Applying Science and Technology to Sustainment of Legacy Systems

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Dr. Marilyn T. Gaska

Chief Engineer, Logistics and Sustainment / Fellow

LOCKHEED MARTIN

ABSTRACT

This presentation will highlight trends in science and technology applications to sustainment to include sustainment as a science, Industry 4.0, and additive manufacturing/business models. Focus topics from the Aircraft Airworthiness and Sustainment Conference also include automation, corrosion/materials, and capability management.

Applying science and technology to sustainment of legacy systems starts with the recognition of sustainment as a science and the motivation to reduce lifecycle costs and improve availability of legacy systems. The new University of Maryland Center for Sustainment Excellence provides an opportunity to focus on sustainment engineering as one of the Integrated Product Support Elements as well as the sustainment focus in the future and Acquisition Reform. The Affordable Systems Operation Effectives (ASOE) framework helps to organize the sustainment sciences puzzle pieces.

Recent focus on taking Industry 4.0 technologies to sustainment has included connected supply chain optimization, including leverage of the Internet of Things. This includes leverage of augmented/virtual/mixed reality for maintenance opportunities. Opportunities for leveraging the digital thread for sustainment is another concentration area.

As a member of the planning committee for the Aircraft Airworthiness and Sustainment Conference, recent focus areas have also included automation for sustainment, corrosion, advanced manufacturing, and capability management. The 2019 Aircraft Airworthiness and Sustainment Conference planned for National Harbor provides an opportunity for expanded participation.

America Makes has also been working for three years on America Makes and Maturation of Advanced Manufacturing for Low-cost Sustainment (MAMLS), with success stories now available. As Additive Manufacturing for Maintenance and Sustainment Advisory Group chair, co-chairing with Office of the Secretary of Defense efforts such as the Additive Manufacturing Business Model Wargames and Workshops will also be discussed. These efforts are good examples of Public Private Partnership collaboration to apply science and technology to improve sustainment of legacy systems.

AGENDA

Sustainment as a Science

Agility and Affordability Challenge and Acquisition Approach

Industry 4.0 for Sustainment

Additive Manufacturing and Business Models

Aircraft Airworthiness and Sustainment Conference Topics

SUSTAINMENT AS A SCIENCE

Applying science and technology to sustainment of legacy systems

Recognition of sustainment as a science

Motivation to reduce lifecycle costs and improve availability

Maryland Center for Excellence for Sustainment Sciences (MChESS)

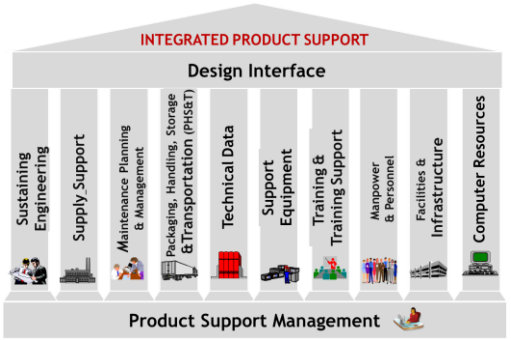
UMD research Acquisition Reform to Enable Military Effectiveness

SUSTAINING ENGINEERING

Sustaining Engineering spans those technical tasks (engineering and logistics investigations and analyses) to ensure continued operation and maintenance of a system with managed (i.e., known) risk. This includes: [1,2]

- Collection and triage of all service use and maintenance data
- Analysis of safety hazards, failure causes and effects, reliability and maintainability trends, and operational usage profiles changes
- Root cause analysis of in-service problems (including operational hazards, deficiency reports, parts obsolescence, corrosion effects, and reliability degradation)
- The development of required design changes to resolve operational issues
- Other activities necessary to ensure cost-effective support to achieve peacetime and wartime readiness and performance requirements over a system's life-cycle

