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# Digital Collaborative Ecosystem for Transition of AF Targeting Capabilities

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# Outline

- Why AFTES?
- Modular Open Systems Architecture
- AFTES Ecosystem
- AF Transition Pipeline
- AFCER
- Academia and R&D Use Cases

# Why AFTES?

## Per Interim National Security Strategic Guidance (March 2021)

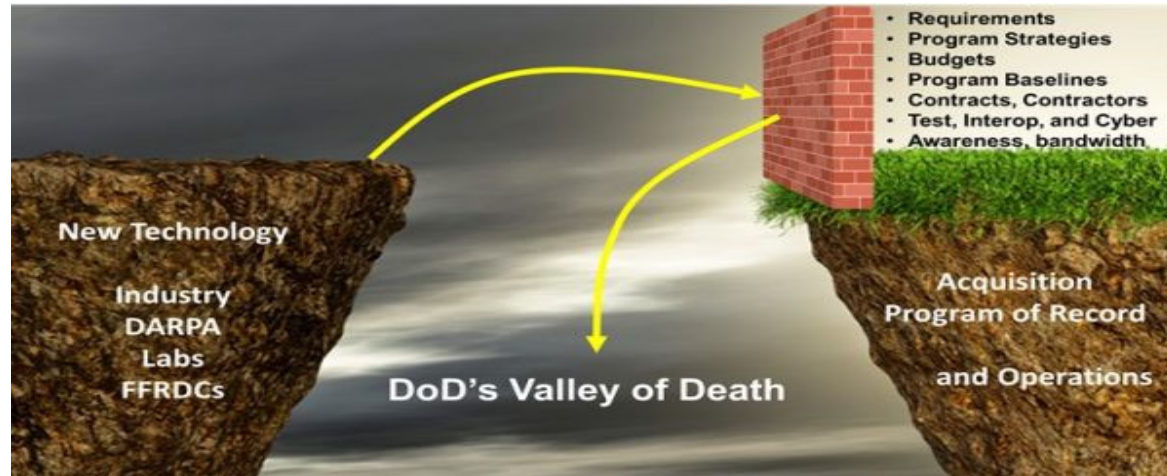
- In the face of strategic challenges from an increasingly assertive **China** and destabilizing **Russia**:
  - Shift emphasis from unneeded legacy platforms and weapons systems to free up resources for investments in the **cutting-edge technologies and capabilities** that will determine our military and national security advantage in the future.
  - **Streamline the processes** for developing, testing, acquiring, deploying, and securing these technologies.
  - Ensure that we have the skilled workforce to acquire, integrate, and operate them.
- ACC Agile Combat Employment (ACE) LOE
- ACC Advance Intelligence Infrastructure and Tools for JADC2 LOE
- Operational Imperative 2 - Achieving Operationally Operationally Optimized ABMS/AF JADC2
- Support Critical Operational Enablers

## AFTES Focus

- **Digital transformation strategies** to mature and transition AF M&S in support of targeting cycle activities and acquisition
  - Software transition from development to operations seamlessly @ **“speed of need”**
    - Facilitate quick pivot and adaptability to meet evolving warfighter requirements
    - Seamlessly warp from **tech stack to edge**
  - **Interoperability**
    - Align with AF programs through **digital thread**, AF Government Reference Architectures and **AF ASoT for AF lethality community of practices** to support Convergence of Effects
      - Supports **ABMS** efforts
  - **Transition M&S to support** weaponeering, CDE and geospatial elements in **peer/near peer adversary engagement**
  - Streamline Training requirements for operational users

- There is a need to accelerate transition of AF capabilities from R&D to operationally ready
- There is a need to change from legacy SOPs for capability development

# Need to Effectively Transition from R&D to Operationally Ready



<https://aida.mitre.org/blog/2022/03/17/program-valley-of-death/>

- Exploring digitally transformed SOPs for technology maturation and transition
- AFTESx/AFTES Ecosystem brings together Lethality MS&A from R&D to Acquisition and Operational through an architectural approach
- Working towards goal of accelerating ability to get capability and data to where it is needed rapidly, analyze and make decisions – in support of near term with scalability/extensibility to future capability
- Injecting early operational feedback as capabilities mature

