FY24 ATI Digital Tracking AI overview

22 April 2024

CAPT J. M. Belmont
Commanding Officer

CAPT R. J. Berti
Executive Officer

Mr. M. D. Meno
Executive Director

We Deliver Flightline Readiness

- Maintenance, Repair and Overhaul Services
- Worldwide Support
- Lifecycle Sustainment Services

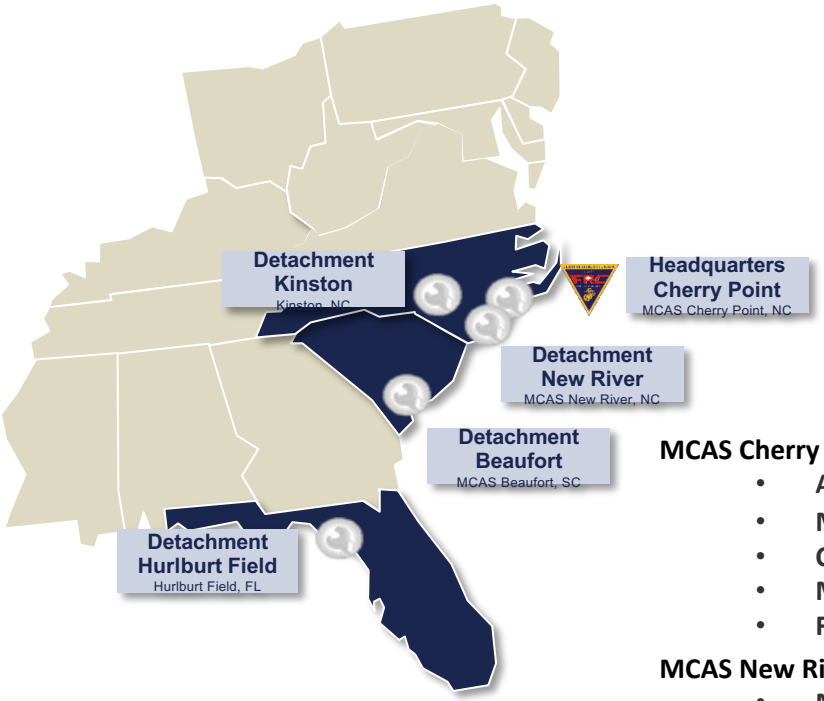
Department of Defense Vertical Lift Center of Excellence

Alignment

- Fleet Readiness Centers are support activities that provide shore-based and depot-level maintenance and support to Naval aviation efforts. They are under the direction of the office of Commander, Fleet Readiness Centers (COMFRC).

COMFRC Locations

FRC East Locations



MCAS Cherry Point

- AV-8B & TAV-8B Harrier
- MV-22 & CV-22 Osprey
- CH-53E/K Super Stallion
- MH-53E Sea Dragon
- F-35A/B/C Lightning II

MCAS New River

- MV-22 & CV-22 Osprey
- AH-1Z Viper
- UH-1Y Venom

NC Global TransPark

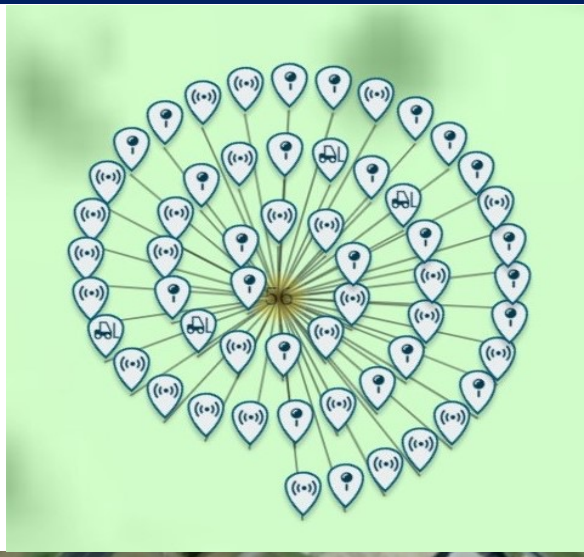
- Air Force UH-1N Huey
- C/KC-130T/J Hercules
- HH-60W Jolly Green II
- MH-139A Grey Wolf