ACQUISITION CAREER FIELD DEFINITION

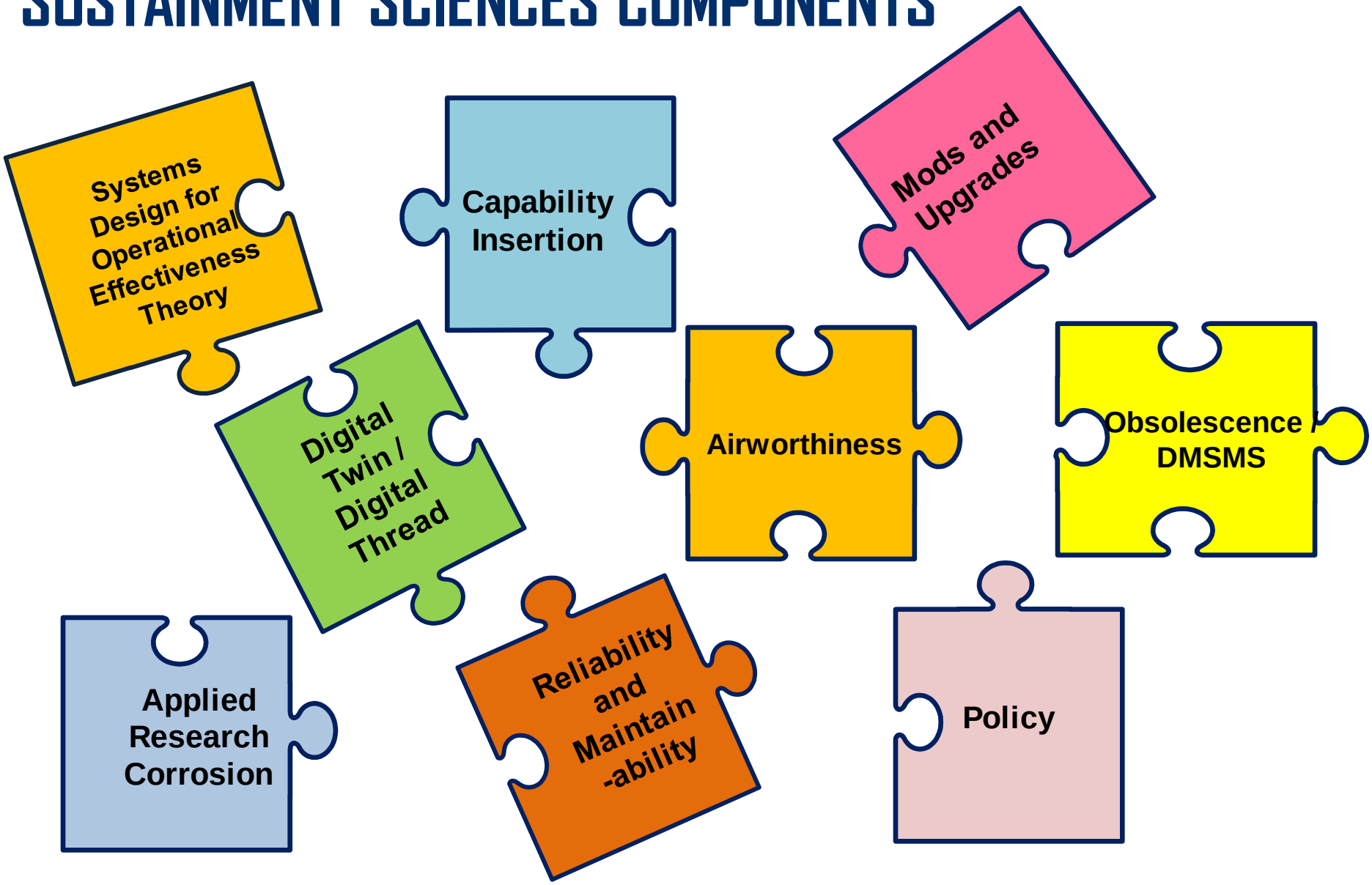


AcqLinks and References:

