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The goal of the project is to conduct a pilot of defined scope of the Joint Food Management System (JFMS) to assess feasibility of the requirements and design for a production system. The results of this effort will serve as the basis of a business case analysis to inform full production system implementation and maintenance.

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Joint Food Management System (JFMS) Modernization and Readiness Analysis Phase IV Pilot
Subsistence Digital Transformation Playbook Pilot Update

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Joint Food Management System Modernization and Readiness Analysis Phase IV

Subsistence Digital Transformation Playbook

Pilot Update

December 30, 2022

Contract Number: SP4701-19-C-0006
Proposal Number: 4545297569
Performance Period: May 25, 2019 – December 1, 2022

VIBRONYX | 725 Cool Springs Blvd, Suite 600, Franklin, TN 37067

Joint Food Management System
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Table of Contents

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EXECUTIVE SUMMARY

Defense Logistics Agency (DLA) Troop Support (TS) Subsistence conducted several internal and external assessments in 2018 and 2019 to better understand the status and future of the Subsistence Prime Vendor Program and to create a vision for its role as the DoD's Executive Agent (EA) for Subsistence. As a result of those assessments, Subsistence leadership established a vision that entails "Transforming and modernizing the Subsistence organization and capabilities to deliver on our Executive Agent role and sustain Warfighter readiness and lethality." To achieve this goal, Subsistence defined Organizational Transformation initiatives focused on Organizational Alignment, its People Strategy, Process Improvements and Technology Enhancements.

A core component of the strategy is to develop, deploy and maintain a data-driven Joint Food Management System (JFMS) to improve supply chain operations for Subsistence, the Military Services, Whole of Government (WoG) customers, DoD Agencies and other key stakeholders. Department of Defense Directive 5101.10, Section-e, requires that DLA "In coordination with the Military Departments, plans, develops, funds, implements and maintains a Joint Food Management System that interfaces with existing Service Systems."

To deliver on the JFMS, DLA TS Subsistence initiated a research and development effort in 2019 to develop a modernization strategy, create a solution roadmap, and define the high-level business, functional, and technical requirements for the JFMS. In Phase I of the project, an analysis was conducted to capture Subsistence requirements for the JFMS and develop a Transformation Playbook to provide practical approaches and a phased roadmap to remedy current state capability gaps and to achieve DLA's desired future state architecture. In Phase II a similar assessment was conducted to define requirements for the Military Services, and Phase III included clarifying processes and technologies that enable the Class I supply chain and understanding the impact of requirements on other JFMS key stakeholders and resulting capabilities needed to execute the end-to-end supply chain solution for the JFMS.

In the Phase IV Pilot, Vibronyx worked with DLA stakeholders to assess the feasibility of specific capabilities to improve Class I management across the supply chain including automation, Artificial Intelligence (AI) and data integration with key Subsistence stakeholders. The scope of this effort was also designed to serve as the basis of a Business Case Analysis (BCA) and to lay the groundwork for the Authority To Operate (ATO) process and operationalization roadmap.

The result of this JFMS Pilot phase is successful Full Operational Capability (FOC) status of the piloted solution requirements to meet minimum proof-of-concept feasibility needs to inform decision making for a production system.

JFMS Pilot Summary Results			
Capability	**Goal**	**Pilot Results**	**Operational Feasibility**
Subsistence Visibility Tower Platform	End-to-end visibility platform that will be presented as a single, web-based point of access where DLA users, authorized appropriately through a role-based methodology, will be able to navigate through a menu system and gain improved situational awareness.	**Successful Proof-of-Concept** • Implemented Visibility Tower using the Vibronyx Intelligence Platform, DLA Qlik visualization software and Hybrid Development architecture. • Integrated data from multiple sources including DLA, non-DLA, and across firewall boundaries in alignment with long-term J6 strategy.	• Barriers to sharing of real data must be overcome for operational effectiveness, especially where APIs and/or data sharing infrastructure is not established.
Military Services Food Ordering Automation	Automate ordering transmission between two commercial vendor solutions and STORES across commercial and NIPRNet networks.	**Successful Proof-of-Concept** • Successful demonstration of solution with a single food services vendor • Solution is designed	• ATO change and approval processes must be followed for both food services vendor and DLA. • Dependent on J6 DevSecOps general availability.
In-Transit Visibility	Examine API integration with US TRANSCOM and DLA Distribution to use shipping data to provide end-to-end visibility.	**Successful Proof-of-Concept** • Successfully implemented integration and descriptive analytics with USTRANSCOM ISDDC in two ways, including first-of-kind pipeline automation of periodic complete data feed and through the Webservices API. • DDSP VSM is a web application that does not have an API to automate integration. • Successful integration of DLA Distribution Packing list provided to Vibronyx.	• Operational integration with USTRANSCOM ISDDC established, however the curated data feed will not provide administrative events. • Web applications automation and integration may be better addressed using RPA, although this is a less recommended option. • Barriers to sharing of real data must be overcome for operational effectiveness, especially where APIs

JFMS Pilot Summary Results			
Capability	**Goal**	**Pilot Results**	**Operational Feasibility**
			and/or data sharing infrastructure is not established.
Predictive Analytics	Prediction of pricing volatility and demand prediction for new contracts.	**Successful Proof-of-Concept** • Pricing is relatively stable and OCONUS volatility that DLA needs could not be determined because of lack of geographical context and lack of disclosure on pricing information by Prime Vendors. • Demand prediction was superseded by the higher priority of frustrated containers/port dwell time prediction • Successful prediction of frustrated containers/port dwell times	• Barriers to sharing of real data (pricing) must be overcome for operational effectiveness, especially where APIs and/or data sharing infrastructure is not established. • Much more data is needed for accurate frustrated containers/port dwell time predictions, however, by DLA ATO timeframe, it is expected that sufficient data will be acquired, but this assumption needs to be verified.
Visualization Dashboards and Reporting	Dashboards and reports that provide visual insight into key food supply chain metrics and actionable key performance indicators (KPIs) for DLA Subsistence stakeholders.	**Successful Proof-of-Concept** • Successful implementation of dashboards using DLA approved Qlik technology into R&D DAGE (FOC). • Additional dashboard reports for order automation added and demonstrated. • Custom CAC card authentication not recommended.	• ServiceNow may offer a viable alternative to Qlik. • DISA and DLA Cyber engagement necessary for DoD enterprise CAC card authentication.
FIAR Compliance Reporting	Develop FIAR reporting requirements and build API to support JFMS FIAR compliance.	**Successful Proof-of-Concept** • Documented data model and API requirements to support FIAR compliant reporting from JFMS system.	

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INTRODUCTION AND PILOT SCOPING

Defense Logistics Agency (DLA) Troop Support (TS) Subsistence conducted several internal and external assessments in 2018 and 2019 to better understand the status and future of the Subsistence Prime Vendor Program and to create a vision for its role as the DoD's Executive Agent (EA) for Subsistence. As a result of those assessments, Subsistence leadership established a vision that entails "Transforming and modernizing the Subsistence organization and capabilities to deliver on our Executive Agent role and sustain Warfighter readiness and lethality." To achieve this goal, Subsistence defined Organizational Transformation initiatives focused on Organizational Alignment, its People Strategy, Process Improvements and Technology Enhancements.

A core component of the strategy is to develop, deploy and maintain a data-driven Joint Food Management System (JFMS) to improve supply chain operations for Subsistence, the Military Services, Whole of Government (WoG) customers, DoD Agencies and other key stakeholders. Department of Defense Directive 5101.10, Section-e, requires that DLA "In coordination with the Military Departments, plans, develops, funds, implements and maintains a Joint Food Management System that interfaces with existing Service Systems."

To deliver on the JFMS, DLA TS Subsistence initiated a research and development effort in 2019 to develop a modernization strategy, create a solution roadmap, and define the high-level business, functional, and technical requirements for the JFMS. In Phase I of the project, an analysis was conducted to capture Subsistence requirements for the JFMS and develop a Transformation Playbook to provide practical approaches and a phased roadmap to remedy current state capability gaps and to achieve DLA's desired future state architecture. In Phase II a similar assessment was conducted to define requirements for the Military Services, and Phase III included clarifying processes and technologies that enable the Class I supply chain and understanding the impact of requirements on other JFMS key stakeholders and resulting capabilities needed to execute the end-to-end supply chain solution for the JFMS.

As a result of Phases I to III, DLA commissioned a Phase IV Pilot to assess the feasibility of developing and operationalizing a production JFMS solution. The effort, conducted over two nine-month Task Orders, focused on a prioritized subset of JFMS requirements including a Subsistence Visibility Tower, Visualization Dashboard and Reporting Analytics, Services Food Ordering Automation, In-Transit Visibility, Predictive Analytics, and FIAR Compliance. The results of this effort and lessons learned will serve as the basis of a Phase V Business Case Analysis to support DLA decision making to operationalize a full production system implementation.

OBJECTIVE

The goal of the project is to conduct a pilot of defined scope of the Joint Food Management System (JFMS) to assess feasibility of the requirements and design for a production system. The results of this effort will serve as the basis of a business case analysis to inform full production system implementation and maintenance.

PILOT SCOPING

In prior JFMS strategy and requirements development phases, the DLA and Military Services aligned on 64 platform and functional requirements of the JFMS based upon the requirement's priority level (e.g. the value add to the organization) and timing (how quickly they should be worked on within the JFMS build and deploy phase). Vibronyx reviewed these requirements based on priority, feasibility, technology capability, and data availability, and selected 27 requirements for inclusion in the Pilot, including 20 high

priority and 7 medium priority requirements. In a collaborative validation exercise, Subsistence leadership agreed to define the scope of the Pilot based on those requirements.

The JFMS Pilot scope included the following capabilities:

Subsistence Visibility Tower Platform
The foundation of the JFMS, built using microservices in close alignment with future J6 architecture and designed to provide a single, web-based point of access for all JFMS user functionality, authorized appropriately through a role-based methodology with CAC-enabled authentication and single sign-on. This platform will also be able to serve as the anchor of the operationalized JFMS beyond the pilot phase.

Military Services Food Ordering Automation
Addressing one of the highest priority requirements both for DLA and the Military Service customers, a pilot capability to automate ordering between the Military Service food management systems and the DLA environment. This automation capability provides a seamless ordering experience for Military Service users, reducing manual workload, reducing errors, and offering more opportunities for analytics and insight into Subsistence operations. This capability also demonstrates an ability to transmit order data from vendor commercial networks across DLA NIPRNet security boundaries using the JFMS.

In-Transit Visibility
In-transit visibility of shipments containing critical subsistence items for Prime Vendor warehouse replenishment at OCONUS distribution facilities, made possible through the integration of shipment process data from USTRANSCOM ISDDC systems and DLA Distribution. Addressing another high priority of the JFMS, this capability surfaces key information about shipments via the visualization dashboards, improving situational awareness and enabling improved customer support.

Predictive Analytics
Predictive analytics for identifying when items will become Not In Stock (NIS) in OCONUS Prime Vendor warehouses due to transit delays of USTRANSCOM container transportation, as well as the predicted date that items will be back in stock. Vibronyx implemented an Auto-ML pipeline to ingest data from USTRANSCOM on an ongoing basis and utilized AI and machine learning models running on a microservices-based infrastructure to generate analytics.

Visualization Dashboards and Reporting
Dashboards and drill down reports that provide visual insight into key food supply chain metrics and actionable key performance indicators (KPIs) for Subsistence stakeholders, built using designs validated in previous phases of the project through the prototyping and proof of concept process. These dashboards were developed using Qlik commercial software in alignment with J6 tool choice, and Troop Support Subsistence will be able to utilize and expand upon the dashboards beyond the Pilot phase.

FIAR Compliance
The scope of the pilot also included additional business analysis with Subsistence stakeholders to further refine the requirements of the JFMS and inform the Phase V Business Case Analysis. A specific focus was placed on understanding the requirements needed to support Financial Improvement and Audit Readiness (FIAR) compliance to ensure that FIAR compliant data is captured and recorded correctly as needed by the JFMS and can be accessed in a standardized and authorized manner.

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PILOT EXECUTION

Execution of the JFMS Phase IV Pilot occurred over two nine-month Task Orders, between June 2021 and December 2022. The project included six tasks aligned with the scoped pilot capabilities: Subsistence Visibility Tower, Military Services Food Ordering Automation, In-Transit Visibility, Predictive Analytics, Visualization Dashboards and Reporting, and FIAR Compliance.

STRATEGIC ALIGNMENT

The Vibronyx Platform and capabilities developed in the Pilot are aligned with the DLA Enterprise Data and Analytics Strategy, which is itself aligned with DLA's Strategic Information Services (J67), the Chief Data Officer, and DLA Analytics Center of Excellence.

While the Platform generally supports all DLA Enterprise Data and Analytics Strategy Lines of Effort (LOE), it specifically aligns closely with LOE 4 Analytics Capabilities. These capabilities include descriptive analytics, diagnostic analytics, predictive analytics, prescriptive analytics, artificial intelligence, and machine learning.

Descriptive Analytics: Summarizes what has already occurred. Answers: What happened?

Diagnostic Analytics: Involves regression analysis to compare various variables against each other. Answers: Why did it happen?

Predictive Analytics: Identifies trends to make a prediction about future outcomes. Answers: What will happen?

Prescriptive Analytics: Analyzes possible scenarios or courses of action to determine which one has the optimal outcome. Answers: What should happen?

Artificial Intelligence: Runs simulations to create all future possible data points to learn faster than the pace of time.

Machine Learning: Self-adjust without human intervention and change underlying algorithms based on vast new simulated data inputs to find optimal outcome.

With this strategic alignment, DLA Subsistence stakeholders can visualize and use data from DLA and its partners as a strategic asset to support and enhance Subsistence missions for the warfighter.

SUBSISTENCE VISIBILITY TOWER PLATFORM

GOAL:	End-to-end visibility platform that will be presented as a single, web-based point of access where DLA users, authorized appropriately through a role-based methodology, will be able to navigate through a menu system and gain improved situational awareness.
PILOT RESULTS:	**Successful Proof-of-Concept** • Implemented Visibility Tower using the Vibronyx Intelligence Platform, DLA Qlik visualization software and Hybrid Development architecture. • Integrated data from multiple sources including DLA, non-DLA, and across firewall boundaries in alignment with long-term J6 strategy.
OPERATIONAL FEASIBILITY:	Barriers to sharing real data must be overcome for operational effectiveness, especially where APIs and/or data sharing infrastructure is not established.

Figure 1 shows the current state of DLA Subsistence capabilities and value proposition from improvements using the Vibronyx developed JFMS system, which provides faster decision-making abilities to DLA stakeholders and COCOM commanders through the intelligent combination of data from several currently siloed data sources.

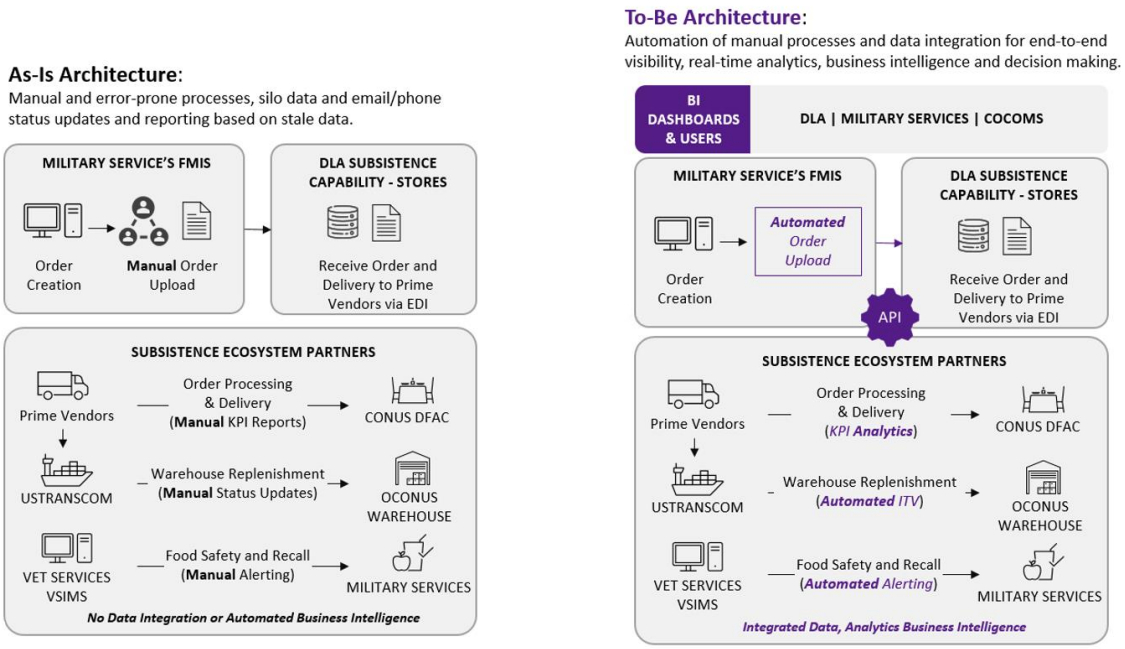


Figure 1: Joint Food Management System Capabilities

PLATFORM ANCHORS AND CAPABILITIES

Vibronyx has leveraged its scalable microservices platform, customized to DLA Subsistence needs. The Vibronyx Platform, recognized by Gartner, is anchored on the three main tenets of Analytics, AI and Automation.

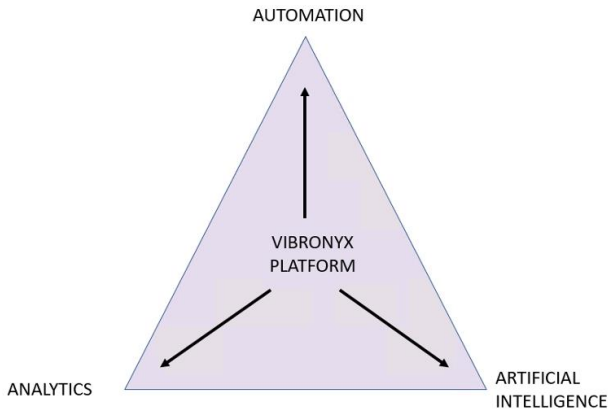
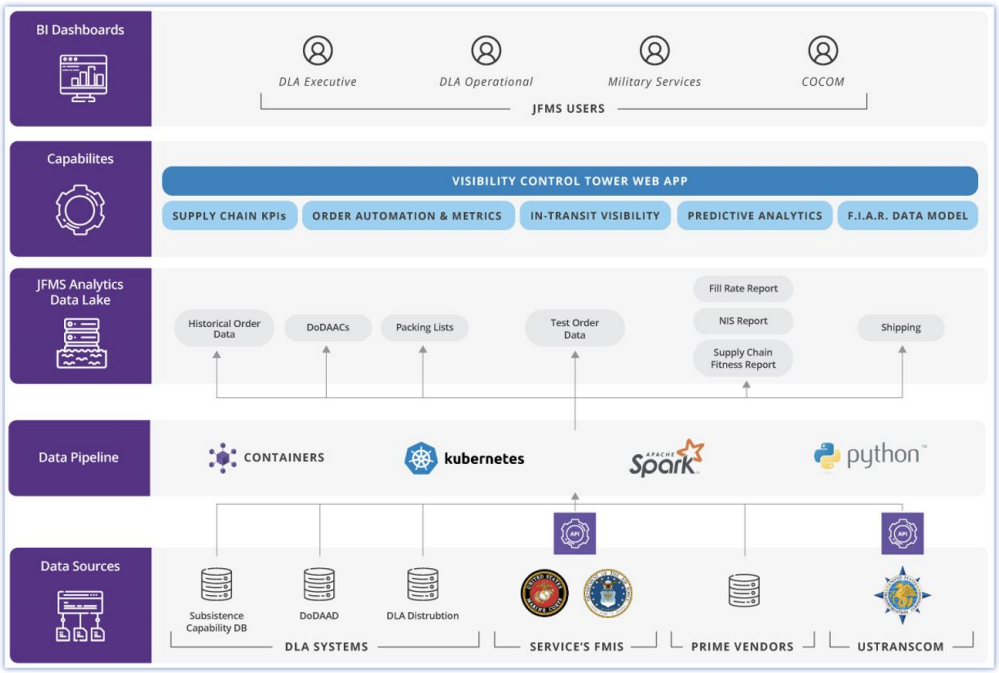


Figure 2: Vibronyx Platform Anchors

This platform, shown in Figure 3 (also shown in Appendix A), incorporates these anchors and is in alignment with the J6 DLA Cloud Hosting Strategy and DLA Architecture Strategy. It harmonizes data from disparate data sources into a scalable and flexible data lake architecture that can be used to develop applications for use within the DLA enterprise or act as a feeder for consumption of data across the DLA, DLA's partners, and the broader DoD organization.

Figure 3: Vibronyx Platform



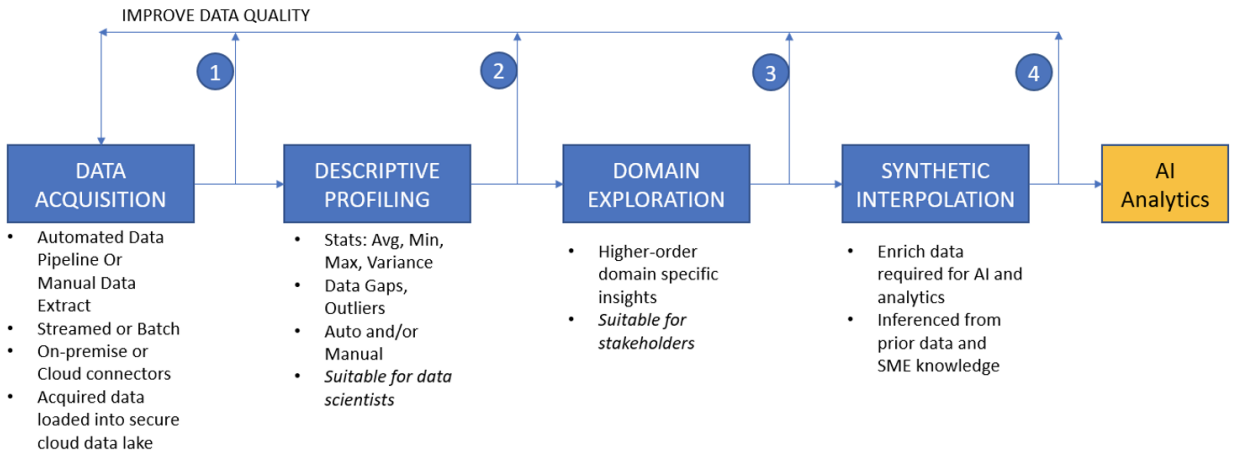
For the JFMS Phase IV Pilot, data needed to be sourced from:

- DLA own internal systems, such as STORES and EBS
- Service Food Management Information Systems (FMIS)
- Prime Vendor data including OCONUS warehouse fitness reports and container packing lists
- USTRANSCOM, which provides real-time data on sealift movement of Subsistence goods across the globe

DATA PIPELINES

Sourced raw data is rarely used as-is. It must go through a curation process (see Figure 4) to become useful and add value for consumption by downstream participants.