# AFTES Digital Collaborative Ecosystem Objective

- **Motivation:** Legacy maturation and transition of AF lethality and vulnerability methodology and data has struggled to meet operational timelines required to meet peer adversary challenges.
- To mitigate the above, AFLCMC/EBRW and AFRL/RWSA have developed a **collaborative digital ecosystem to facilitate and anchor transition** of AF lethality and vulnerability methodology and data
- Utilizing digital infrastructure, principles of agile development, modular open system architecture and common software development and data management strategies, the AFTESx / AFTES ecosystem was created to support digital transition of capabilities in a time, cost and resource efficient manner.
  - ACC/A22T is providing input to ensure transparent requirements are lined up with operational goals to streamline the process of transitioning capability in support of AF targeting from R&D to operationally ready.
- AFLCMC EBRW, AFRL and ACC A22T have benefited from this collaboration from the perspective of **strategic roadmap planning, risk reduction as well as early and frequent operational stakeholder input to enable expedited delivery of interoperable, modular, operationally ready lethality and vulnerability M&S capability.**

# Digital Engineering Strategy

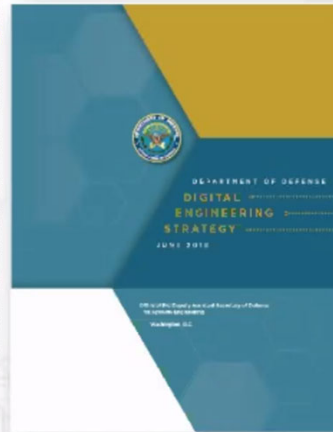
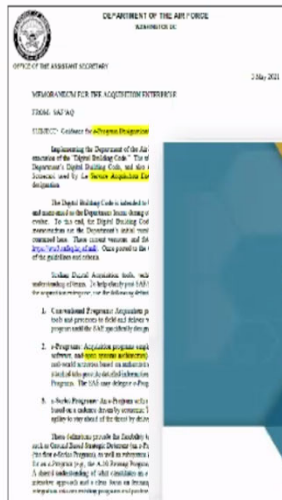


## Why Are We Here?

### Digital Engineering Strategy:

- More robust engineering practices
- Advanced and cost-effective weapons systems
- Maintain superiority against threats.
- Employ the "digital trinity" (digital engineering, agile software, and open systems architecture)

**SAF/AQ e-Program Designation** – Provides "Digital Building Code" implementation guidance and metrics for achieving the department's e-Program Designation for Digital Acquisition.



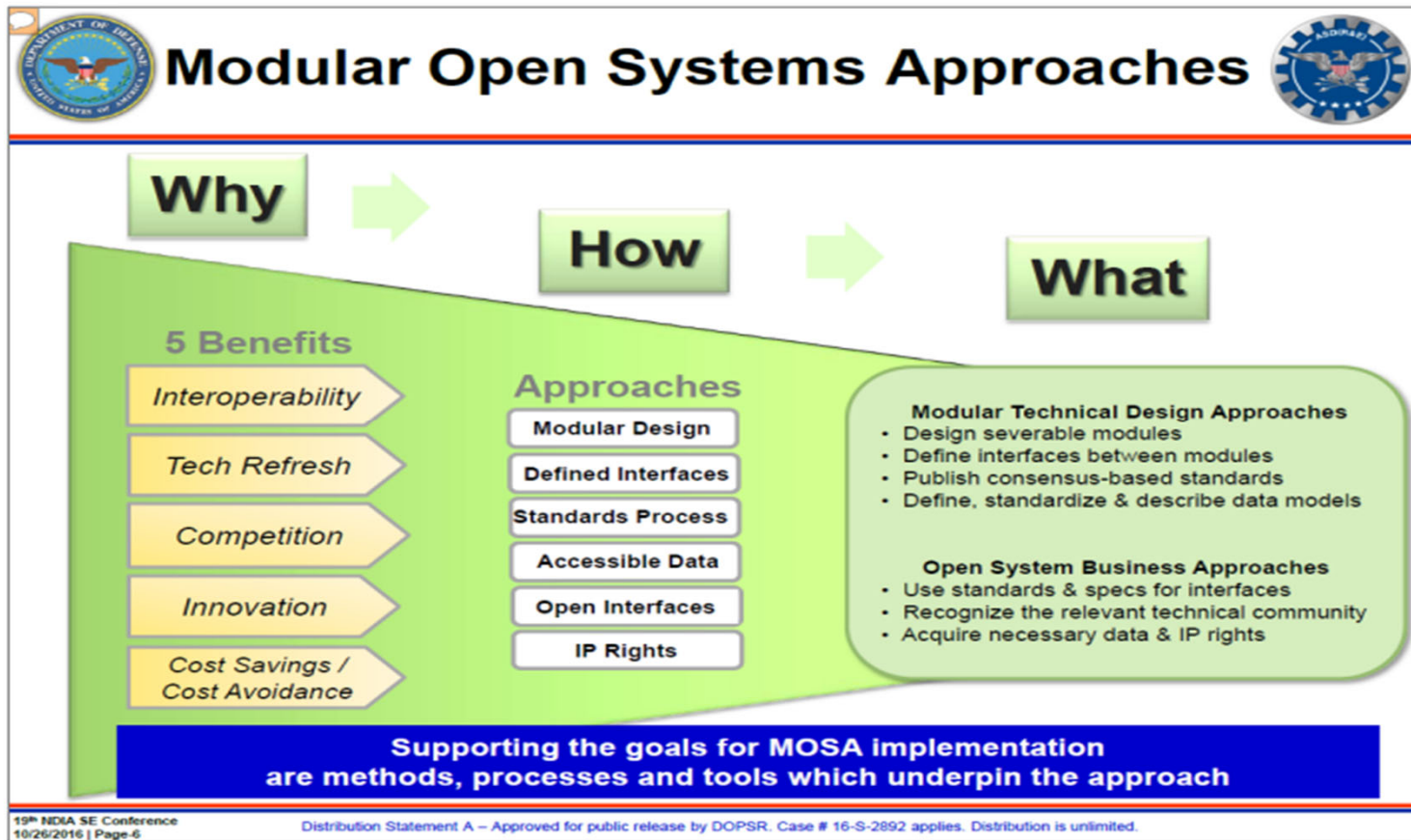
- 1 Formalize the **development, integration and use of models** to inform enterprise and program decision making
- 2 Provide an enduring **authoritative source of truth**
- 3 Incorporate **technological innovation** to link digital models of the actual system with the physical system in the real world
- 4 Establish supporting **infrastructure and environments** to perform activities, collaborate, and communicate across stakeholders
- 5 Transform a **culture and workforce** that adopts and supports Digital across the lifecycle