•**[1] Website:** ACQuipedia – Sustainment Engineering

•**[2]** Integrated Product Support Element Guidebook, Chapter 3 – Dec 2011

SUSTAINMENT SCIENCES COMPONENTS



AGILITY AND AFFORDABILITY CHALLENGE

Acquisition approach to support lifecycle management

Tech insertion mods and upgrades for enhanced capability

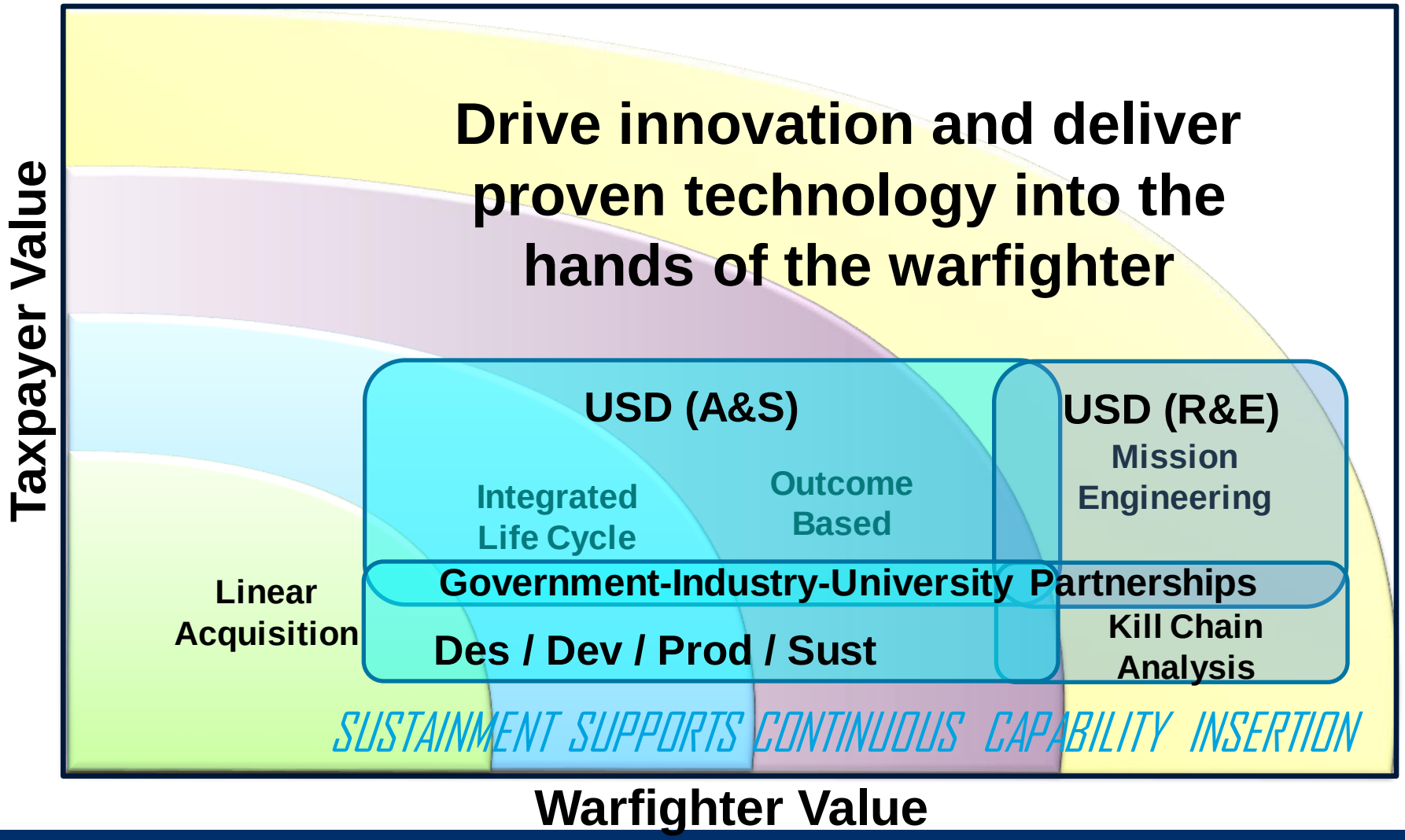
Defect/reliability/maintainability root cause analysis

Obsolescence focus and Modernization Through Spares history

Acquisition reform research (UMD)

A CAPABILITY VALUE FRONTIER

In Support of Acquisition Approaches to Enable Military Effectiveness (Gaska and Richburg, NDIA SE Conf. 2017)



ADAPTIVE ACQUISITION APPROACH

Focused on optimizing warfighter value for greater capability and lower cost to achieving continuous kill chain optimization

Integrates mission engineering during the initial capability development engineering of product and sustainment solutions