Figure 4: Data Curation Process

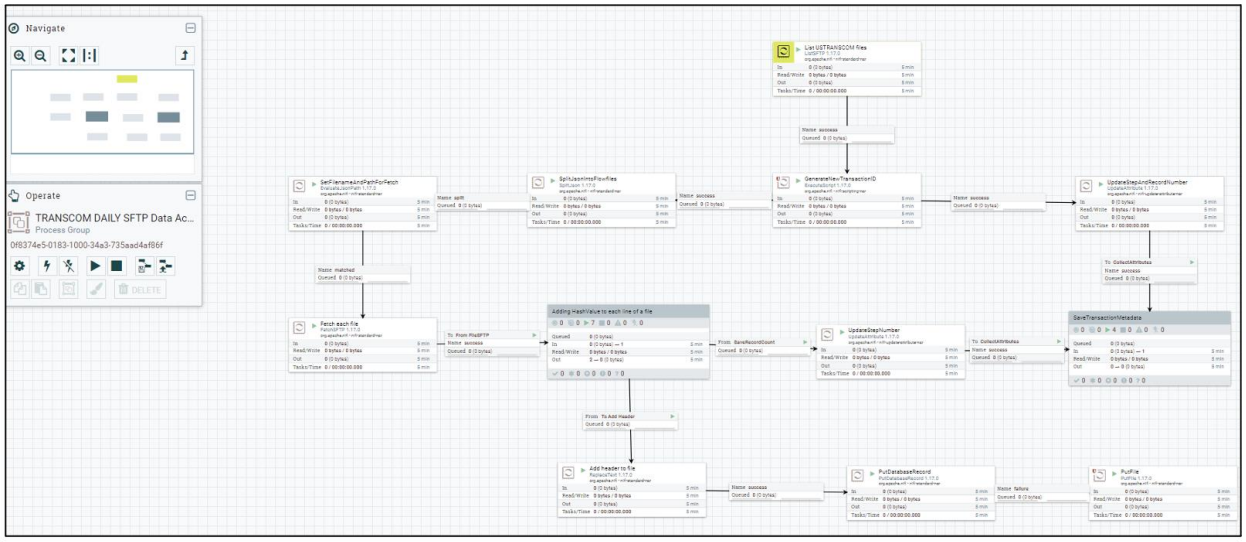


Further, curated data from each data source may interact with data from other sources to develop higher-level cross-analytics and offer an enriched picture by combining data in a meaningful manner. To do this at scale, Data Pipelines are created in the Vibronyx Platform by using an elastic cloud-first strategy and leveraging open source.

Data Pipelines are workflows to source, process, curate and combine data and develop analytics that are made available to relevant stakeholders in a number of ways in accordance with mission requirements.

Figure 5 shows an example of a Vibronyx Platform data pipeline to automatically source daily data from USTRANSCOM.

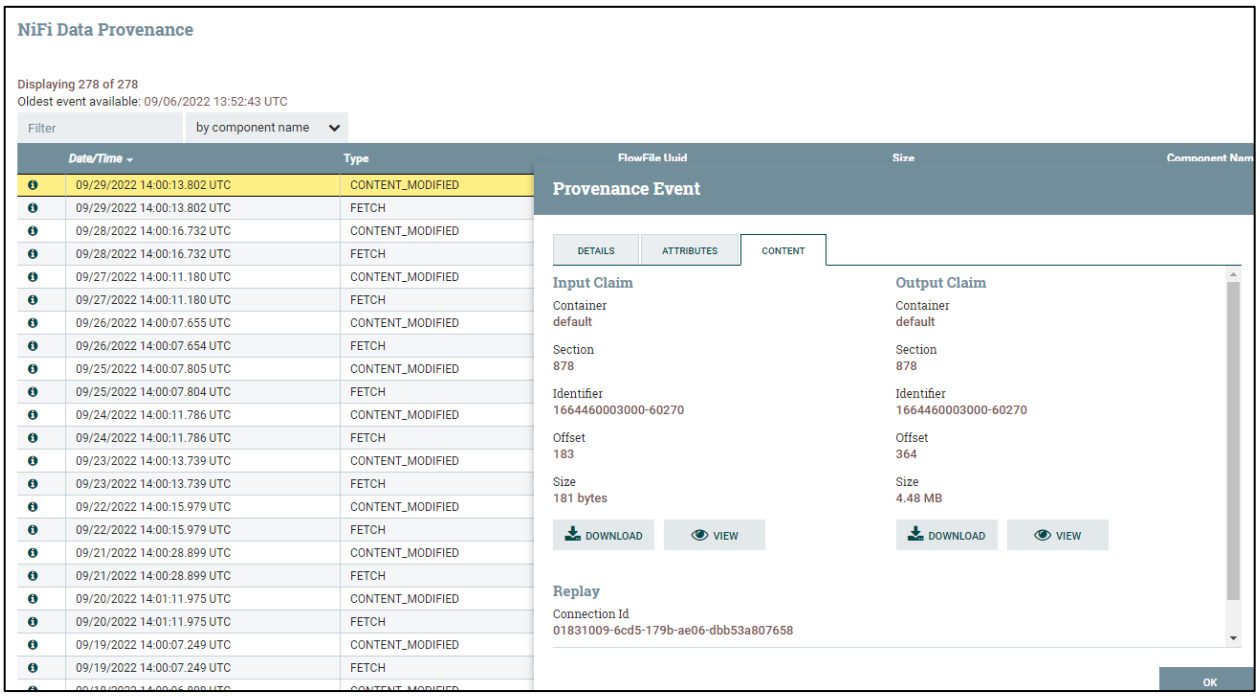
Figure 5: USTRANSCOM Data Pipeline



The USTRANSCOM Data Pipeline is also shown in Appendix B.

Based on Apache NiFi technology that was developed by the National Security Agency (NSA), the data pipeline technology available in the Platform provides a level of robustness, traceability, and introspection of the provenance of the data as shown in Figure 6.

Figure 6: NiFi Data Provenance



DATA ACQUISITION

The Vibronyx Platform has been adapted to source data for the JFMS Phase IV Pilot from several data sources. These data source classification types include:

- Systems of Record such as STORES, EBS, etc.
- Vendor Reports such as Not In Stock (NIS), Fill Rate etc.
- Subsistence shipment manifests such as Packing Lists
- DLA partner sealift transport data feeds such as USTRANSCOM
- Library master data such as DoDAAC and LSN/NSN databases
- Application data created for the JFMS including Contracts and Order Automation

Vendor Compliance Reports

The DLA receives many different types of documents from Prime Vendors that support compliance with vendor performance and reporting requirements, as shown in Figure 7.

Figure 7: Prime Vendor Reports

Reports received from Contractor Frequency		
1 CONUS, 1 OCONUS	Fill Rate, Non Catch-Weight Items	Monthly
1 CONUS, 1 OCONUS	Fill Rate, Catch-Weight Items	Monthly
3 CONUS	Ability One Subcontracting	Monthly
4 CONUS	Small Business	Monthly
5 CONUS	Descending Case	As Required
6 CONUS	Descending Dollar	As Required
7 CONUS, 10 OCONUS	NAPA Report	Monthly
8 CONUS	Customer Contact/Visits	As Required
9 CONUS, 8 OCONUS	Not in Stock (NIS)	Monthly
10 CONUS, 5 OCONUS	Government Rebates and Discounts (General)	Monthly
10b CONUS, 9 OCONUS	Government Rebates and Discounts (Food Show) (Contractor will report any rebate/discount additions, deletions or changes by item)	As Required
11 CONUS	Earned Income Categories	(Update as applicable)
12 CONUS	Private Label Savings	Quarterly
2 OCONUS	832	Monthly
3 OCONUS	Slow Movers (Excess Stock)	Monthly
4 OCONUS	Socio-Economic Report	Monthly
6 OCONUS	Contract Retention Plan	Yearly
7 OCONUS	Supply Chain Fitness Report (SCFR)	Weekly
11 OCONUS	National Contract Items	Monthly
12 OCONUS	Container Utilization Waivers	Monthly
13 OCONUS	Cost Savings Report	Monthly
14 OCONUS	Financial Status Report	Monthly
15 OCONUS	DLA Owned Material Report & Monthly Inventory Report	Monthly
16 OCONUS	DLA Owned Material Physical Inventory Report	Annually

For the JFMS Phase IV Pilot only a subset of the Prime Vendor reports data was provided, aligned with the primary goals of Warehouse readiness and In-Transit Visibility identified in the subset of requirements that were approved for Phase IV. These Prime Vendor reports include:

- Supply Chain Fitness Report
- Fill Rate Report
- Not In Stock (NIS) Report
- Packing List

Data Source Data Type
Data sources comprise a mix of structured and unstructured data. While many of the data were obtained from their sources as feeds, Contracts data was also generated from scraping techniques applied to the public domain.

Data Source	Data Type
STORES	Structured
Fill Rate Report	Semi-structured
NIS Report	Semi-structured
Packing List Report	Semi-structured
DoDAAC	Structured
Supply Chain Fitness Report	Semi-structured
USTRANSCOM TCMD API	API, Structured
Order Automation	Structured
Contracts	Scraped, semi-structured
LSN / NSN	Semi-structured

DATA SOURCE DESCRIPTIONS

STORES
STORES is the existing production transaction and cataloging system for DLA Subsistence and is the system of record for orders, substitutes, pricing, catalogs designed for Services and their specific locations.

STORES is a custom DLA system and in alignment with DLA Modernization Strategy, this system may be replaced by an equivalent or its capabilities may be shared between more sustainable future systems. That rationalization is in process, but Vibronyx needs to design the JFMS to flexibly accommodate both the current and future Subsistence systems of record.

Vibronyx received one year's STORES data (July 2019 - July 2020) that includes orders and receipts, among other data elements that were ultimately not deemed relevant for the JFMS Pilot. This data was securely

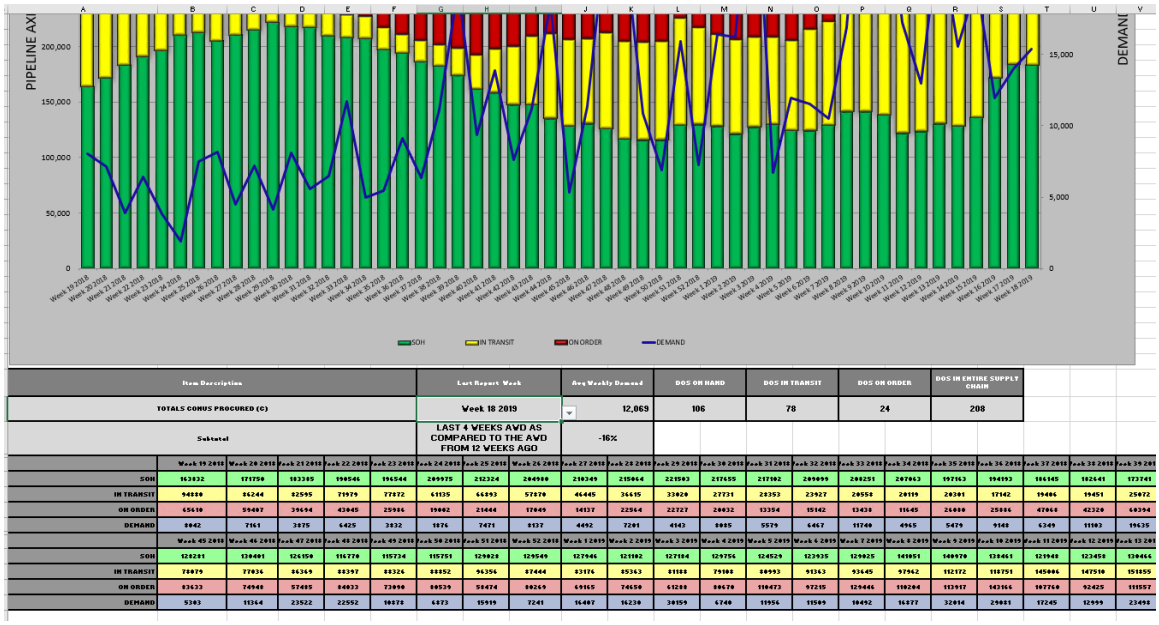
transferred via DoD SAFE, stored in DLA approved Vibronyx AWS GovCloud tenancy and loaded via a data pipeline to a data lake within AWS GovCloud.

Supply Chain Fitness Reports

Supply Chain Fitness Reports are Excel-based weekly reports with complex macros and data visualization to provide rolling 52-week prior aggregation metrics as well as current week data snapshot. Unfortunately, this makes the spreadsheet cumbersome to work with, large in size, and despite the sophistication of the report it is not a solution that meets DLA's need to obtain end-to-end visibility of the Subsistence supply chain

Vibronyx received two sample Supply Chain Fitness Reports populated with data.

Figure 8: Supply Chain Fitness Report



Item Description	Last Report Week	Avg Weekly Demand	DOS ON HAND	DOS IN TRANSIT	DOS ON ORDER	DOS IN ENTIRE SUPPLY CHAIN
TOTALS CONUS PROCURED (C)	Week 18 2019	12,069	106	78	24	208
Subtotal	LAST 4 WEEKS AVD AS COMPARED TO THE AVD FROM 12 WEEKS AGO	-16%				

	Week 19 2018	Week 20 2018	Week 21 2018	Week 22 2018	Week 23 2018	Week 24 2018	Week 25 2018	Week 26 2018	Week 27 2018	Week 28 2018	Week 29 2018	Week 30 2018	Week 31 2018	Week 32 2018	Week 33 2018	Week 34 2018	Week 35 2018	Week 36 2018	Week 37 2018	Week 38 2018	Week 39 2018
SOH	163832	171750	183385	198546	196544	209575	212324	204988	210349	215064	221593	217655	217182	209699	208251	207643	197163	194193	186145	182641	173741
IN TRANSIT	94888	86244	82595	71979	77872	61135	64893	57870	46445	36415	33828	27731	28353	23927	29558	28119	28381	17142	19486	19451	25472
ON ORDER	65610	59497	39694	43045	25986	19602	21644	17849	14137	22564	22727	20632	13394	15162	13439	11645	24888	25886	47066	42328	40394
DEMAND	8842	7161	3875	6425	3832	1876	7471	8137	4492	7201	4143	8885	5579	6457	11740	4965	5479	9148	6349	11193	19635
	Week 45 2018	Week 46 2018	Week 47 2018	Week 48 2018	Week 49 2018	Week 50 2018	Week 51 2018	Week 52 2018	Week 1 2019	Week 2 2019	Week 3 2019	Week 4 2019	Week 5 2019	Week 6 2019	Week 7 2019	Week 8 2019	Week 9 2019	Week 10 2019	Week 11 2019	Week 12 2019	Week 13 201
SOH	126281	120491	126159	116770	115734	115751	129828	129549	127946	121182	127184	129756	124529	123935	129825	141851	140670	130461	121948	123458	130464
IN TRANSIT	78979	77836	86369	88397	88326	88852	96356	87444	83176	85363	81188	79198	86993	91363	93645	97962	112172	118751	145896	147510	151859
ON ORDER	83633	74948	57485	84033	73898	88539	84474	80269	69165	74659	61288	86678	110472	97215	126446	110284	113417	143166	167760	92425	111557
DEMAND	5303	11364	23522	22552	19878	6873	15919	7241	16487	16230	30159	6740	11956	11549	10492	16377	32014	24931	17245	12999	23498

NIS Report

The NIS Report is a simple Excel-based report that details the NSNs that are not in stock. The NIS Report is only triggered for those items requested for a specific Military Service customer order with information provided on the report including purchase order number, ship and container.

Vibronyx received a blank template of the report as shown in Figure 9.

Figure 9: Not In Stock Report

Not In Stock Notification

Ship :
Purch.Order No. :
Cont # :
Delivery Date :

NO	NSN	Description	Ord Unit	Qty	REMARKS	ETA Replenis

Packing List Report

The Packing List Report is provided to DLA Distribution by the Prime Vendor when Subsistence items are consigned for shipment to OCONUS warehouse locations. This report acts as the shipment manifest, providing the Transportation Control Number and Container number used by USTRANSCOM along with the purchase order and item level detail, as well as other metadata that could be used for in-transit visibility.

Vibronyx received a single complete sample Packing List as seen in Figure 10.

Figure 10: Packing List

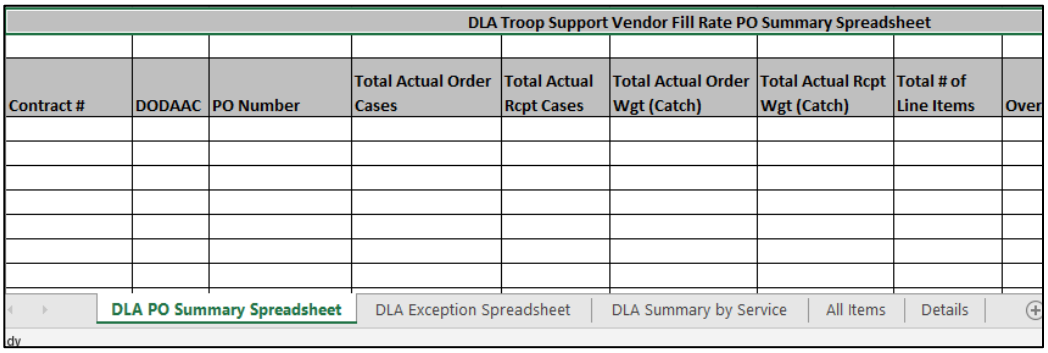
CONSIGNOR:	UTOC CORP. C/O TOWARDS CO. LTD	**Date:**	16-Nov-19	
ONSIGNEE SHIP TO:		**Container #:**	GAOU 6121150	
		Seal #:	6246776	
		TMD #:		
		Net Weight [KGS]:	8468	
Contract:		**Gross Weight [LBS]:**	21644	
		Manufacturer PO #:	63145	
No. Pallets:	25	**SCAC:**	APLS	
Vansize:	40	**POE:**	3D2	
Temp [Range]	-NONE-	**POD:**	UQ5	
RDD:	320	**TAC:**		
Booking Ref:	USM0119562			
PCFN #:	226132	**Pallet Weight [LBS]:**	1161	
Vessel:	PRESIDENT CLEVELAND			
Container TCN:	SC31053148M215MM2	**Truck #:**		
		Trailer #:		

Item	PO Reference	NSN	Manufactu SKU	GTI	Description	Brand	Uni	Qty Ordered	Unit Net Weight KGS	Total Ne Weight KGS	Unit Pric $	Extende Price $
2	613994	8915-01-E19-6350			JUICE, LEMON, RECONSTITUTED, 12/32 FL OZ COO, 12/CS	SUN TREE	CS	41	11.703	479.815	16.8	688.8
2	616672	8910-01-E61-3651			MILK ALT, SS, SOY, ORGANIC, 12/32 FL OZ CO	PEARL	CS	12	12.016	144.189	20.4	245.04
2	616663	8950-01-E09-2857	100012691		SALT, TABLE, IODIZED, 12/4 LB BG	DIAMOND CRYS	CS	100	21.773	2177.266	11	1095
2	616659	8945-01-E62-3982	5001256		SHORTENING, LIQ, DFF, TFF, CANOLA, CLEAR, LONG FRY LIFE	BUNGE	CS	120	15.876	1905.108	20	2400
5	616659	8945-01-E61-7377	5008239		NON-STICK COOKING SPRAY, AEROSOL, CANOLA, TFF, LIQ, 6	EZ COAT	CS	123	2.889	355.398	19	2334.54
2	615529	8920-01-E62-1025	3800055122		TOASTER PASTRY, CIN, LF, WHL GRAIN, FROSTED, 12/1.76 OZ	KELLOGGS	CS	60	5.987	359.249	37.1	2224.2
4	615529	8920-01-E62-1027	3800055130		TOASTER PASTRY, SBERRY, LF, WHL GRAIN, FROSTED, 12/1.	KELLOGGS	CS	60	5.987	359.249	37.1	2224.2
5	615529	8920-01-E09-1908	3800026547		CEREAL BAR, RICE/MARSHMALLOW, 80/1.3 OZ PG	KELLOGG'S	CS	60	2.948	176.903	31.1	1864.2
9	615529	8920-01-E60-3473	3800018315		CEREAL, VARIETY, HEALTHY, 60/1.25 -2.7 OZ CO, 1/8.25 LB CS	KELLOGG'S	CS	120	4.01	481.176	45.7	5481.6
12	615529	8920-01-E09-4278	3800035945		CEREAL BAR, MULTI-GRAIN, LF, SBERRY FILLED, 48/1.3 OZ PC	KELLOGG'S	CS	75	1.769	132.677	15.9	1193.25
8	615529	8920-01-E29-7712			CRACKERS, OYSTER, 300/0.5 OZ PG	ZESTA	CS	10	4.255	42.547	27.8	277.5
9	615529	8920-01-E29-3178	3800022055		CEREAL, VARIETY, 1/72 CT CSD BXS/CS	KELLOGG'S	CS	48	2.082	99.936	29.6	1418.4
22	615529	8920-01-E59-8920	3800012611		CEREAL, VARIETY, KELLOGG'S, 1.3-2.8 OZ CUPS, 60 CT, 1/7.5 LB	KELLOGG'S	CS	96	3.248	311.784	39.2	3760.32
1	614496	8950-01-E09-7684			SESAME SEEDS, WHL, MIN 18 OZ CO, 1 LB SIZE CO	UNISTEL	CS	72	0.513	36.905	4.3	309.6
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Fill Rate Report

This report is filed by a Prime Vendor weekly with the DLA and provides the DLA with the vendor-calculated fill rate for the most recent time period, including an itemized list of allowed exceptions. The Vendor Fill Rate is reported to the DLA via an excel spreadsheet on a weekly basis.

Figure 11: Fill Rate Report



DoDAAC

DLA DAAS manages Department of Defense Activity Address Code Database (DoDAAD) data store for the entire Department of Defense. DAAS has provided Vibronyx with a specification of elements in this database. While this database captures diverse elements extensively, two key elements are not provided:

- Relationship with the Unified Combatant Commands (COCOM)
- GPS coordinates for each DoD Activity Address Code (DoDAAC).

Tactical Address Code (TAC) is an abstraction of address information used for different purposes. The original DoDAAC specification calls out three different types of TACs:

TAC	Description
TAC1	Used for mailing
TAC2	Used for shipping
TAC3	Used for billing

For the JFMS project, only the TAC2 address variant was used.

DoDAAD data elements specification can be found on the DLA website[1]. The document provides a list of the DoDAAD data elements, as seen in Figure 12.

[1] https://www.dla.mil/Portals/104/Documents/DLMS/Committees/DoDAAD/DoDAAD-Data-Elements.pdf

Figure 12: DoDAAD Data Elements

DoDAAD Data Elements

Revised: 11-10-2022

The following are the data elements, descriptions, and business rules used within the DoDAAD for DoDAACs and RICs. Fields marked in ***red*** are minimum required fields to create a record. Fields marked with an asterisk (*) apply to DoDAACs and RICs.