MCAS Beaufort

- F/A-18A-D Hornet
- F/A-18E-F Super Hornet

AFB Hurlburt Field

- CV-22 Osprey



Our Capabilities

- AV-8B & TAV-8B Harriers
- MV-22 & CV-22 Osprey
- AH-1Z Viper
- Air Force UH-1N Huey
- HH-60W Jolly Green II *
- C/KC-130T/J Hercules *
- UH-1Y Venom
- CH-53E/K Super Stallion/King Stallion
- MH-53E Sea Dragon
- F/A-18A-D Hornet & F/A-18E-F Super Hornet
- F-35A/B/C Lightning II
- MH-139A Grey Wolf *

- T400 Reduction Gearbox (UH-1N)
- T58-400B (Presidential VH-3D Sea King)
- T64 (CH/MH-53E)
- *F-35B Lift System* *
- *T408 (CH-53K King Stallion)* *
- F402 (AV-8B & TAV-8B)

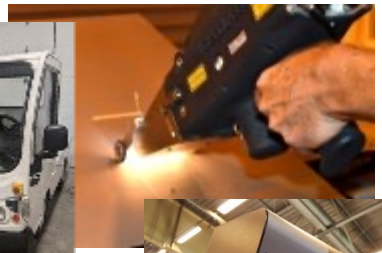
- Gas turbine compressors
- Auxiliary power units
- Gearboxes
- Rotor blades
- Hydraulic & pneumatic actuators
- Fuel controls
- Avionics

- Metal plating, coating, forming, heat-treating
- Welding
- Material analysis
- Non-Destructive Inspection
- Low observable paint
- Titanium tube bending, inspection, testing
- Composite & fiberglass fabrication
- CNC machining (5-axis)
- 3-D printing & additive manufacturing

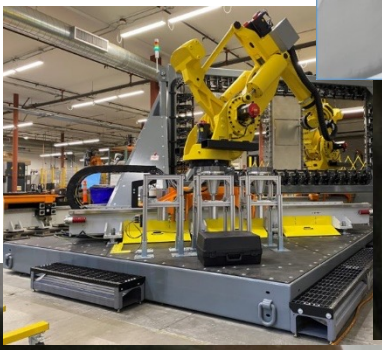
* *Denotes establishing capability*

Machines and People Comprise our Capability



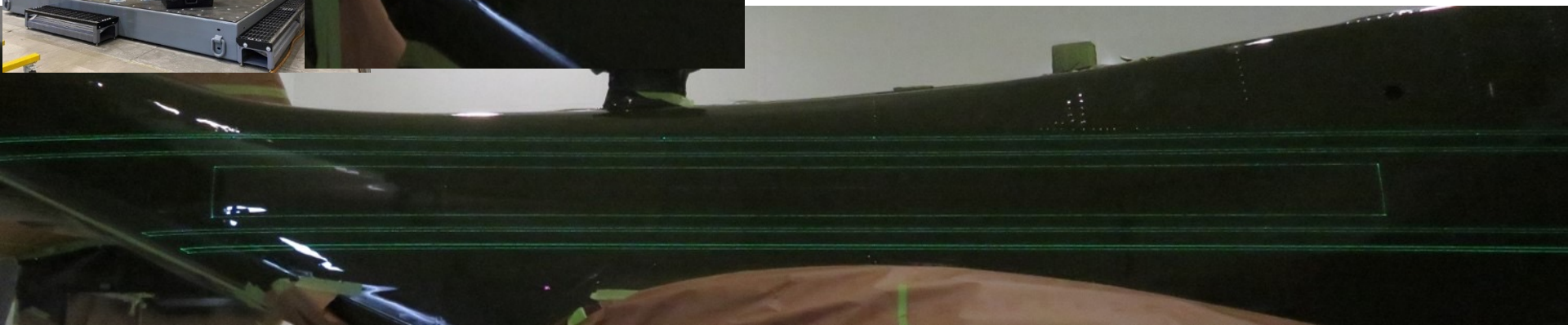







Reactive Machine Systems in use or being developed and are primed for future implementation of Machine Learning:

- Additive Manufacturing Polymer and Metal
- Autonomous Material Handling
- Robotic Systems
- Cold and Thermal Spray
- Laser Ablation
- Laser Projection
- Metal Forming



