer service, and achieving audit readiness.

To identify the right size inventory, DLA has determined that there is difficulty in maintaining Material Availability (MA) of items with extreme demand. MA is the immediate availability and release of DLA material against requisitions. The very high demand leaves a significantly low amount of items remaining in backorder for multiple months with the root cause of the MA failures being unknown.

Many of the items with MA failures fall in the Acquisition Advice Code (AAC) D National Item Identification Numbers (NIINs). AAC D NIINs are integrated materiel, which are managed, stocked, and issued by the DoD. These items do not require specialized controls for shipment, other than those imposed by the Integrated Materiel Manager (IMM)/service supply policy. DLA's current analysis on AAC D is divided into categorizes of the items by level of demand, which include:super high, high, medium, and low demand. The GMU team will focus these items into more groups to enable better forecasting and accurate safety stock levels or policies.

II. Problem Statement

DLA's initiative to resizing inventory was scoped to an analysis solely on AAC D NIIN's current inventory processes. Since AAC D NIINs have such high demand, improvements to AAC D's current inventory allocation and forecast will have the greatest effect on DLA's current inventory management. The team will analyze current data on AAC D to identify indicators for the MA failures. Execution of cluster analysis to categorize the items into other similar behavior groups will identify parameters that are germane to inventory replenishment decision making, supply chain management execution and policy. This study will also investigate methods to improve DLA's current inventory control model by further refining the following for future models:

- Backorder, holding, and ordering costs
- Price breaks or discounting
- Demand and lead time variance
- Minimum buy quantity to promote competitive bidding

The flowchart, figure 1 below, depicts the plan for completion of this study, with details in the following sections.

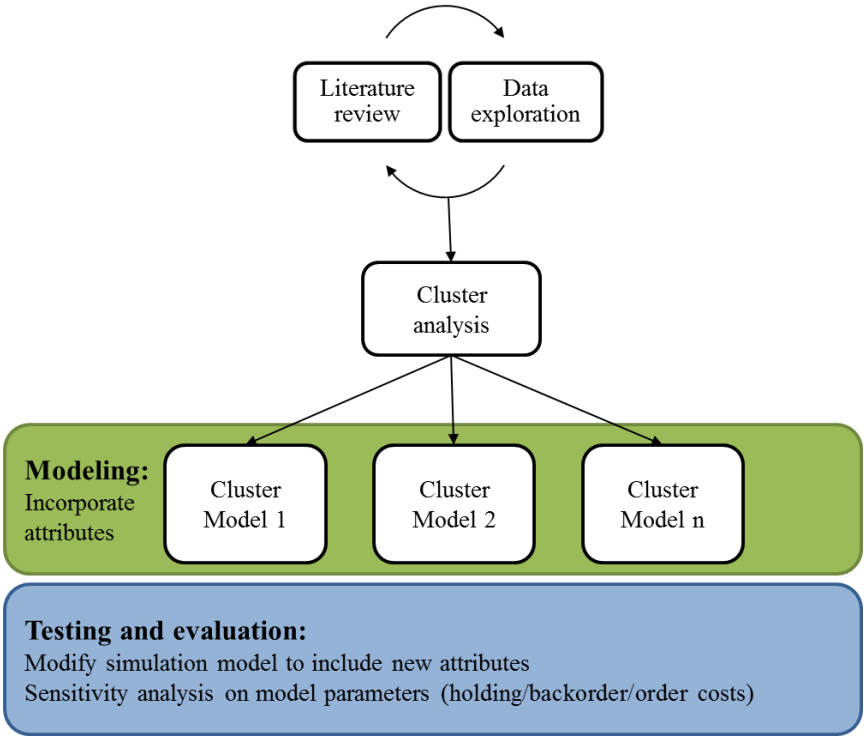

Figure 1

III. Literature Reviews

The first objective of this study is to conduct a literature review to identify best practices for inventory management and application of the coefficient of variation CoV when determining forecastiblity.