Field Name	Max Field Length	Definition/Instructions
Record Information (TAC1)		
DoDAAC (or RIC)*	6	**The Activity Address Code** – A six-position alpha-numeric identifier assigned to specific units, activities, or offices that require a DoDAAC in order to be identified in business systems that rely upon the DoDAAC as the entity identifier. **The Routing Identifier Code** – A three-position alpha-numeric identifier that serves as a shortened form of a DoDAAC and is used to uniquely identify a unit, activity, or organization that requires system ability to route transactions, or receive transactions routed to it, within logistics and financial business systems that rely upon legacy 80 record position format transactions and routing logic through DAAS. Note: RICs are prefaced with "ZZZ" in the DoDAAD (e.g., RIC "B16" is "ZZZB16" in the database.).
UIC	6	The Unit Identification Code is a six-character code created by the DoD Components to identify an activity in manpower and readiness reporting systems. Depending on the Service's internal business processes, this field should be populated with the appropriate UIC to which the DoDAAC is associated, as applicable.
Organization Type Code	1	Type of Organization: F=Federal, D=DoD, S=State, N=NGO, X=Foreign.
Deletion Date	8	Date DoDAAC or RIC is to be deleted. Can be set for a future date. When set for a future date, the future date is not displayed in the database search results. Date format is MM/DDD/YYYY.
Authority Code	2	Identifies what Supply system uses this activity is authorized to conduct. Also impacts financial billing authority. • 00 = Full Authority (requisition, ship, bill). Requires all three TAC addresses. • 01 = Ship-to Only. Requires TACs 1 & 2. • 02 = Bill-to Only. Requires TACs 1 & 3. • 03 = Do Not Ship-to. TACs 1 & 3 required. • 04 = DLA Disposition Services Only. All TACs required. • 05 = Non-Requisition. TACs 1 & 2 required. • 06 = Free Issue. Can only request free-issue items. TACs 1 & 2 required. • 07 = No authorities – Administrative use only. TAC1 required.
Contractor	1	Contractor flag – Y/N indicator that identifies whether or not the DoDAAC/RIC is for a contractor. If Y, it makes all Contract Information fields mandatory. Can only be set

A data feed snapshot of DoDAAD was provided to Vibronyx with the missing caveats curated in the data feed for sensitivity reasons. This snapshot can be considered to be a library database for the JFMS Pilot although in reality there are periodic updates as DoDAACs are expired and new ones added.

The DoDAAC itself is a meta-coded identifier with the following specification:

Figure 13: DoDAAC Specification

DoDAAC – Department of Defense Activity Address Code
- Like a Military Zip Code
- First Six Digits of the DTID or MILSTRIP Number
- Example: **FB2515**01230001

USTRANSCOM TCMD API

USTRANSCOM's ISDDC TCMD API was covered in detail in the Phase III Transformation Playbook.

Contracts

DLA contracts with Prime Vendors to fulfill subsistence orders from the Services. Through a contractual agreement Prime Vendors are obligated to stock, replenish, and supply various Military Services DoDAACs in different Food Service Regions (which approximately align with COCOM boundaries) across the globe. As mandated by the Berry Amendment, Prime Vendors are required to supply certain subsistence items sourced from the Continental United States (CONUS), which are shipped to overseas warehouse locations using USTRANSCOM and coordinated by DLA Distribution.

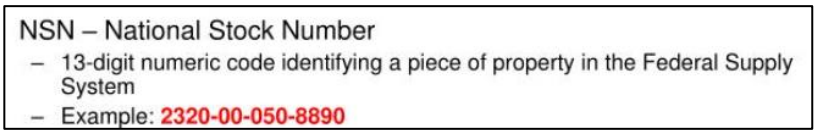
Prime Vendor contracts are considered public, but item pricing information is considered vendor proprietary.

This data model has been abstracted out of the STORES database so that the STORES no longer maintains the Contracts and Vendors within its data model.

LSN/NSN

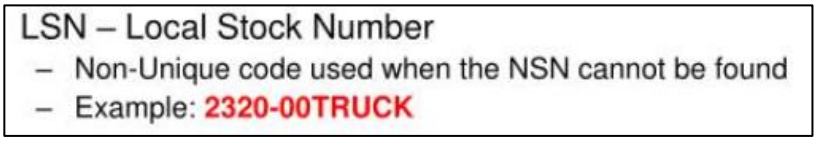
DLA Subsistence uses Local Stock Number (LSN) and National Stock Number (NSN) identifiers. The NSN is a nation-wide standard established for consistency across the entire Federal Supply Chain with the following specification:

Figure 14: NSN Specification



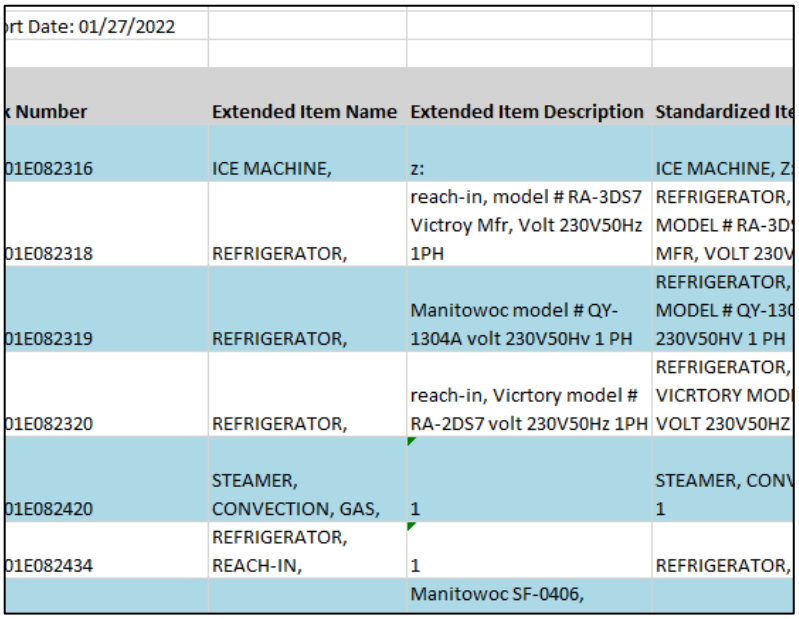
However, it is recognized that the NSN database cannot reasonably cover every single item across the Federal Supply Chain. LSNs fill in the gap when an NSN is not available and the database of LSNs is maintained by DLA Subsistence locally. While the NSN has a standard format, LSNs can have a locally-standard format. LSNs must be used only in a specific context as code collisions are possible across LSN databases.

Figure 15: LSN Specification



DLA Subsistence provided Vibronyx with a snapshot of the Subsistence LSNs as shown in Figure 16.

Figure 16: Subsistence LSNs



ort Date: 01/27/2022			
k Number	Extended Item Name	Extended Item Description	Standardized Ite
01E082316	ICE MACHINE,	z:	ICE MACHINE, Z
01E082318	REFRIGERATOR,	reach-in, model # RA-3DS7 Victroy Mfr, Volt 230V50Hz 1PH	REFRIGERATOR, MODEL # RA-3D MFR, VOLT 230V
01E082319	REFRIGERATOR,	Manitowoc model # QY-1304A volt 230V50Hv 1 PH	REFRIGERATOR, MODEL # QY-130 230V50HV 1 PH
01E082320	REFRIGERATOR,	reach-in, Vicrtory model # RA-2DS7 volt 230V50Hz 1PH	REFRIGERATOR, VICRTORY MOD VOLT 230V50HZ
01E082420	STEAMER, CONVECTION, GAS,	1	STEAMER, CONV 1
01E082434	REFRIGERATOR, REACH-IN,	1	REFRIGERATOR,
		Manitowoc SF-0406,	

Order Automation

Order Automation is both a data source and an application module generating data specifically developed for the Military Service Food Management Information Systems order automation solution in the JFMS project. This module addressed a key pain point for the DLA and Services alike. The value proposition for Order Automation is covered in detail in the Military Services Food Ordering Automation section. As this module was developed for the JFMS project, Vibronyx did not need to receive any data from DLA or partner sources.

COMPLETENESS OF SOURCE DATA

Vibronyx had to conduct the Pilot with differing levels of completeness of source data. Data source completeness can be categorized along the following dimensions:

Data Completeness Category	Explanation
Volume	Were enough instances of the desired data provided? This includes elements not related to timeframes
Feature	Were all desired elements provided, are there any relevant missing features?
Time	Does the data span a large enough timeframe? Typically this is needed for AI computations
Precision	Are data values provided with the accuracy required for the desired analytics outcome?

For the JFMS Pilot data sources, the following table describes the completeness of raw data obtained from the data sources:

Data Source	Volume	Feature	Time	Precision
STORES	No	Yes	Yes	Yes
Supply Chain Fitness Reports	No	Yes	No	Yes
NIS Report	No	Yes	No	n/a
Packing List Report	No	Yes	No	n/a
Fill Rate Report	No	Yes	No	n/a
DoDAAC	Yes	No	n/a	No
USTRANSCOM TCMD	Yes	Yes	Yes	Yes
Contracts	No	Yes	No	n/a
Order Automation	Yes	Yes	Yes	Yes

As can be seen, some data sources are more complete than others, and there remain significant gaps. There are several reasons why data sources show incomplete data:

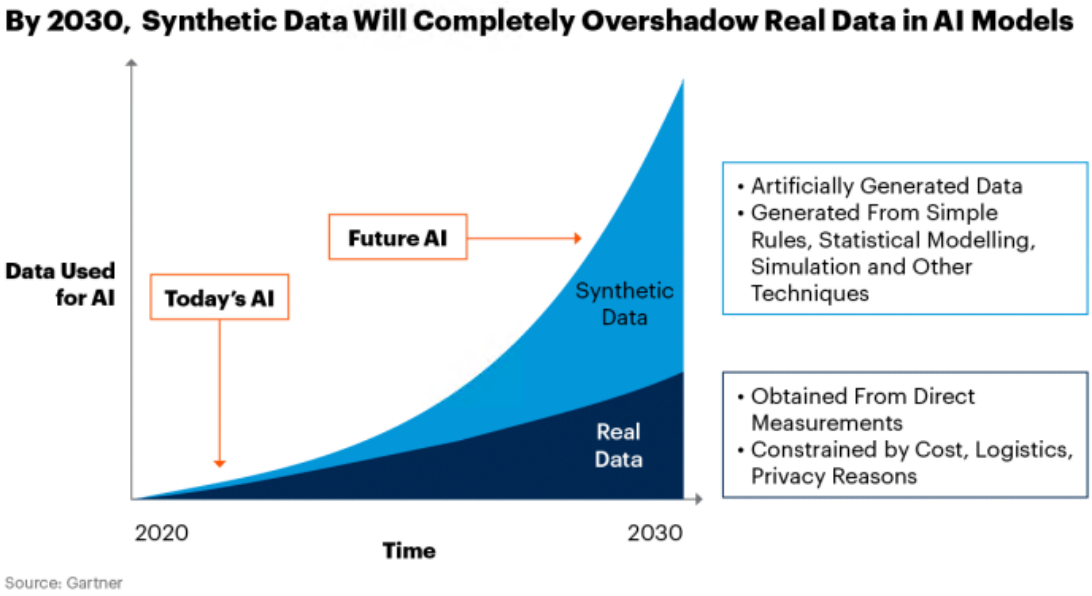
- Data extraction from the original production data source is difficult.
- Business processes need to be modified to obtain regular data feeds.
- There is sensitivity to sharing of data, especially from Prime Vendors due to leakage of price competitivity.
- Stakeholders providing data do not have incentives or directives to actively engage.

SYNTHETIC DATA STRATEGY

To overcome the lack of completeness of data, Vibronyx has utilized a set of tools to augment the data using synthetic methods.

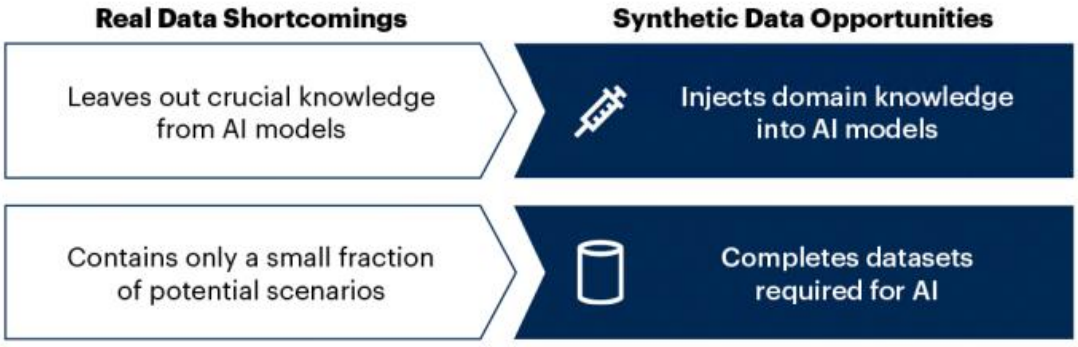
Synthetic data has high value for data analytics, especially the use of augmented data analytics using AI and Machine Learning and is proving to be a low-cost high-value approach to obtaining realistic-looking data when sources of real data are either unavailable or sparse.

Figure 17: Synthetic Data Prediction



Gartner has identified a number of Synthetic Data applications, of which the following two have been significantly employed to prove out the JFMS Pilot:

Figure 18: Synthetic Data Opportunities



Specifically, within the Phase IV Pilot, each of the data sources was identified to benefit using Synthetic Data approaches in the following ways:

Figure 19: Pilot Synthetic Data Use Cases

DATA TYPE	Volumization - Small Data Set	Sensitive Data	Domain Knowledge Augmentation
STORES	Y		
Fill Rate Report	Y	Y	
NIS Report	Y	Y	
Packing List Report	Y	Y	
DoDAAC		Y	
Supply Chain Fitness Report	Y		
In Transit Visibility			Y
Order Automation			Y
Contracts			Y

Holistic Data Exploration using Synthetic Data

A key activity within the data acquisition process is the need to understand and explore the structure of data and develop a better understanding of the business processes that are captured in the data.

The combination of data sources affords the ability to critically assess individual data models from an integrated viewpoint and identify opportunities to identify linkages and/or evolution for efficiency.

Synthetic data approaches allow for this data exploration process to be rapid and agile.
In the JFMS Pilot, Vibronyx leveraged this practice to create a Dependency Matrix that clearly identifies the linkages between the various data sources.

Figure 20: JFMS Pilot Dependency Matrix

DATA TYPE	SPEC	DATA	LAYER2	STORES	Fill Rate Report	NIS Report	Packing List Report	DoDAAC	Supply Chain Fitness Report	TCMD API call	Order Automation	Contracts	NSN
STORES		Y	n/a										
Fill Rate Report	Y	Y	n/a										
NIS Report	Y	Y	n/a										
Packing List Report	Y	Y	n/a										
DoDAAC	Y	Y	n/a										
Supply Chain Fitness Report	Y	Y	Y										
In Transit Visibility	Y	Y	Y										
Order Automation		Y	Y										
Contracts	Y	Y	Y										
NSN	Y	Y	n/a										

Not Applicable
Dependency
No Dependencies

Specification Development

Synthetic data approaches permit the development of specifications for the intentional creation of synthetic data. For JFMS Pilot development , specifications for each of the data sources were created and subject matter expert business logic was used to write Python code that generated synthetic data.

For example, the STORES data was volumized to create 3 years of data using the original one-year real data set. This expanded the availability of data to 4,326,838 lines of purchase orders and 18,860,682 lines of receipt details.

Every specification consistently covered the following topics:

- Background and general context for the data source
- Limitations and scope
- Data outputs format in target data lake
- Data augmentation goal (such as volumization, new data creation etc.)
- Cross-reference dependency (this is based on the Dependency Matrix in Figure 20)
- Data lake detail / schema identification for data being generated
- Source control / Git-based source control repository identification
- Data model for the synthetic data
    - Layers 1 through N: Additional tiers of processing that adds value to the raw data are included
- Specification version control

Vibroyx then wrote Python code to conform to each specification. A sample of the written code is as shown below:

Figure 21: Python Code Sample

```python
import pandas as pd
from extract.purchase_orders import get_purchase_orders


def create_dataframe(purchase_orders):
    df = pd.DataFrame(purchase_orders, columns=['purchase_order_number', 'award_date'])
    return df


def create_3_year_dataframe(purchase_orders_1, purchase_orders_2):
    df1 = pd.DataFrame(purchase_orders_1, columns=['purchase_order_number', 'award_date'])
    df2 = pd.DataFrame(purchase_orders_2, columns=['purchase_order_number', 'award_date'])
    df = pd.concat([df1, df2])
    df.drop_duplicates(inplace=True)
    return df


def return_3_years_of_purchase_orders(db1, db2):
    po1 = get_purchase_orders(db1)
    po2 = get_purchase_orders(db2)
    df = create_3_year_dataframe(po1, po2)
    return df
```

Data Lake Using Oracle

The Vibronyx Platform can leverage data lake technologies which are built for Big Data and analytics. However, DLA does not have a standardized data lake and the DLA strategy of integration with DoD Advana is not clearly articulated at this time. In the absence of a clear data lake architecture, Vibronyx leveraged the use of the DLA enterprise-approved Oracle database.

Schemas

The approach to the Oracle data lake consisted of segmenting each data source into its own data schema. For example, the STORES data source in the Oracle database was segmented into the schema: jfms_pilot_raw_stores_synth.

Where needed and in accordance with the Dependency Matrix in Figure 20, database grants were issued so that each schema could be integrated and connected with dependent data sources identified in the Matrix. For example, Figure 22 shows the Fill Rate schema being granted privileges to the Contracts, DoDAAC, and STORES schema.

Figure 22: Fill Rate Schema

```
-- GRANT FILLRATE user based on dependency
EXEC PROC_JFMS_PILOT_SCHEMA_GRANTS('JFMS_PILOT_RAW_CONTRACTS_SYNTH', 'JFMS_PILOT_RAW_VNFILRATE_SYNTH');
EXEC PROC_JFMS_PILOT_SCHEMA_GRANTS('JFMS_PILOT_RAW_DODAAC_SYNTH', 'JFMS_PILOT_RAW_VNFILRATE_SYNTH');
EXEC PROC_JFMS_PILOT_SCHEMA_GRANTS('JFMS_PILOT_RAW_STORES_SYNTH', 'JFMS_PILOT_RAW_VNFILRATE_SYNTH');
```

Materialized Objects and Aggregation Layers

Legacy BI analytics compute and cache aggregations at the visualization layer. With Big Data, this repeated computation at the level of the visualization layer (typically browser or desktop client and now increasingly the mobile device) leads to a deteriorated user experience.

Materialized Objects alleviate this performance concern by moving the computation burden to the server layer. These Objects also improve the developer experience by updating aggregations in near real-time when new data is available. This improves the front-end user experience considerably and is considered a modern analytics best practice.

In Oracle, Materialized Objects are available as Materialized Views capability and this has been leveraged to additional layers of aggregated data. In the example shown in Figure 23, the Oracle Materialized View aggregates Contract data.

Figure 23: Oracle Materialized View

```
175     exec_ignore_errors(con, "DROP MATERIALIZED VIEW LAYER2_CONTRACT_GENERAL_METRICS")
176     exec(con, """
177         CREATE MATERIALIZED VIEW LAYER2_CONTRACT_GENERAL_METRICS
178         BUILD IMMEDIATE
179         REFRESH FORCE
180         START WITH SYSDATE NEXT SYSDATE + 1
181         AS
182         SELECT
183             contract_status_id,
184             COUNT(contract_id)
185         FROM
186             contract
187         GROUP BY contract_status_id
188     """)
```

KEY TAKEAWAYS

- The Vibronyx Platform flexibly accommodated sourcing data from eleven disparate sources for the JFMS Pilot.
- The data sources have varying levels of completeness of data when categorized in the dimensions of volume, feature, time, and precision.
- Synthetic data approaches were applied that had the following benefits:
    - Adding completeness to the data
    - Enabling exploration and establishment of linkages between previously siloed data sources
    - Refining data models in the data source
- Specifications were developed to implement synthetic data strategy.
- DLA-approved Oracle database was used as a substitute for a data lake in the absence of a DLA data lake strategy.
- The Materialized Objects best practice was used to move the analytics computational burden to the server layer while simultaneously improving the user experience.

MILITARY SERVICES FOOD ORDERING AUTOMATION

GOAL:	Automate ordering transmission between two commercial vendor solutions and STORES across commercial and NIPRNet networks.
PILOT RESULTS:	**Successful Proof-of-Concept** • Successful demonstration of solution with a single food services vendor. • Solution is designed.
OPERATIONAL FEASIBILITY:	• ATO change and approval processes must be followed for both food services vendors and DLA. • Dependent on J6 DevSecOps general availability.

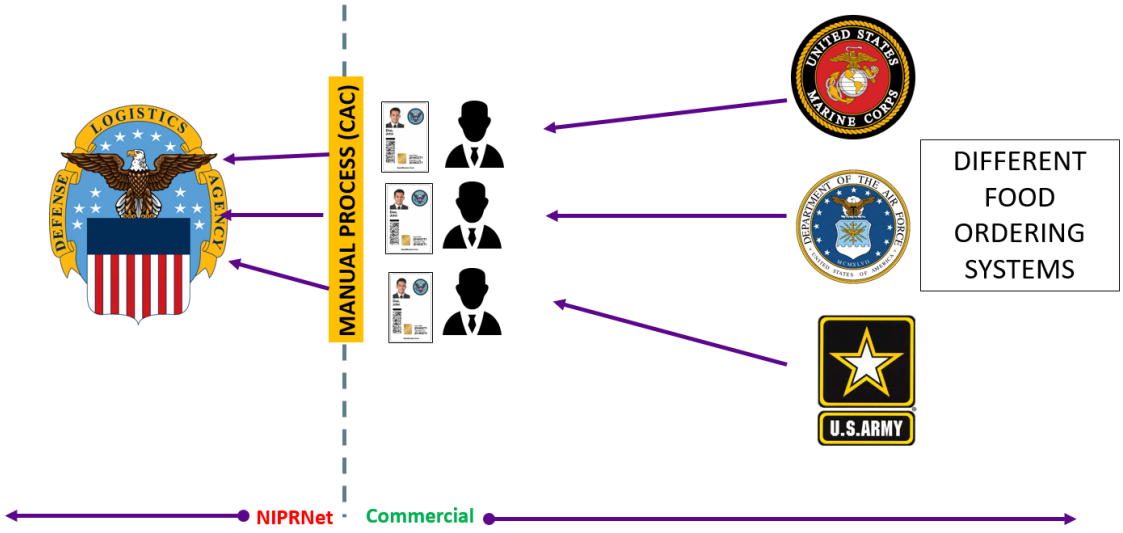
In Phases II and III, Vibronyx documented and identified manual friction points in the food ordering process between the Services food ordering systems and DLA internal systems as a key pain point for both DLA and Military Service stakeholders. In Phase IV, Vibronyx was tasked with architecting a solution to reduce or eliminate these friction points and pilot an automation capability with one or both of the commercial food ordering vendors – Crunchtime (Air Force) and/or Computrition (Marine Corps, Defense Health Agency). Computrition agreed to engage with Vibronyx and prove out an ordering automation pilot.