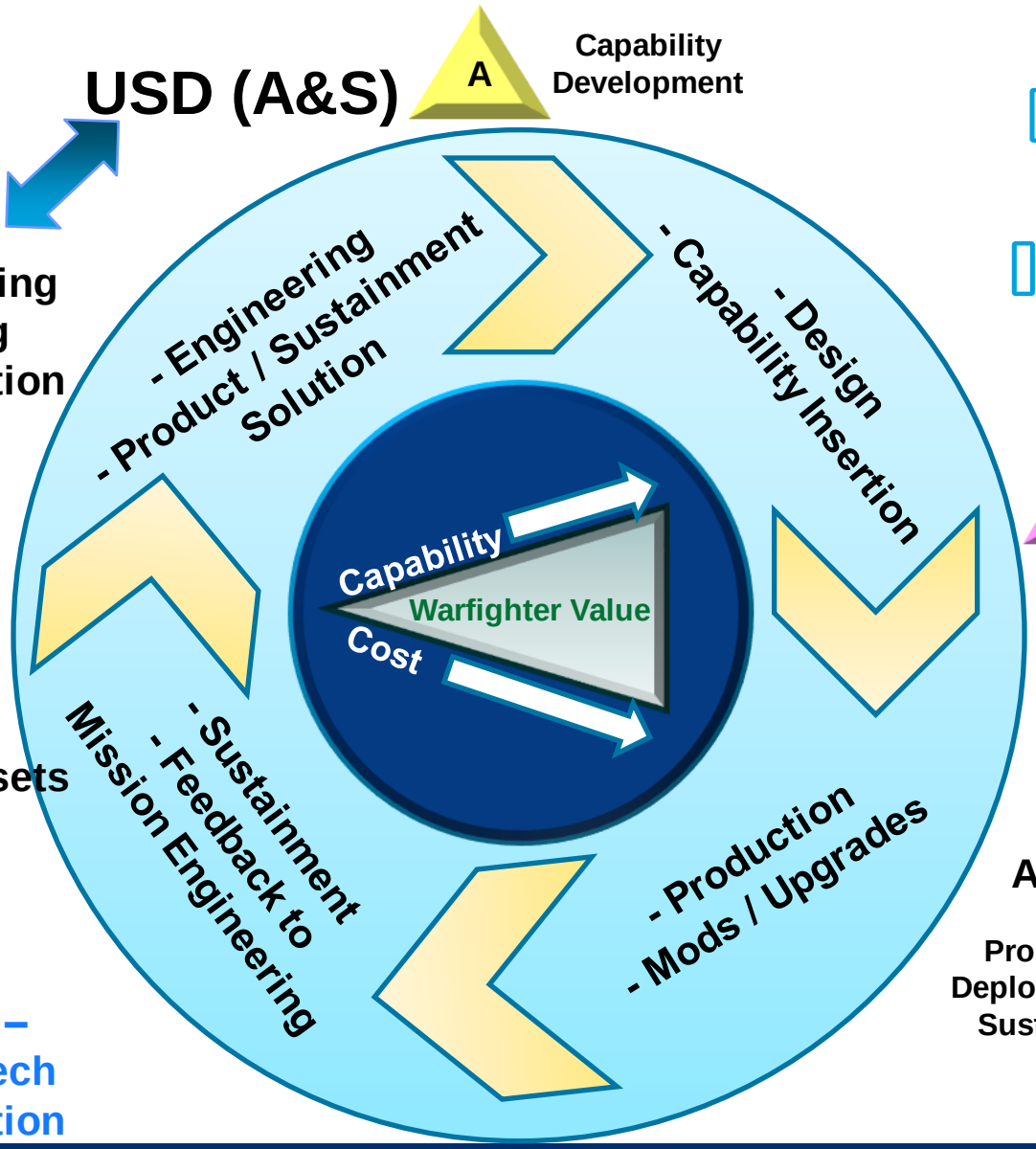
Selects architectures that support capability insertion and provide for continuous capability improvement

Accommodates ease of modification and upgrade incorporation

Implements operational concept with sets of systems to achieve mission objectives and support multiple missions