IV. Technical Approach

The study has been separated into four efforts: data exploration, cluster analysis, model development, and testing and evaluation.

i. Data Exploration

Data exploration is concurrent with will be concurrent with literature reviews, both require research and since these tasks support the team's learning process of how to evolve the analysis. The team will identify datasets required to analyze metrics.

Here, the team will identify the indicators of failure to maintain Material Availability (MA) by examining statistically significant relationships to items that have an frequent MA failures. Possible influences on MA include Demand Plan Accuracy (DPA), Back Order Establishment (BOE), Days of Inventory On hand (DIOH), administrative lead time (ALT) and production lead time (PLT).

ii. Cluster Analysis

The second effort will the execution of cluster analysis of AAC D NIIN data in order to categorize them into distinct groups. These categories will be based on industry best practices, identified from the study's

literature review, and DLA defined metrics. The clusters will compartment similar NIINs when conducting model development and runs ensuring appropriate modeling behavior.
The team plans to meet with a George Mason University (GMU) statistics department professor for guidance on cluster analysis and to understand the nuances of software-enabled functions. The provided guidance will lead the team to which methods to employ when grouping the AAC D NIINs.

iii. Model Development

Assessment of DLA's current approach, methods, and model for determining assets to stock is the first course of action the team will execute. Analysis and revision of the timing of inventory ordering and amounts to keep in stock is a significant deliverable from the modeling efforts. The DLA Operations Research and Research Analysis (DORRA) developed simulation models their inventory management processes and analyzes policy change. The DORRA simulations runs in both Arena and SAS and models the behavior at the AAC NIIN level. A disadvantage of this model is that it does not currently incorporate stochastic demand processes with application of probability distributions. Instead, it utilizes the last two years of demand to assess the impact of new policies.

The team will assess the current model to determine the statistical validity of the model. This will be done by analyzing model inputs, methods, and results. The level of analytical rigor of the model will be determined, in addition to, comparisons with historical datasets.

Recommendations on methods of improving the model based on the previously identified best practices and cluster analysis will be provided to DLA. Modeling each cluster in Arena and with an optimization that minimizes the number of backorders established, stock required, and costs due to storing stock required in inventory are the basis for recommendations on methods of improving the model. The model will also maximize material availability (MA) and attainment to plan.

The team will investigate incorporation of stochastic processes to the model's demand parameters based on historical data analysis and creation of distributions.

iv. Testing and evaluation

Execution of trials in the revised simulation in accordance to a plan established for each cluster will result in standards for the groups. The plan to list input parameters and requirements for the specific cluster, since they may have differing behaviors, is the primary deliverable from the model runs.

The model will be validated by comparisons with historical datasets. Comparisons of prediction intervals for the historical datasets and the Arena runs will provide evidence for the validity of the model and determine if there is a statistically significant difference.

Upon validation of the model, analysis on the sensitivity of the model for each cluster will be done by varying input parameters of the model. The effect of the varied input parameters on the output results through statistical analysis determines how sensitive the groups are to specific policy changes. At this time it may be valuable to identify subject matter experts to review the performance of the model during the varied conditions to assess if the model is not only valid but logical and if the policies are in fact implementable.

The final report will document the results of the study as a whole; to include, results on the cluster analysis, model development, and testing and evaluation. In addition, providing recommendations to DLA's current methods and policies to the sponsor will represent the final deliverable.

V. Management Approach

i. Resources

The team is made up of three OR students, each of which work full time jobs for the DoD. The team will employ all software afforded to them by GMU, the Microsoft Office suite, and Google Docs as an internal collaboration tool along with a government facing data sharing site to acquire bulk data drops on the AAC D NIINs.

ii. Schedule

The team has identified the necessary tasks for successful completion of this study in table 1, below. The team plans to meet with the sponsor bi-monthly, as his schedule allows in doing so.

