Chris McCorkle

Data Science and Analysis Flight (DSAF) Flight Chief in the 418th Supply Chain Management Squadron at Tinker AFB, Oklahoma

USAF 448th Supply Chain Management Wing

- Digital Transformation in United States Air Force Supply Chain Analytics

NH-04, Mr. Chris McCorkle
Data Science and Analysis Flight Chief
USAF 418 SCMS/GUBB
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Agenda

- **USAF 448th Supply Chain Overview**

- **DSAF Key Capabilities**

- **448th SCMW Analytics Strategic Vision**

- **USAF Supply Chain Analytics Journey**

- **ZTDF BOM 360**

- **Next Higher Assembly Graph Modeling**

- **Quantum Computing (QC)**

- **Robotics Process Automation (RPA)**

- **Future Plans**

USAF 448th Supply Chain Overview

638 SCMG Robins AFB, Georgia

- ❖ C-5, C-130, F-15 Structural & Avionics
- ❖ Common Avionics, Electronic Warfare
- ❖ Special Operations Forces/Personnel Recovery
- ❖ Support Equipment (Automatic Test Systems & Vehicles)
- ❖ Armament Accessories
- ❖ Global Hawk

748 SCMG Hill AFB, Utah

- ❖ A-10, F-16, T-38 Structural & Avionics
- ❖ Intercontinental Ballistic Missiles
- ❖ Landing Gear, Secondary Power
- ❖ Space & Command, Control, Communications and Intelligence
- ❖ Sustainment and Support of Critical Items Associated with the Nation's Nuclear Enterprise

848 SCMG Tinker AFB, Oklahoma

- ❖ Propulsion
- ❖ Instruments
- ❖ Accessories
- ❖ KC-135, B-52, B-1, B-2, E-3 Structural
- ❖ KC-46, B-21 Weapon System Support

948 SCMG Tinker AFB, Oklahoma

- ❖ Enterprise Support for Performance Mgmt. Business Processes and Procedures
- ❖ Supply Chain Risk Management/Budget
- ❖ Data Sciences and Analysis ⭐
- ❖ Supply Chain Planning/Strategic Sourcing/ Foreign Military Sales
- ❖ Workforce Development
- ❖ Category Mgmt., Performance Mgmt.

Supplying Warfighter Dominance

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Data Science and Analysis Flight Capabilities

Mission
Provide objective, accurate, and timely information to Senior Leaders so they can make better/informed decisions

Vision
DSAF is able to cut through anecdotes, conventional wisdom, and volumes of data to find and expose the _truth_