COMFRC Challenges Requiring Solution

What are the challenges? Asset Management

Upper – DoD asset audit failures (FY 24 - 6th consecutive failed DoD wide audit)
- Accountability for 100%, procured, designed, fielded
- 3 main COMFRC sites @ +/- 280k Assets
  - Does not include asset counts for IT, Safety, environmental, Field Team services, or any detachment/interdiction sites. * *Always growing, always changing, H60, C-130…*
- Current man hrs. @ 15.5k to conduct COMFRC inventory @ 3 sites
  - With DT and IoT: 372-man hrs. for +/- 80k @ 3 sites
- COMFRC detachment sites = 47 (does not include Depot interdiction sites)

Middle – Pre-Operational records and use
- Inspection records are handwritten in terms of compliance
- Assets never stop moving, some records are misplaced, require retention
- Transfer and acceptance throughout the enterprise complicates

Lower – Business and production planning
- Where to invest labor and financial investment
- Accommodate the customer, do I have this organic capability
- Where to best use limited human and financial resources

DT and IoT (ML translation) Decision to Address Depot Challenges

Why Digital Tracking, IoT, and AI, how will this address enterprise challenges?

Upper – Reduction of MANYEARS associated with inventory of enterprise assets

Middle – Remove pre-operational record challenge and associate data collected in a variety of ways to facilitate conformance

Lower – What do I have, Where is it, Can I find it, Can I use it?

*IoT and DT comes with semantic model analytics vice conceptual, we turn policy into software processes, inject quality, and mistake proof human data inputs/Outputs. Combining Machine Learning data along with Machine Health & Environmental Monitoring as well as Supply/Logistics, Financial… is beginning of total process data collection and mapping via software input/output like: Integrated Computer-Aided Manufacturing (ICAM), a US Air Force program that develops tools, techniques, and processes to support manufacturing integration.

Software Semantic Analytics

Semantic Model Analytics and Ontology of data, what will this do for us = AI

Following the *"Weak AI"* model type, Humans leveraging RF mobile devices or fixed RF infrastructure through a software that is process driven converted from policy, create a data pool similar to the same data pools collected from "Reactive Machines." This is called "IoT of things" in DT

- Specific inputs with specific exhausts for specialized duties.

"IoT of things" identifies patterns of human process data sets via mathematical algorithm imbedded into code. Historical data human process data "IoT of things" additionally inputted, provides predictions with new exhaust values.

- This is the essence of *Machine Learning (ML)*; in the IoT of things, humans become the machine, and the ML provides similar data pool opportunities like those collected with equipment data.

- Expected inputs/exhausts = *Supervised Learning for ML*, with historical data pools added. *predictability in future exhausts = Unsupervised Learning; this is the foundation of ML.*

Software and Middleware analytics contain hidden algorithms known as *"Deep Learning (DL)"* allowing for complex relationships in data to form (ontology of data), complex patterns weigh input, historical input, then weigh for best exhausts

- This is what is required to establish optical image, human speech, and language processing in AI

"Natural Language Processing (NLP)" is established with volumes of *"DL"* data teaching the software and middleware to understand and produce written and spoken language similar to humans

- This is the feature that allows for the "Ask a Question" portions of the software analytics

"Computer Vision" is the application of *"ML"* collected from DT, images, videos, in a broken-down form to provide exhaust data which identifies, organizes, and tags items in the same manner of humans accordingly.

- This is the feature where all intake of materials within an activity are sorted, organized, and routed which is beneficial for use cases such as Parts Tracking.

"Reactive Machines" react to specific inputs/exhausts, do not store memory, or rely on history to assist with a decision in real time.

- *Data collected is used for completing specialized duties in ML, as well as creating conventions for data pool collection.*

Software Semantic Analytics

Semantic Model Analytics and Ontology of data, what will this do for us = AI

"Limited Memory" uses past data and predictions based from collected intakes and exhausts to make decisions.

- Uses past data to predict

- Requires continuous training and convention to analyze and utilize new data. Or, an established AI environment enabled to Autc-Train.

* Current software analytic model does NOT pursue *"Theory Of Mind AI"*, or *"Self-Awareness AI"* as they do NOT theoretically exist.

What Type of AI effort are we interested in ?

