Headquarters U.S. Air Force

I n t e g r i t y - S e r v i c e - E x c e l l e n c e

Quantitative Augmentation via Neuro-evolutionary Technologies toward Ubiquitous Modeling (QuANTUM)

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Quantitative Augmentation
AF/A9
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Variation 4
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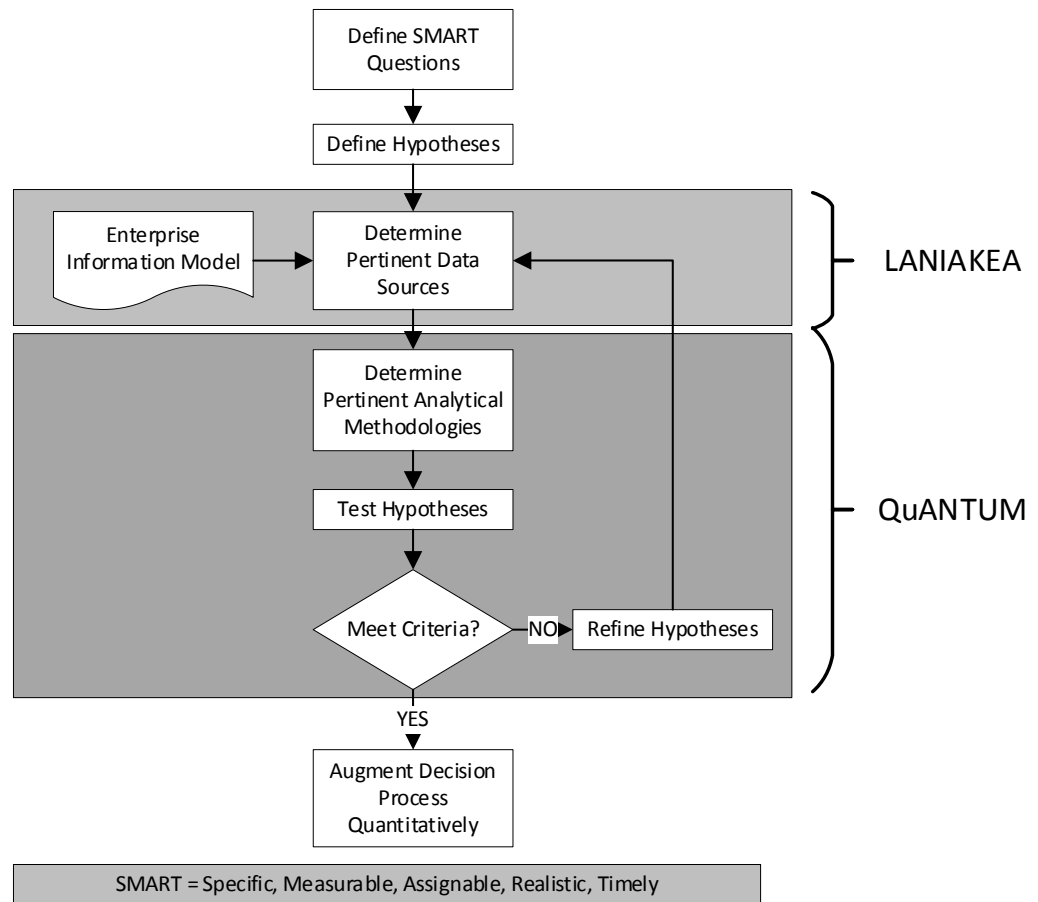
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The Air Force, and many organizations, faced severe challenges:

- **Limited exposure to hypothesis testing**
- **Insufficient substantiation due to "data anemia"**
- **Insufficient analytical rigor to justify position**
- **Lack of analytical knowledge available**
  - **Scientific analysts are in high demand and low supply**
  - **Assumptions to use a methodology are often overlooked**
- **Lack of toolsets to carry out necessary analytics**
  - **Network policies guard security but limit analytical capability**
  - **Tools are expensive and not purchased for the enterprise as a whole**
- **Lack of common language to communicate position DoD-wide**
  - **Based on English and not on math (e.g. Fully-Burdened Cost)**
  - **Undefined, Ambiguous, or inconsistent definitions**

- **Quantitative Augmentation (QA) injects the scientific process into the decision process**

- **QA couples the four tenants of scientific experimentation:**
    - **Hypothesis**
    - **Data (Observations)**
    - **Methodology**
    - **Test**