- Artificial Intelligence
- Big Data & Analytics
- Operations Research
- Data Science
- Data Visualization
- Robotics Process Automation
- Machine Learning
- Trending, Diagnostics, & Prognostics
- Digital Engineering
- Computer Vision
- Zero Trust Data Fabric
- Digital BOM
- Simulation
- Quantum Computing
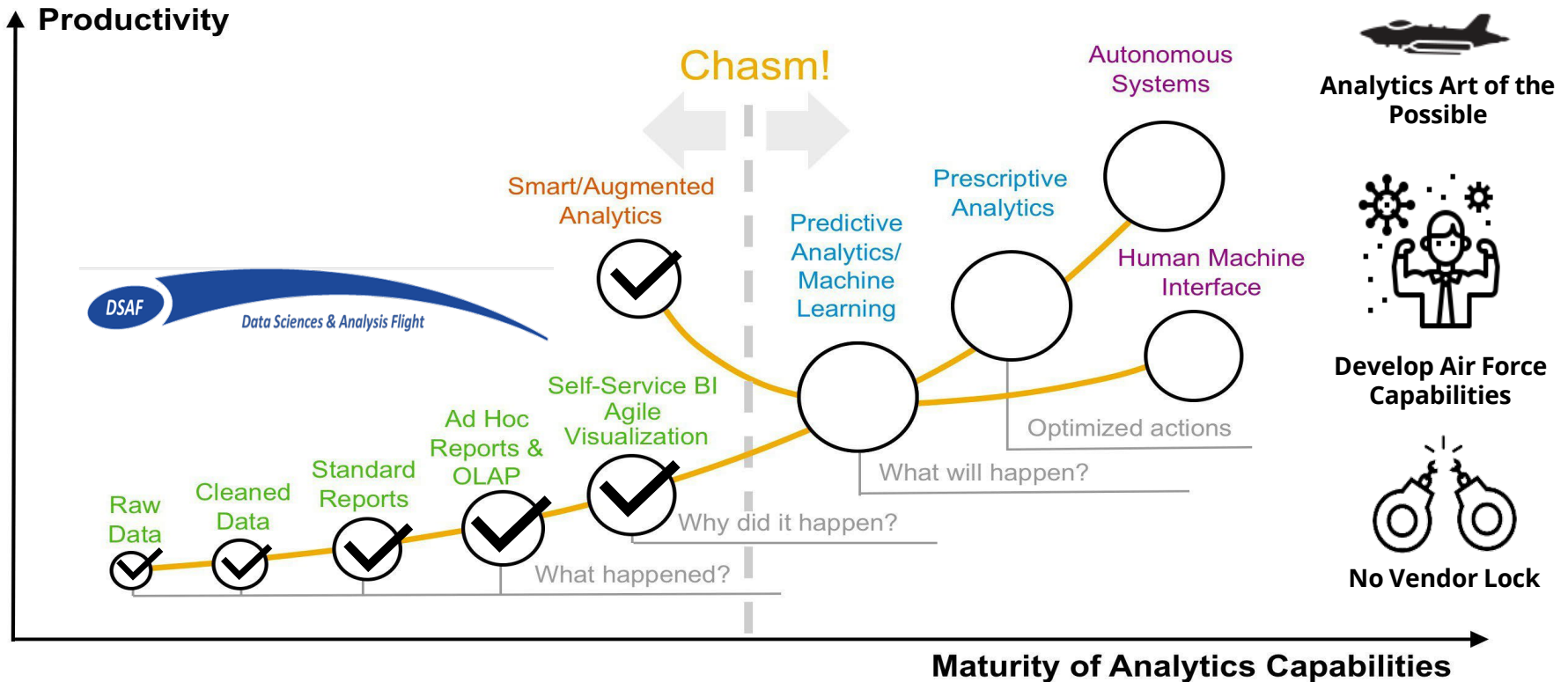- Self Service Analytics
- Data Architecture

Data Science and Analysis Flight (DSAF)