### The Problem:

- Programs and warfighting mission sets are not integrated across weapon systems
- JADC2 / ABMS mandate "holistic integration"
- A Common and Standardized communication method is needed to synchronize and link... warfighting requirement... to system development... to system test & evaluation

**DoD Mandates Digital Engineering and Acquisition for all Weapon Systems**

# Modular Open Systems Architecture (MOSA)





# Modular Open Systems Architecture (MOSA)

## 1. *Enhance Competition*

- Open architecture with severable modules, allowing components to be openly competed.

## 2. *Facilitate technology refresh*

- Delivery of new capabilities or replacement technology without changing all component in the entire system.

## 3. *Incorporate innovation*

- Operational flexibility to configure and reconfigure available assets to meet rapidly changing operational requirements

## 4. *Enable cost savings/cost avoidance*

- Re-use of technology, modules and/or components from any supplier across the life cycle.

## 5. *Improve Interoperability*

- Allow severable software and hardware modules to be changed independently
  - Defense Acquisition Guidebook 3-2.4.1, Modular Open Systems Approach
  - Defense Logistics Agency: Defense Standardization Program Title 10 U.S.C. 2446a.(b), Sec 805



# AFTES Ecosystem

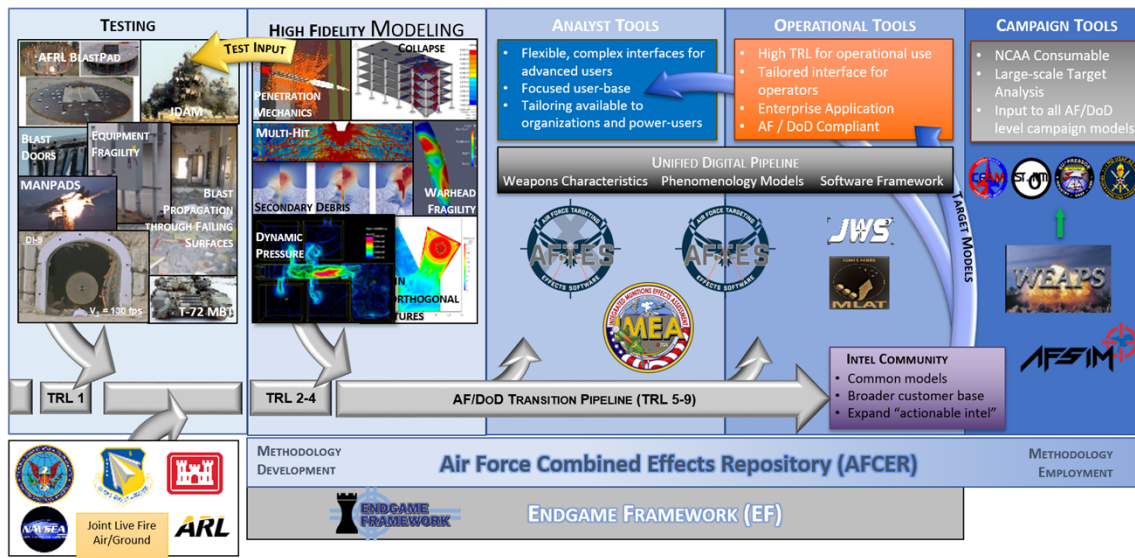
## Air Force Targeting and Effects Software Ecosystem