Software and Middleware analytics possesses the foundational requirements in type of AI for:

- **Weak AI**

Software and Middleware analytics possesses the foundational requirements this kind of AI:

- **Reactive Machines**
- **Limited Memory**

Software and Middleware analytics possesses the foundational requirements to leverage the following AI tools:

- **Machine Learning**
- **Neural Networks**
- **Deep Learning**
- **Natural Language Processing**
- **Computer Vision**

**** Leveraging semantic analytics model is the foundation for enhanced AI and a major element of DT implementation***

Software Semantic Analytics

Data Engineering
Data Forensics

Semantic Modeling and
Knowledge Engineering

Data Ingest & Alignment
With V&V testing

Application Design, UI/UX
and Data Fabric Interface

Vendor | **Vendor** | **Vendor** | **Vendor**

ANAUTICS

BOM for X

VAULT

Vendor

Vendor Use Cases

- Asset Availability
- Supply Readiness Review
- Periodic Parts Maintenance
- ALC Throughput

Semantic Modelling

File structures to be provided to Semantic Modellers to create a model and provide a XML/OWL file for ingestion into DataOS

XML/OWL Files + BS2 + AA + SRR + PDM Files will be provided to DataOS to ingest

Data Fabric

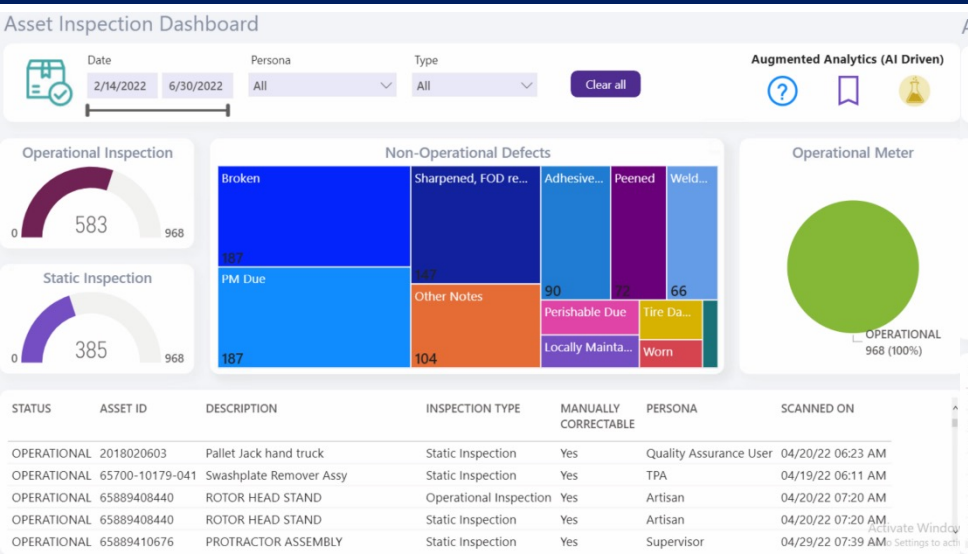
1. Ingestion -
   Data from all sources will be ingested into Data Fabric using the provided XML/OWL model to create data connections between the data sets.
2. Transformation -
   Data will be validated and transformed for data quality in DataOS based on the provided XML/OWL.
3. Cataloguing -
   Data Dictionary will be generated based on the info provided by XML/OWL. This has to be done manually if DataOS can't auto dictate using the XML/OWL.
4. Data Controls -
   Data Masking and controls will be put in place based on the requirements.
5. SWRL Query -
   Queries will be written and flare jobs will be run in order to increase efficiency on the analytics dashboards.