TECHNICAL CHALLENGES AND ASSUMPTIONS

Firewall Boundary
Services food ordering systems that interface with the DLA are typically contracted by the Services and are deployed either into the commercial Internet or DoD NIPR environment. The Vibronyx solution was tasked to be flexible enough to handle both environments. DLA internal systems are always deployed within the NIPRnet (when data is labeled as Controlled Unclassified Information CUI) or SIPRnet for Classified Information (such as OPRATS) protected environments. Therefore, there is a DLA firewall boundary that orders originating in the Services food ordering systems must cross before being processed by DLA internal systems.

The current method to cross the NIPRnet firewall is by manual intervention with using a CAC credential that can be safely used to convey the order. While safe, the manual steps required can result in delays and errors.

Figure 24: Current Order Processing Method Requiring Manual Intervention



No Impact to Production Processes
The Vibronyx architected solution needed to be demonstrated in the Pilot, but it was implicitly recognized that the solution could not disrupt current food services software deployment and processes as the Authority to Operate (ATO) was not within the scope of the Pilot. However, the solution had to be sufficiently realistic and stable to be approved during a future ATO process.

STORES Modernization
The Vibronyx solution had to account for the ongoing consideration at DLA to rationalize/modernize the STORES system. Thus, the solution had to be flexible enough to be able to work with a future system without major rework during the ATO process.

Cyber Team Approval
Cybersecurity is a major consideration when data is conveyed across firewall boundaries, especially when this data is being introduced into the more controlled NIPR environment. The Vibronyx solution had to be approved by the DLA cyber teams and pass any Security Technical Implementation Guide (STIG) concerns.

Minimal Impact to Food Services Ordering Software
Commercial Food Management System vendors have their own lifecycle management and a major consideration for the JFMS solution is to have a minimal impact on the re-architecture of such software. This will allow for maximum flexibility to work "out-of-the-box" with Food Management System vendors that were not a part of the Pilot process.

PILOT TECHNICAL SOLUTION SCOPE

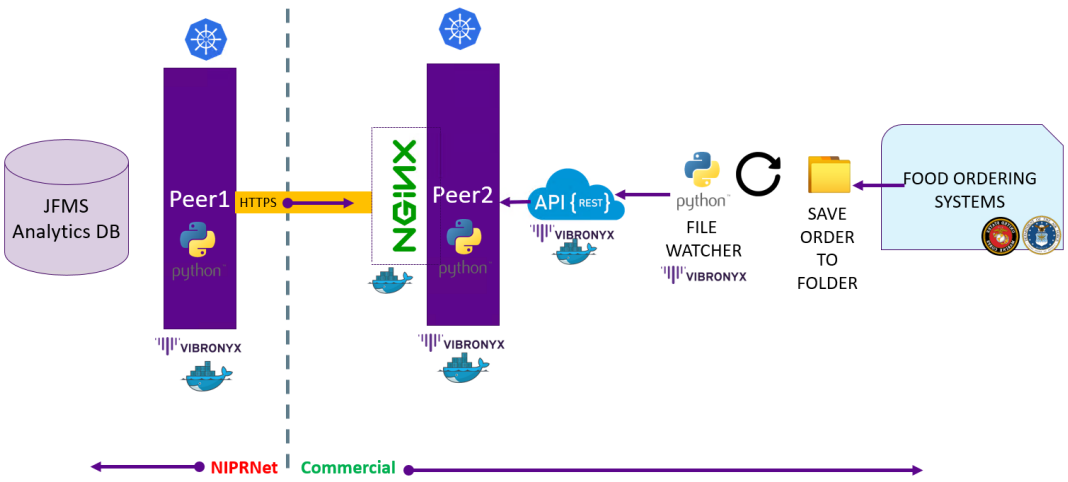
To address the challenges and assumptions listed above, Vibronyx helped to assemble a joint team comprised of Vibronyx technical personnel, Computrition technical personnel, DLA R&D DAGE/ARTET personnel, and DLA cyber team stakeholders. The following technical scope and requirements were jointly agreed to for the Pilot:

- Vibronyx solution would be approved by the DLA cyber team.
- Computrition would establish a parallel environment in their hosting environment where the food management system is deployed so as not to impact the current ATO process.
- Order transmission across the firewall boundary was deemed to be more important than introspection of the contents of the order. This had the following benefits:
    - Flexibility in accommodating an evolving transaction recording system
    - Focus on the firewall boundary problem rather than transaction contents.
- Design should accommodate multiple food ordering locations/system instances and multiple Military Services at the same time, as expected in the future ATO.
- To accelerate the development process it was agreed to simulate the NIPR firewall boundary in the Vibronyx AWS GovCloud environment.

TECHNICAL SOLUTION

Vibronyx worked with and obtained DLA cyber approval for the high-level design architecture shown in Figure 25.

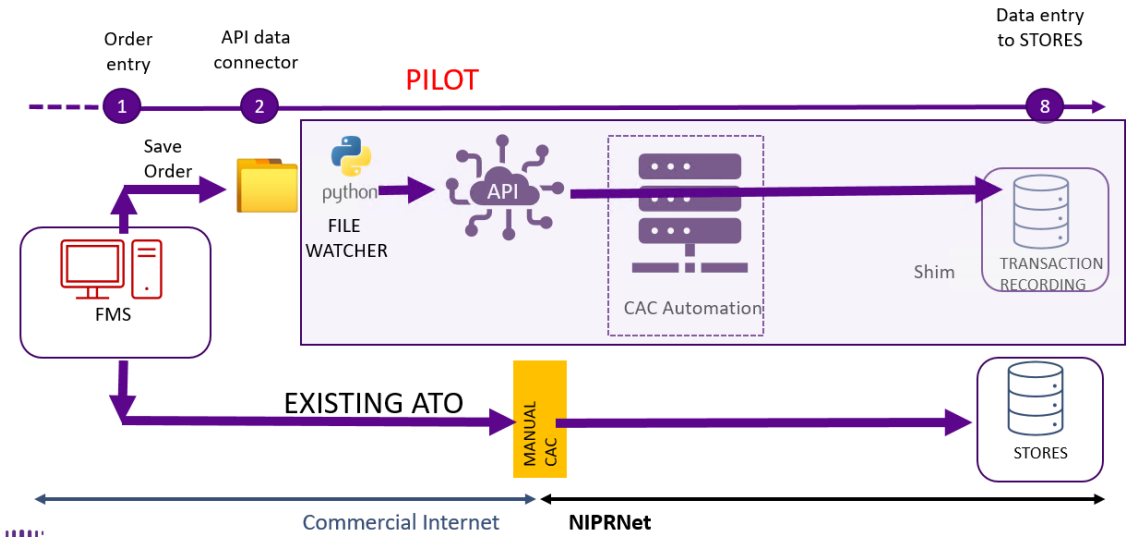
Figure 25: Food Ordering Automation Solution Software



In this architecture, Peer1 within the NIPR environment is polling updates from Peer2 – a microservices component to which orders are uploaded to using an API layer on an "on-demand" basis. Polling is conducted on a specific approved and well-accepted HTTPS channel. The File Watcher (Agent) is a component that observes for orders saved to a local folder on the Food Management System platform. The File Watcher leverages the existing ATO business process where orders are stored and then manually transmitted to DLA using a CAC.

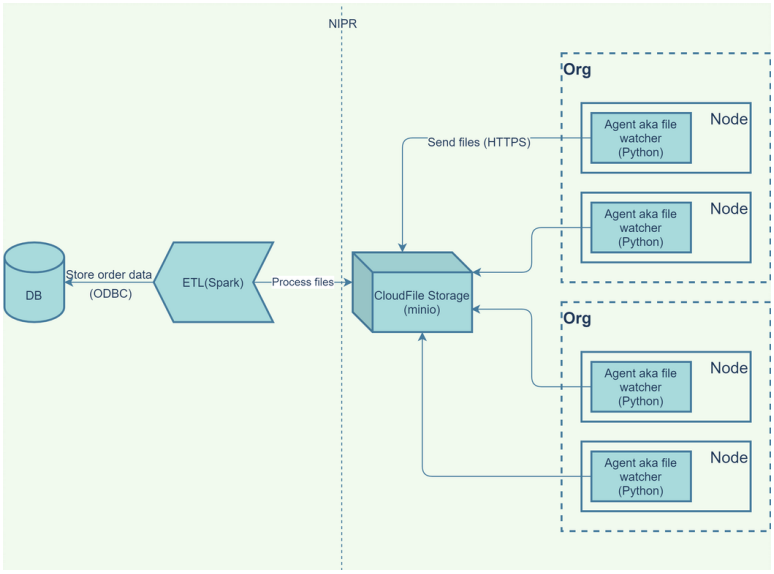
Vibronyx proposed the solution shown in Figure 26 from the Food Management System vendor point of view and obtained approval from Computrition. By design and intent, the existing ATO process is not impacted.

Figure 26: Computrition Solution Architecture



The components within Peer2 in Figure 25 are designed to be microservices-based with an ability to accommodate multiple locations/system instances across multiple Services organizations. This is shown in Figure 27 below.

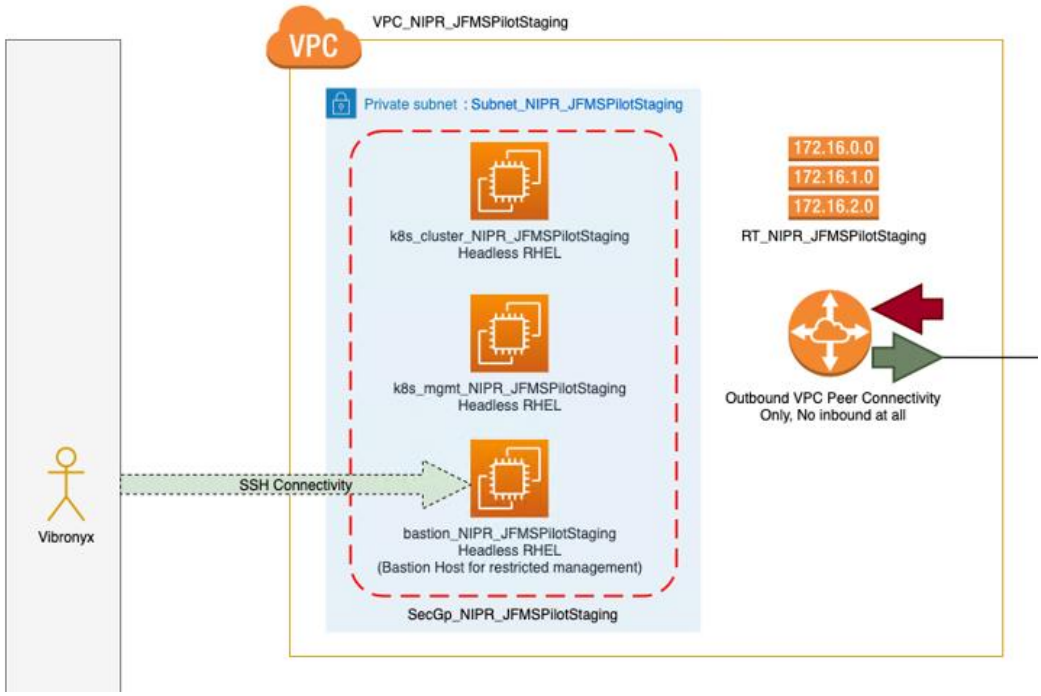
Figure 27: Peer2 Components



Microservices components used in this solution leverage mature, open-source, and well-adopted technologies including Apache Spark for scalable processing and MinIO Amazon S3-standard compliant storage. This also reduces the level of custom components needed to develop the solution and is a sustainable strategy for the DLA.

The DLA NIPR environment and strict firewall boundary was simulated in the AWS GovCloud environment as shown in Figure 28.

Figure 28: Simulated NIPR / Firewall Boundary



KEY TAKEAWAYS

- Vibronyx was able to transmit orders generated by Computrition in their hosting environment into the DLA-simulated AWS GovCloud in the one-minute timeframe. This implies that orders created on the Computrition side were conveyed to the DLA side in almost real-time.

- The solution implementation demonstrates significant improvement in order transmission time over the current manual/CAC process and addresses a key point of friction between DLA Subsistence and the Services.

- Vibronyx designed and implemented a dashboard visualization component to capture analytics with the data provided by the order automation capability (see Visualization Dashboards and Reporting). Aggregated order metrics are presented along with a detailed transaction trace providing high visibility into the metadata of the order.

IN-TRANSIT VISIBILITY

GOAL:	Examine API integration with US TRANSCOM and DLA Distribution to use shipping data to provide end-to-end visibility.
PILOT RESULTS:	**Successful Proof-of-Concept** • Successfully implemented integration and descriptive analytics with USTRANSCOM ISDDC in two ways, including first-of-kind pipeline automation of periodic complete data feed and through the Webservices API. • Successful integration of DLA Distribution Packing list provided to Vibronyx.
OPERATIONAL FEASIBILITY:	• Operational integration with USTRANSCOM ISDDC established, however the curated data feed will not provide administrative events. • Web application automation and integration may be better addressed using robotic process automation (RPA), although this is a less recommended option. • Barriers to sharing of real data must be overcome for operational effectiveness, especially where APIs and/or data sharing infrastructure is not established.

DATA SOURCES AND CONSIDERATIONS

USTRANSCOM
The United States Transportation Command (USTRANSCOM) is a valued partner for DLA assisting Subsistence and the Prime Vendors to move food shipments across the globe. The Surface Deployment and Distribution Command (SDDC) within USTRANSCOM provides origin-to-destination distribution solutions by collaborating with shippers and commercial industry to enable reliable, cost effective, global surface deployment, and distribution transportation services.

ISDDC
The Integrated SDDC (ISDDC) is a sophisticated information system that combines many other point stakeholder solutions participating in USTRANSCOM operations (for complete details of ISDDC see Phase III Transformation Playbook).

ISDDC Data End Points
USTRANSCOM ISDDC enables data sharing with ecosystem partners including the DLA in three ways:

- *ISDDC Browser Application:* This application, available from the NIPR Net and requiring CAC approval at https://eta-teams.transport.mil/teams is a reporting application that enables the user to report on ISDDC data in a number of ways. The application is primarily built using Cognos.
- *Web Service:* this is an authenticated SOAP/XML API end point for a specific subset of the data available within ISDDC. For the JFMS project, DLA/Vibronyx was approved for the TCMD Web Service and this service was tested out in Phase III. For more details on Service Level Agreements,

and the type of information available through this end point, please see the Phase III Transformation Playbook.

- *Periodic full data feed:* this is a full, yet curated data feed of the state of the ISDDC system provided on a periodic basis, typically once a day. Vibronyx implemented this first-of-kind service for the DLA in Phase IV. The data feed comprises the state of shipments across multiple transport modes within the USTRANSCOM distribution system. As such, this information provided on a periodic basis can be combined with DLA and Prime Vendor data to give DLA stakeholders and COCOM commanders an end-to-end view of shipments at the item-level on a near-real-time basis which can tremendously improve situational awareness.

Periodic Full Data Feed Technical Details

ISDDC can provide a full data feed of the ISDDC to USTRANSCOM ecosystem partners. This data feed is complete yet curated before sharing with partners. Although mostly standardized, the data feed cannot be obtained by self-service mechanisms. There are Service Level Agreements (SLA) and cybersecurity considerations to formalize access to the data feed first.

Hardening Data Access

Once agreements are in place, the data is made available to a partner from a secure FTP (SFTP) site. To harden the SFTP endpoint, access is restricted by using a well-known RSA 2048 asymmetric encryption key instead of a username/password. In addition, the SFTP endpoint is restricted to approved IP addresses used by the client.

Curated Data Specifications

As mentioned, the ISDDC system contains integrated data from a wide variety of information systems. The ISDDC team provides curated data that has gone through a rigorous pre-processing and reconciliation process prior to issuance to the data partner. The ISDDC periodic feed is provided as a fixed-field file with 110 columns. Figure 29 shows a screenshot of the ISDDC Data Feed specifications.

Figure 29: Flat File Specifications ISDDC Data Feed

No	NAME	DATATYPE	DESCRIPTION
1	TCN	VARCHAR2(17)	Transportation Control Number
2	IBS_BCK_OFFICE	VARCHAR2(25)	IBS Booking Office
3	UNIT_NM	VARCHAR2(30)	IBS Unit Name
4	BOOK_CONSIGNOR	VARCHAR2(703)	Booked Consignor
5	BOOK_CONSIGNEE	VARCHAR2(703)	Booked Consignee
6	POE	VARCHAR2(250)	POE
7	POD	VARCHAR2(250)	POD
8	VOYDOC	VARCHAR2(5)	VOYDOC
9	SHP_AGNCY	VARCHAR2(50)	Shipping Agency
10	RCV_AGNCY	VARCHAR2(50)	Receiving Agency
11	CONSIGNOR	VARCHAR2(703)	Consignor
12	CONSIGNOR_ST	VARCHAR2(205)	Consignor State
13	CONSIGNOR_UIC	VARCHAR2(9)	Consignor UIS
14	CONSIGNEE	VARCHAR2(703)	Consignee

The Transportation Control Number (TCN) is an identifier that describes a shipment. Each TCN can be fulfilled by one or more Containers, which are standard shipment units and can contain individual items

shipped by Prime Vendors or DLA Subsistence. Containers are counted in Twenty-Foot Equivalent Units (TEU), a standard of size. Thus, a forty-foot Container would be 2 TEU. Each line item in the ISDDC feed indicates an update of the movement of a Container, recorded as an Event to the Container.

The curated data, although comprehensive in many ways has two data elements that are not included by design:

- No locations / DoDAACs are provided with their GPS coordinates. These coordinates are available in the web application that the approved user can log into, however, GPS coordinates are stripped from the data feed, for the purposes of sensitivity to movement.
- Administrative Events, which are Events relating to documentation, customs and other factors that cause delays in movement of containers are not included in the ISDDC data feed. These Events are available in the web application that the approved user can log into.

The data within the ISDDC periodic data feed is labeled with the supply class and includes all supply class including Subsistence. At 43%, Subsistence forms a significant part of the shipment movement tracked across all of these supply classes. Figure 30 shows the list of supply classes that are included within the ISDDC data feed.

Figure 30: Supply Classes Included with ISDDC Periodic Data Feed

1	AMMUNITION
2	CLOTHING,INDIVIDUAL EQUIPMENT, TOOLS, AND ADMIN SUPPLIES
3	CONSTRUCTION MATERIALS
4	MAJOR END ITEMS
5	MATERIAL FOR NON-MILITARY PROGRAMS (CIVIL AFFAIRS)
6	MEDICAL MATERIALS
7	NOT PROVIDED
8	OTHER
9	PERSONAL DEMAND ITEMS
10	PROPELLANTS, PETROLEUM, OILS, AND LUBRICANTS
11	REPAIR PARTS
12	SUBSISTANCE
13	UNKNOWN

TECHNICAL SOLUTION

Vibronyx Automated Data Pipeline for DLA

In a first-of-kind implementation at the DLA, Vibronyx has created a fully automated data pipeline to obtain the ISDDC daily feed and record it to a data lake for further processing. The automated data pipeline has been implemented using state-of-the-art technology based on Apache NiFi that was initially developed by the National Security Agency (NSA).

The Vibronyx automated pipeline (see Appendix B) has been continuously in operation for nearly six months. In that timeframe, over 600,000 rows of data have been sourced and recorded from the ISDDC periodic data feed.

Since the data feed is a periodic update, the data lake environment set up by Vibronyx contains an accumulation of data and offers a comprehensive picture of the movement of a container on a daily basis using events that are triggered on each container.

USE CASES AND ANALYTICS

Data available from sealift visibility by itself can enable insights in a number of use cases:

- Port Congestion
- Port Dwell
- Transit-time accuracy
- Planning
- In-transit visibility
- Delays
- Customer experience
- Detention and Demurrage costs

Descriptive Analytics

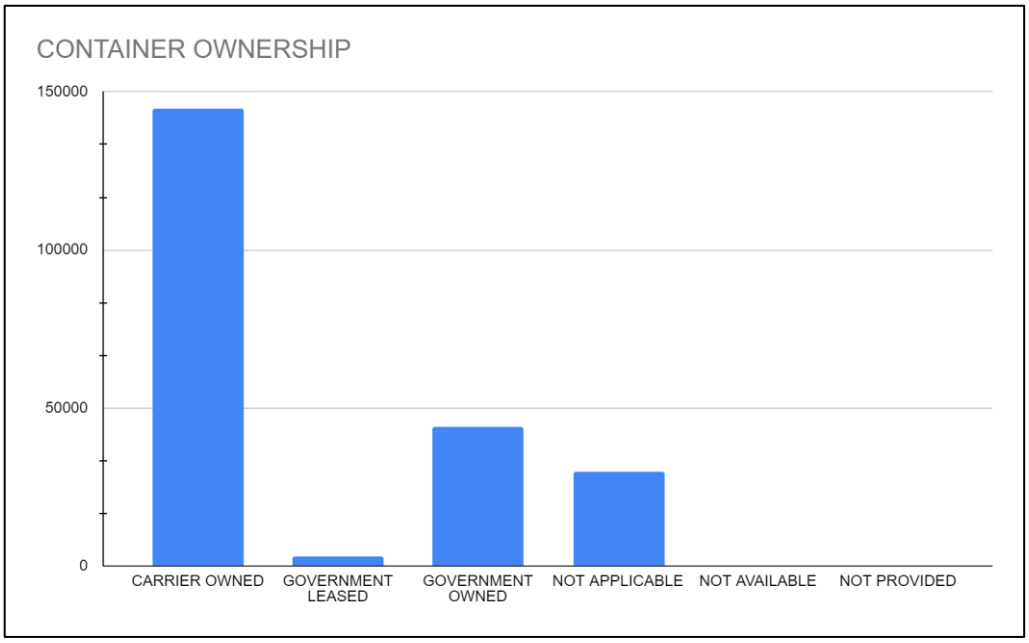
Based on the data that has been received, Vibronyx has conducted a descriptive analytics exercise to obtain high level insights into the data.

Descriptive analytics offer insights into the state of existing data. Trends and insights can be manually inferred using descriptive analytic technique. This can be contrasted with predictive techniques, which are typically forward looking into data that is not available yet.

Vibronyx has discovered the following preliminary (non-comprehensive) insights in the ISDDC data:

1. As already mentioned, all supply classes are included with the ISDDC periodic data feed including Subsistence. Subsistence constitutes a significant portion (43%) of all containers shipped in the supply classes.
2. Although 43% of all containers are related to Subsistence, only 20% of the ISDDC data is related to Subsistence container events. This implies that Subsistence containers experience simpler transits.
3. Subsistence containers are shipped between/to approximately 30% of the locations used by the full set of supply classes.
4. 93% of Subsistence shipments associated with a single TCN are also shipped in a single container. Therefore, it is a reasonable assumption to use the TCN or the associated Container number as an identifier for Subsistence shipments.
5. 99% of Subsistence shipments are fulfilled in Containers that are Carrier-owned (rather than Government owned, or Government leased). See Figure 31.