- Digital Collaborative Ecosystem for Transition of AF Lethality and Vulnerability Targeting Capabilities
- Provides combination of **Operational** and **Analytical** capabilities within a single Modeling & Simulation (M&S) architecture
- Improves methodology/capability development and direct transition of those capabilities to the warfighter

## Goals

- Support **fully integrated Process** (Weaponeeing, Collateral Damage Estimation and Geospatial Component)
- Support laboratory **Studies, Analysis and Development** activities across all weapon and target domains
- Provide a more efficient transition “**pipeline**” between the analytic/development activities and operational communities
  - Common methodology and data repository and development tools
  - **Continuous Build Test** environment (CBT) (aka **Continuous Development/ Continuous Integration CD/CI**) for improved production efficiency and quality
- Employment of **standard data sources and data models**
- Standardized UX/UI across capabilities

# “Transition Pipeline” for Munitions Effects

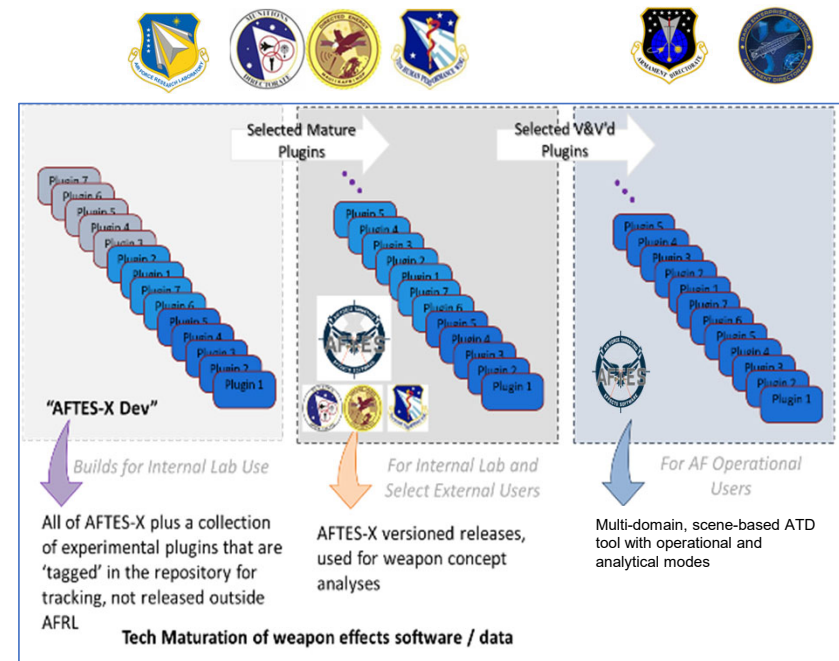


- Enabled by:
  - An AWS GovCloud hosted tech stack as the development infrastructure
  - Endgame framework as the modular open software architecture
  - Air force combined effects repository (AF CER) as the Authoritative Source of Truth (ASoT) for AF lethality methodology/models and data, across TRL and digital maturity levels. (“Change”)
- Enables:
  - AF teams, from R&D to operational, to build upon and utilize same M&S models from inception to operationally ready
  - Integrated Effectors/Combined Effects
  - Leveraging and re-use of M&S capabilities across AF and DoD tools and programs (“Accelerate”)

OV-1 for our digital maturation and transition pipeline for tools supporting AF operational user and DoD analytical communities.