- Deliver Industry Standard Analysis Capabilities to SCM Enterprise

- Strategic Research, Studies, and Analysis

- Robotics Process Automation
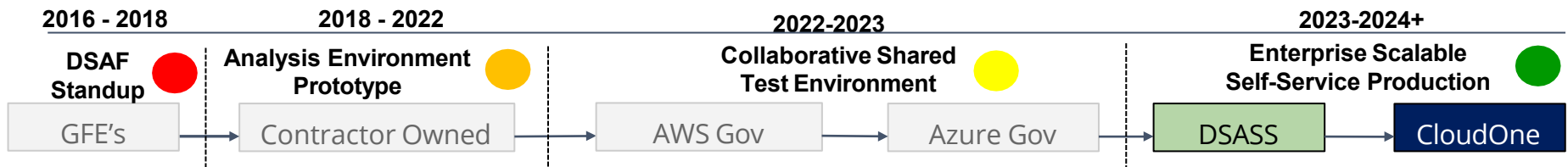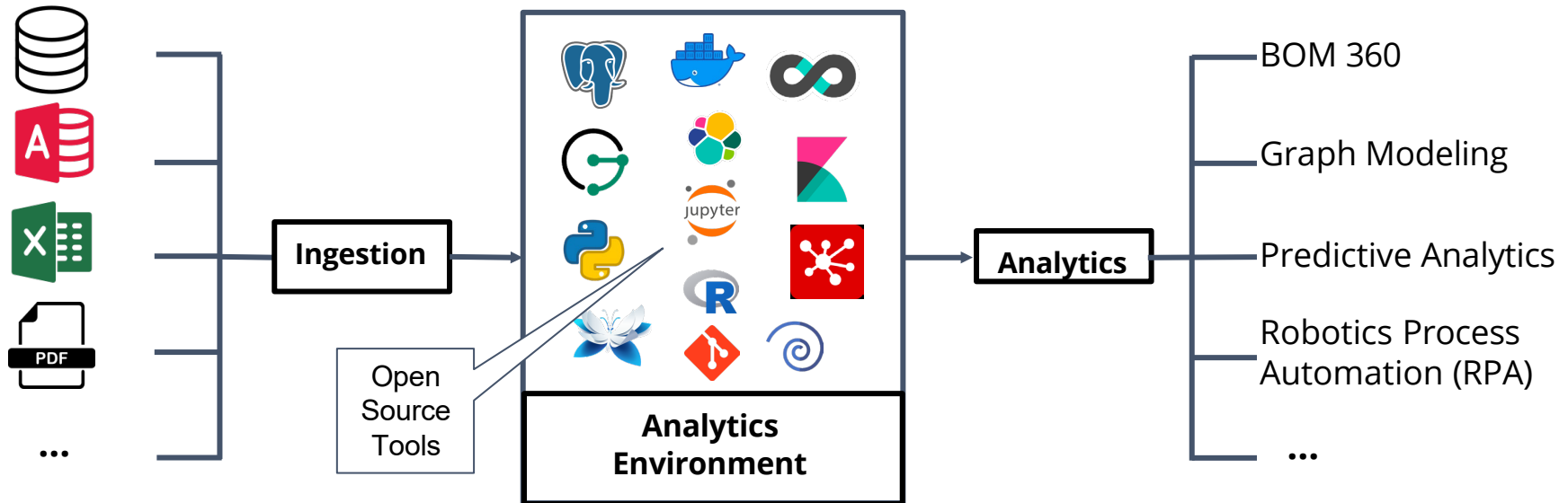
- Mature Data Science and Advanced Analytics

Productivity

Chasm!

Autonomous Systems

Analytics Art of the Possible

Smart/Augmented Analytics

Prescriptive Analytics

Predictive Analytics/ Machine Learning

Human Machine Interface

Develop Air Force Capabilities

DSAF — *Data Sciences & Analysis Flight*

Self-Service BI Agile Visualization

Optimized actions

What will happen?

No Vendor Lock

Ad Hoc Reports & OLAP

Standard Reports

Why did it happen?

Raw Data

Cleaned Data

What happened?

Maturity of Analytics Capabilities

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USAF Supply Chain Analytics Journey

| 2016 - 2018	2018 - 2022	2022-2023	2023-2024+
