



VAULT Data Platform

DAFITIC Briefing
August 2024

Department of the Air Force

Chief Data & AI Office - SAF/CND

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Agenda



- Foundation & Overview
- Tenant Space Offerings
- Data Provisioning
- BYOT Overview & Process
- **Service Requests and Escalation Process**
- Use Case Demonstration
- Summary



Disclaimer



Reference to a vendor, contractor or any other non-government entity is for informational purposes only and not to be considered as an endorsement.



VAULT Data Platform

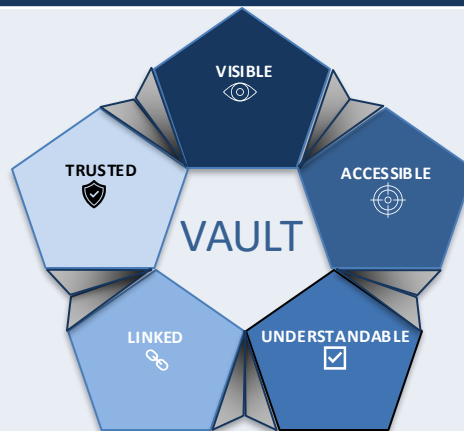
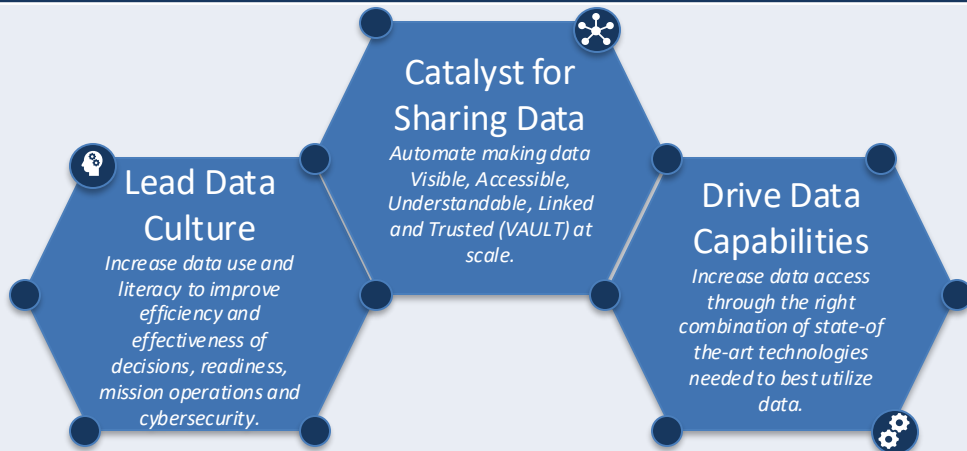


Vision & Mission

VISION – DAF Warfighters leveraging cutting-edge enterprise data and AI solutions to achieve unmatched strategic, operational and tactical excellence.

MISSION – Empower information dominance and operational superiority of Airmen and Guardians through data and AI oversight policy, and governance for decision advantage and successful mission execution.

Strategic Goals



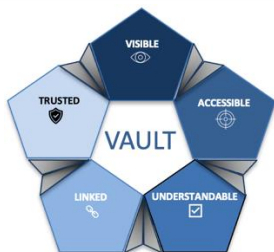


VDP Impact – Customer Focus

Enhance Data Sharing: Support an evolving DAF Data Ecosystem. Sharing data between the Big 6 platforms thru automations. Support advancement toward a virtualized data fabric while supporting current day data sharing needs thru innovative technologies.

Design for Evolution, Extensibility & Scalability: Drive DevSecOps methodologies and P1 alignment (BigBang and deployment methodologies). CI/CD build/deployment pipelines, GitOps for applications, and focus on Kubernetes. Deliver tools to the platform but without enabling vendor lock within the platform.

Data as a Strategic Asset: Ensure data is visible and accessible thru automated data pipelines to acquire, scan, enhance, promote & egress data. Provision data to users within their tenant and the platform.



Defense
Department
Data Strategy

Data Service
Reference
Architecture

Air Force Data
Management
Policy

VAULT foundation is built upon 3 core policies/directives.



VAULT Data Platform – *Evolution*



- NIPR VAULT Contract Award – July 2018
- IL4 ATO

2018

	TENANTS	ACCOUNTS
NIPR	25	300+
SIPR	3	200+

- IL6 ATO

2020

	TENANTS	ACCOUNTS
NIPR	100	13,000+
SIPR	13	900+

2022

	TENANTS	ACCOUNTS
NIPR	134	16,500+
SIPR	20	1,200+

2024

	TENANTS	ACCOUNTS
NIPR	10	200

- SIPR VAULT Contract Award
- IL5 ATO

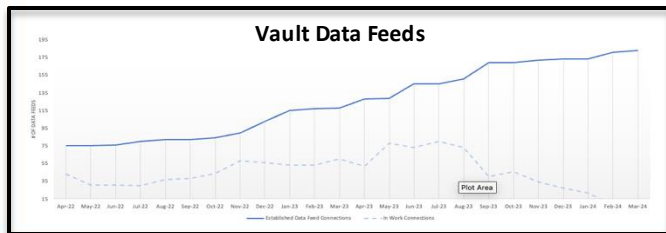
2019

	TENANTS	ACCOUNTS
NIPR	50	6,000+
SIPR	13	600

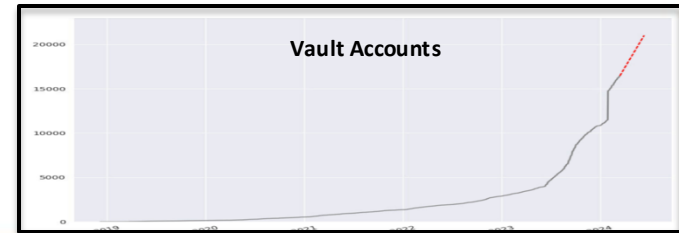
2021

	TENANTS	ACCOUNTS
NIPR	122	10,000+
SIPR	14	1,000+

2023



~185 Data Feeds





VAULT Data Platform – *Current Status*



AFLCMC/HNII is the Program Management Office for the VAULT Data Platform, with CDAO as the Functional Management Office



Successfully achieved a NIPR ATO-C Renewal on 27 February 2024 for 1 year



Successfully achieved a SIPR ATO Extension in July 2024 for 90 days
— To be renewed in October 2024



New System Integrator transition completed!