Figure 31: Subsistence Shipments Container Ownership



6. Subsistence shipments predominantly originate from CONUS locations (and Guam). This is consistent with the Berry Amendment rules (10 U.S.C. 2533a in Section 832 of Public Law 107-107) and general understanding around Prime Vendor shipments.
7. Approximately 50% of the containers shipped in Subsistence contain refrigerated goods.
8. Over half of the DLA Subsistence container traffic transits through Europe.

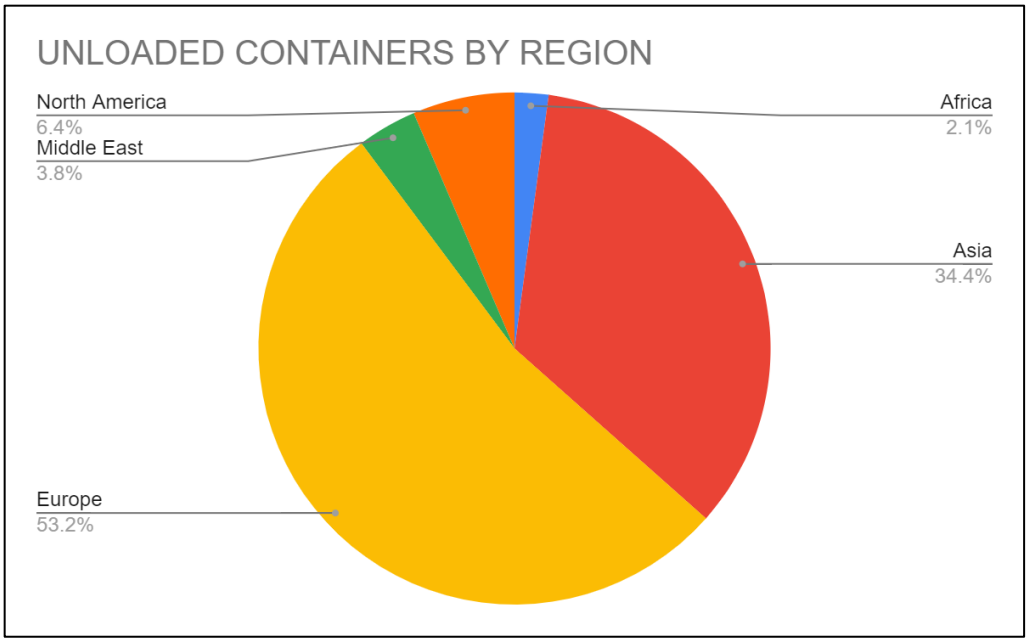
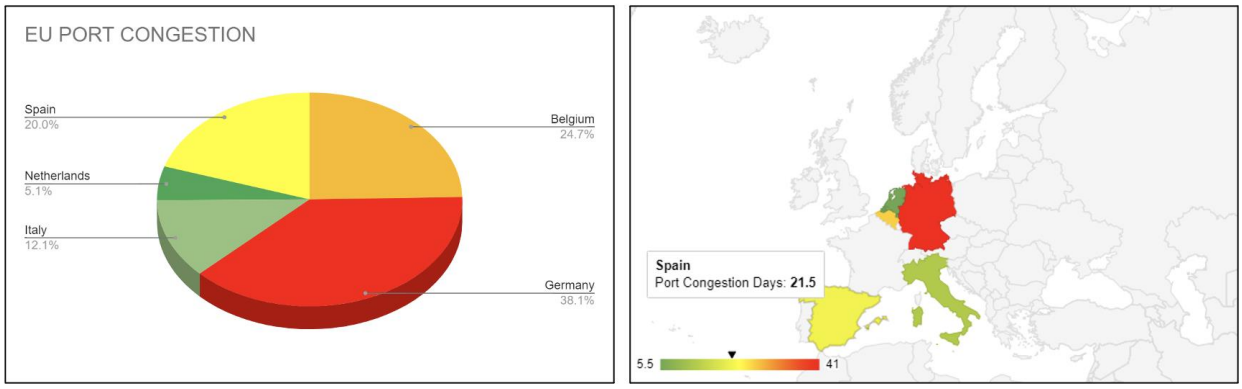


Figure 32: Unloaded Containers By Region

9. Antwerp, Belgium experiences the highest level of container traffic as well as the most significant amount of container congestion/frustrated containers for Subsistence. On average, containers are expected to be congested in Antwerp for a period of 54 days. In general, frustrated containers are a significant pain point for the Services and DLA in general, especially in the EU theater.

Figure 33 shows an aggregated view of port congestion and unloaded container traffic in the EU region.

Figure 33: Aggregated view of EU Port Congestion



Predictive Analytics

Vibronyx conducted predictive analytics addressing Frustrated Containers, which was identified as one of the most significant use cases of predictive analytics using data from USTRANSCOM. Execution details and findings have been presented in the next section.

KEY TAKEAWAYS

- Vibronyx established the first fully automated pipeline for acquisition of USTRANSCOM ISDDC data on a periodic basis.
- Subsistence accounts for 43% of all container shipments but only 20% of the events across all the supply classes
- Almost all Subsistence shipments are done using containers and each shipment is most often contained in a single container
- Approximately half of Subsistence shipments are refrigerated.
- Antwerp, Belgium is a significant bottleneck to Subsistence shipments. Most container transit traffic and Frustrated Container experiences are at Antwerp. This finding can directly inform DLA planning processes.

PREDICTIVE ANALYTICS

GOAL:	Prediction of pricing volatility and demand prediction for new contracts.
PILOT RESULTS:	**Successful Proof-of-Concept** • Successfully implemented integration and descriptive analytics with US Pricing is relatively stable and OCONUS volatility that DLA needs could not be determined because of lack of geographical context and lack of disclosure on pricing information by Prime Vendors. • Demand prediction was superseded by the higher priority of frustrated containers/port dwell time prediction • Successful prediction of frustrated containers/port dwell times
OPERATIONAL FEASIBILITY:	• Barriers to sharing of real data (pricing) must be overcome for operational effectiveness, especially where APIs and/or data sharing infrastructure is not established. • Much more data is needed for accurate frustrated containers/port dwell time predictions, however, by DLA ATO timeframe, it is expected that sufficient data will be acquired, but this assumption needs to be verified.

For Phase IV, Vibronyx was tasked with developing and implementing:

- Task Order 1: Pricing Volatility predictive analytics in the dashboard
- Task Order 2: Demand Prediction analytics for new contracts

These two line items were approved in early 2020. Due to the nature of shifting priorities, Task Order 2 demand prediction was substituted with a high-value opportunity for predictive analytics around the problem of Frustrated Containers based on strategic guidance from DLA leadership.

PRICING VOLATILITY PREDICTION CHALLENGES

In the Phase III Transformation Playbook, Vibronyx articulated key findings along with results that impacted the challenge in determining pricing volatility.

- *High computational cost relative to benefit:* In the report, it was identified that model development was computationally intensive with the use of mature open-source tools. Interdependence of over 130 features was not examined due to the computation intensity even when computational resources were scaled vertically.
- *Sparse data*: there is a very small amount of data demonstrating price changes ("Minority Class" data). Intuitively, this is also expected as most pricing changes by vendors are bound by the guidelines of contractual terms.
- *No geographical context:* Subsistence leadership believe that OCONUS pricing is more volatile, however no orders in the transactional orders (currently STORES) database is tagged with geographical information. STORES orders need to be combined with data sources that provide this context including possibly US TRANSCOM and DLA Distribution. Further, this may be

available for current active shipments, however developing a historic view may be impossible. These considerations are not in scope for Phase IV.

- *No pricing contractual information:* Due to sensitivities of the Prime Vendor, pricing information and contracts data were not provided to Vibronyx. In the absence of this data, volatility is challenging to determine.

Due to these challenges and lack of appropriate pricing volatility considerations, it was also determined that providing these types of predictive visualizations on the dashboard would not be of value to DLA Subsistence.

JSPB FRUSTRATED CONTAINER/PORT DWELL FOCUS

In April 2022, Vibronyx attended the Joint Services Policy Board to brief senior leadership on the value of the JFMS Readiness dashboards. In that meeting, leaders allocated significant time towards discussion of Frustrated Containers (i.e. containers being "stuck" in port). This is also known as Port Dwell in the commercial shipping industry.

While it was acknowledged that Frustrated Containers was a concern for a number of years, it became a particular focus at the meeting due to the high priority associated with Russia/Ukraine conflict occurring merely weeks before the JSPB. Causes of Frustrated Containers discussed included a number of administrative items including:

- OSD Policy
- Prime Vendors inability to secure health certificates in a timely manner even with NATO SOFA agreements in place
- Manual corrections and couriering of paper documentation
- Exceptions not being handled in an appropriate manner

DLA currently has no advanced analytical techniques to help DLA planners and shippers in alleviating or finding workarounds to bottlenecks due to Frustrated Containers

USE CASE: PREDICTING FRUSTRATED CONTAINERS/PORT DWELL

USTRANSCOM Data Acquisition Pipeline
In the months following the JSPB, Vibronyx implemented the first-of-its-kind automated data acquisition pipeline for real-time movement of shipments that are fulfilled using USTRANSCOM.
This presented a unique opportunity in that DLA, through Vibronyx, now has USTRANSCOM data that Vibronyx can apply advanced analytical techniques (both Descriptive and Predictive) to address Frustrated Container problems.

Vibronyx has applied Descriptive analytics to the USTRANSCOM data and has confirmed the Frustrated Container problem for DLA Subsistence. In addition, Vibronyx has developed a quantitative metric of the Frustrated Container problem. On average, containers can expect to dwell in Antwerp, Belgium for 54 days (almost 2 months), which can produce significant challenge as Antwerp is also the port through which the highest number of DLA Subsistence containers are routed. DLA is now aware of the shipping bottlenecks at an enterprise level - a capability that was not available to the DLA prior to this project.

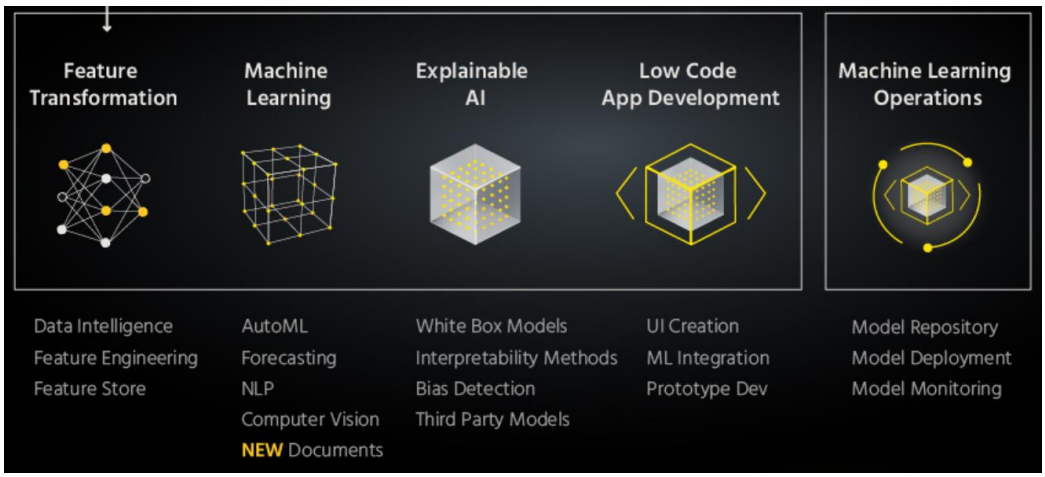
Significant follow up questions are now being asked that can be answered using predictive analytics:

- Can Frustrated Container port dwell time be predicted for new shipments?
- What are the correlating factors influencing port dwell time? By avoiding these correlating factors, can port dwell time be reduced? This information would be useful for planners.

Vibronyx h2o.ai Scalable Machine Learning

During the Phase IV Pilot, Vibronyx formalized a partnership with h20.ai to integrate the company's tools within the Vibronyx Platform for scalability and distributed computation in AI and Machine Learning. Figure 34 shows the aspects of the platform that complement but also go beyond the capability of the Python AI/ ML open-source ecosystem.

Figure 34: h2o.ai AI and Machine Learning Capabilities



The h2o.ai platform brings computational flexibility and speed of experimentation to citizen data scientists in an appealing and understandable low-code environment. The platform is implemented using industry standard Microservices including Kubernetes containers and thus is compatible with the Vibronyx platform as well as with the overall DLA strategy. It provides an ability to implement model development into a production pipeline using AutoML techniques while still keeping AI models agile and responsive to drift and trend changes in source data.

H2o.ai's platform has been regarded by Gartner as a clear leader rivalling even Google in completeness of vision.

Figure 35 shows the fit and integration of the h2o.ai platform within the Vibronyx Platform.

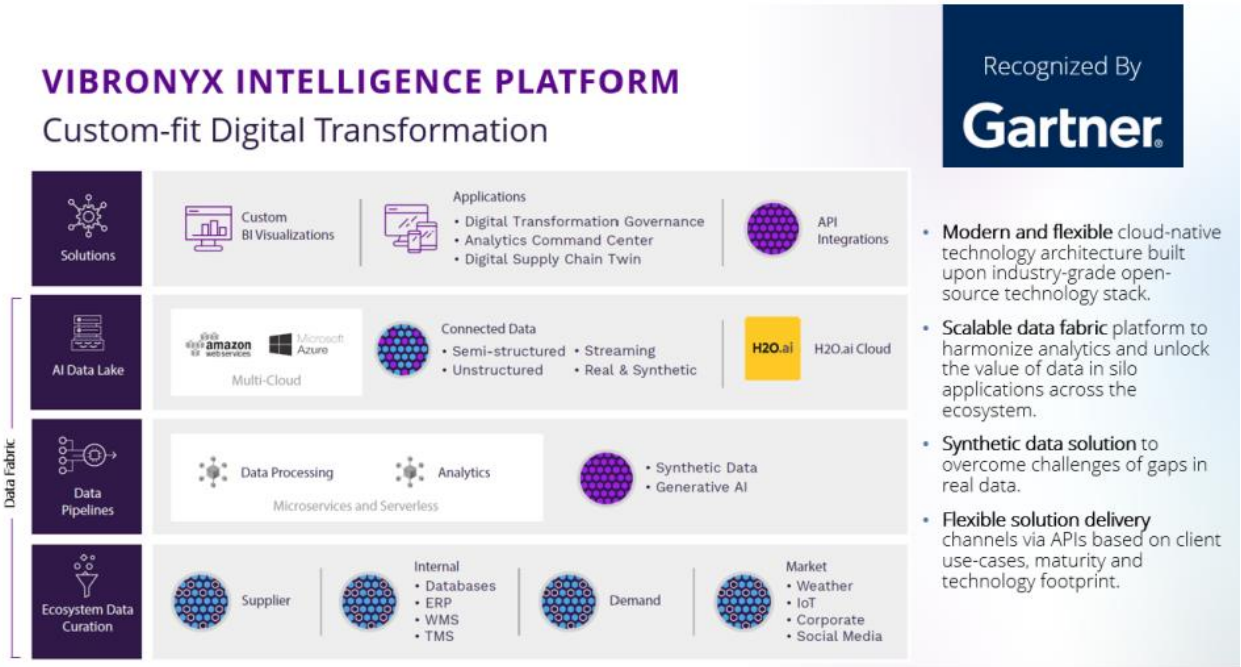


Figure 35: Vibronyx Platform and h2o.ai

Replacement of Workstream In Task Order 2

Due to the reasons of higher priority, availability of data and the availability of a best-in-class platform, demand prediction analytics for new contracts was replaced by prediction analytics for Frustrated Containers/Port Dwell.

In particular, the following task was included in the prediction workstream: Prediction of Port Dwell number of days for DLA Subsistence shipments.

Predicting Frustrated Container/Port Dwell Number of Days

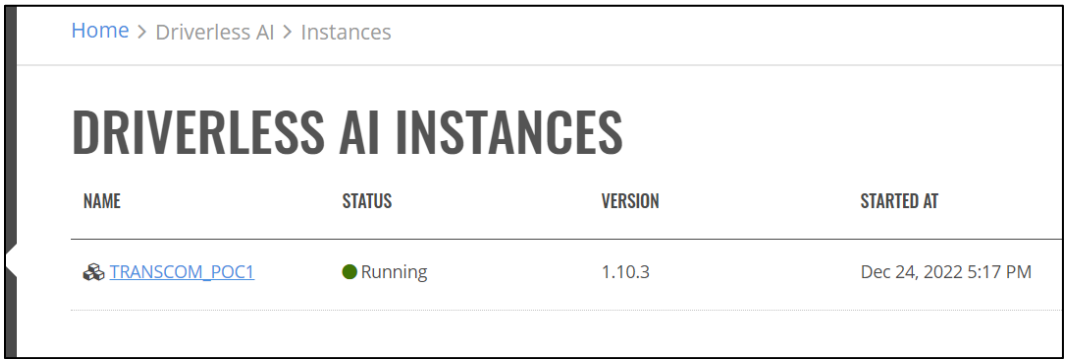
As detailed in the section on In Transit Visibility, a number of descriptive analytics have been generated to inform insights on the state of Frustrated Containers/Port Dwell. Key findings for Frustrated Containers are summarized below:

- Antwerp, Belgium experiences the largest amount of container traffic as well as the highest Port Dwell time of 54 days.
- Although not as severe as Antwerp, the ports of Rotterdam, Netherlands and Bremerhaven, Germany have significant 40-day or more Port Dwell times
- Other than the above European ports, Lome (Togo, Africa) also experiences 40-day or more Port Dwell times.

Driverless AI

H2o.ai's platform is designed to scale vertically and horizontally by the implementation of a Microservices architecture. The Driverless AI component allows for the scalable execution of a low-code citizen data scientist experimentation and model-design platform. Figure 36 shows a proof-of-concept container used for the USTRANSCOM.

Figure 36: h2o.ai Low-Code Driverless AI Container Instance

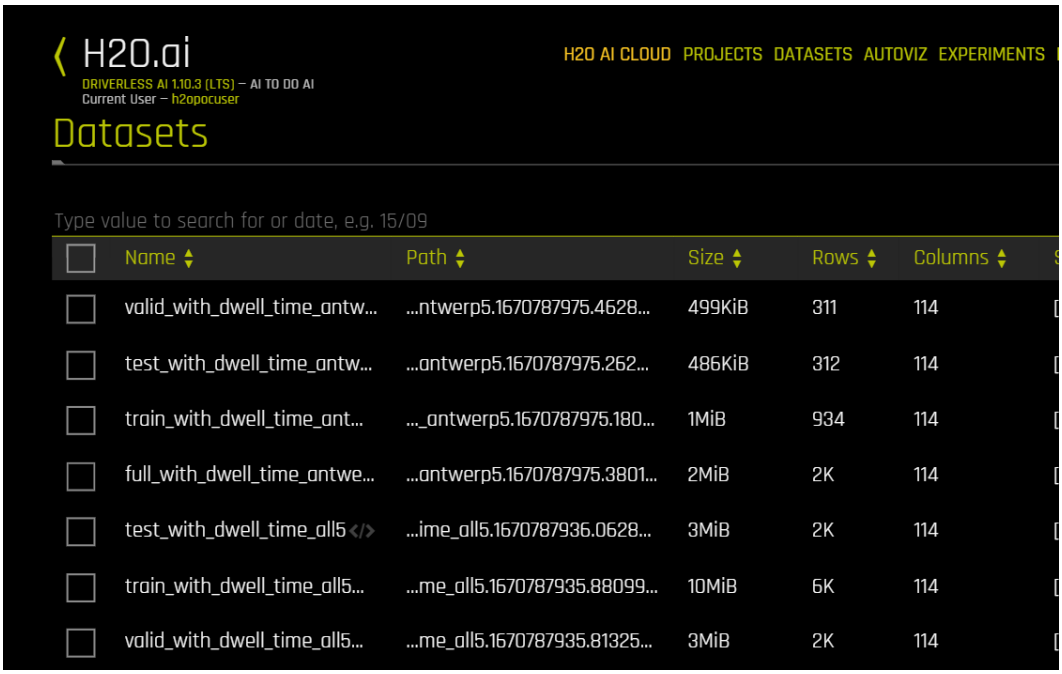


Data Volume for H2o.ai

Figure 37 shows the data sets used for experimentation. Various options were explored to predict Port Dwell times:

- Predict port dwell across all ports, to the extent that dwell time can be calculated at ports
- Predict port dwell for Antwerp only

Figure 37: Vibronyx Platform and h2o.ai USTRANSCOM



The first three rows shows that with the data isolated to Antwerp only, the system automatically segments the data into Training (60%), Test(60%) and Validation (20%) sets.

Although it may appear that nearly 600,000 records across all the supply classes are recorded, the number of actionable records for the purpose of Subsistence Port Dwell is much smaller as summarized below:

	Number of Rows	Percent of entire ISDDC data
All supply classes	~ 600,000	100%
Subsistence supply class	~100,000	17%
Subsistence records that could be used for Port Dwell days	~11,000	1.8%
Subsistence records that could be used for Port Dwell days: Antwerp only	~2000	0.3%

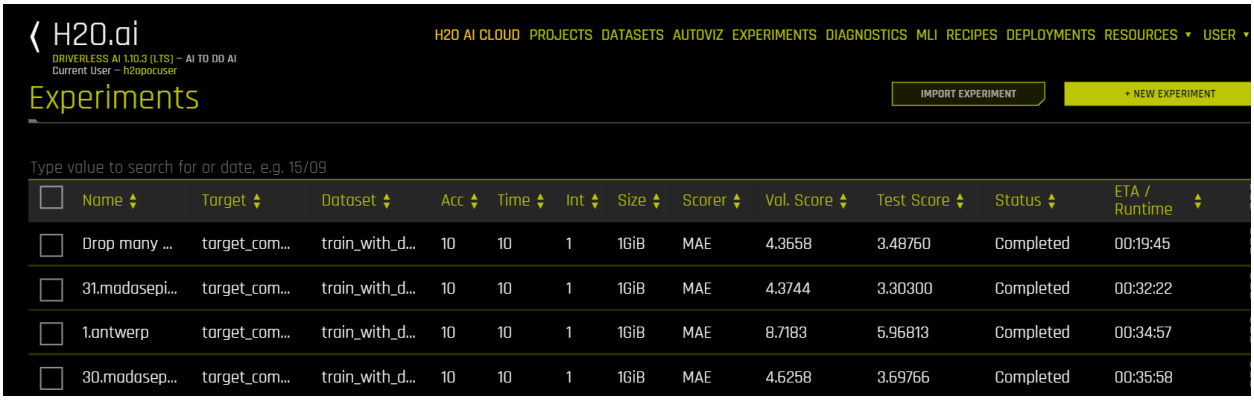
As machine learning models work best on large data volumes, focusing on the port dwell problem greatly reduces the efficacy of the model (overfitting and underfitting). There are two ways to compensate for the volume of the data:

- Wait until enough real data are created and transferred. This may not be feasible for a realistic time frame. Even doubling the volume of the original data set by waiting another six months will not realize a sufficiently voluminous data set for Port Dwell.
- Use Synthetic data approaches to volumize the data set. This can be done inexpensively and within a reasonable time frame. Although not the same as real data, it can complement real data to an acceptable degree of risk and precision. This approach is recommended for further exploration in the Business Case Analysis and forthcoming phases.