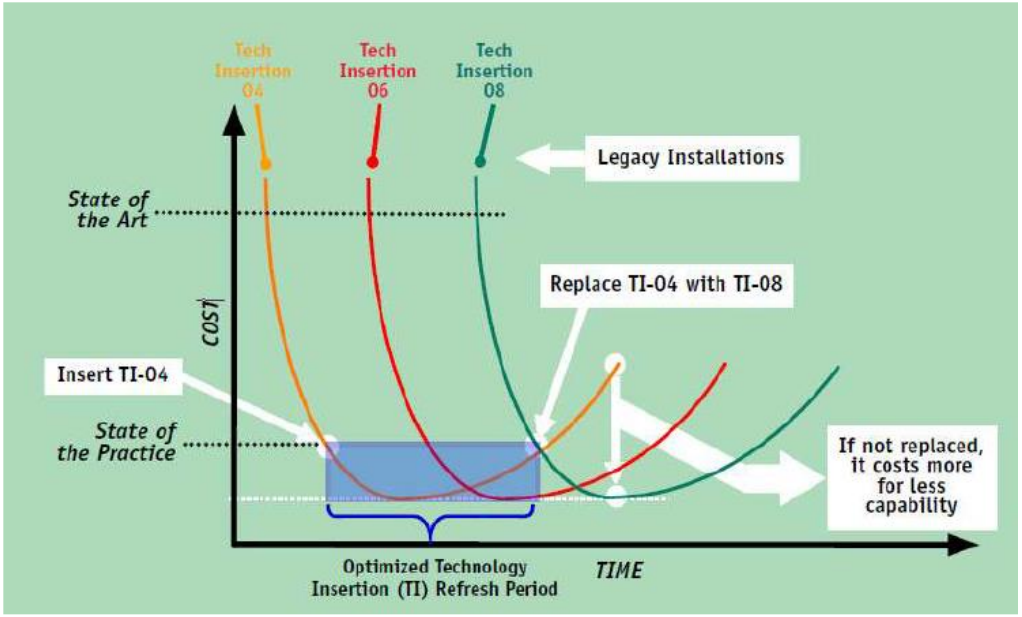
Obtains O&S feedback to mission engineering to complete a closed loop approach that drives continuous capability improvements

ADAPTIVE ACQUISITION



ACOUSTIC RAPID COTS INSERTION (ARCI) EXEMPLAR

"The ARCI business model maintains an optimized Technology Insertion (TI) refresh period to provide a cost-effective method to increase processing capability through the APB processes. Each new TI cycle (18–24 months) typically has double the capability due to Moore's Law." (p. 8, APB=advanced processing builds)



CAPT Jim Stevens, "The How and Why of Open Architecture", Undersea Warfare Magazine, Spring, 2008, Issue 37.

NEAR 10X COST REDUCTION CITED FOR NAVY SHIP SET (P. 7)

INDUSTRY 4.0

Focus on extending Industry 4.0 technologies to sustainment

Digital transformation life cycle perspectives (PHM Society 2018)

Connected supply chain optimization (CTMA/DLA Partners 2018)

Internet of Things (IoT) for life cycle/service management

Augmented/virtual/mixed reality (A/V/MR) for maintenance

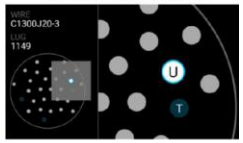
INDUSTRY 4.0 AND A/V/MR

Digital Thread and Industry 4.0 (Don Kinard, NIST MBE Conference, 2018)

Augmented Reality

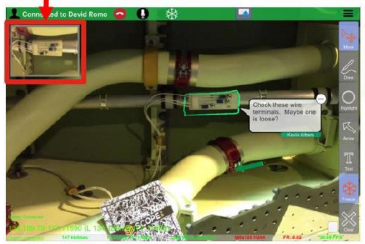
Guided Work Instructions with Voice Controls (After)