# AFTES Ecosystem Overview

- **AFTES is the application sustained by AFLCMC/EBRW**
  - Initially focused on transitioning AF R&D targeting capabilities to operationally ready tools using ASoT and MOSA principles
  - Integrated/interoperable Weaponeering, CDE and Geospatial functions
    - Eliminates fat-fingering of data
    - Eliminates conversion of points in multiple coordinate reference systems
    - Uses industry best practices to create common UX/UI across activities
      - Facilitates streamlined training across activities (in line with ACC ACE LOE)
- **AFTES-X (AFTES eXploratory) is an application developed by AFRL/RWM**
  - Provides risk mitigation and roadmap planning for AFTES
  - Injected development via SBIRs, internal R&D efforts, and Weapons PEO
- **AFTES-X → AFTES methodology development, maturation and transition pipeline**
  - Facilitates timely and efficient transition of capability to the warfighter
  - Aligned with AF Digital Campaign Guidance
  - Development using Modular Open Systems Architecture (**Endgame Framework**) and common software development and data management standards
    - Eliminates integration re-work from R&D to “operationally-ready”
    - Facilitates warfighter access to capability at “Speed of Need”
    - Enables Combined Effects integration



# AFTES Ecosystem Overview (Cont.)

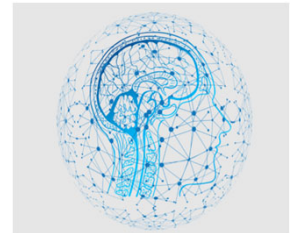
- **GOTS Modular Open Systems Architecture (MOSA)**
  - Facilitates leveraging and re-use of capabilities across AF / DoD tools and programs
    - Mandated by Title 10 United States Code 110 (U.S.C.) §4401, §4402 and §4403 (formerly Title 10 U.S.C. §2446a., b., and c)
    - To include ABMS and JADC2 Efforts (in line with ACC Infrastructure/ABMS LOE)
  - Aligns with JP 3-60 (Target Cycle), CJCSI 3160.01D (CDE), and AFMAN 14-401 (Targeting Tradecraft/Data Standards), and CJCSI 3370.01D (TCM/PPM)
- **Fulfills requirements for modeling weapons within a fully characterized 3D scene**
  - Will support IOC and concept weapons using the same 'physics' engine and M&S architecture
- **Supports an interface with mission level simulation**
  - Advanced Framework for Simulation and Modeling (AFSIM)
- **AFTES Schedule**
  - MVP Release: July 2022
  - Version 1.0 Release: ~July 2023



# AFCER – Supporting the Ecosystem

## AFCER as ASoT for AF Lethality CoP

- Democratize Methodology and Data across CoP
  - Facilitate Community Leveraging
    - Increase Product Speed – deliver at “speed of need”
    - Reuse of capabilities and data
    - Potential MS&A Force Multiplier
      - Allows AF to utilize same M&S methodologies from inception to fielding
- Standardize and Configuration Manage across AF tools and analyses
- Effective Community Leveraging to increase speed and maximize resources
- Digital Map/Landscape of capability
- Originally created to support AFTESx -> AFTES digital maturation and transition pipeline
- Scalable and Extensible
  - Leveraged in support of other AF and DoD efforts



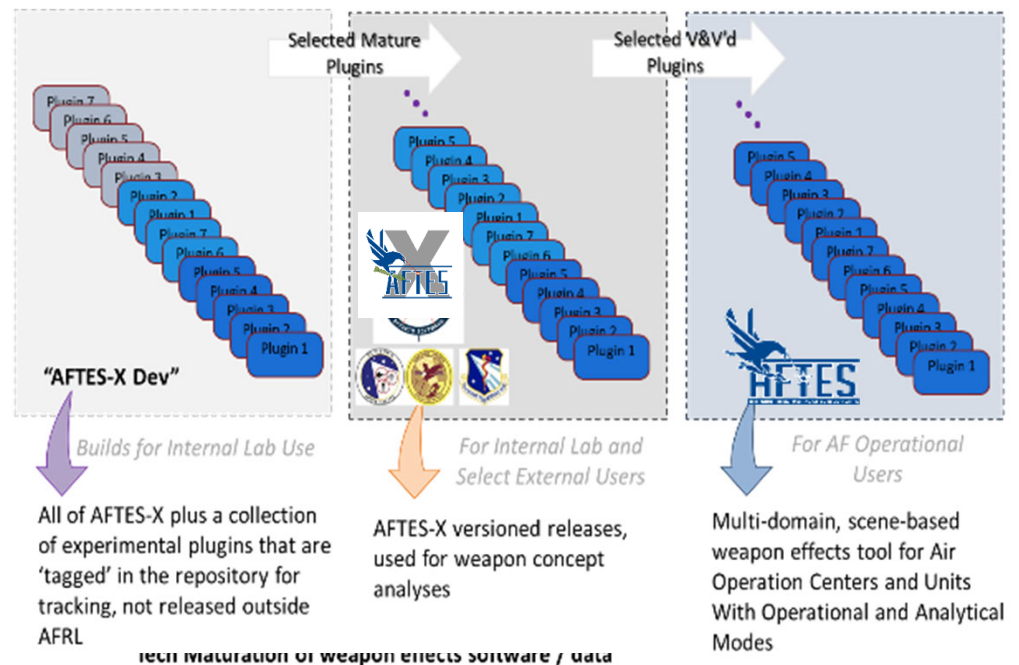
“The goal of the authoritative source of truth is to enable delivery of data to the right person for the right use at the right time” (DES)