Rapid Experimentation With Dropping Columns

Several columns (such as PCFN) are flagged with high correlation to the Port Dwell times. These findings by the machine learning algorithm must be superseded by human subject matter understanding. The h2o.ai platform accounts for this by allowing the data scientist to drop irrelevant columns. Figure 38 shows this rapid experimentation methodology.

Figure 38: Vibronyx Platform and h2o.ai US TRANSCOM Rapid Experimentation



For each experiment, the model can be generated. The Val. Score (Validation Score) and Test Score columns show how the model performed on Validation and Test data respectively. The numbers are expressed in terms of the Mean Absolute Error (MAE) which determines how "close" the prediction was to the new data that the model has not seen.

Figure 39 shows an experiment being run with the PCFN column dropped. Note that the column does not need to be dropped in the original data set, a new experiment can be set up to ignore one or more columns. Using Driverless AI, h2o.ai will determine the variable importance and allow the data scientist to configure and control a number of different settings that affect the time to run vs. accuracy of the model training.

Figure 39: Vibronyx Platform and h2o.ai USTRANSCOM Experiment Drop PCFN

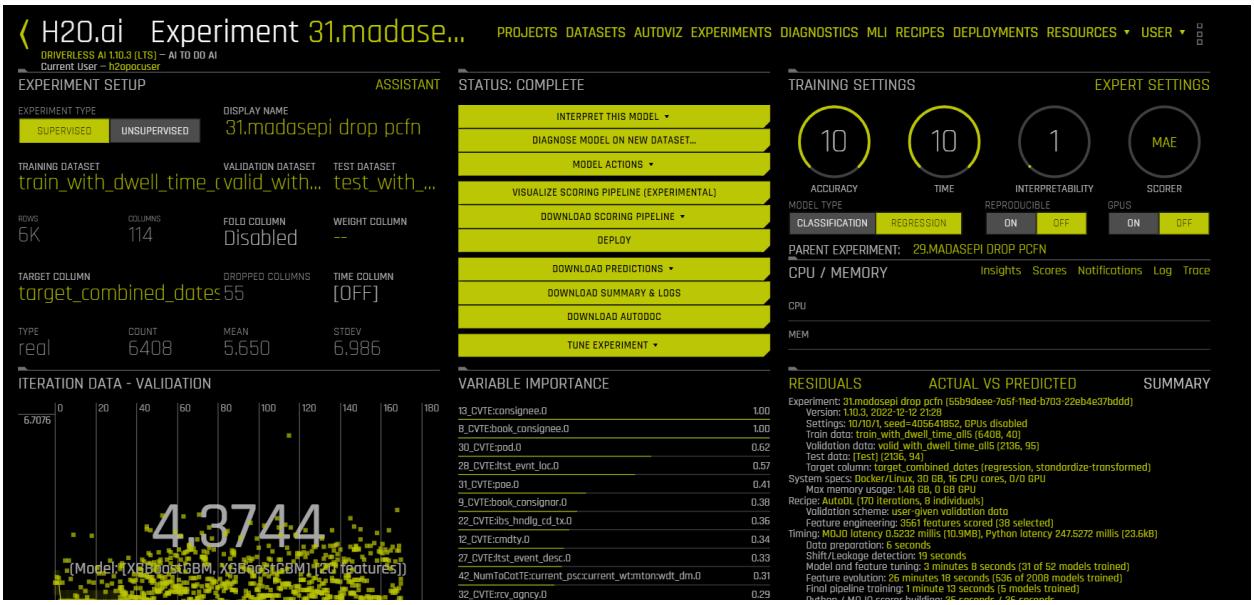
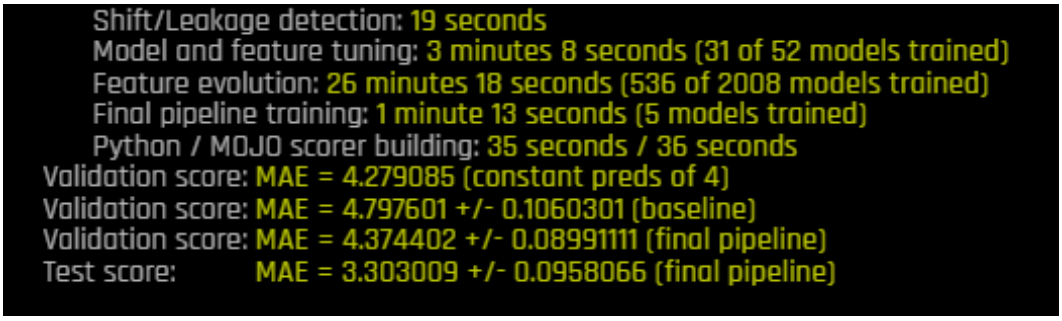


Figure 40 shows the results of the experiment. The Validation score is 4.73 whereas the Test Score is 3.3. Takeaways:

- Interpretation: With the Test data that the model has not previously seen during the training run, the model is able to predict Port Dwell to an accuracy of 3.3 days.
- A Test Score better than the Validation Score is beneficial as the Test Score reflects predictions on new data that have not been seen by the trained model.

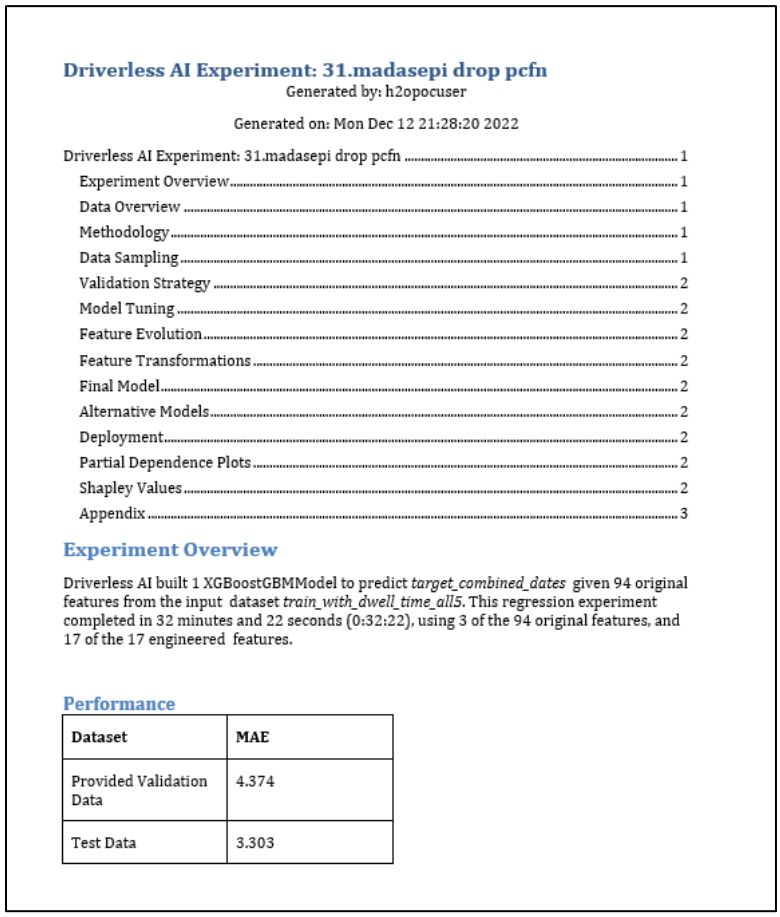
Figure 40: Vibronyx Platform and h2o.ai Drop PCFN Val and Test Scores



The H2o.ai platform is also able to automatically generate documentation to inform the data scientist. The documentation provides considerable detail and information to tune the model or otherwise re-

engineer the settings. Figure 41 shows a screenshot of the documentation that is automatically created by the h2o.ai system at the completion of the experiment.

Figure 41: Vibronyx Platform and h2o.ai Drop PCFN Automatic Documentation



Driverless AI Experiment: 31.madasepi drop pcfn

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Experiment Overview

Driverless AI built 1 XGBoostGBMModel to predict *target_combined_dates* given 94 original features from the input dataset *train_with_dwell_time_all5*. This regression experiment completed in 32 minutes and 22 seconds (0:32:22), using 3 of the 94 original features, and 17 of the 17 engineered features.

Performance

Dataset	MAE
Provided Validation Data	4.374
Test Data	3.303

More experimentations conducted by using and dropping the original set of columns from the ISDDC data are needed to fully develop the ideal model.

Antwerp vs. General Port Dwell Days

While most Port Dwell days predictions are generalized across all ports, experiments also focused on predicting port dwell solely at Antwerp without consideration of other ports.
However, the model with specificity on Antwerp is less accurate than all the ports:

Port Dwell Days Prediction	Test Score (Mean Abs Error in Days)
All Ports	3.3
Antwerp Only	5.96

This is likely because of the sparsity of the data. As mentioned earlier, port dwell times focused only on Antwerp account for just 0.3% of data and may not be enough to appropriately train a model. Further investigation and experimentation must be done in forthcoming phases.

KEY TAKEAWAYS

- Pricing volatility prediction is not feasible until Prime Vendor pricing data is available
- Frustrated Container Port Dwell time prediction was used in place of demand prediction for new contracts due to the urgent focus on Frustrated Containers in Europe because of the Ukraine conflict this year.
- Some Port Dwell time prediction experiments were run using the scalable Microservices platform of h2o.ai that is aligned and integrated into the Vibronyx platform.
- Port Dwell times form a very small part (1.7%) of the overall ISDDC data feed. Data that focuses on specific problem ports like Antwerp form an even smaller part (0.3%) of the overall ISDDC data.
- Machine Learning regression models cannot run effectively on small sparse data sets. Synthetic volumization is an approach that may reduce or eliminate this issue.

VISUALIZATION DASHBOARDS AND REPORTING

GOAL:	Dashboards and reports that provide visual insight into key food supply chain metrics and actionable key performance indicators (KPIs) for DLA Subsistence stakeholders.
PILOT RESULTS:	**Successful Proof-of-Concept** • Successful implementation of dashboards using DLA approved Qlik technology into R&D DAGE (FOC). • Additional Dashboard reports for order automation added and demonstrated. • Custom CAC card authentication not recommended.
OPERATIONAL FEASIBILITY:	• ServiceNow may offer a viable alternative to Qlik. • DISA and DLA Cyber engagement necessary for DoD enterprise CAC card authentication.

In Phase I and II of the JFMS project, Vibronyx worked with DLA and Military Service stakeholders to envision a series of business intelligence dashboards to support Subsistence business processes. In Phase III, we demonstrated the validity of the future state exercise by developing a clickable visualization prototype displaying advanced descriptive and predictive analytics using real DLA Subsistence data. To build upon these results, the Phase IV JFMS pilot was scoped to include the development of dashboards and drill down reports using Qlik, with reporting and predicted data generated through the back-end integration workstreams developed in the other tasks of the Pilot.

Qlik Dashboard – R&D DAGE
DLA has chosen Qlik as the enterprise-wide choice for visualization software. The Vibronyx Platform used in JFMS project and Pilot is flexible and aligned with this choice.

Content and Capabilities
Ideation around the JFMS Project dashboards originate from the list of business requirements approved for execution within the Pilot. By iterating with Subsistence stakeholders using agile design thinking methods, Vibronyx developed high fidelity mockups that were approved by Subsistence stakeholders for implementation in Qlik.

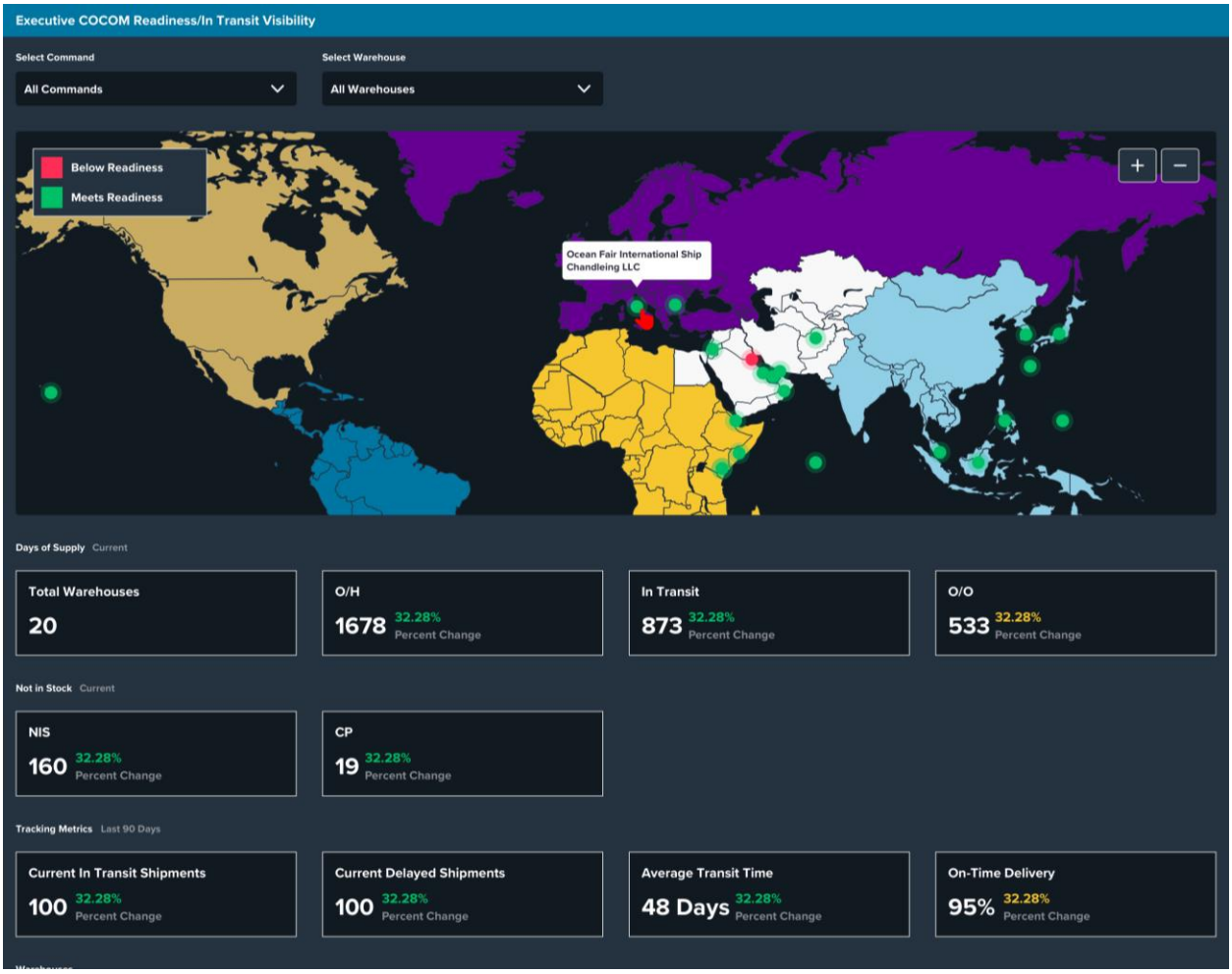
For the JFMS Pilot, Qlik dashboard comprised the following capabilities:

- Four visualization "sheets" consisting of a COCOM Readiness Dashboard and In-Transit Visibility Dashboard, Supplier Operations Dashboard, Customer Order Automation Dashboard, and Executive Dashboard.
- In the Pilot, the dashboards would not provide drill-down ability into item-level detail and metrics and KPIs would be visualized at an aggregate level.
- The dashboards would source data from the back-end data lake, approved as the Oracle enterprise edition database

HIGH FIDELITY DESIGN MOCKUPS

Vibronyx began the Pilot dashboard development process by creating clickable high-fidelity mockup designs to refine and validate requirements with Subsistence stakeholders prior to development and implementation in Qlik. These mockups were created following agile principles and best practices for user experience and data visualization, using InVision design software to allow for rapid, iterative revisions following stakeholder feedback. The designs included relevant KPIs, metrics, and visualizations ideated in previous phases of the project and demonstrated several states of the JFMS application including dropdown and filter functionality.

Figure 42: COCOM Readiness / In-Transit Visibility Dashboard

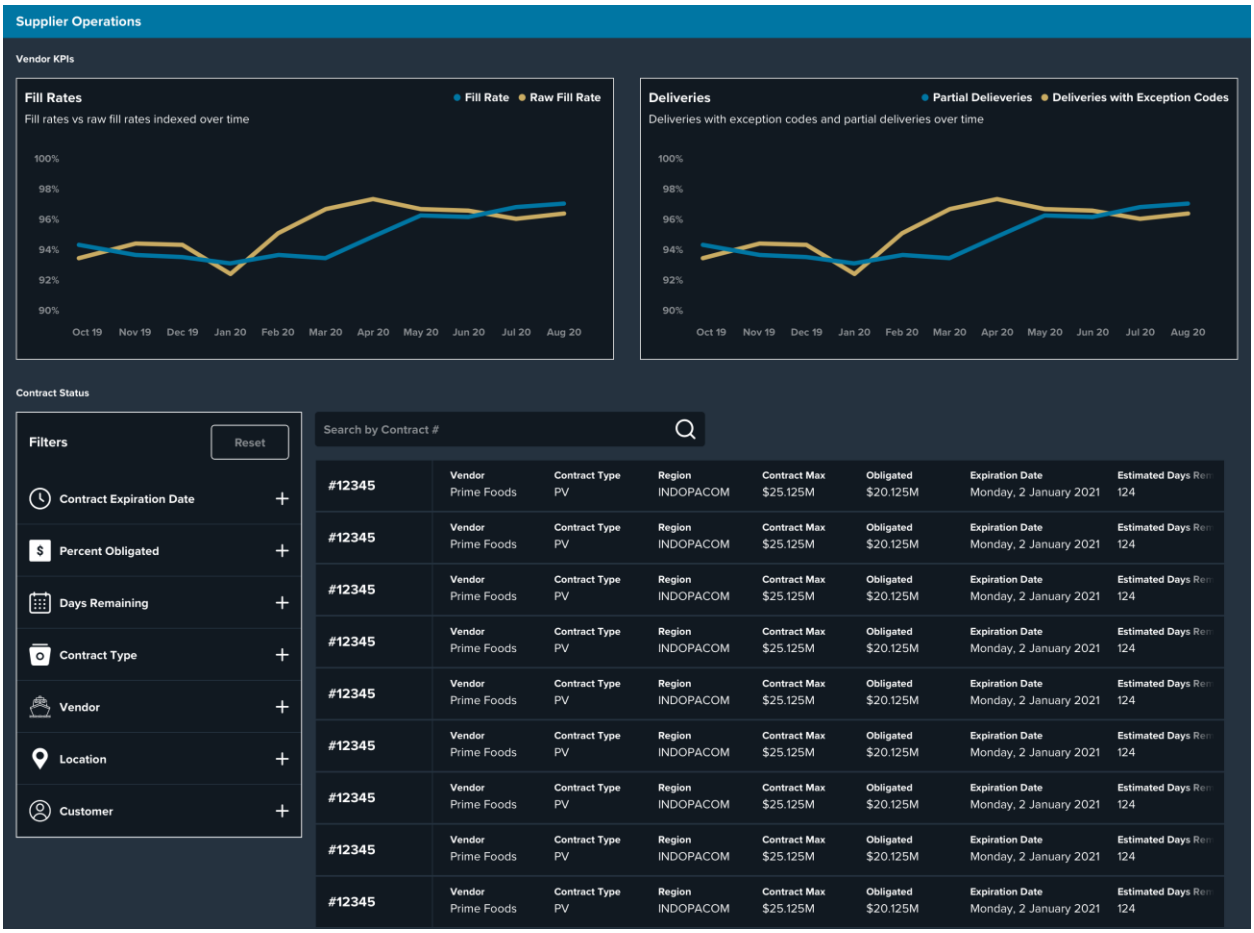


COCOM Readiness and In-Transit Visibility Dashboard

This dashboard (Figure 42) was designed to provide a global view of the Subsistence supply chain and Prime Vendor program for DLA and COCOM leadership stakeholders. It integrates internal data from DLA sources with external data from sources that include Prime Vendors, USTRANSCOM, and DLA Distribution and addresses two key pain points that have been validated as high priority requirements of the future JFMS:

- Providing more real-time visibility of the readiness metrics derived from weekly Prime Vendor fitness reports. Currently, the aggregation of these reports is a manual process, which frequently results in out-of-date information being briefed to readiness stakeholders and stakeholders who are making decisions related to specific COCOMs.
- Providing USTRANSCOM shipment process visibility for OCONUS Prime Vendor warehouse replenishments, tracking shipments through the shipping process, surfacing information about the most recent event milestones, and flagging shipments that are delayed.

Figure 43: Supplier Operations Dashboard



Supplier Operations Dashboard

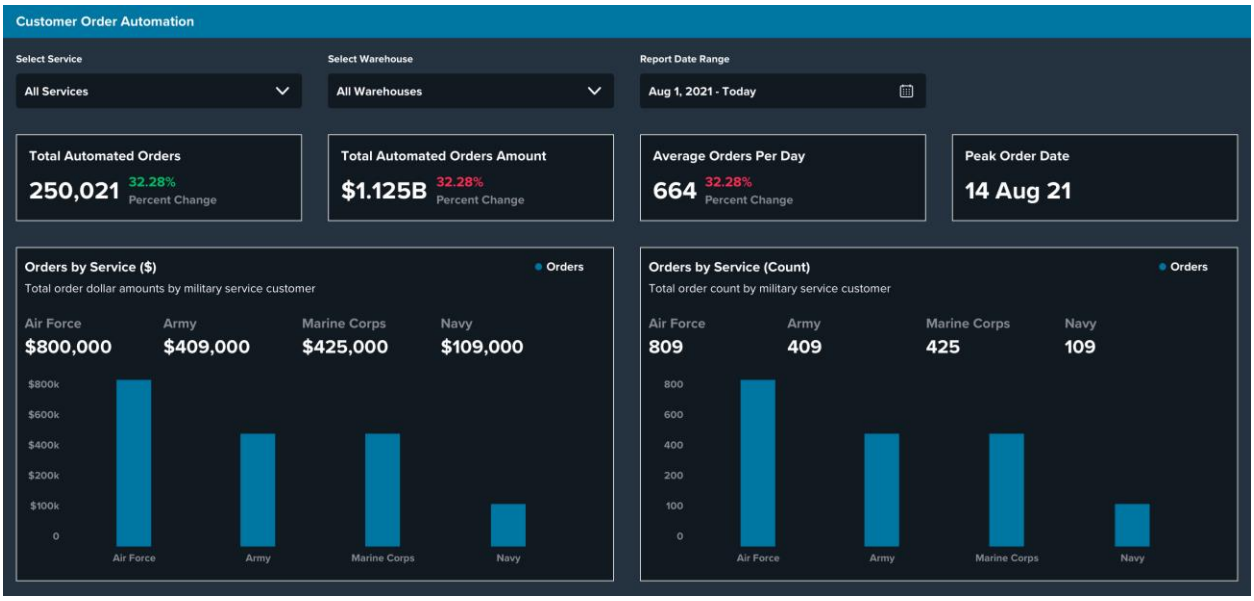
This dashboard (Figure 43) was designed to support the Subsistence Supplier Operations team, utilizing vendor-provided fill rate reports to track vendor performance metrics against contractual requirements, and using DLA data from customer receipts to show how the customer's experience of vendor performance compares to the vendor-reported version of the metric.