DSAF Standup 🔴	**Analysis Environment Prototype** 🟠	**Collaborative Shared Test Environment** 🟡	**Enterprise Scalable Self-Service Production** 🟢
GFE's	Contractor Owned	AWS Gov → Azure Gov	DSASS → CloudOne

ZTDF BOM360 Vision

- Manual effort for "Perfect BOM" estimated at 10Y/$750M across all weapon systems – *rethink approach*
- AFSC/EN vision for building a common, digital BOM across all weapons systems
    - Human out of the loop, 0% data loss, continuous data-driven improvements, automation at the heart of every action
    - All weapon systems with a "Good Enough" or "Getting Started" BOM over next 2-3 years

Ingest/sync with files or systems
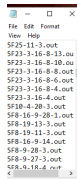
Kedro Pipeline
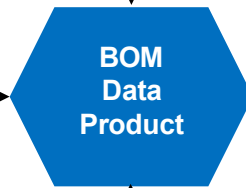Ingestion, verification, validation and recommendation pipeline
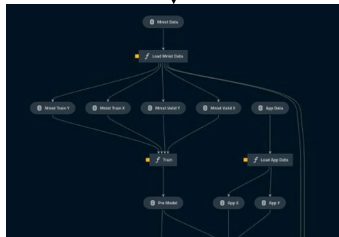
J85: Extracted 21,000+ parts (9,600 unique) - 4 minutes