- **Ensure that hypotheses can be substantiated or repudiated**
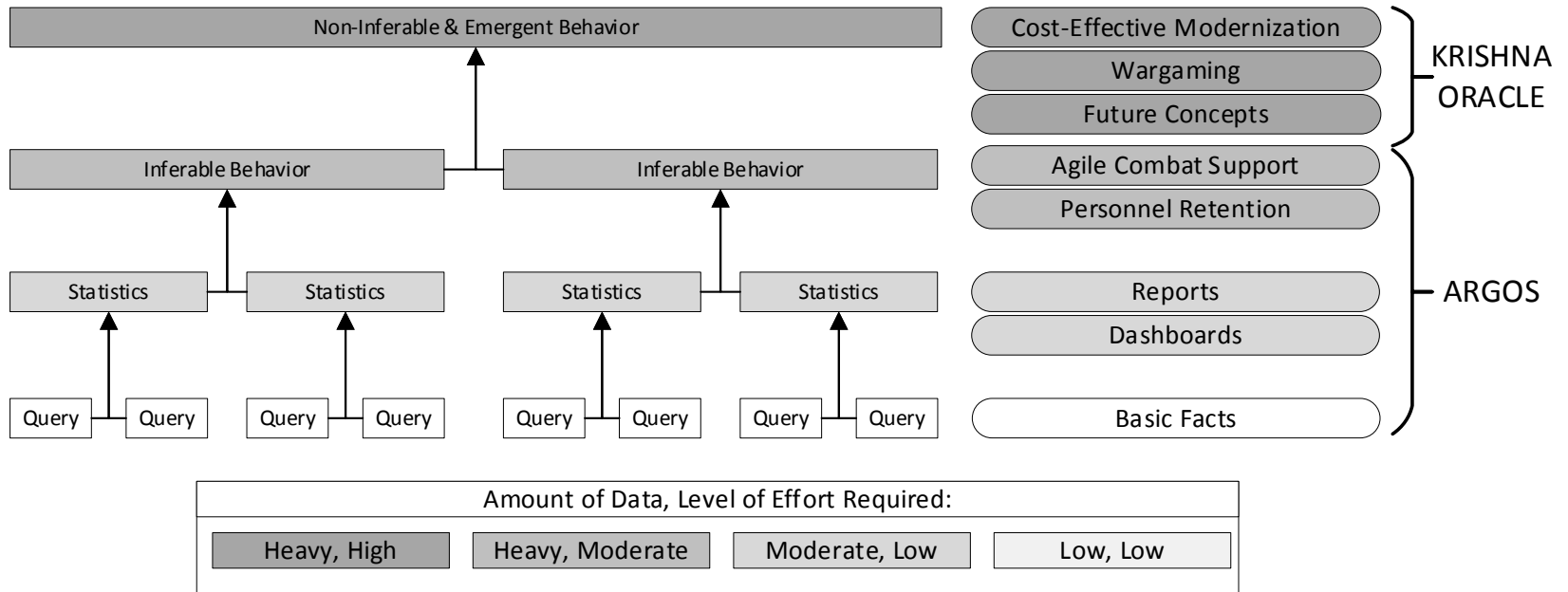
- **Results can be replicated**

Flowchart:
Define SMART Questions → Define Hypotheses → Determine Pertinent Data Sources (Enterprise Information Model → Determine Pertinent Data Sources) [LANIAKEA] → Determine Pertinent Analytical Methodologies → Test Hypotheses → Meet Criteria? → NO → Refine Hypotheses (loops back) [QuANTUM] → YES → Augment Decision Process Quantitatively

SMART = Specific, Measurable, Assignable, Realistic, Timely

- **There are different categories of S.M.A.R.T. Questions**

- **Each requires a modified or different methodology or methodologies to address**