VAULT Data Platform: Fact Sheet



Number of Accounts:
16,500+



Data Feeds: ~185



Tenants:
~140



Data Files: ~3 Billion



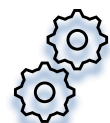
VDP Instances:
NIPR, SIPR, JWICS <Future>



Data Storage/Size: ~3.7 PB



Bring Your Own Tool (BYOT):
~20 Deployed



VAULT Enterprise Tools: ~20

**Data represents NIPR & SIPR data

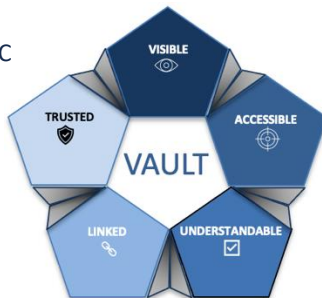


VAULT Data Platform – Mission Support



VAULT Supports Critical Missions & Delivers Value to the Department of the Air Force
VAULT Data Platform Supports over 110 Dedicated Workspaces “Tenants” across NIPR & SIPR

38th Engineering Squadron	A1ZR	AFGSC	AFRL-RYWA	Analytics & Assessment Directorate	Cyberworx	FLTS	MROi	SAF/CND
40 FLTS	ACC	AFIMSC	AFSC	AWPPAO	DAFCINT	HAF/DSI	myFDdata	SAF/CO
412 TW-PA	ACC-A3	AFIT-USAFA	AFSOC	BESPIN	DSAF	HBAT	NGBFM	SAF/SA
417 FLTS	ACTF	AFMAA	AFSVC		EITaaS	HPSRF	OMBPC	SAFMG
46TS-TGBB	AETC A1	AFMC-FM				HQ AETC CSS	OSD-CAPE	SMARTFM
76sweg	AF/HO	AFNWC-NC3				Kesssel Run	OSI	TruDat
96 CTG Data WG	AFA4LM	AFOSI-SFMIS				KRADOS	PMTEC-Tableau	UDTAI
96 RNCS	AFAC	AFOTEC	AFTC	C-19	F-22	LogUot III	Readiness Pathfinder	USAF-TestPilotSchool
A1 myData	AFBIT	AFRC	AFWIC	CON-IT	F15EXPO	MDACOST	Rhombus Guardian	USSOCOM
A1XD	AFCAA	AFRL-CDAO	AMCA2Y	CTIO/S9	F35	Minute Man III	SAF-IE	Vulcan

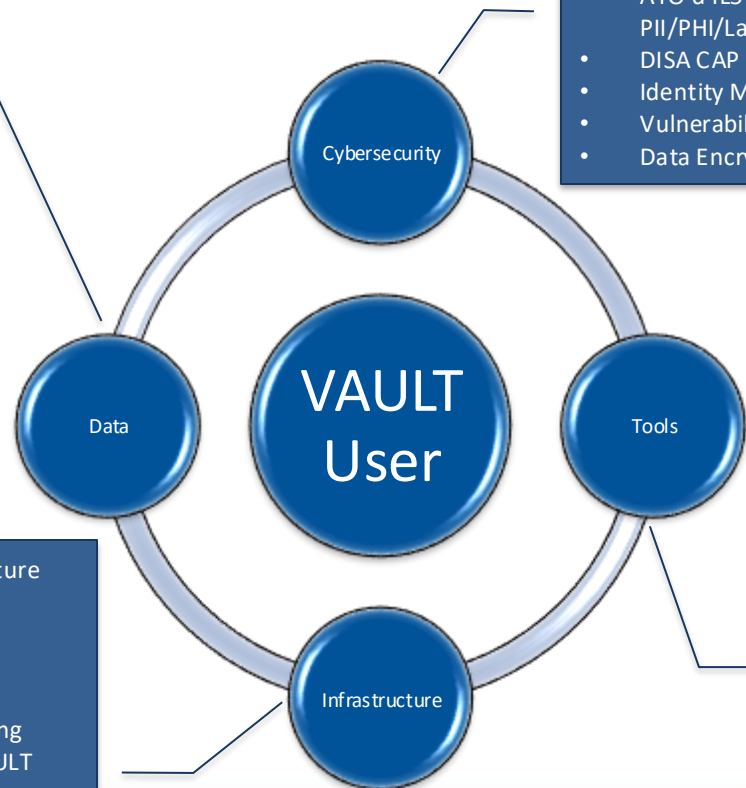




VDP Impact – Core Capabilities

- VAULT enables:
 - Data Access and Visibility thru implementation of Data Pipelines
 - Data Access thru automated Data Acquisition
 - Data Curation, Analysis, Discovery and Wrangling thru provisioning of the Enterprise and BYOT Tool Suites
- VAULT implements Data Access Controls to properly manage access to Limited Visibility/Limited Distribution Data thru RBAC
 - ABAC Access Control Implementation <future>

- Cloud based Scalable Architecture
- Automated CI/CD deployment pipelines
- Platform 1 Alignment and Kubernetes Deployments
- Tenant Space Offerings enabling private workspaces within VAULT