DSAF/Logistics
- D043
- G005M

Logistics Data

Continuous Improvement

BOM Data Product

Consume

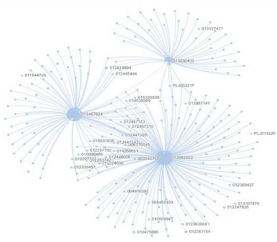Sustainment Data

MROi
- REMIS
- PDMSS

BOM Insights from different viewpoints
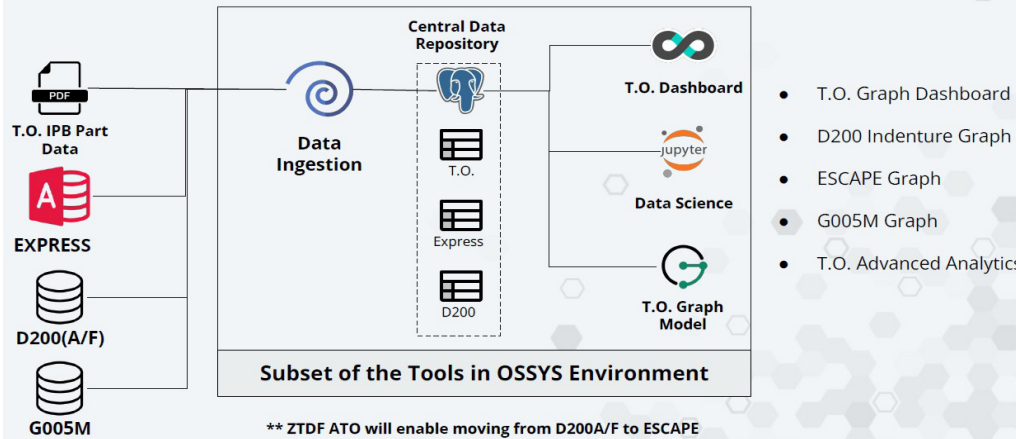
ML/AI Technology: Graph Modeling
AFSC

Business Need:
Modeled representation of indentured relationships to visualize and perform advanced analytics on connected dependencies
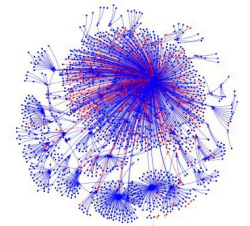
Next Higher Assembly Graph Models

Central Data Repository

T.O. IPB Part Data

EXPRESS

D200(A/F)

G005M

Data Ingestion

T.O.

Express

D200

T.O. Dashboard

Data Science

T.O. Graph Model

- T.O. Graph Dashboard
- D200 Indenture Graph
- ESCAPE Graph
- G005M Graph
- T.O. Advanced Analytics

Subset of the Tools in OSSYS Environment

** ZTDF ATO will enable moving from D200A/F to ESCAPE

Key Features:
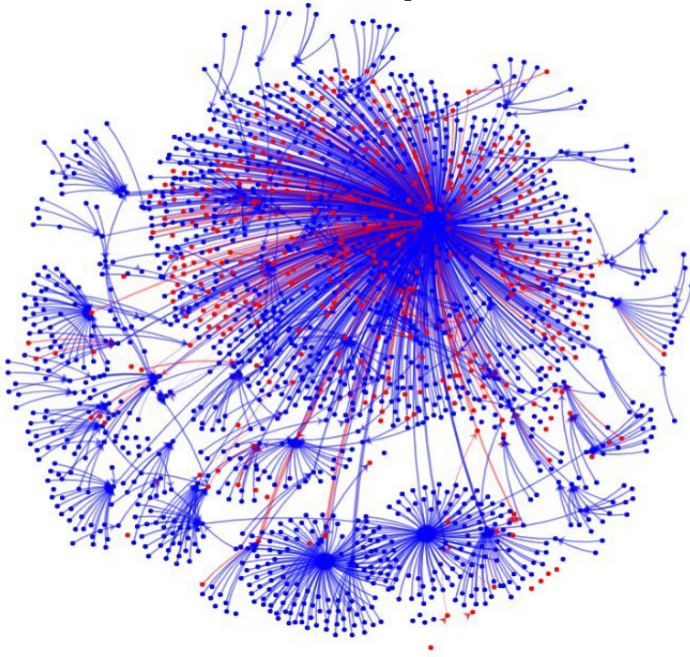Graph databases and models are an emerging technology and analytics space under active research