- **Understanding the type of question is the first step to answering it**

Non-Inferable & Emergent Behavior

Inferable Behavior · Inferable Behavior

Statistics · Statistics · Statistics · Statistics

Query · Query · Query · Query · Query · Query · Query · Query

Cost-Effective Modernization
Wargaming
Future Concepts
} KRISHNA ORACLE

Agile Combat Support
Personnel Retention

Reports
Dashboards

Basic Facts
} ARGOS

Amount of Data, Level of Effort Required:
Heavy, High | Heavy, Moderate | Moderate, Low | Low, Low
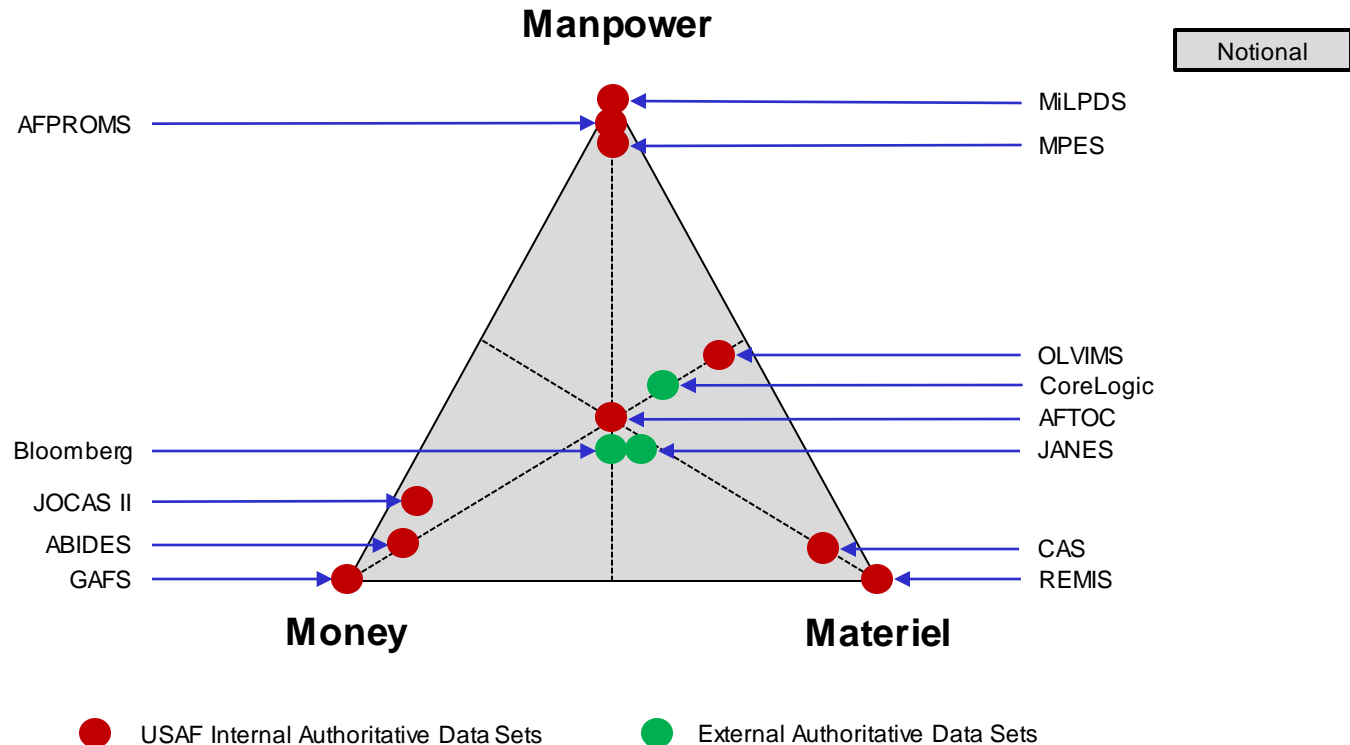
M³ Paradigm

We may dissect most senior-level enterprise-wide questions into three core tenants:

Manpower   **Money**   **Materiel**

…and map authoritative data sets to those…

Manpower

Notional

AFPROMS →

MiLPDS
MPES

OLVIMS
CoreLogic
AFTOC
JANES

Bloomberg →
JOCAS II →
ABIDES →
GAFS →

CAS
REMIS

Money   **Materiel**

● USAF Internal Authoritative Data Sets   ● External Authoritative Data Sets

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Strategic Overview

| QuANTUM	LANIAKEA	PERSEUS
Cross-Domain/Functional Analytical Platform comprised of 4 Stages: • ARGOS • KRISHNA • ORACLE • KRONOS	AF Galactic Data Supercluster of Authoritative Data	AF Galactic Data Supercluster of Synthetic Data