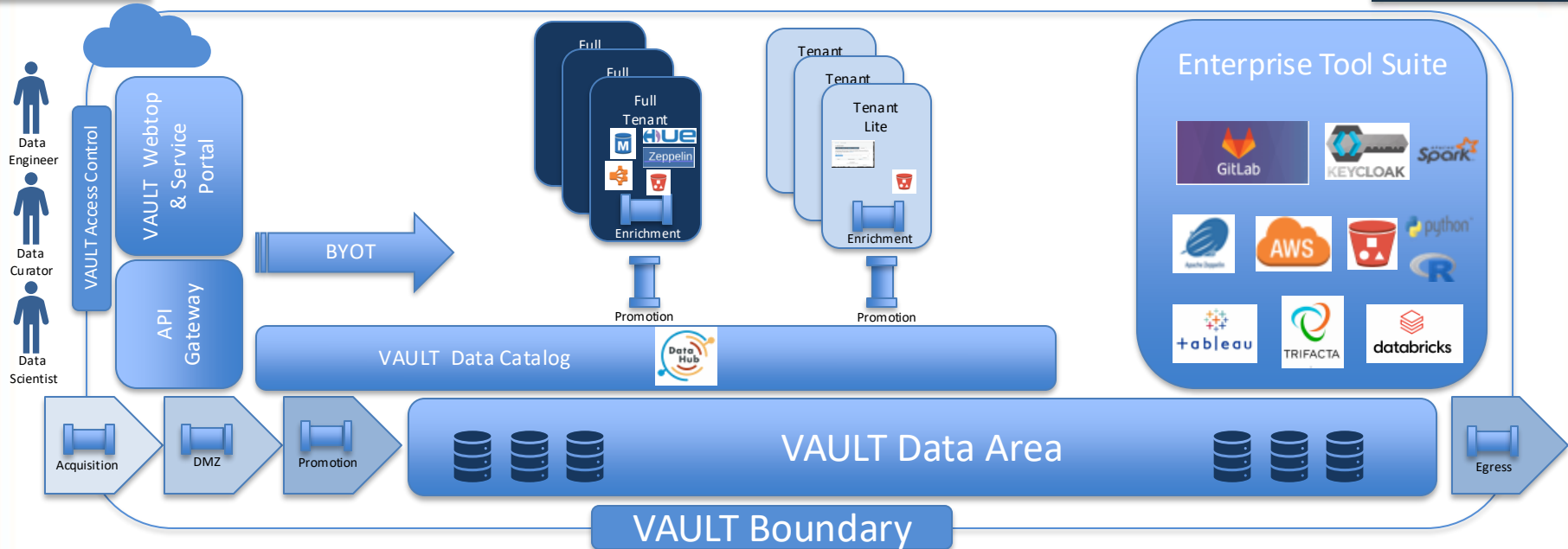


- ATO'd IL5 and IL6 boundary with PII/PHI/Law Enforcement Overlay
- DISA CAP Connection
- Identity Management
- Vulnerability Scanning
- Data Encryption

- VAULT enables microservices to support plug and play open source and COTS tools – preventing vendor lock on the program
- VAULT provides three major areas of tools:
 - Infrastructure
 - Enterprise
 - Bring Your Own Tool
- Infrastructure tools support the key infrastructure capabilities (I.e. Keycloak)
- Enterprise tools are provided to the platform users as an enterprise service
- Bring Your Own Tool (BYOT) enables users to bring a tool of their choice to the platform in their tenant space.



VAULT Data Platform



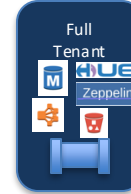
The VAULT Data Platform provides cyber-secure, cloud-based tools to connect, find, share, and learn from AF data – Enables Executive Order on Maintaining American Leadership in Artificial Intelligence



VAULT Data Platform – Tenant Spaces

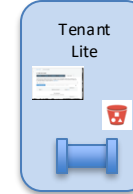


- A tenant space is a private workspace for storing, building, and maintaining organization-specific data and workflows
- VAULT Data Platform offers the following options when it comes to a tenant space:
 - Full Tenant
 - Tenant Lite
- Each tenant option supports different use cases and comes with a different cost model



"Full" Tenant

- Hue and Zeppelin enable data analytics, experimentation, and cleansing
- Elastic MapReduce (EMR) and Relational Database Service (RDS) are used by Hue and Zeppelin for processing
- Databricks
- Typical compute stack in NIPR and SIPR consists of:
 - Two (2) r5a.2xlarge EC2 servers (8 vCPUs and 64GB RAM per server)
 - One (1) db.t2.xlarge RDS server (4 vCPUs and 16 GB RAM)
- S3 buckets for data storage



Tenant "Lite"

- S3 console access still allows tenants users to upload and download data
- S3 buckets for data storage



VDP Impact – Data Provisioning



VAULT Data Execution

VAULT enables data sharing through automated acquisition and data discovery, to user enabled enrichment and visualization using enterprise & BYOT tools and finally promoting and sharing the data to the platform and the enterprise.

Acquisition

- Enables self-service acquisition of data feeds
- Captures Business and Data Source & Set Metadata
- Automated Pipeline established for Envision Data Sharing

DMZ

- VDP Protection Pipeline
- Protects VDP from security threats hidden within the data
- Performs Scanning of Data
- Quarantine & Archiving of Data

Promotion

- Promotes Data to the Enterprise Data Area or directly to the tenant space
- Verify/Validate and tag data based upon information collected during the acquisition phase
- Captures File Based Metadata
- Performs Data Transformation <if required>



Enrichment

- Data Enrichment Pipeline
- Performed by the VAULT users
- Performed using Enterprise and BYOT tool suites
- Data Maturation, Curation, Linking, Wrangling
- Enrichment Pipeline is within a VAULT user space

Egress

- Pipelines to enable Data Egress from VAULT
- Data Egress from VAULT or Cross Domain
- Enables Auditing, Tagging and Cataloging

VAULT Data Catalog

VAULT Data Area



VAULT Data Platform – Data Acquisition (1 of 2)