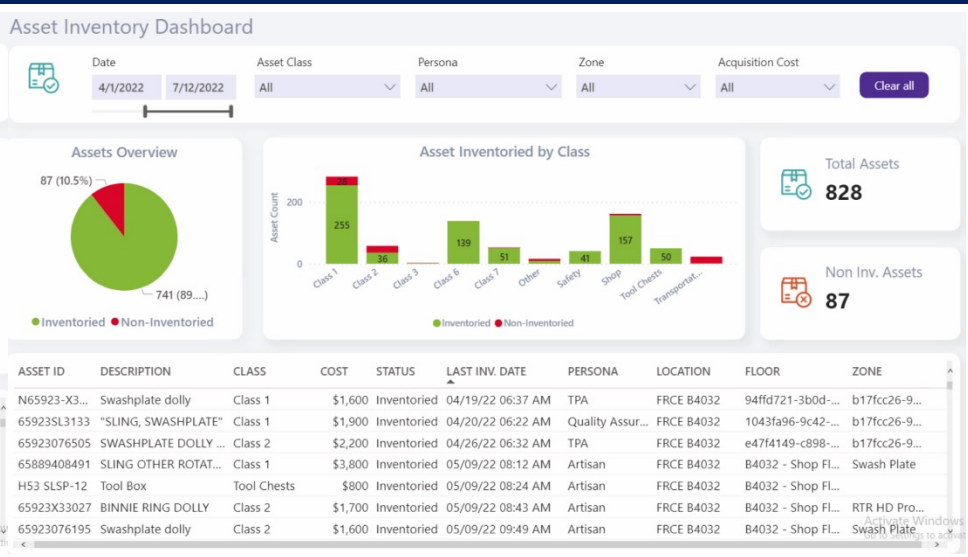
Vendor

Business Intelligence | UI / UX

Analytics and AI/ML Deeper Analysis

Software Semantic Analytics





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OPERATIONAL	2018020603	Pallet Jack hand truck	Static Inspection	Yes	Quality Assurance User	04/20/22 06:23 AM
OPERATIONAL	65700-10179-041	Swashplate Remover Assy	Static Inspection	Yes	TPA	04/19/22 06:11 AM
OPERATIONAL	65889408440	ROTOR HEAD STAND	Operational Inspection	Yes	Artisan	04/20/22 07:20 AM
OPERATIONAL	65889408440	ROTOR HEAD STAND	Static Inspection	Yes	Artisan	04/20/22 07:20 AM
OPERATIONAL	65889410676	PROTRACTOR ASSEMBLY	Static Inspection	Yes	Supervisor	04/29/22 07:39 AM