- **ARGOS**
  - Provides insights into potential historical relationships
  - Requires historical, authoritative data (via LANIAKEA)
- **KRISHNA**
  - Provides prescriptive solutions to AF portfolio configuration
  - Evaluates aggregated and emergent-types of effects (e.g. effectiveness, lethality, agility, etc.) stochastically via massively distributed, parallel, physics-based, imperfect information, multi-AI-driven simulations at the campaign/multi-campaign level.
- **ORACLE**
  - Provides postulation of new weapon system platforms
  - Solution requires traversing multi-variate capability-to-cost curve
  - Requires Specifications-to-Cost hypersurface via QuANTUM-ARGOS
- **KRONOS**
  - Provides multiple improved portfolio scheduling trajectories to move from a current portfolio to an improved solution given a constraint set
  - Technical Term: Resource-Constrained Weighted Scheduling Optimization Problem (RCWSOP)
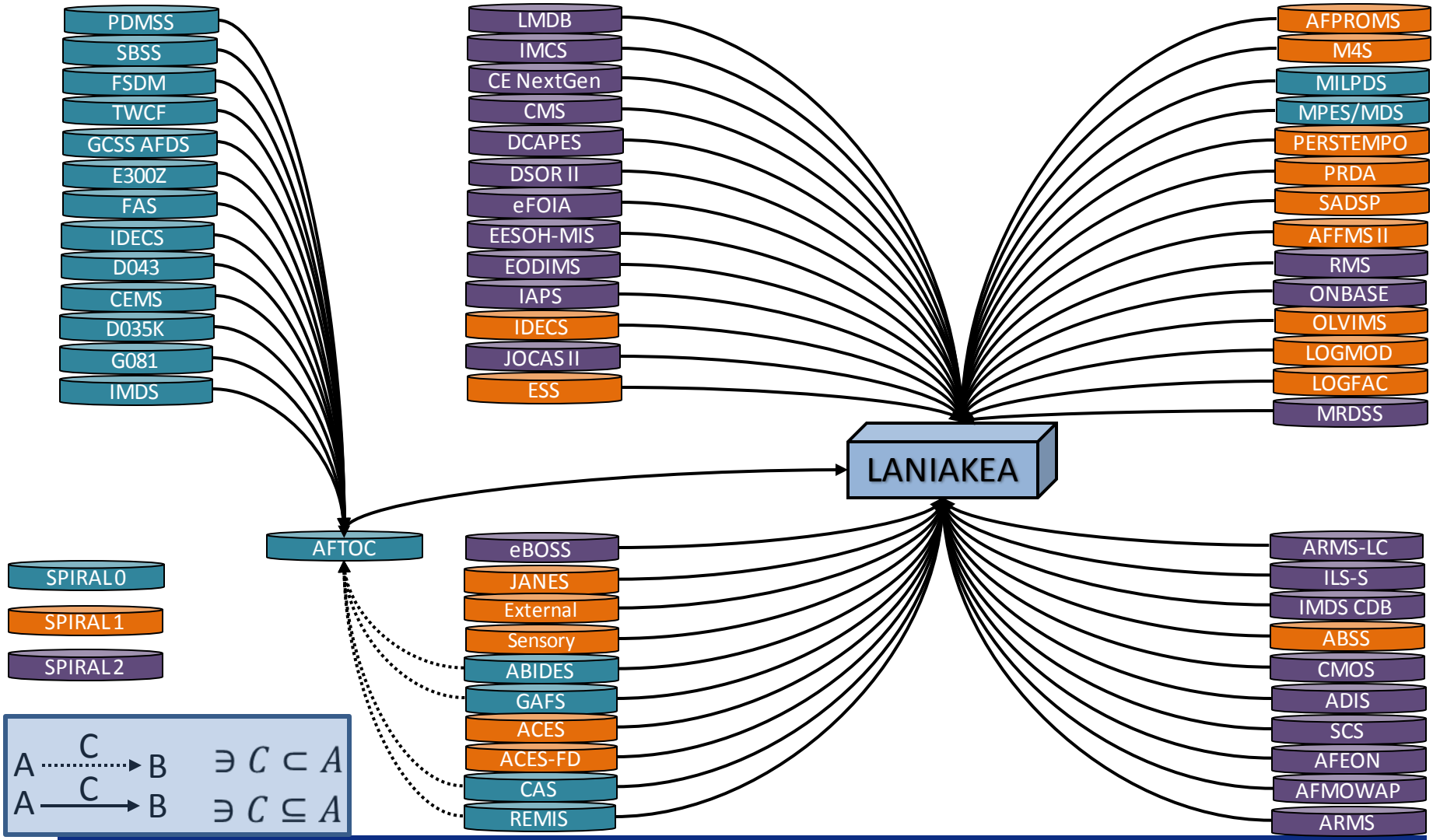
Future Deliverables Synopsis

- **Active Cloud instance (LANIAKEA) that QuANTUM can access**
    - **Cloud storage**
    - **Cloud computing**
    - **Redundant backups**
    - **Tailored cost based on use**

- **Virtual and analytical platform for development and access to LANIAKEA: ARGOS**

- **Data Portfolio-as-a-Service (DPaaS)**

- **Algorithmic Portfolio-as-a-Service (APaaS)**

- **Validate platform's utility based on complex AF issues:**
    - **Agile Combat Support (support tail of the AF, ~40% TOA)**
    - **Personnel Recruitment & Retention (PR&R)**

- **Data Reports**

- **Lessons Learned**

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