- Data can be acquired and brought into the VAULT Data Platform via several methods
 - Varies in terms of connection, speed and size of data to be transferred, level of effort required on data provider and the VAULT team, and the speed of delivering/receiving data

Method	Description	Supported File Size	Level of Effort	Typical Turnaround Time
Direct upload via Apache Hue	Users enabled to directly upload data via Hue application	≤ 500MB	- LOW ✓ VAULT user account required	Data available upon upload completion
Secure File Gateway (SFG)	- Secure data transfer between DoD systems and those interfacing with the DoD systems on NIPR and SIPR networks - Relays and folders created for each customer - Data providers granted access to drop files to the relay into the Vault Platform	≤ 100GB	- MEDIUM - Data provider requirements • DISA account • Access to DISA's SFG relay	2-4 weeks (Dependent on DISA)
Secure File Transfer Protocol (SFTP)	- Network protocol for accessing, transferring, and managing files on remote systems. - Allows securely transfer of data files	≤ 100GB	- MEDIUM - Requirements • Creation of RSA Public / Private Keys • Possible Firewall changes	5+ weeks VAULT team... Creates Public keys Updates Firewall rules Establishes/tests connection



VAULT Data Platform – Data Acquisition (2 of 2)



Method	Description	Supported File Size	Level of Effort	Typical Turnaround Time
AWS Cloud S3-to-S3	- Object storage solution - Provides scalability, data availability, security, and performance - Data provider can upload data to specific S3 buckets and make them available for the platform to ingest - All data formats supported	≤ 5TB	- MEDIUM - Requirements: - Granted access to specific bucket - For both Data provider and VAULT Data Platform	≤ 2 weeks (VAULT team creates required bucket, grants appropriate permissions and makes bucket available)
AWS Snowball	- AWS will ship Snowball device to provided location - Recipient required to load data and mail it to specified location per provided instructions	≤ 80 TB (per snowball)	- HIGH - Requirements: - Data Provider approval	5+ weeks Order of snowball by VAULT takes about 2-3 weeks, Loading of data, shipping back to AWS, and uploading to Vault takes 1.5 – 2 weeks. Approval by provider hosting provider can vary in duration.)
Removeable Hard Drive	- Data downloaded to external hard drive - Handed over to proper personnel	≤ 500 GB	- MEDIUM - Requirements: - Approved hard drive - USB exception within Data Provider's organization	4+ weeks (Acquire approved hard drive, downloading of data, doing the hand-off, and uploading of data.)
Application Programming Interface (API)	Application Programming Interface (API) to federate Metadata and data between system (Under development)			



Vault Data Platform Impact - BYOT



VDP offers a unique and highly requested Bring Your Own Tool (BYOT) process to enable tenants to bring custom applications to their tenant spaces for utilization in data manipulation and visualization.

- VDP has ~20 unique BYOT applications currently deployed
- VDP currently has a backlog of ~20 unique BYOT applications requesting deployment thru various phases of the BYOT process

Sample BYOTs on VAULT

Dataiku	Appian	Swimlane
Plotly Enterprise	Immuta	Galvanize
ITIPS	DAFBOP / PERforM	COGYNT
Tableau Write-Back	Rhombus Guardian: SLRD & Force Structure	
A1 myData – Erwin & Informatica Tools (PowerCenter, Data Quality & Address Doctor, Axon, EDC, MDM)		

Mission Critical BYOT Examples:

- SAF/CDM – mission impacts supporting insider threat initiatives
- SAF/MG – supporting direct provisioning of the PERforM capabilities
- ITIPS – enabling ITIPS access thru VAULT
- A1 myData – directly supporting the transition of A1 TMDE to the VDP
- A8 – SLRD & ForceStructure

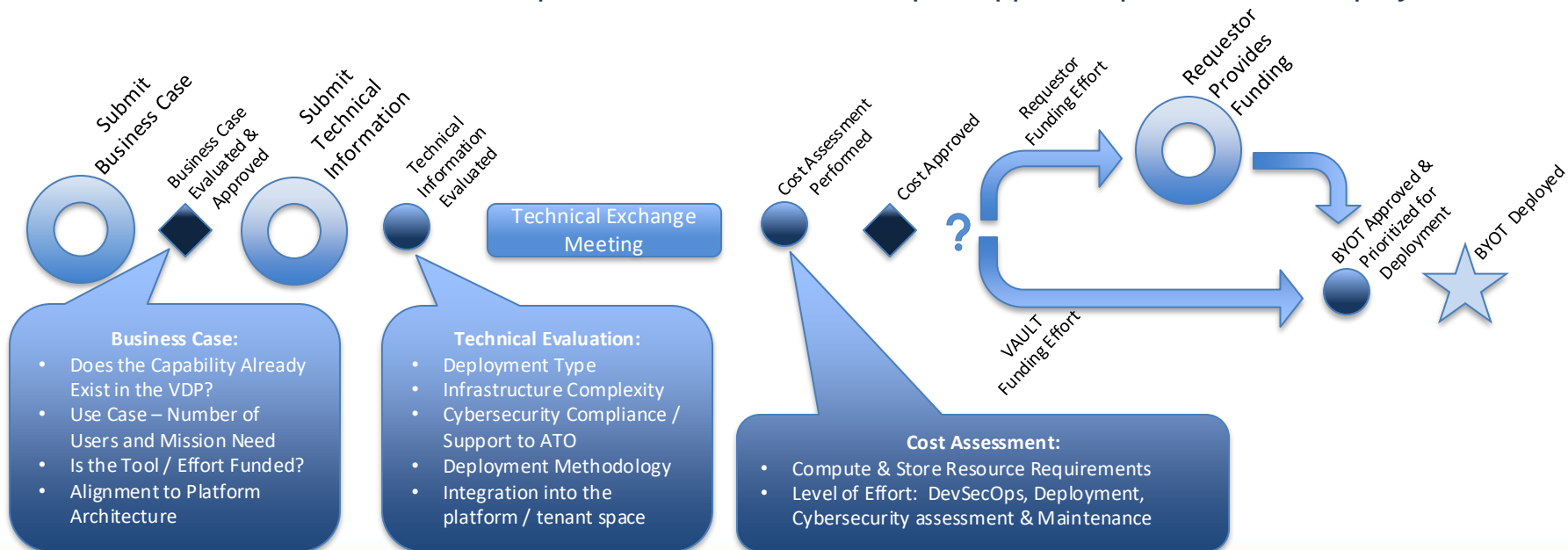




Vault Data Platform - BYOT



- VAULT BYOT process is designed to capture and evaluate the business need and technical requirements – enabling a thorough understanding and plan to deployment
 - BYOTs are routed thru the process, evaluated and, upon approval, prioritized for deployment