# AFCER – Digital Maturation and Transition Pipeline Use Case

- **AFCER (AF Combined Effects Repository) is a collection vulnerability/lethality methodologies/modules and data**
  - AF Accredited modules to provide rapid application development
  - ASoT for Lethality CoP
- **AFCER CM in support of COE Effectors LOE**
  - CM Annotations
    - Versioning
    - Digital Maturity
    - Methodology Maturity
    - Data Maturity
  - Promotes
    - Collaboration
    - Standardization
    - Leveraging Effort
- **Aligned with AF Digital Campaign Guidance**
- **Development in common Framework (EF) eliminates integration re-work**
- **Use of common repository (AFCER) standardizes data and methodology across integrated capabilities**
- **Allows AF to utilize same M&S tool from inception to fielding**

AFCER Supporting Digital Maturation and Transition of AF Lethality M&S





# Capture Data Associated with Each Artifact

- Artifact Name:
- Govt Agency:
- Govt POC: (Name, phone number, email)
- Artifact Type: (Methodology, Data, report, MBSE (Cameo Models), Source code...)
- Effector Category, Methodology Category
- TRL: (1-9)
- HRL: (working with HMT team to define)
- Operating System (Windows, Linux, iOS, Multiple)
- Digital Maturity/State
- Upload Date:
- Dependencies (EF version X, other modules, etc..)
- Associated documentation
  - Domain of applicability (User/Analyst guide)
  - VV&A docs
  - Data requirements/examples (link to digital location)
- Test Suites (if available)
- Meta-data tag/documentation JSON?
- Domain Level Analytical/Operational/Developmental/SBIR
- Comment section (so MM can add additional specific information)

# Front End Interface

## Admin Mode

- Approve new users
  - Verify/set permissions/access levels
  - Build permissions hierarchy
    - Are permissions artifact specific (rare cases)?
    - Are permissions tied to category/subcategory?
    - Are permissions tied to Analyst/Operational/Developmental/SBIR (maturity level)?
- Approve upload of new artifacts
  - Review process? (Are all pieces there to 'run' module?)
  - Who is going to do this?? At what levels?
- Download artifacts
- Search for artifacts
- Modify artifacts
  - Modify data associated with
  - Upload an update
- Add categories/subcategories
- Review/report download logs

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## User Mode

- Search ability
- Download with appropriate permissions
- Upload to repository
- Request permissions/access
- Access to User Forum

## Search function

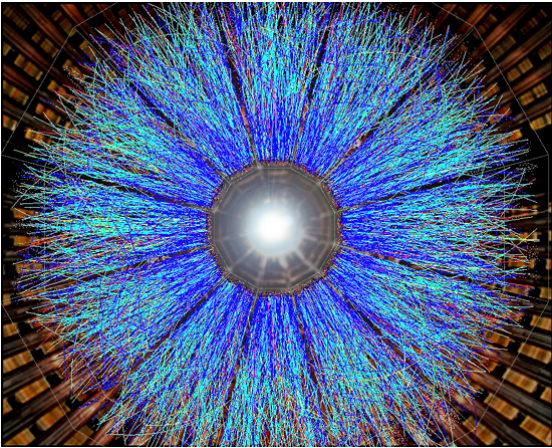
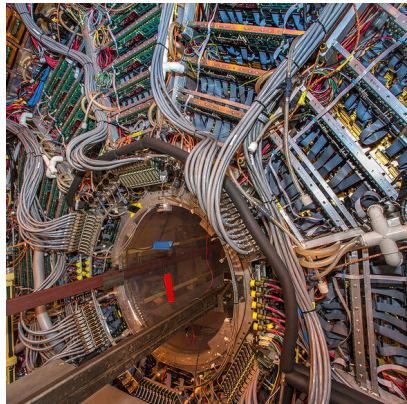
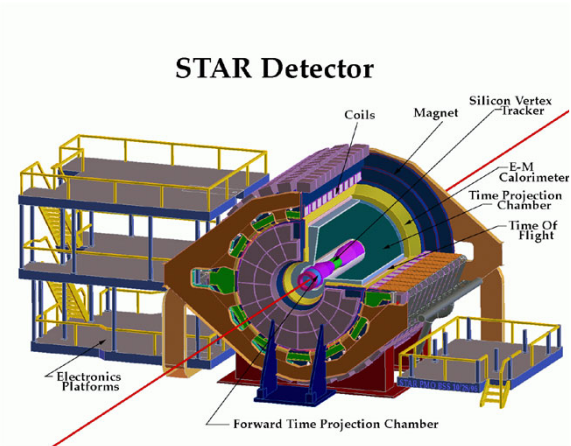
- Available to all users
- Search by:
  - TRL
  - Category/Subcategory
  - Analyst/Operational/Developmental/SBIR - need name for this!
  - Govt agency
  - POC
  - Op System