Operator's view in glasses



Remote Augmented Reality

"Technician" view on Tablet

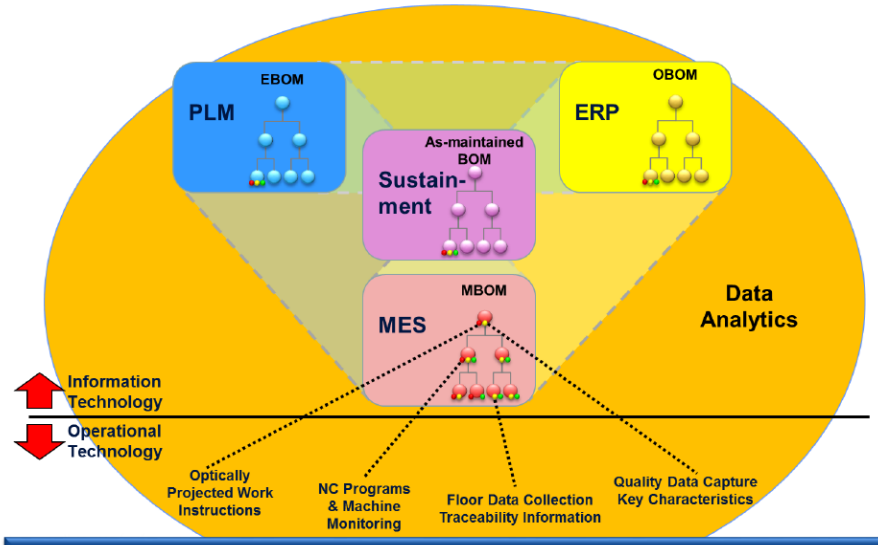


"Expert" view at Desktop Computer

"Technician" view on Tablet

"Expert" view at Desktop Computer

The Connected Enterprise – Industry 4.0



The Connected Enterprise Enables Automated Metrics, Financial Reporting, Data Analytics, Integration with Factory Equipment, and Real Time Management Visibility

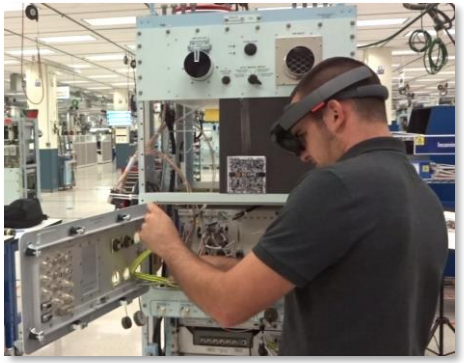
SUPPLY CHAIN AND MAINTENANCE USE CASES

Virtual Subject Matter Expert (SME) – virtual SME can see what maintainer sees

Hands free maintenance - use case synergy with manufacturing (as early as Hopps, AeroDef 2013)

- Heads up work instructions— Work Instructions in AR/ MR, with 3D overlays and text that links to a server
- TechAssist at DoD Maintenance Conference 2017
- Smart Glasses and AR in Aerospace Manufacturing: Finding the Niche (Christi Fiorentini, AWE, 2016)

Aeronautics Global field service collaboration and travel reduction



Training and Logistics Solutions

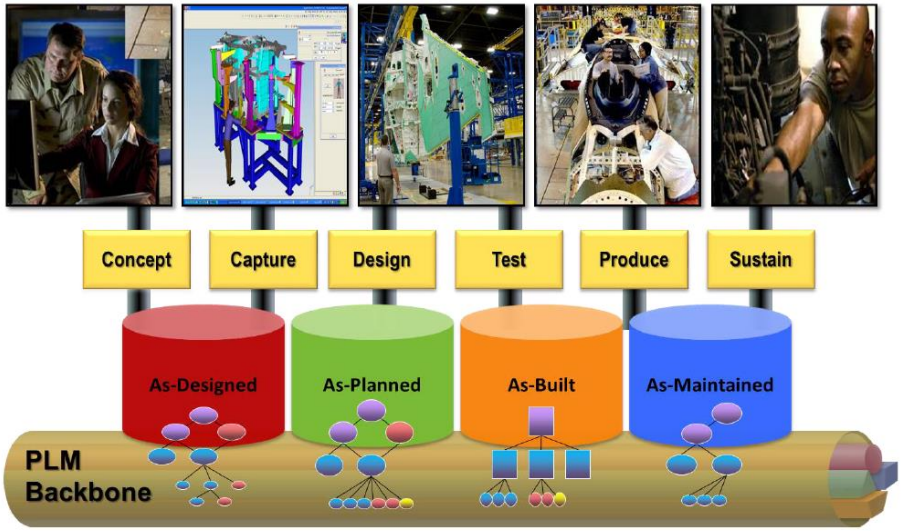
LIFECYCLE PERSPECTIVES

Early design with Collaborative Human Immersive Lab (CHIL)

Applying Virtual Reality, and Augmented Reality to the Lifecycle Phases of Complex Products (Rabbitz and Crouch, 2017)

A/V/MR leveraging the Bill of Materials (BOM) across the lifecycle (Don Kinard, NIST MBE Conference, 2018)

The BOM is the Golden Thread



ADDITIVE MANUFACTURING FOR SUSTAINMENT

America Makes Maintenance and Sustainment Advisory Group Chair

OSD Additive Manufacturing for Maintenance Operations (AMMO)