Results:
Next Higher Assembly (NHA) graphs generated using Enterprise Supply Chain Analysis Planning Execution (ESCAPE) Bill of Materials (BOMs). Used to show supply chain interconnectivity and supply chain complexity. Used to identify Mission Impaired Capability Awaiting Parts (MICAP) items and connected relationships, as well as the combined impact on F-15E aircraft.

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Weapon System (WS) MICAP Blast Radius

WS NHA Graph Model

- **For MICAP NIINs, what other parts up the indenture tree are affected?**

- **Each node is a NIIN or WS**
  - **Blue - No MICAP**
  - **Red - MICAP**

- **Each edge between nodes points from sub-component to Next Higher Assembly (NHA)**

- **Summary statistics over 10yrs MICAP data**
  - **1,987 Nodes/NIINs in graph**
  - **2,168 Edges**
  - **530 unique MICAP'd NIINs**
    - **1,352 MICAP Total Incidents**
    - **518,126 MICAP Total Hours**
    - **424 organically repaired MICAP'd NIINs**

F-15E MICAP Blast Radius *with Contract (KTR)* Suppliers

Competitive

Sole Source
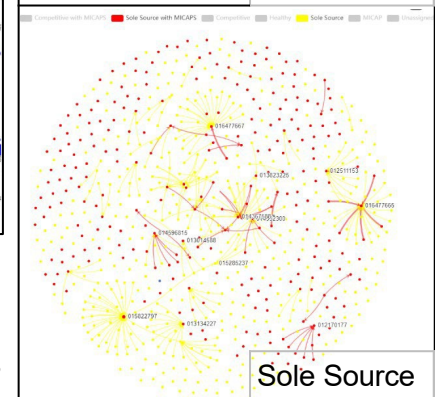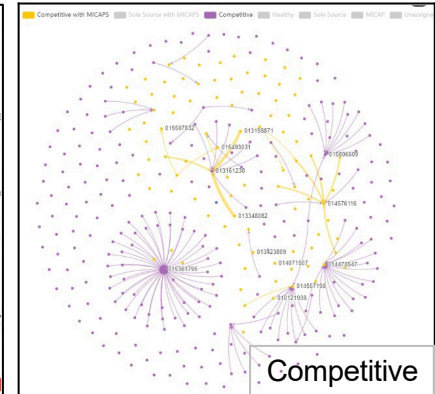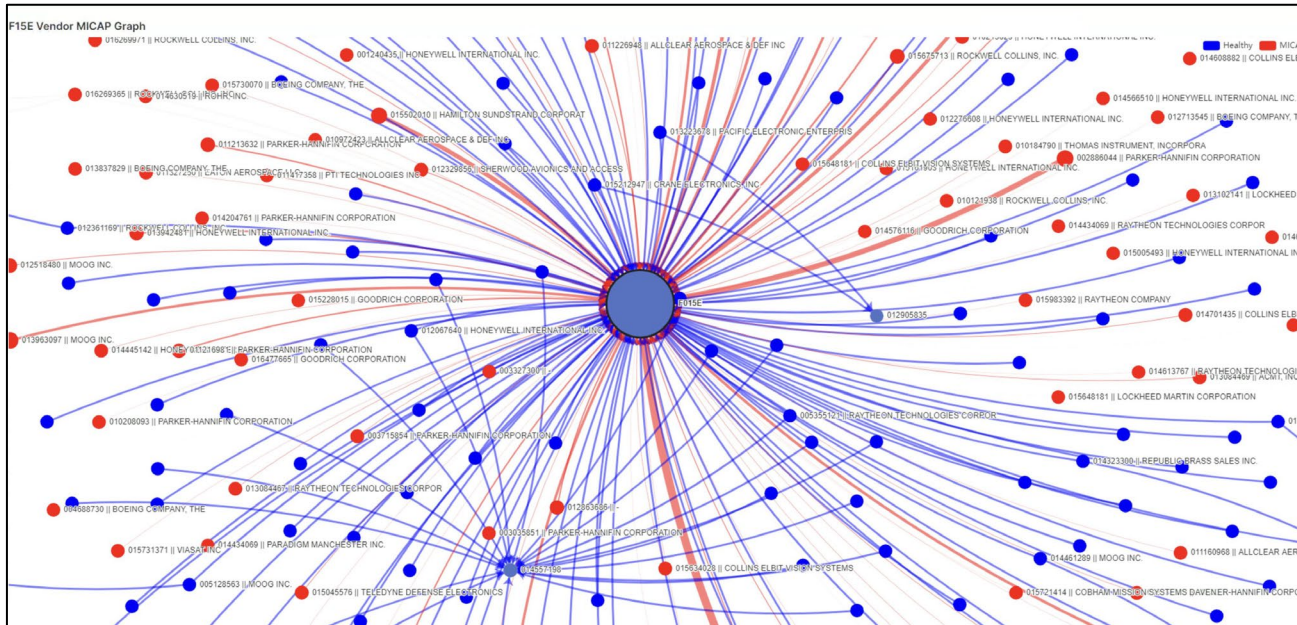
DSAF currently uses Graph Models to analyze relationships between WS MICAPs and USAF Managed Items repaired by KTRs to identify potential weaknesses in Supply Chain.