Table 2. Plan of action

Task	Deadline
Present problem definition	11 Sep
Meet with sponsor	11 Sep
Meet with GMU Statistics Department professor	25 – 30 Sep
Analyze data and identify clusters	25 Sep – 02 Oct
Submit status report	02 Oct
Identify modeling parameters	02 Oct
Submit status report	09 Oct
In progress review presentation	16 Oct
Execute model runs	16 Oct
Model output analysis	23 Oct
Finalize documentation	30 Oct
Submit draft of final report	06 Nov
Submit final report	21 Nov
Present final presentation to faculty	12 Dec

The Tier 2 schedule and division of labor is shown in the below figure. It is broken out into two phases, pre and post in progress review (IPR).

Legend		
Not started	O = required in update to Stephen	
Started	X = Required in update to Dr. H	= Feedback Date
	XO = Major Deliverable Date	= Biweekly Mtg Topic

			Priority: Analyze Data and Identify Clusters					Priority: Identify Modeling Parameters and Select COA				Priority: Execute Model Runs and integrate into IPR							
Focus areas w/ OER			19-Sep-14	22-Sep-14				25-Sep-14		30-Sep-14	1-Oct-14	2-Oct-14			9-Oct-14			14-Oct	
Pre IPR	Lit review, data analysis and clustering	Brittney			Team Meets w/ Dr. Thang					X -Delivers Input Assessment to Stephen		Executes Input Analysis							
		Derek	X - Requests current data sets based on teams selections	X - Follow up with data request						X - Delivers Clustering results to Stephen						Executes Output Analysis			
		Matt																	
	Modeling and Analysis of Output	Brittney								X - Delivers Proposed Modeling method to Stephen		Assess input and identifies input data							
		Derek	Researched COA 2 (Stochastic Optimization)									Assess Arena Model and develops runs			Executes Model Runs				
		Matt	X - Requests manual for current Arena model	Begins methodology creation for Stochastic Optimization				Team Meets w/ Dr. Xu				Formulates Model and Implements			Executes Model Runs				
	Documentation Production and Conclusions	Brittney	X - Sends draft paper and presentation to Stephen							Documents Input Analysis		O- Feedback integrated into 1 pager to Dr. H		Documents insights from Input Analysis		O - 1 pager to Dr. H on Input analysis execution, Model runs done so far, Output analysis proposal			
		Derek	X - Sends draft presentation to Team										Documents Output Analysis						Documents insights of output analysis
		Matt						Documents Modeling Parameters					(Con't of Documentation of Modeling Parameters)						

Legend		
Not started	O = required in update to Stephen	
Started	X = Required in update to Dr. H	= Feedback Date
	XO = Major Deliverable Date	= Biweekly Mtg Topic

			Priorit- react to feedback and create final presentation					Priority - Packaging and Finalizing charts and briefing				Priority - Finalizing Report				Make Final Edits		Present to Staff	
Focus areas w/ OER			17-Oct-14				23-Oct-14			28-Oct-14	30-Oct-14			4-Nov-14	6-Nov-14		21-Nov-14		12-Dec-14
Pre IPR	Lit review, data analysis and clustering	Brittney	Research comments and guidance					Finalize data analysis and charts			XO -Deliver Draft presentation	Finalize data analysis and charts			XO -Deliver draft final report	Ensure website is active and documents are published	XO - Deliver Final Brief and Paper	Ensure all products are published to website	Deliver final briefing to faculaty and Graduate
		Derek																	
		Matt																	
	Modeling and Analysis of Output	Brittney			Execute new model runs if necessary														
		Derek									XO -Deliver Draft presentation				XO -Deliver draft final report		XO - Deliver Final Brief and Paper		
		Matt						Construct final modeling slides				Construct final modeling slides							
	Documentation Production and Conclusions	Brittney																	
		Derek		Revise documentation			O - Update on the execution of research and model runs	Document guidance from Dr. H			XO -Deliver Draft presentation	Document guidance from Dr. H							
		Matt													XO - Deliver draft final report		XO - Deliver Final Brief and Paper		