VAULT Data Platform – Foundational Capability



VAULT drives key behaviors to demonstrate “Visible, Accessible, Understandable, Linked & Trusted”

- Enabling **INTEROPERABILITY** through a collaborative model to support Data Sharing across data platforms and the enterprise!
- Enable **SELF-SERVICE** through the deployment of tools to support user needs without creating vendor lock in the platform
- Automated and rapid deployments to ensure platform stability and relevancy following the **DoD Enterprise DevSecOps Reference Design**
 - CI/CD Pipelines
 - Kubernetes Deployments enabling an automatically scaling platform

VDP Foundational Capability

Self Provisioning to VAULT Data Platform	Identity Control Access Management (ICAM)	API Provisioning* API Gateway & API/Tableau Integration
Constantly Expanding Enterprise Tool Offering	Attribute Based Access Control*	Data Access Management
Bring Your Own Tool Enabling users to customize their data exploration experience	Data Provisioning & Data Sharing Automated / Self-Service data sharing pipeline with Envision Data Feed pipelines to tenant space and/or Enterprise Area	Automated Data Pipelines Data Acquisition Pipeline Data Scanning and Quarantine Transform Pipeline* Promotion Pipelines*
Jupyter Hub Capabilities Provides robust capability to VAULT users for complex and large data computations.	Data Catalog Data Catalog containing all public enterprise platform data information Capable of integrating with DAF Enterprise data catalog	Automated Metadata Definition Metadata is defined for a subset of enterprise platform data – full definition is in work
Automated Plotly CI/CD Pipelines	Data Tagging	* Capability available soon



VDP – Platform Visibility



The VAULT Data Platform leverages a combination of open source and commercial products to meet the diverse needs of its customer base. The VDP's enterprise applications enables exploitation of both open-source resources such as Python or R and vendor-specific low-code/no-code capabilities such as Tableau or Dataiku.

AWS

- A significant portion of VAULT's foundational architecture is provided by AWS.
- This includes configurations for S3 storage, Relational Data Bases, EC2 Instances, and EMR instances for Full-Stack tenants.

BYOT

- The Bring Your Own Tool (BYOT) process enables VAULT users to bring their preferred vendor applications into the VAULT Data Platform.

Open Source

- Many enterprise applications in the VDP allow VAULT users to implement open-source code in Python, R, Scala, SQL, etc.
- These include Databricks, Plotly, RShiny, Jupyterhub, and others.



VAULT Data Platform – Data Tagging



- New data ingested into the VAULT Data Platform receives the following tags, informed by the data owners and tenant managers.

Tag	Value
type	enterprise tenant ingress egress infra quarantine
subtype	data app cert
pii	true false
phi	true false
pii_level	{ 1 .. 7 }

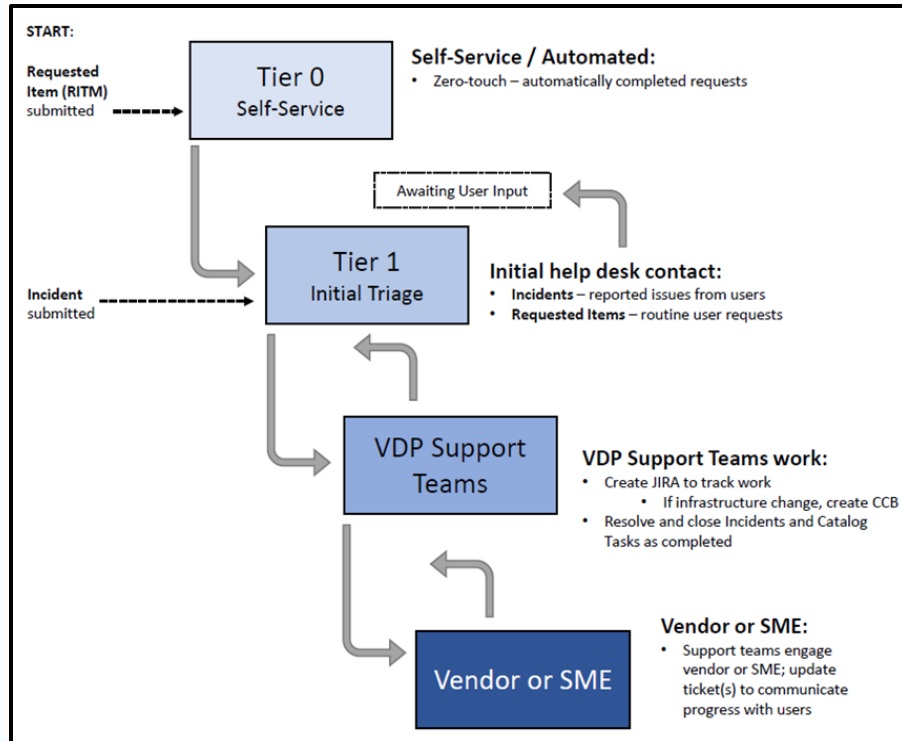
Tag	Value
law_enforcement	true false
tenant_sensitive	true false
limdis	true false
govt_only	true false
env	nipr sipr jwics
il_level	2 4 5 6