Collaboration on AM Business Model Wargames / Workshops

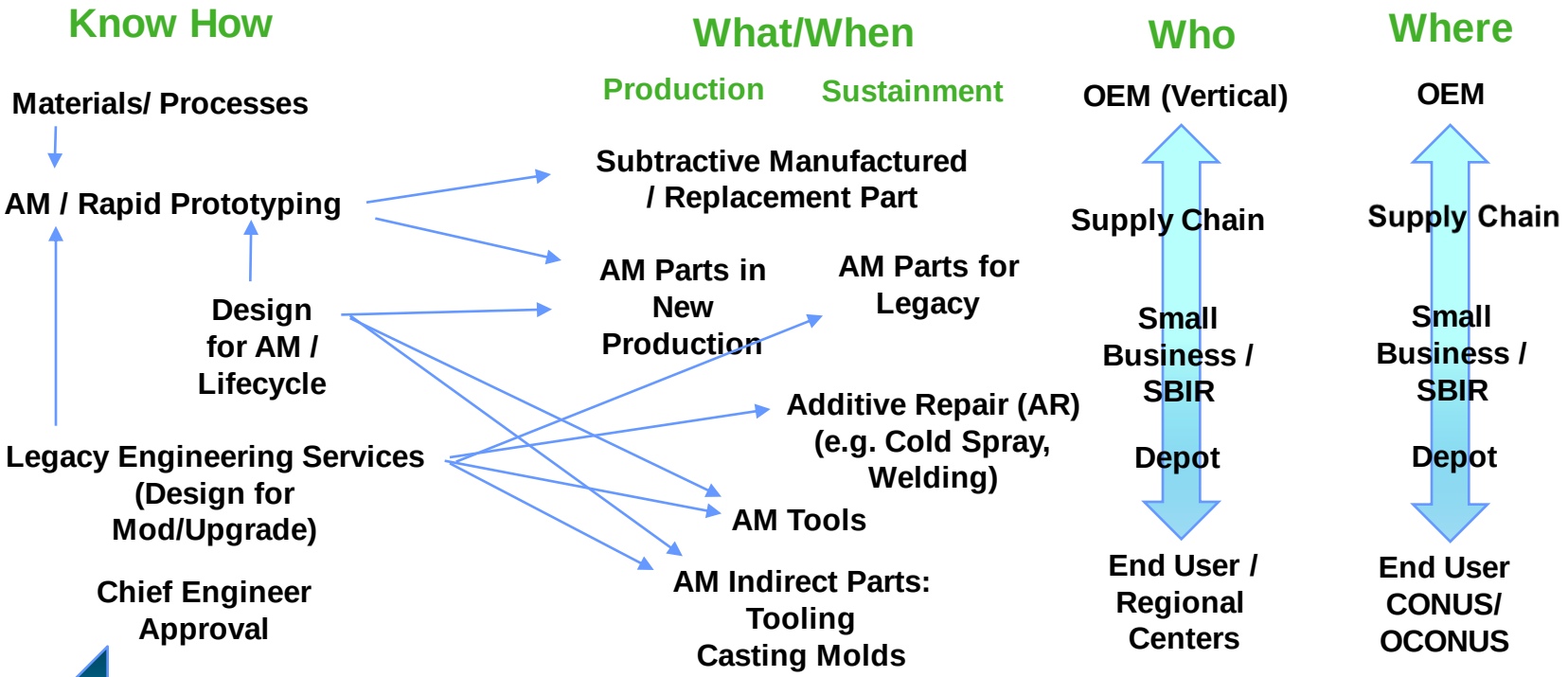
America Makes and Maturation of Advanced Manufacturing for Low-cost Sustainment (MAMLS) Phases I - III

PUBLIC PRIVATE PARTNERSHIP COLLABORATION TO APPLY SCIENCE AND TECHNOLOGY TO IMPROVE SUSTAINMENT OF LEGACY SYSTEMS

INDUSTRY USE CASES AND VALUE CHAIN

Joint Staff Enterprise Development "JED" Talk June, 2015

Why? Faster, Lower Cost, Improved Readiness, Lower Inventory/Warehousing



Model Based Engineering / Digital Thread / Intellectual Property Agreements/Contracts

How Much? Business Model/Business Case

Qualification and Certification (Machine/Design Authority/Quality/Airworthiness)

AIRCRAFT AIRWORTHINESS AND SUSTAINMENT FOCUS

Member of the planning committee for the Aircraft Airworthiness and Sustainment (AA&S) Conference