The Supplier Operations Dashboard also supports contract management by tracking obligation against long term Subsistence contracts and estimating the number of days remaining on a contract, based on the contract maximum and a calculated average daily obligation. This enables the Supplier Operations team to see how quickly contracts are approaching expiration, so they understand when they need to begin working on a new or bridge contract.

Customer Order Automation Dashboard

The Customer Order Automation dashboard (Figure 44) was designed to track the automation of orders between Military Service food management systems and DLA and can also provide confirmation to Military Service users that their orders have been successfully processed.

Figure 44: Customer Order Automation Dashboard

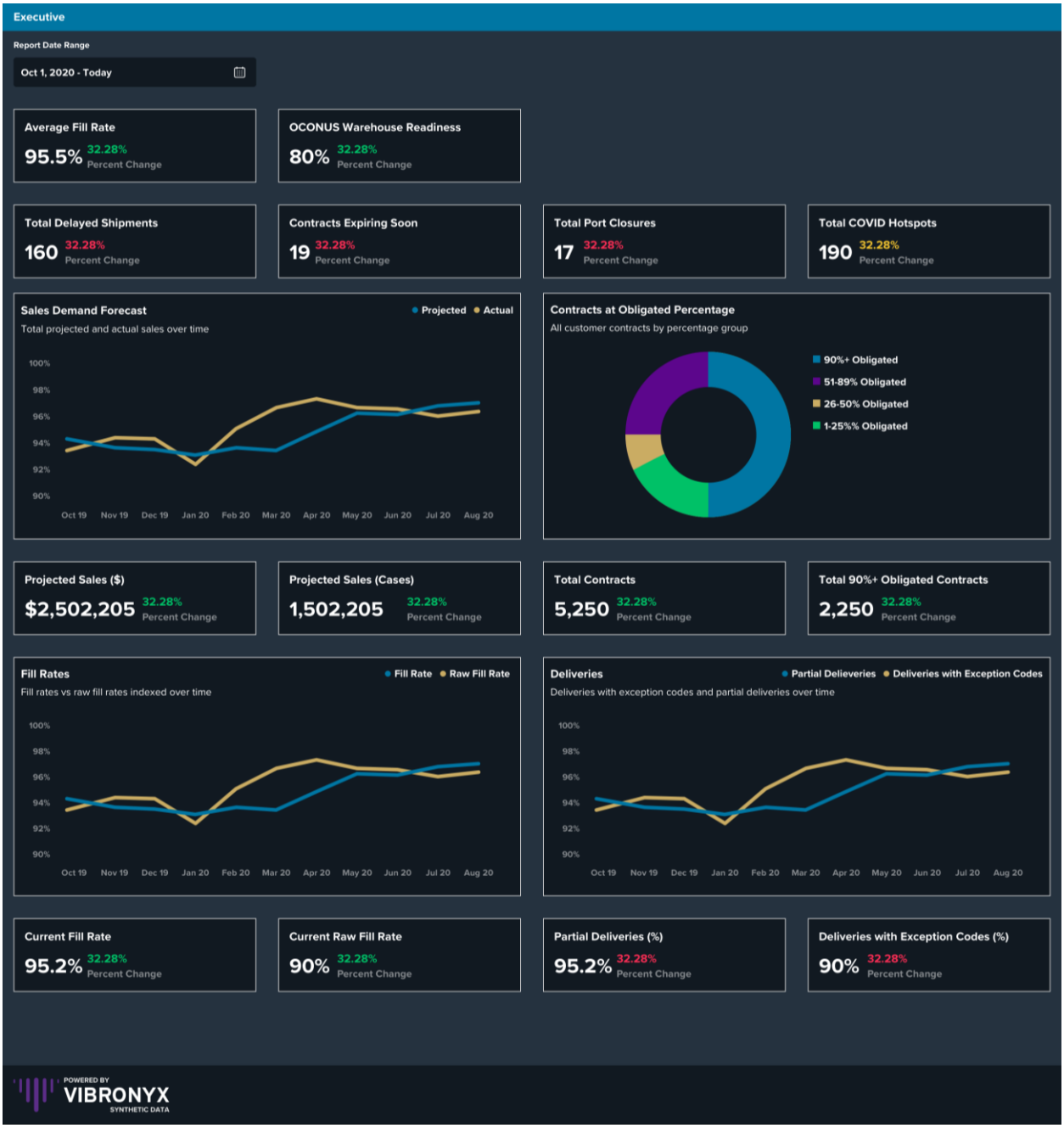


Executive Dashboard

The Executive Dashboard (Figure 45) was designed to provide the enterprise view of the supply chain for Subsistence leadership, surfacing key pieces of information from the other dashboards including readiness and shipment tracking indicators, sales KPIs, contracting KPIs, and supply chain performance KPIs.

Full dashboard design mockups are shown in Appendices C-F.

Figure 45: Executive Dashboard



QLIK DEVELOPMENT

Qlik Architecture

Qlik (Qlik Sense Enterprise) is a visualization software with components that can be deployed in a clustered environment as shown in Figure 46 and Figure 47. The clustered environment is not compatible with the standard Kubernetes Microservices architecture. For the management of the services, Qlik uses a locally installed PostGreSQL database by default.

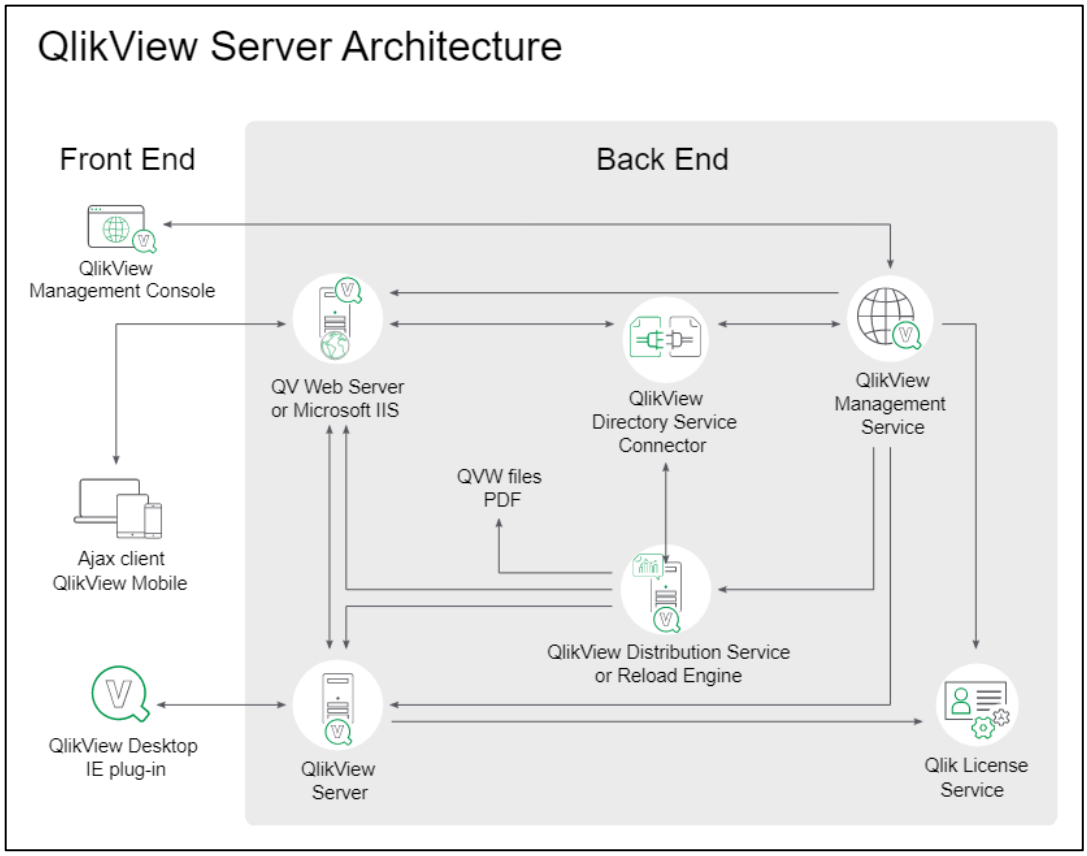


Figure 46: Qlik Architecture

Qlik is a Microsoft Windows-based platform and cannot be installed into Unix-like environments that are most used for Microservices. This is shown in Figure 48.

For the Pilot, a single-node cluster was installed on a Windows Server virtual machine, one each in the AWS GovCloud environment and the R&D DAGE environment. By default, user credentials and logins to the single node Windows clusters are tied to Windows accounts that need to be created prior to the installation.

Qlik also requires a Windows Service Account that is used to run Qlik software services in the background even when the human user has logged out of the server.

Figure 47: Qlik Clustering

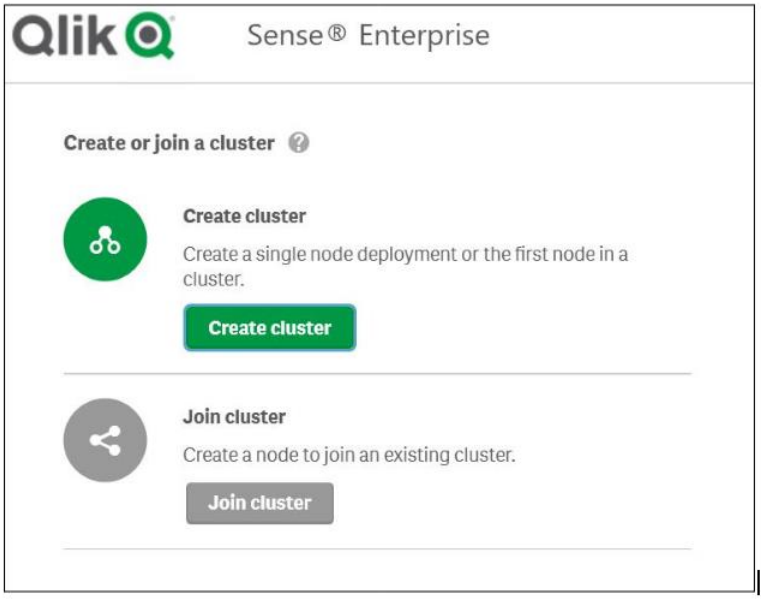


Figure 48: Qlik Microsoft Platform

System requirements

Component	Requirements
Platforms *	• Microsoft Windows Server 2012 • Microsoft Windows Server 2012 R2 • Microsoft Windows Server 2016 • Microsoft Windows Server 2019 • Microsoft Windows Server 2022 For development and testing purposes only: • Microsoft Windows 8.1 • Microsoft Windows 10 • Microsoft Windows 11

Qlik Dashboard Files

Qlik dashboards and visualizations (called "sheets" that can be grouped under "apps") can be exported and restored as QVF files. These apps can be exported to include the data underlying the app or exported without the data and configured to connect to any ODBC-compliant database.

QVF files were exported from the Qlik instance in the AWS GovCloud environment (see section on Hybrid Development) and imported into the Qlik instance in the R&D DAGE environment by transfer of these files using secure DoD SAFE file transfer.

R&D DAGE Windows Server Provisioning

In order to provision the virtual machine within R&D DAGE and configure it in a manner that it can satisfactorily run the Qlik software in a single node cluster environment, the following workstreams need to be accomplished:

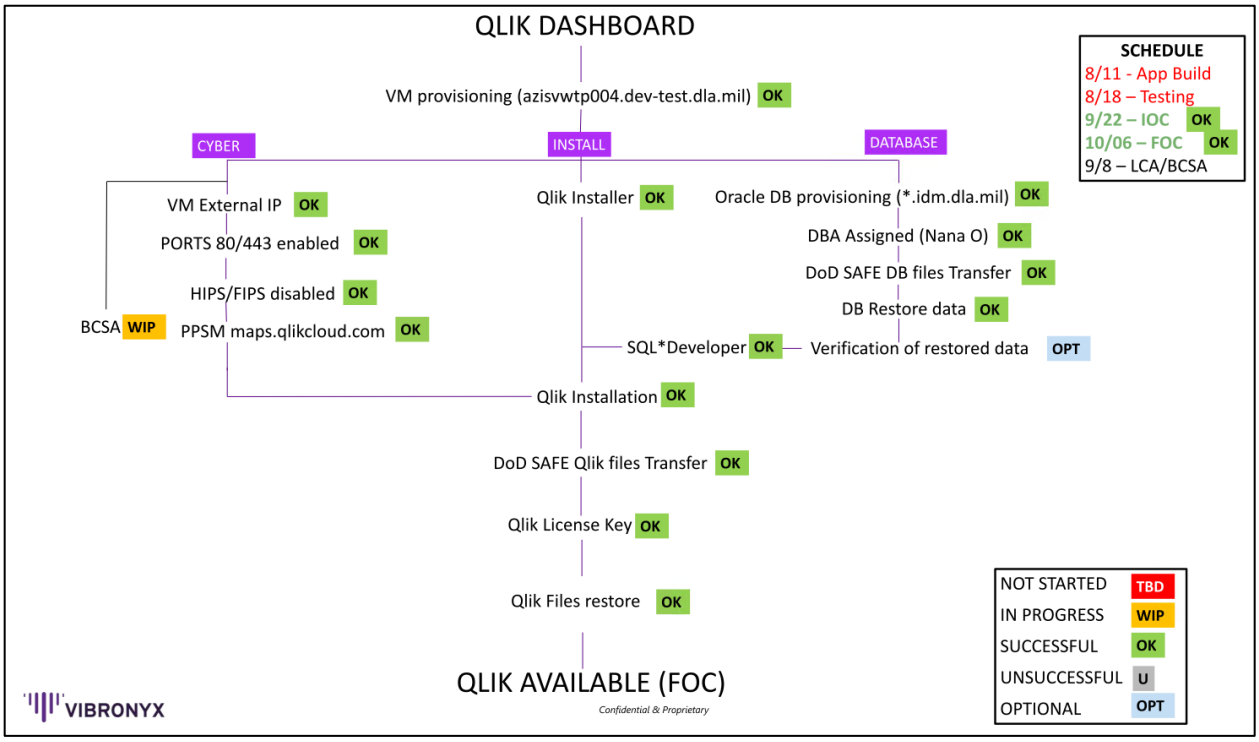
- Creation of the Windows Server instance and provisioning of M-accounts to be able to have the Qlik team within DLA R&D DAGE and Vibronyx to login to the server.
- Provisioning of the Windows Service Account that is needed to run Qlik services in the single-node cluster in the background.
- Approval and installation of software on the virtual machine through the DLA Software Center
- Alignment with the DLA cyber team to create relevant documentation, obtain approvals and implement firewall exceptions.
- Provisioning and configuration of the Oracle enterprise database with data restored from the AWS GovCloud Oracle enterprise database.

Vibronyx Project Coordination

At the request of DLA R&D DAGE Team (ARTET) and project management, Vibronyx coordinated the sub-teams working on the installation. Weekly technical check-ins were arranged, and issues addressed in the workstreams.

Figure 49 shows a visual designed by Vibronyx of the three main workstreams of Cyber, Installation and Database with a workflow that indicates the dependency of the workstreams and activities within the workstream. Each week, progress across these activities were assessed. Where needed, activities were edited or deleted. Color coded status markers were used to quickly assess the status of the activity. Major milestone timelines were also shown in the Schedule for easy assessment of progress.

Figure 49: Qlik R&D DAGE Workstreams



IOC and FOC

Initial Operational Capability (IOC) was declared on Sep 9, 2022 and upon further testing Full Operational Capability FOC) was declared on October 10, 2022 for the Qlik dashboard implementation in R&D DAGE.

KEY TAKEAWAYS

- Vibronyx accelerated the Qlik dashboard implementation screens for DLA Subsistence using agile development methodology, design thinking, high fidelity mockups, and hybrid architecture in AWS GovCloud and R&D DAGE
- Stringent processes requiring the coordination of several sub-teams are necessary in R&D DAGE even in a Development/Test environment. Most of the activities and documentation is for cyber assurance and compliance.
- Vibronyx used a unique way to coordinate activities and workstreams for the Qlik dashboard implementation within R&D DAGE to guide the project to FOC and a successful conclusion.

FIAR COMPLIANCE

GOAL:	Develop FIAR reporting requirements and build API to support JFMS FIAR compliance.
PILOT RESULTS:	**Successful Proof-of-Concept** • Documented data model and API requirements to support FIAR compliant reporting from JFMS system.

In previous phases of the project, Subsistence leadership validated two high-priority, near term requirements of the JFMS related to compliance with the Financial Improvement and Audit Readiness (FIAR) methodology:

- System maintains audit-ready record of evidential matter to maintain FIAR compliance
- System supports control activities to maintain FIAR compliance (including providing STORES user account information)

To enable the future JFMS platform to collect all the data required to support the needs of FIAR compliance, the Phase IV Pilot was scoped to include a discovery process to better understand and refine these requirements. Vibronyx conducted interviews with subject matter experts familiar with FIAR compliance and DLA financial auditing processes, also taking into consideration internal control needs and information technology system requirements for the JFMS. Discussion participants included the DLA Troop Support Branch Chief for Audit Readiness and Process Compliance as well as stakeholders from Subsistence Customer Operations and J8 Troop Support Finance.

The current state financial auditing process for DLA includes an external audit conducted by Ernst & Young. Auditors select a randomized set of line items for audit on an annual basis, and then supporting evidential matter is pulled from various sources to verify that proper financial records have been maintained for these transactions. Data is pulled from existing systems of record, which includes EBS and STORES, as well as the Department of Defense Activity Address Directory (DoDAAD) for detail on DoDAAC level.

To maintain FIAR compliance, internal controls are required for any interaction between two systems to validate data is passed in an accurate and secure manner. Controls are documented using Process Cycle Memoranda, which detail where systems interact, what entities own the systems, and where data is passed. All controls are tested annually by the Audit Readiness and Process Compliance office and testing results are signed off on by the various subject matter experts that participate in the testing process. Currently the testing process is tracked manually using documents and spreadsheets and does not employ a digital tracking system.

KEY TAKEAWAYS

The team identified the following key challenges related to FIAR compliance that have relevance to the JFMS:

- Data quality, including discrepancies in data between different systems including the DLA ordering system, EBS, and Military Service food management systems
- Challenges with visibility of data for comparison and discrepancy identification

The team also identified the following system capabilities that the JFMS could provide to better support financial auditing and FIAR compliance:

- Tracking and improving the visibility of internal control testing results
- Validations to ensure that data is entered correctly, and that data is passed accurately from system to system
- Improved visibility of information (including DoDAAC, fund code, Standard Line of Accounting/SLOA) in the DLA ordering system, EBS, and Military Service Food Management System so information can be compared and discrepancies can be identified
- Searchability to support audit research to the line item level, including: DLA ordering system PO number, individual line document number, and by date range

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ADDITIONAL DEVELOPMENT AND RECOMMENDATIONS

HYBRID DEVELOPMENT LIFECYCLE

STRATEGIC ALIGNMENT

DLA is transitioning from legacy data-center-based purpose-built IT infrastructure to a "Cloud First" environment through the use of the General Purpose enterprise-wide cloud solution that can be secured from the commercial internet called the Joint Enterprise Defense Infrastructure (JEDI) and Commercial Best Practices in alignment with the Deputy Secretary of Defense Memorandum DoD Cloud Strategy and the DoD Digital Modernization Strategy Objectives 1.2 and 1.4. DLA has published documents DLA Cloud Hosting Strategy that clearly outlines the intent to use Containerization, Microservices and DevSecOps as well developed a five-year implementation plan DLA Architecture Strategy the to transform key systems to align with the DoD Cloud Strategy.

DEVELOPMENT/TEST AND STAGING/PRODUCTION

The DLA Cloud Hosting Strategy clearly defines six Impact Levels based on DISA Department of Defense Cloud Computing SRG specification. The JFMS project is concerned with the custody and transmission of data labeled Controlled Unclassified Information (CUI) or lower in protection level. The DLA Cloud Hosting Strategy document provides the following guidance:

Impact Level	Data Protection	Environment	Development Tools
IL 4	CUI	Development/Test	Permitted
IL 5	CUI	Stage/Production	Not permitted

TRANSITION CHALLENGES

DLA R&D DAGE environment used for the Vibronyx JFMS Pilot is intended for the purpose of Development/Test and thus at Impact Level IL4. In the Phases III and IV, Vibronyx has employed different types of development tools.

In Phase III, Vibronyx used industry-accepted Python-ecosystem tools for predictive analysis. These tools incorporate a vast array of open-source libraries that are carefully curated and published into the open-source domain. The DLA Cloud Hosting Strategy acknowledges that within development and testing environments "the use of compilers and other documented development tools is permissible" and that where "development systems need access to tools or information outside of the environment need to transit through a T&D DMZ".

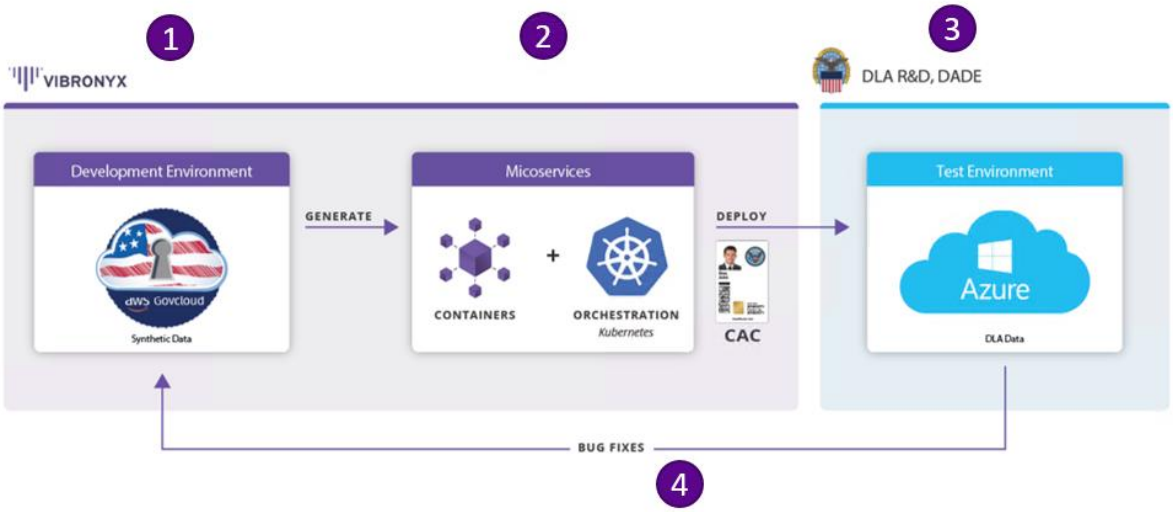
While most of the infrastructure of DLA R&D has transitioned to a cloud environment, IT processes to provision those cloud resources have not and development environments are treated with an impact designation of IL5 or higher. Vibronyx would have experienced significant delays where library re-curation could have taken months or detailed accounting for storage allocation at the operating system is not cost-effective to obtain given cloud storage costs.