Future Implementation: Develop Machine Learning Predictions of KTR On Time Deliveries (OTD) Failures

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Quantum Computing (QC)

ML/AI Technology: Quantum Computing Predictive Algorithms
448 SCMW

Business Need:
Low Demand and Highly Variable Items are historically unforecastable using classical forecasting methods.

Key Features:
Cutting-edge technology, learning curve with research and development

Combines Machine Learning with the power of Quantum Computing to improve supportability for low demand and highly variable items
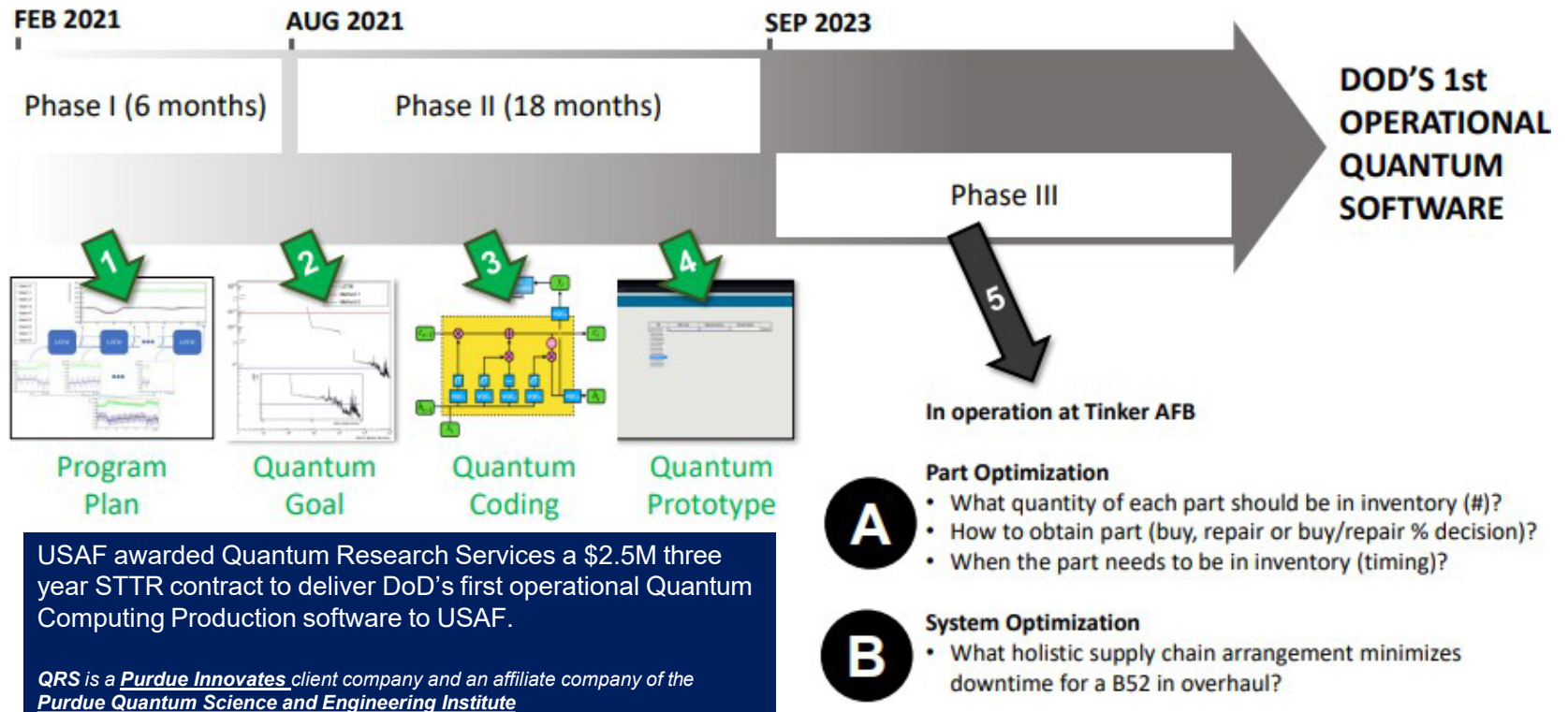
Results:
Uses Quantum Computing with machine learning to generate the algorithms used for each item to recommend buy and repair requirements based on the unique demand history of an item. The tool is moving from theoretical models to production in FY24.

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Quantum Program At-A-Glance

FEB 2021
AUG 2021
SEP 2023

Phase I (6 months)
Phase II (18 months)
Phase III

DOD'S 1st OPERATIONAL QUANTUM SOFTWARE

1. Program Plan
2. Quantum Goal
3. Quantum Coding
4. Quantum Prototype

5. In operation at Tinker AFB

USAF awarded Quantum Research Services a $2.5M three year STTR contract to deliver DoD's first operational Quantum Computing Production software to USAF.

*QRS is a **Purdue Innovates** client company and an affiliate company of the **Purdue Quantum Science and Engineering Institute***

A **Part Optimization**
- What quantity of each part should be in inventory (#)?
- How to obtain part (buy, repair or buy/repair % decision)?
- When the part needs to be in inventory (timing)?

B **System Optimization**
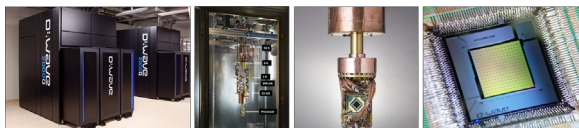- What holistic supply chain arrangement minimizes downtime for a B52 in overhaul?