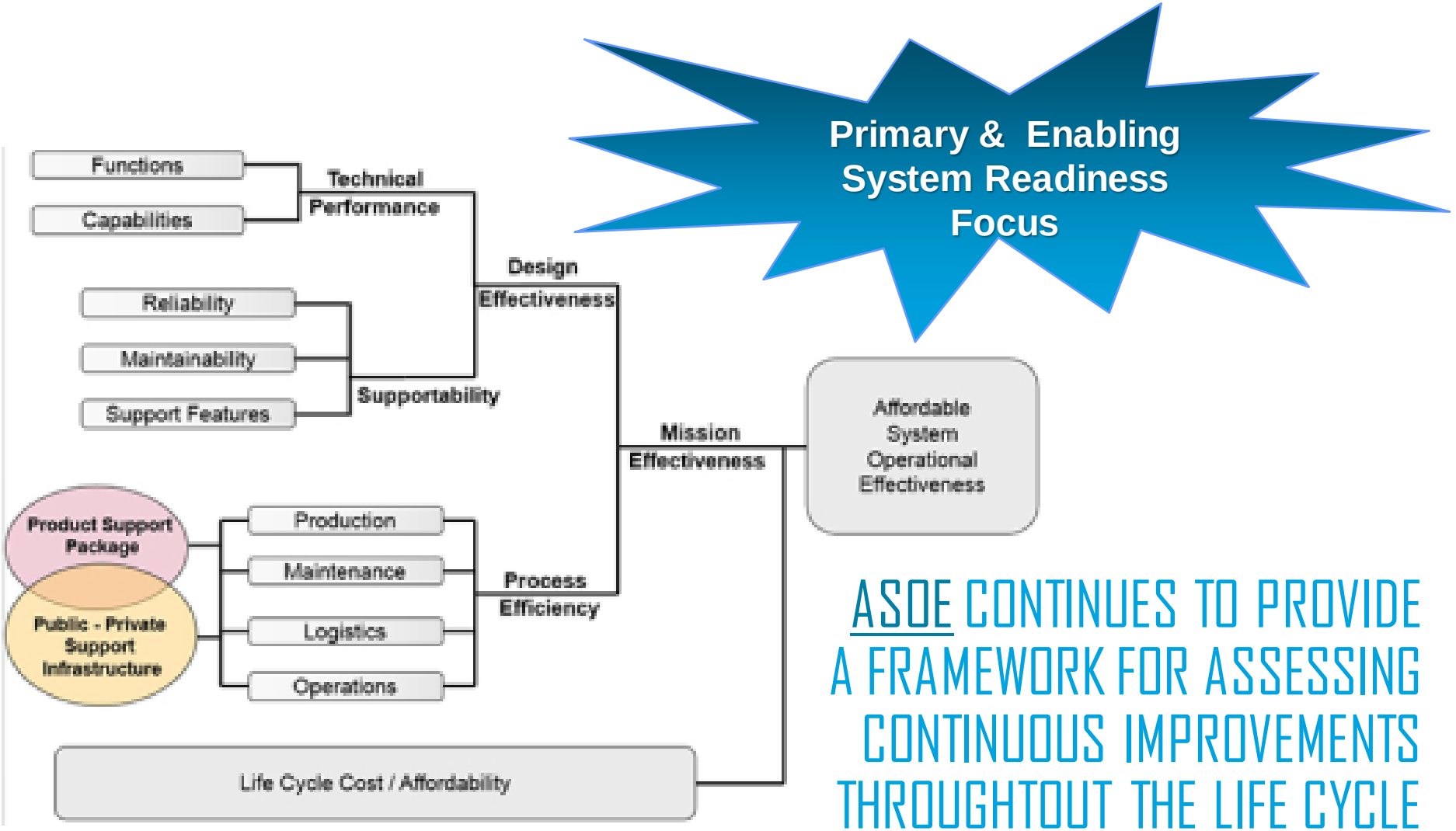
Focus areas have also included:

- advanced manufacturing
- automation for sustainment
- digital thread/twin
- corrosion
- capability management

2019 AA&S Conference opportunity

2019 NATIONAL HARBOR LOCATION PROVIDES AN OPPORTUNITY FOR EXPANDED PARTICIPATION

AFFORDABLE SYSTEMS OPERATIONAL EFFECTIVENESS (ASOE)



ASOE CONTINUES TO PROVIDE A FRAMEWORK FOR ASSESSING CONTINUOUS IMPROVEMENTS THROUGHTOUT THE LIFE CYCLE


LOCKHEED MARTIN