Service Requests Flow & Prioritization



Service Operation Flow



Incident Prioritization

Impact + Urgency = Prioritization

IMPACT (Effect)	LOW	MEDIUM	HIGH
	OPERATIONS/SERVICES DISRUPTION		
	Minor	Significant	Severe
URGENCY (Speed)	MINIMIZING OPERATIONS IMPACT		
	Immediate	Prompt	Immediate
	Not Action Required	Action Required	Action Required

INCIDENT PRIORITY

1	CRITICAL	3	MEDIUM
2	HIGH	4	LOW

INCIDENT PRIORITY				
U r g e n c y	High	1	2	3
	Medium	2	3	4
	Low	3	4	4
		High	Medium	Low
IMPACT				



Response & Resolution Times*



EVENT TYPE	RESPONSE TIME	RESOLUTION TIME	EFFECTIVE TIME
Priority 1 - Critical	Immediate (within 15 minutes)	Resolved within 4 hours	0800-1600 EST, M-F and best effort beyond Duty Hours
Priority 2 - High	Within 1 duty hours	Resolved within 1 duty days	0800-1600 EST, M-F
Priority 3 - Medium	Within 2 duty hours	Resolved within 3 duty days	0800-1600 EST, M-F
Priority 4 - Low	Within 4 duty hours	Resolved within 5 duty days	0800-1600 EST, M-F
Service Requests	Within 8 duty hours	5 duty days for standard requests	0800-1600 EST, M-F

DUTY HOURS									AFTER HOURS														
08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00
Standard support operations and escalations are in effect during normal Duty Hours.									After-hours support and escalations are available in accordance with specifically awarded contract agreements.														

* Eastern Standard Times



VAULT Demonstration



VAULT Webtop



Welcome to VAULT

Logout

15:54:47

HelpDesk ▾



Help Desk & Requests

VAULT-DEFAULT ▾



VAULT Default Hue



VAULT Default
Zeppelin

Other Resources ▾



Plotly Dash Enterprise



Data Lake



Axon



Plotly Dash



AD Lookups



Databricks



Shiny Server



VAULT Help Desk: Tenant, Data, Apps

GET STARTED WITH VAULT

ALL REQUEST ITEMS

Tenant Management Requests

Applications

PII Access

Bring your own Tool

Tenant Spaces

Data Requests

Quick Links

DAF Data Fabric

Vault Community Forum

Information Hub

Submit Help Desk Ticket

Browse All Request Items

How can we help?

SECRETARY OF THE AIR FORCE
CHIEF DATA OFFICE

QUICK LINKS

Vault Community Forum
Community Forum

Information Hub
HelpDesk Articles

Webtop
VAULT Webtop

Submit Help Desk Ticket
Submit a trouble ticket for issues in VAULT

DAF Data Fabric
External Site

MY ACTIVE ITEMS

0 Tasks

RECOMMENDED FOR YOU

Request Access to Apps

POPULAR TOPICS

MY REQUESTS

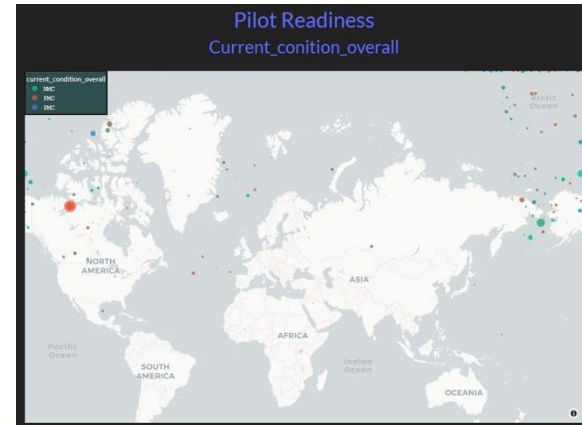
View Open requests Search open requests

Request	State	Updated
Databricks REQ0027918 SEPIDEH MAHARATI	Open	12d ago
PII Certification Update REQ0024108 SEPIDEH MAHARATI	Open	5mo ago
Databricks REQ0024039 SEPIDEH MAHARATI	Open	5mo ago



Sample Use Case

- Goals:
 - Determine the current readiness levels of Pilots and Aircraft across the department
 - Use a classic ML model to predict readiness levels
- Data Sources:
 - G081: Provides unclassified maintenance data for Mobility airlift aircraft
 - ARMS: Provides aircrew training records used to determine readiness
- NOTE: Synthetic data for demonstration purposes





Sample Tooling Pipelines

Ingest

Store

Munging

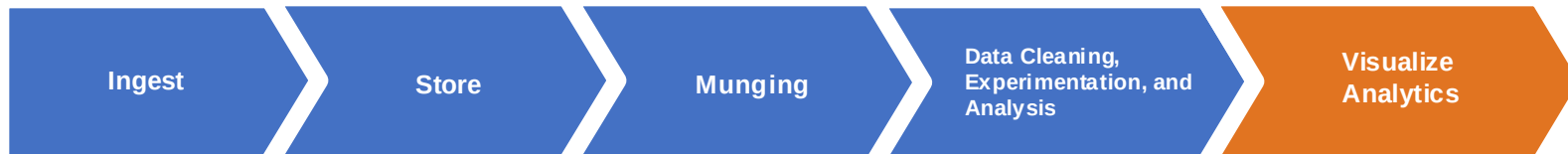
Data Manipulation,
Cleaning, and
Experimentation

Visualize
Analytics





Tenant Lite Sample Use-Case Pipeline



Utilizing curated, or better yet, trusted data in Delta Lake can save data analysis tremendous time



Time to complete data cleaning work in Databricks? For basic use-case, as little as a couple hours.