ASSET ID	DESCRIPTION	CLASS	COST	STATUS	LAST INV. DATE	PERSONA	LOCATION	FLOOR	ZONE
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65923SL3133	"SLING, SWASHPLATE"	Class 1	$1,900	Inventoried	04/20/22 06:22 AM	Quality Assur...	FRCE B4032	1043fa96-9c42-...	b17fcc26-9...
65923076505	SWASHPLATE DOLLY ...	Class 2	$2,200	Inventoried	04/26/22 06:32 AM	TPA	FRCE B4032	e47f4149-c898-...	b17fcc26-9...
65889408491	SLING OTHER ROTAT...	Class 1	$3,800	Inventoried	05/09/22 08:12 AM	Artisan	FRCE B4032	B4032 - Shop Fl...	Swash Plate
H53 SLSP-12	Tool Box	Tool Chests	$800	Inventoried	05/09/22 08:24 AM	Artisan	FRCE B4032	B4032 - Shop Fl...	
65923X33027	BINNIE RING DOLLY	Class 2	$1,700	Inventoried	05/09/22 08:43 AM	Artisan	FRCE B4032	B4032 - Shop Fl...	RTR HD Pro...
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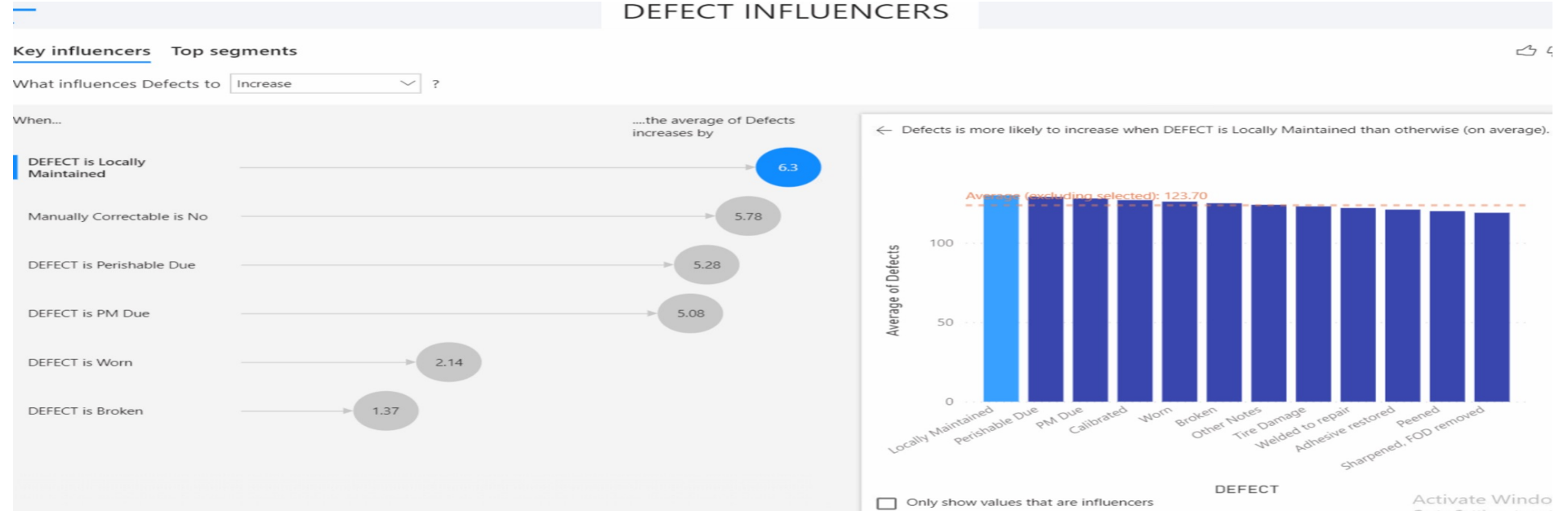
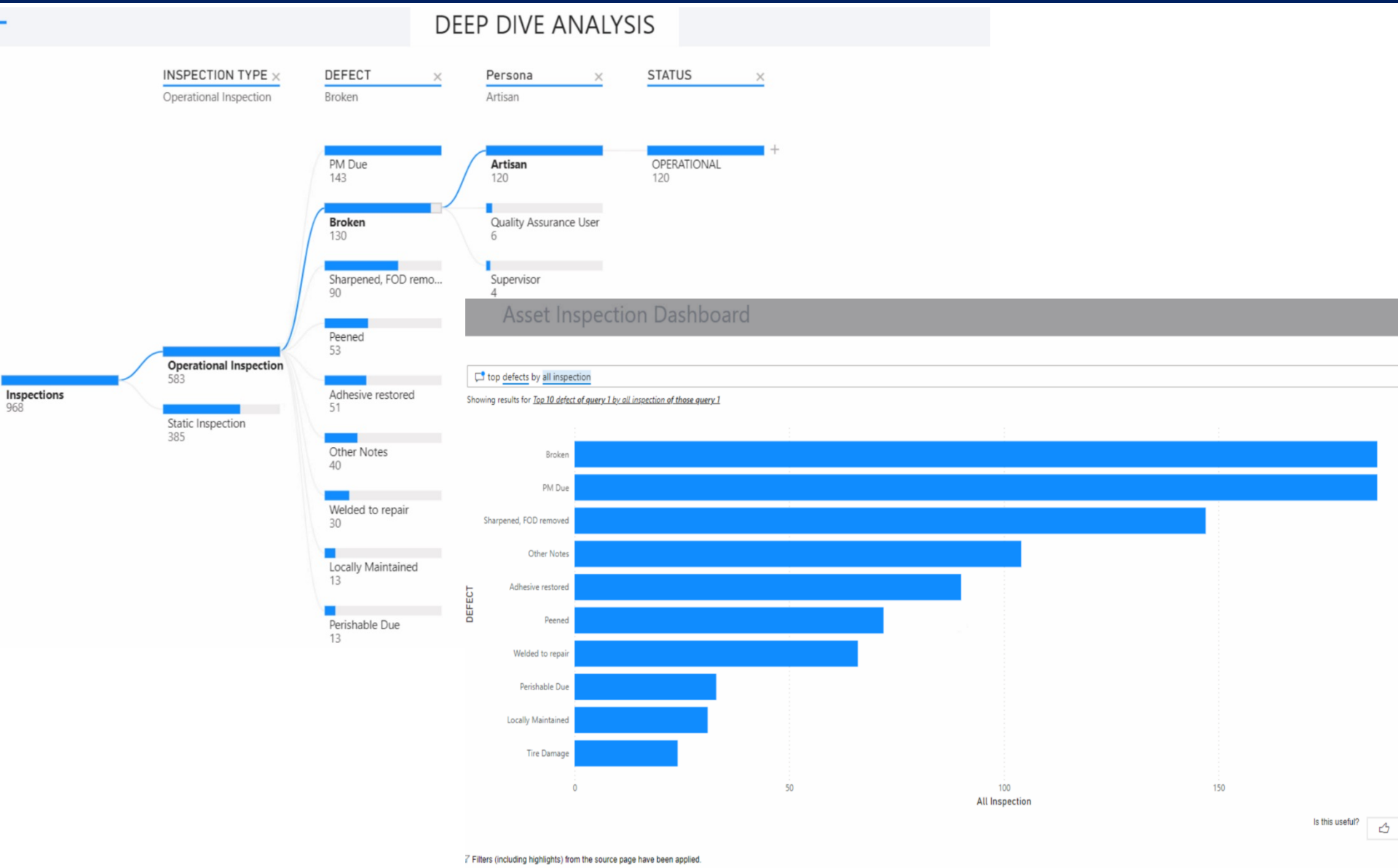