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# HEP Use Case

- **Highly Complex Experimental Designs**
  - Large, geographically distributed collaborative effort
  - Very Large Amounts of Data
  - Digital Design essential to execution
- **Ca. 1980s – 1990**
  - Data transfer cumbersome
  - On site contribution necessary to experiment execution
  - And this for less complex fixed target, and early lower energy collider experiments
- **1991 – Present**
  - Rollout of www in support of Effort
    - ASoTs
    - Data Standards
    - Digital access
    - Leveraging and Sharing of Capabilities

# HEP Use Case Continued

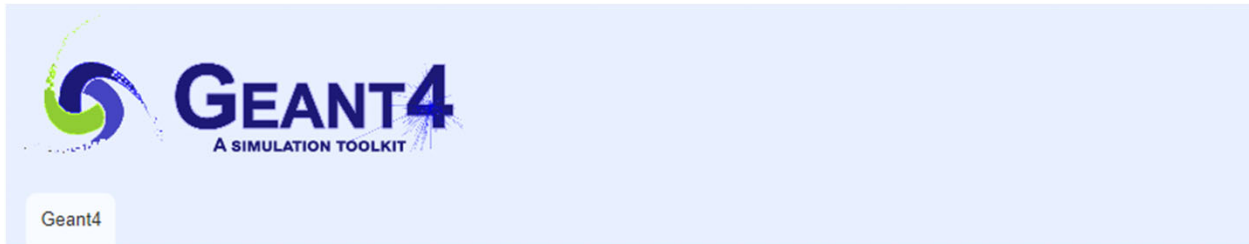


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# HEP Use Case Continued



CERN Program Library Long Writup W5013

## GEANT

Detector Description and  
Simulation Tool

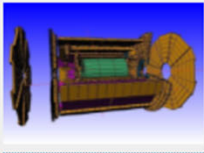

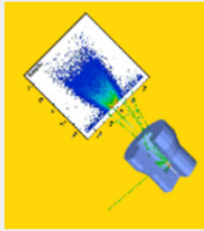
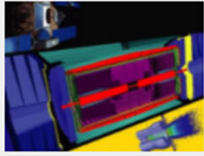
Application Software Group  
Computing and Networks Division

CERN Geneva, Switzerland

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## Applications

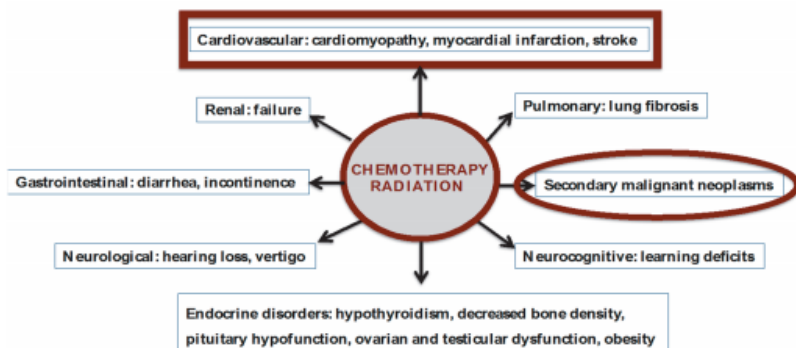
High Energy Physics	Space and Radiation	Medical	Technology Transfer
			