HYBRID DEVELOPMENT ENVIRONMENT

The potential months-long delay is not aligned with DoD or DLA modernization strategies nor does it allow for an agile approach to software value demonstration with DLA stakeholders and leadership.

Vibronyx developed, proposed, and obtained agreement from DLA for a hybrid development solution that leveraged both the DLA-approved Vibronyx AWS GovCloud environment and the R&D DAGE environment as shown in Figure 50.

Figure 50: Hybrid Development Environment



1. Pilot development work in Vibronyx AWS GovCloud. Development Microservices artifacts are generated.
2. Pilot development Microservices artifacts are moved to the R&D DAGE Environment for testing.
3. Microservices artifacts are deployed into the R&D DAGE environment leveraging the DevSecOps approach outlined in the DLA Cloud Hosting Strategy.
4. Feedback loop used to fix issues identified in the software in the R&D DAGE environment.

This innovative and first-of-kind development solution has the following advantages:

- Allows development to be done in parallel to transition of DLA business IT processes.
- Utilizes a "cloud-first" approach in alignment with the long-term DoD/DLA Modernization strategy.
- Permits the use of CUI across a hybrid environment.
- Lays the foundation for the seamless integration with DLA DevSecOps, cluster and Continuous Integration/Continuous Deployment (CI/CD) as these capabilities are rolled out across the enterprise.
- Future-proofs the current solution so that does not need to be significantly re-architected for next generation Kubernetes deployments.

- Agile approach allows for quick feedback and demonstration of value to the DLA stakeholders and leadership.

R&D PROJECT EFFICICENCY IMPROVEMENT RECOMMENDATIONS

R&D Sandbox
The DLA Cloud Hosting Strategy outlines the Development/Test enclave. This enclave is needed by DLA to safely conduct R&D and utilize mature Commercial Off-The-Shelf (COTS) software used in common practice in the non-DoD environment. Rapid and agile experimentation is especially important for the DLA for the use of advanced analytics, including AI and Machine Learning.

However, processes and practices within the DLA for conducting proofs-of-concept in R&D are based on operational environments and Authority To Operate (ATO) considerations. Therefore, the timeframe for the development of proofs-of-concept is long. This does not allow the DLA to learn quickly, rapidly examine new paradigms or "fail fast."

Vibronyx recommends that DLA explores the implementation of a Development and Test enclave outlined in the DLA Cloud Hosting Strategy by using a Sandbox methodology. A software Sandbox is an environment that is hosted within the NIPR environment, has access to the general commercial Internet, can be used to quickly allocate and tear down software experimentation workstreams, yet is segmented and isolated away from DLA operational systems. Such a sandbox can also be monitored for malware and nefarious activity on a continuous basis.

Dashboarding Technology
DLA has standardized on Qlik as the enterprise dashboarding visualization tool of choice. The JFMS dashboards in the Pilot phase were developed using Qlik and aligned with the ultimate intent of integration within the Qlik Enterprise Dashboard.

ServiceNow is another enterprise-wide software standardized at the DLA that is utilized primarily for workflow and ticketing-based applications. However, some major sub-commands within the DLA are also using ServiceNow for the visualization capability it offers.

Vibronyx recommends that DLA assess Qlik vs. ServiceNow for visualization in future applications and determine the use cases that would be most appropriate for each visualization capability and the implications for people, process, and technology.

Predictive Analytics and Enterprise Data Availability
AI and Machine Learning models are best trained using as much real data as possible. However as demonstrated in the JFMS Pilot, real data is either sparsely available or not provided due to a number of concerns including sensitivity of the data, competitiveness considerations, and volume. This is in contrast to the DLA Data and Analytics Strategy Concept of Operations (CONOPS) that identifies data as an enterprise asset. The CONOPS specifically calls out two Lines of Effort so that data may be protected, processed and shared in a manner aligned with DLA governance standards and policies.

Vibronyx recommends that DLA assess the people, process and technology that will enable the

governance and more effective sharing of data between the DLA and vendors conducting R&D projects. This will prepare the DLA for smoother transitions and protected utilization of data as new capabilities developed in R&D projects are operationalized.

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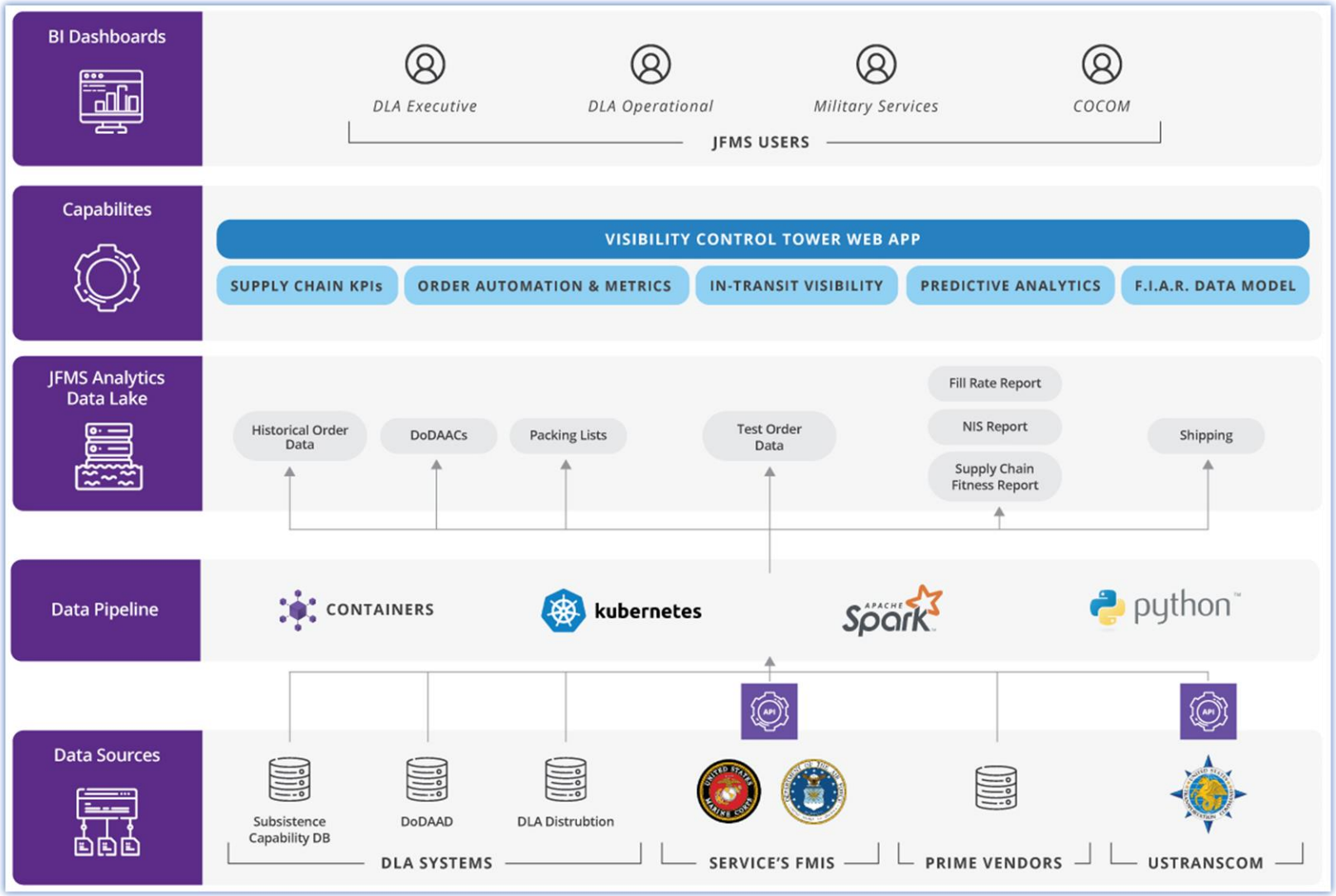
APPENDICES

APPENDIX A: Vibronyx Platform



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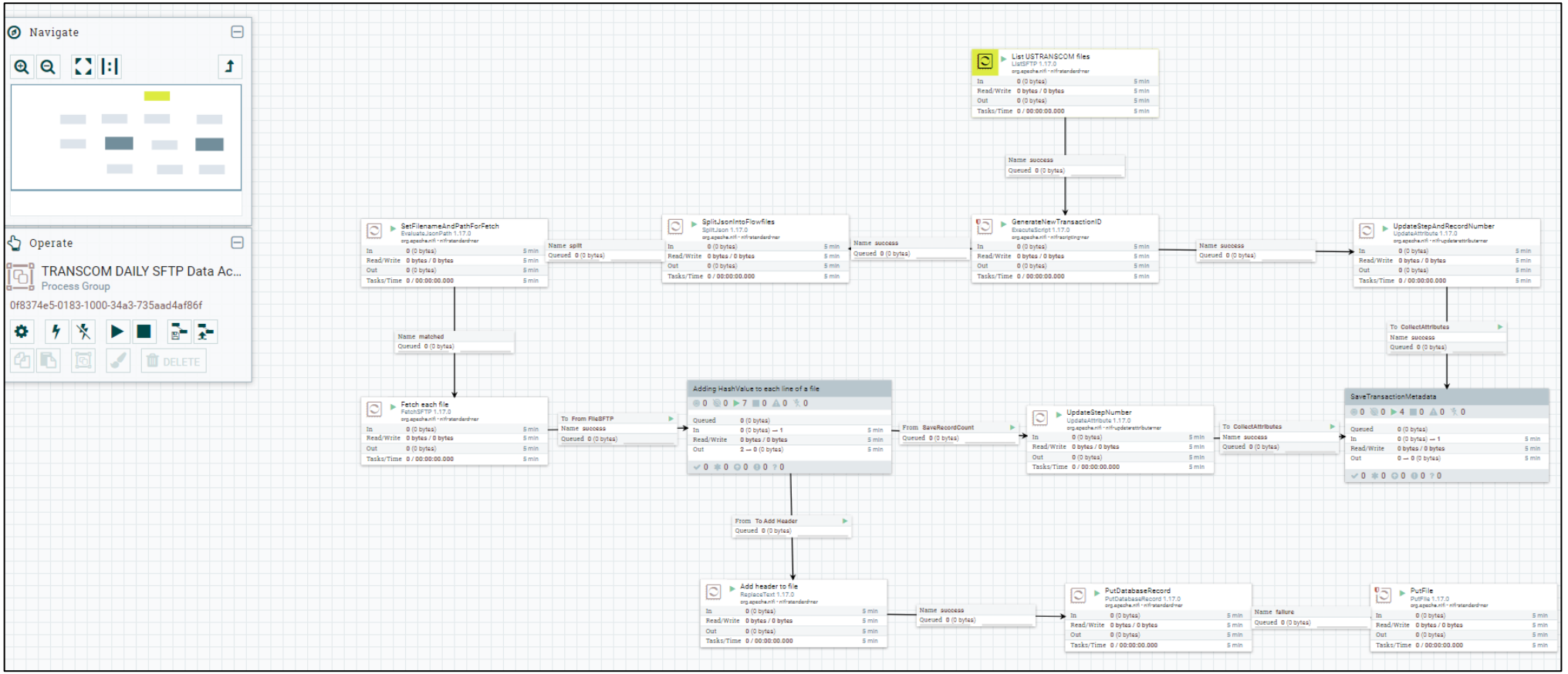
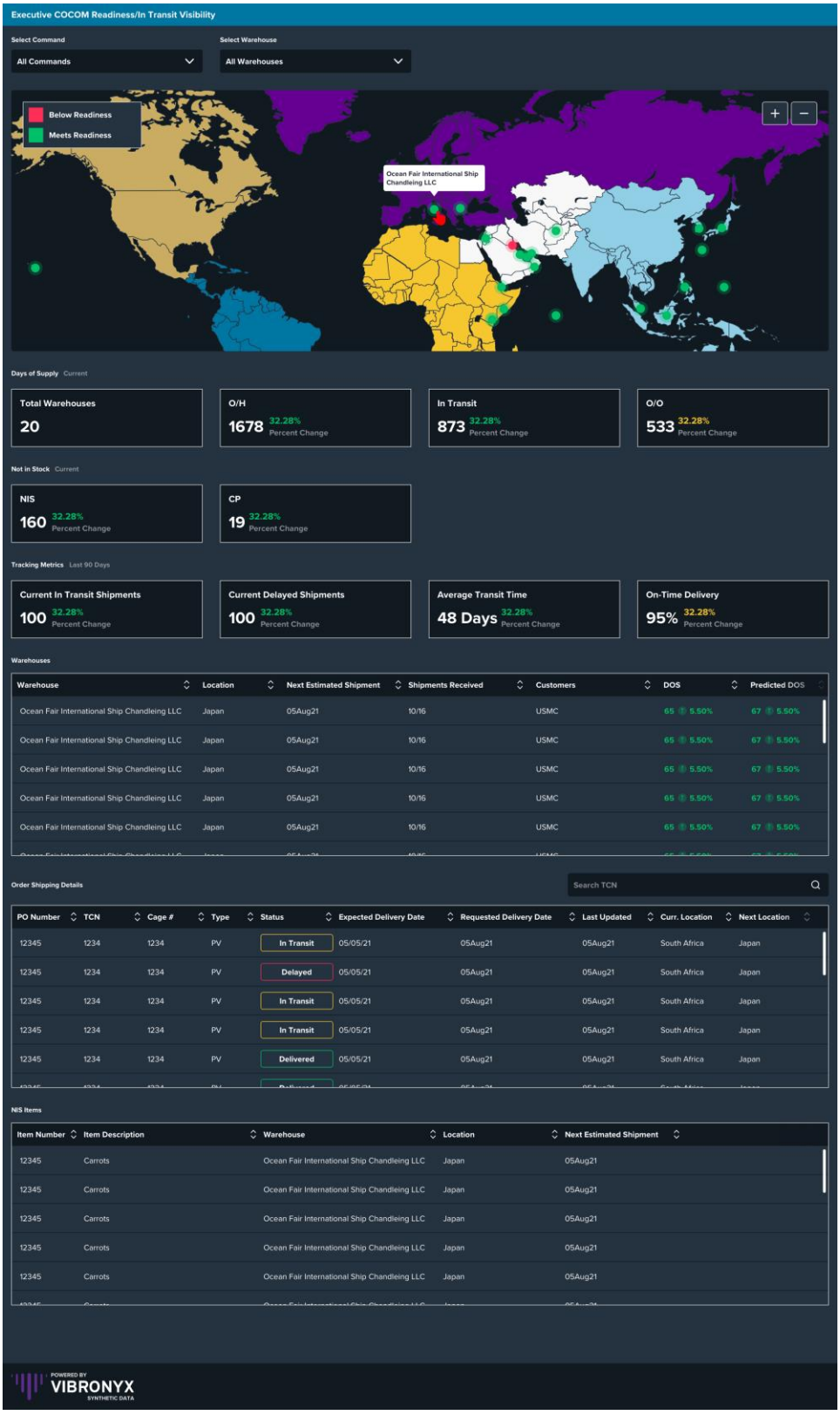
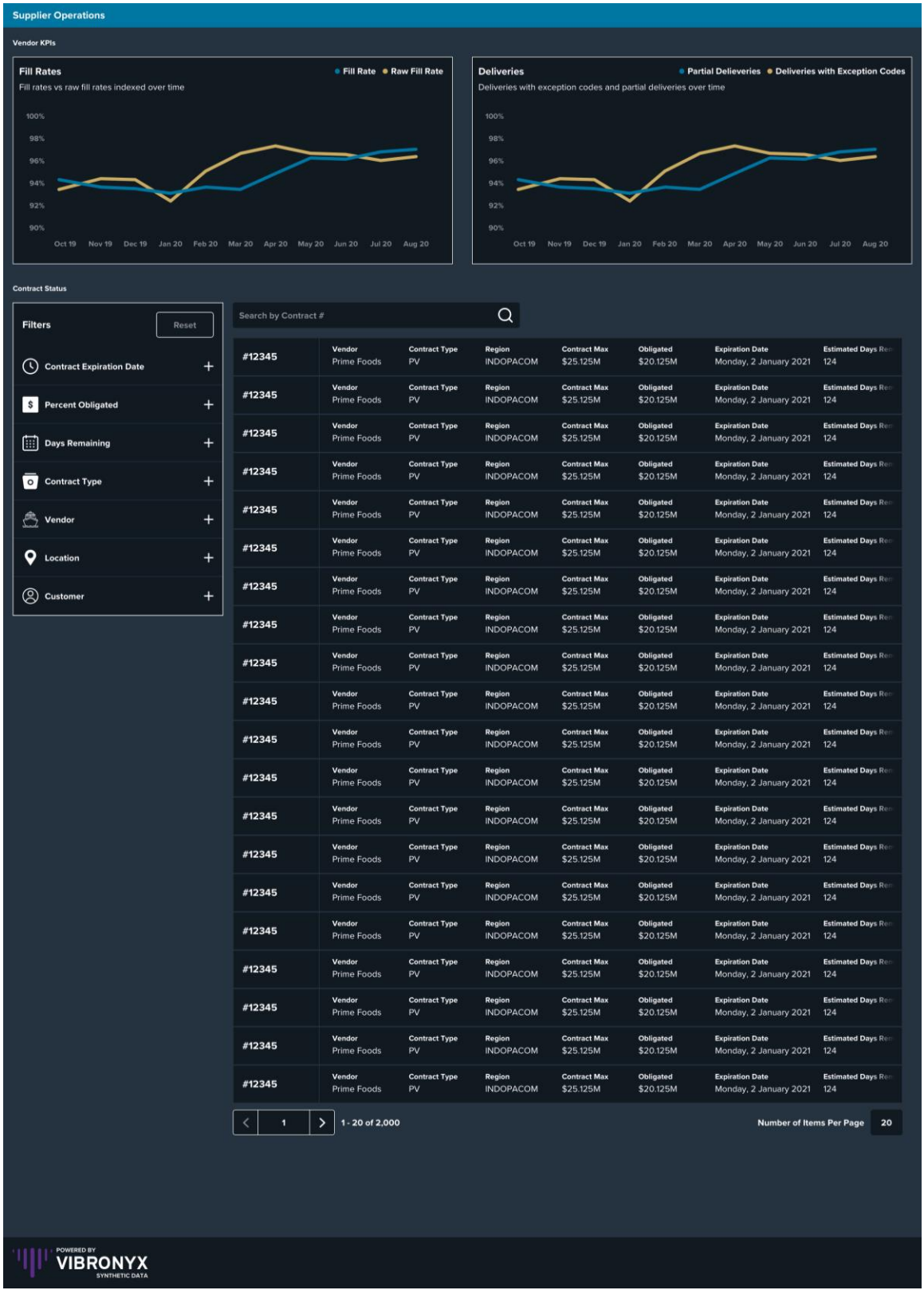
APPENDIX B: USTRANSCOM Data Pipeline



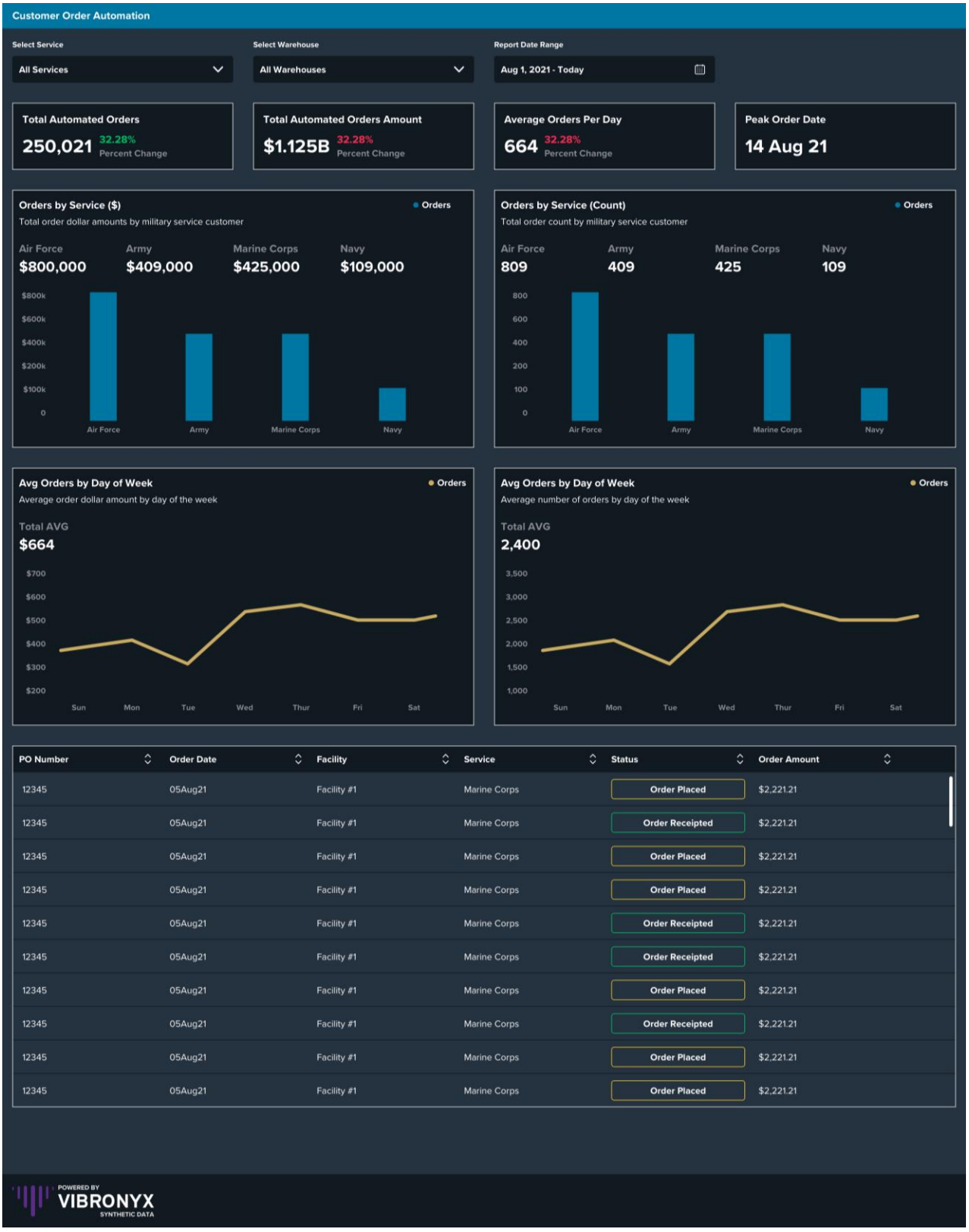
APPENDIX C: COCOM Readiness and In-Transit Visiblity Dashboard



APPENDIX D: Supplier Operations Dashboard



APPENDIX E: Customer Order Automation Dashboard



APPENDIX F: Executive Dashboard