Software Semantic Analytics



Software Semantic Analytics & Ontology of Data

Software Analytics (extension of awarded SBIR II software state, NAVAIR ontology analytics, use of: semantic modeling tools)

*** FUTURE EFFORTS**

Ontology leveraging semantic modeling tools adds interconnections for: materials used, personas/person interacting, tools leveraged to effect repair, locations where best/worst actors occur, location population density, technical process ordering, and historical work order data to derive deep analytics by formalizing a system for modeling concepts and their relationships.

Unlike relational database systems, which are essentially interconnected tables, ontologies put a premium on the relationships between concepts or processes by storing the information in a software for use in predictive and augmented solutions driven by software solution modeling.

Software Semantic Analytics & Ontology of data

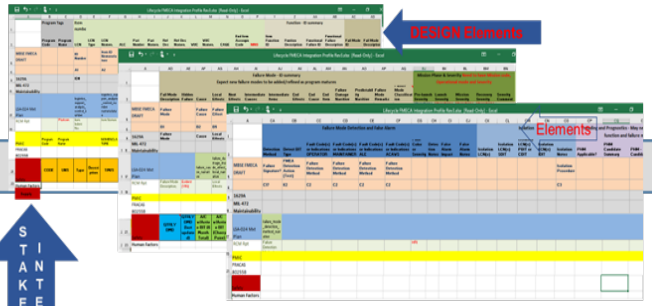
Lifecycle Design Ontology

System Design Elements
- ❑ *Definitions*
- ❑ *Format*
- ❑ *Standards*

Product Documents & Data

Lifecycle Stakeholder Interfaces, Products, Processes and Data

STAKEHOLDER INTERFACES



OWL Protégé

DEFINITION

Schema

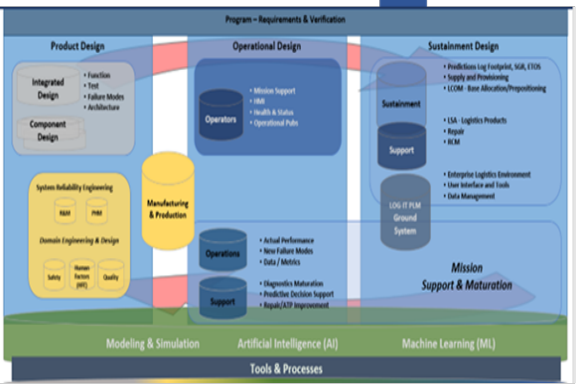
IDE

Database(s)
Tables
Datatypes

DEMO with Part/Sample of FMECA DID Part Nomenclature and MTBF & CA elements

Design Data

CAMEO



System Product Design, Engineering, Processes & Modeling

Domain Engineering, Processes & Modeling

UML, XML, SML, ATML, DAGML

Sustainment Domain Engineering, Products, Processes and Modeling

AI/ML Modeling Applications

Acquisition Domain (MBSE, Requirements Verification, Affordability, Operations, etc.) Engineering, Products, Processes and Modeling

Operational Data