- Time to write code and configure/customize Plotly Dash Application? Half a day or less for basic use-case
- Time to deploy? Plotly Enterprise is self-service so app can be deployed same day. Plotly Dash will require a help desk ticket.

Time to Completion? $\approx$ 1 day



Databricks: Delta Tables



The screenshot displays the Databricks web interface. On the left is a dark sidebar with navigation options: Data Science & E..., Create, Workspace, Recents, Search, Data (highlighted), Compute, Jobs, Help, Settings, and a user profile. The main content area is titled 'Database Tables' and 'DBFS'. It features two panels: 'Databases' and 'Tables'. The 'Databases' panel lists various databases, and the 'Tables' panel lists tables under the selected database. A 'Create Table' button is visible in the top right. The URL at the bottom of the browser window is https://databricks.afdatalab.af.mil/#table/vault_g081_curated/g081_aircraft.

Database Tables DBFS Create Table

Databases Filter Databases

- 1229700703weaverda_spar...
- 1229700703weaverda_spar...
- 1260155470_harrell_r_7qf4...
- 1501141557larkinsh_spark...
- 1606301584bolincla_spark...
- 1606301584bolincla_spark...
- 4tes_training_db
- a9_covid_tracker
- a9a_stage
- a9test
- a9test2022
- aaax_db
- abacademo
- active_directory
- afa4lm_db
- afac_cda_db

Tables Filter Tables

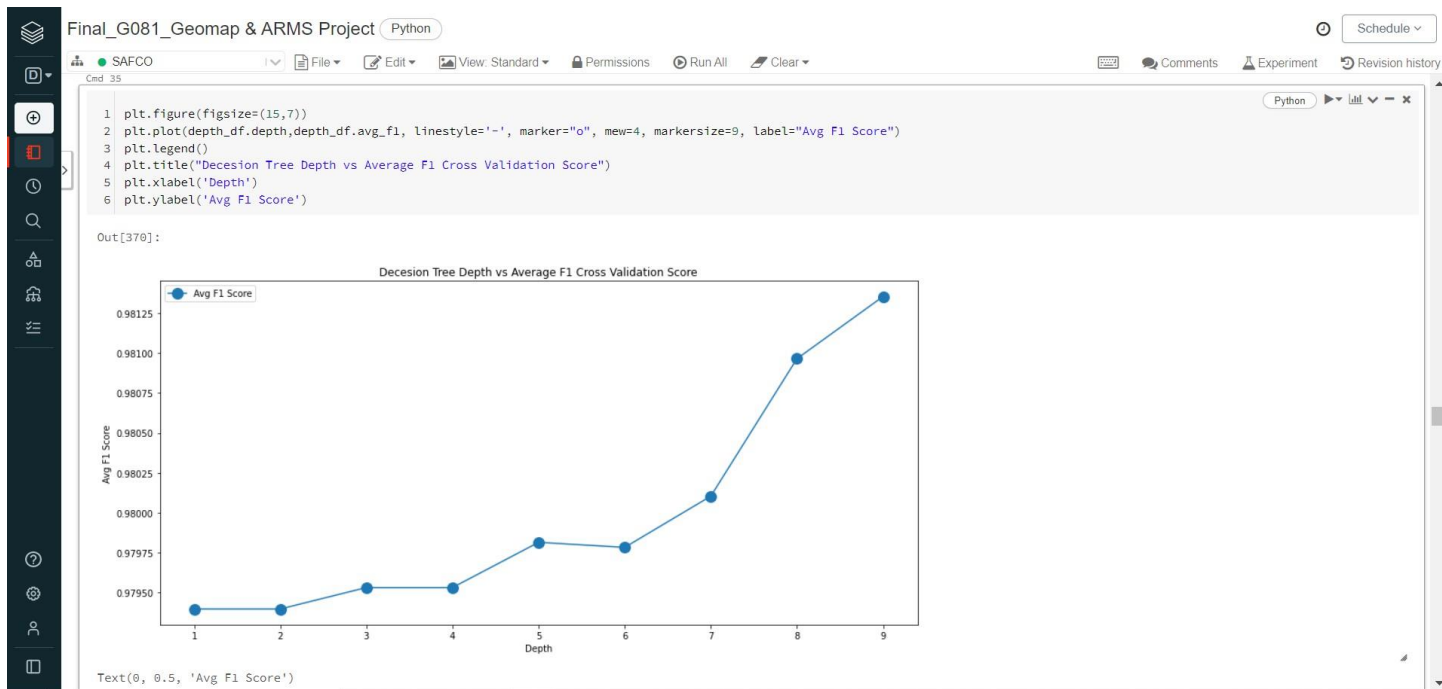
- g081_aircraft
- g081_aircraft_schedule
- g081_aircraft_status_history
- g081_bases_with_sran
- g081_component
- g081_debrief
- g081_deviation
- g081_discrepancy
- g081_end_item
- g081_engine
- g081_engines_join_aircraft
- g081_flight
- g081_geoloc_icao
- g081_mdc
- g081_mds
- g081_mission
- g081_mission_design