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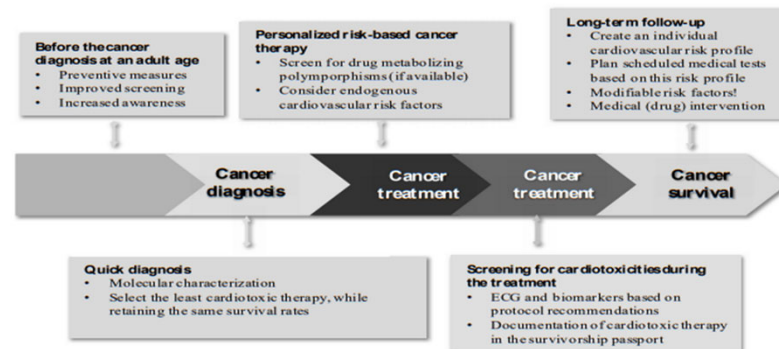
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# Medical Research Use Case

- Strategic Application of ‘Chemo-Cocktails’
  - Late Mortality and Cardiovascular Morbidity after Cancer at A Young Age
  - Digitized all 5 year youth onset cancer patient records and sibling cohort records
    - Collaborative and expanding ASoT
  - Numerical Methods applied as Proof Of Concept
  - AI/ML
  - Tailored Chemotherapy to address cancer and avoid negative cardiovascular effects



**Figure 2: Overview of the late adverse health effects of cancer therapy.** Second malignant neoplasms are the greatest lethal threat, followed by cardiovascular late complications as the primary non-malignant cause of death. Virtually any organ system may be damaged.



**Figure 15: Overview of an optimal plan of the diagnosis of cancer, cancer therapy, and surveillance after cancer to reduce and perhaps prevent cardiovascular late adverse effects.**



# Drug Design Use Case

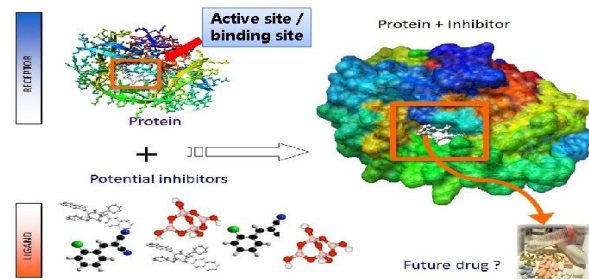
Facilitated by Digital Transformation

- ASoTs
  - Ie. National Protein Database
  - 3D Modeling and Digital Design
    - Narrows Down Areas to Investigate in detail



## Structure-based (target-based) Drug Design

It is used to **design a new drug molecule** based on the **knowledge of the three-dimensional (3D) structure of the**





# Summary

- AFTES is essentially an integration of systems brought together to form a unified seamless workflow. Enables use of both real models (i.e., for coordinate mensuration) and synthetic models (i.e., for weaponeering and CDE). AFTES bridges functional gaps between these two volumetric domains, while retaining spatial fidelity, absolute and relative positioning, and coordinate measures. Several subsystems work interactively to achieve this.
- AFTES has a fully synchronized AFTES-X version. AFTES-X developed and used by AFRL is intended for the USAF weapons development and testing environments (e.g., the AF Digital Engineering Environment, etc.). By offering the tools for the end-to-end kinetic/non-kinetic targeting cycle, AFTES will provide full USAF coherency across the development-testing-fielding weapon lifecycle.
- The AFTES-X to AFTES relationship establishes a digital transition pipeline for data and methodology from development and maturation on the R&D side (with AFTES-X), to the fielding of mature VV&A'd capability (with AFTES) in alignment with current AF Digital Transformation Guidance.
  - Development and transition of capability using the AFTES-X to AFTES digital pipeline increases speed to fleet while reducing fielding development costs
- AFTES is an Air Force-specific system supporting the complete Air Force-specific weapon life cycle.
  - AFTES capabilities support AF requirements and can be leveraged by the greater DoD community.

# Summary

- The AFTESx /AFTES digital ecosystem has resulted in a transition pathway that leverages software development efforts from R&D and facilitates transition into an operationally ready capability with minimal additional development required, saving time and cost.
- The AFTESx /AFTES digital ecosystem supports interoperability at the engagement level, with efforts for vertical interoperability to mission as well as high fidelity modeling levels.
- Early injection of operational inputs/needs have helped streamline and align efforts to accelerating capability from operational need, through R&D, to operationally ready. In addition, pivots and continuous improvement of capability is facilitated.
- Build once and use often – the AFTESx/AFTES ecosystem is a use case for the benefits of creating a collaborative ecosystem of interoperable capabilities that can be leveraged by multiple organizations and programs.

Questions

**Thank you for your  
attention!**