Particle Physics & Quantum Computing

The Jung research group @Purdue:

- Solve High Energy Physics "data challenges" by Quantum Annealing and gate-based QC
  - D-Wave, IBM-Q, Quantinuum

  - Harvest wealth of Large Hadron Collider data by Machine Learning & AI, Nov 2022
    - **Purdue physicists awarded DOE grant for high energy physics and AI**
      https://www.physics.purdue.edu/news/2022/1201_jung_liu_doe.html
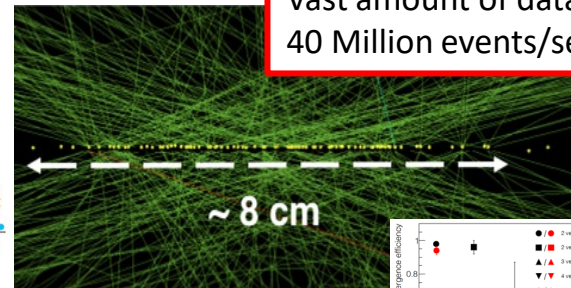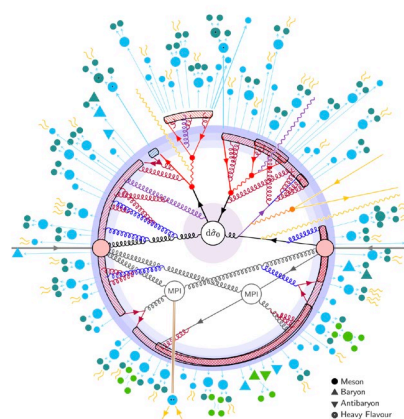
- **Apply developments for real-world problems**
  - Supply-Chain challenges: DoD Tinker AF
  - <u>Core team:</u>
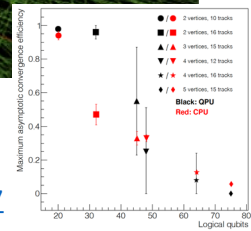   - Prof A. Jung, PhD cand. AJ Wildridge and E. Krimins (CEO, QRS)

Vast amount of data:
40 Million events/sec

~ 8 cm

Submitted o NIM A
S.Das, AJ. Wildridge, A.Jung
https://arxiv.org/abs/1903.0887
9

A. Jung

Robotics Process Automation (RPA)

Technology: UI Path Automation
448 SCMW

Business Need:
Repetitive, rules-based tasks consume a significant amount of manpower hours that can be allocated to more valuable efforts.

Key Features
- Low to no-code Commercial Off the Shelf technology
- Automates repetitive, low-value workload

Results:
Currently 10 RPAs are deployed into Production
ROI Estimate: ~ 900+ Man Hrs

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RPA Program At-A-Glance

Program Performance

Bots in Production:
10

Bots in Development:
3

Bots in Queue:
8

Time Savings

Time Saved:
~ 900 Hours

Average Development Time:
6 weeks

Average Time Savings:
91%

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Top Automations

Hiring Matrix	**Mineral Bot**
Saves an average of 10 hours per month; Expected to increase	Saves 80 hours per month
*Demo	*Demo

M024B	**Gains Loss**
Saves contracting (RIPIT) and licensing costs (SAS)	Saves 4 hours per month
*Demo	*Demo

FMS Daily Backorder	**BusyBotty**
Saves 60 hours per month	Saves 4 hours per month per user

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Future Plans

■ Advanced Analytics

- **■** Continue USAF ML/AI Maturity
- **■** Operationalize ZTDF
- **■** Productionize Quantum Models
- **■** Predictive/Prescriptive Analytics
- **■** Generative AI Use Cases
- **■** Neural Networks and Deep Learning

■ Robotics Process Automation (RPA)

- **■** High ROI Enterprise Bots
- **■** Productionize Unattended Bots
- **■** SMART Bot (AI/ML) Integration

AI Maturity Model

Level 1 Awareness	Level 2 Active	Level 3 Operational	Level 4 Systemic	Level 5 Transformational
				AI is part of business DNA
			AI is pervasively used for digital process and chain transformation, and disruptive new digital business models	
		AI in production, creating value by e.g., process optimization or product/service innovations		
	AI experimentation, mostly in a data science context			
Early AI interest with risk of overhyping				

gartner.com/SmarterWithGartner

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Questions?