Refresh

https://databricks.afdatalab.af.mil/#table/vault_g081_curated/g081_aircraft



Databricks: Data Prep & Machine Learning





Databricks: Plotly Dash Graph Configuration



```
Final_G081_Geomap & ARMS Project Python
SAFCO File Edit View: Standard Permissions Run All Clear
Command took 0.02 seconds -- by a user at 5/10/2023, 1:46:16 PM on unknown cluster
Cmd 103
Python

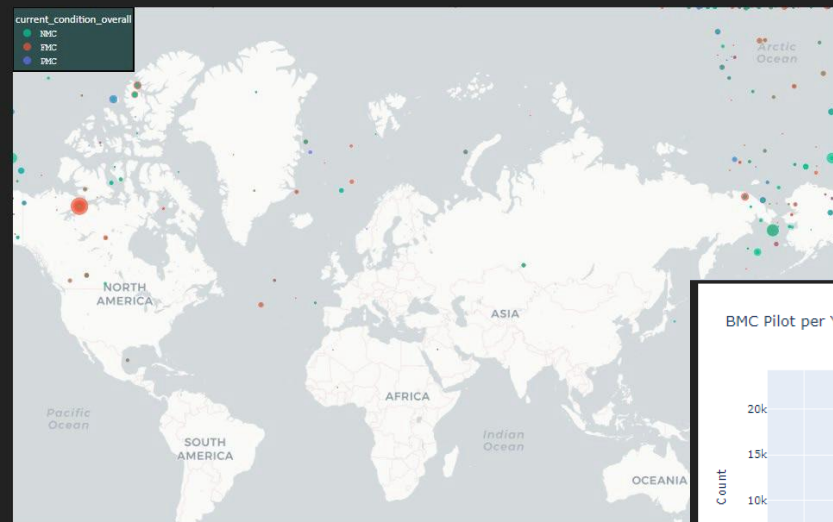
1 #-----## New layout ##-----
2 ###First Page
3
4 #g081_aircraft_count_pandas
5 this_condition = g081_aircraft_count_pandas["current_condition_overall"]
6 Default = g081_aircraft_count_pandas
7 PMC = g081_aircraft_count_pandas[g081_aircraft_count_pandas["current_condition_overall"]=="PMC"]
8 FMC = g081_aircraft_count_pandas[g081_aircraft_count_pandas["current_condition_overall"]=="FMC"]
9 NMC = g081_aircraft_count_pandas[g081_aircraft_count_pandas["current_condition_overall"]=="NMC"]
10
11 #condition = g081_aircraft_count_pandas["current_condition_overall"]
12 ### Home Page
13 #Title
14 start_layout = dbc.Container([
15     html.H1("Pilot Readiness", style = {'textAlign': 'center', 'color': '#636EFA'}),
16     html.H2("Current_condition_overall", style = {'textAlign': 'center', 'color': '#636EFA'}),
17
18     html.Br(),
19
20     #Graph
21     dbc.Row([
22         dbc.Col([
23             dcc.Graph(id = 'map', figure = px.scatter_mapbox(g081_aircraft_count_pandas, lat="latitude",lon="longitude",color = 'current_condition_overall',size = 'count',hover_name =
24                 'current_condition_overall',hover_data =
25                 ['latitude','longitude','count','command_code_nomenclature']).update_layout(legend=dict(x=0,y=1,traceorder="reversed",title_font_family="Calibri",font=dict(family="Courier",size=14,color="ghostwhite"),bgcolor="darkslategray",bordercolor="Black",borderwidth=2,height=800,mapbox={"style": "carto-positron", "zoom":2}, margin={"l": 0, "r": 0, "t": 0, "b": 0}))
26             ],)
27         ],),
28     html.Br(),
29     dbc.Row([
```



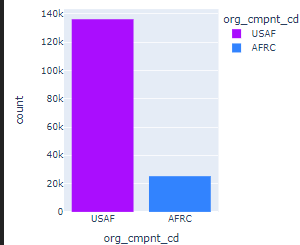
Plotly Dash



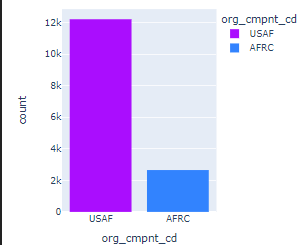
Pilot Readiness Current_conitioin_overall



Count of F035A Pilots per Org



Count of Simulators per Org



BMC Pilot per Year



CMR Pilot per Year





VAULT Data Platform - Summary



VAULT enables users data access and utilization thru multiple offerings: dedicated tenant spaces, data acquisition, enterprise data, an enterprise tool suite and Bring Your Own Tools and a suite of tools that enable data exploitation activities.

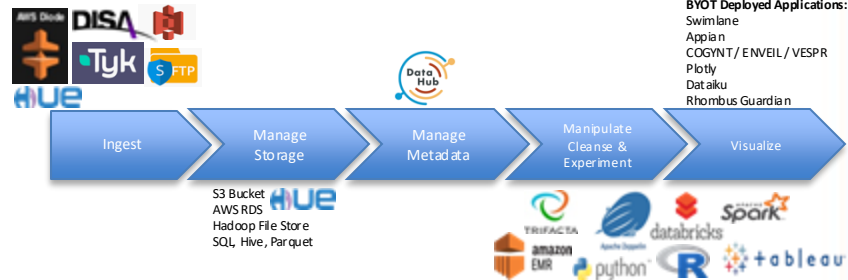


- Users can **self provision** to VAULT
 - NIPR: <https://afdatalab.af.mil/>
 - SIPR: <https://afdatalab.af.smil.mil>
- Users can work in the following areas:
 - VAULT Default Tenant – access to Enterprise Data Area & Enterprise Tools (Cannot access limited/controlled data)
 - New Tenant Space or Existing Tenant Space
 - Access to Enterprise Data, Enterprise Tools, Limited/Controlled Data <as applicable>
 - Supports BYOT Deployment



- A VAULT Tenant space is a private workspace for storing, building and maintaining organization-specific data and workflows
- VAULT Tenant Space Offerings
 - Full** <VAULT Default> = S3, Hue, Zeppelin, RDS & EMR
 - Standard** = S3, JupyterHub <in work>
 - Lite** = S3 and Console
- Each tenant option supports different use cases and comes with different cost models

- VAULT offers a unique capability to **Bring Your Own Tool (BYOT)** to the platform and the User Tenant Space.
 - These tools are GOTS, COTS or custom code tools that a tenant space may need to support data exploration and visualization



- VAULT offers a constantly expanding **Enterprise Tool Suite** to support a full lifecycle of data exploitation activities customizable to the users.
 - Note: Some tools require licensing or participation in cost sharing



QUESTIONS?