Research & Development

SEAPOWER THROUGH ENGINEERING

TOPIC LEARNING OBJECTIVES

Upon successful completion of this topic, the student will be able to:

1. Recognize the U.S. technology posture in relation to defense acquisition.
2. Explain the role of science and technology in defense acquisition.
3. Recognize the continuum of science and technology development from the university environment to advanced technologies and key traits of maturity levels.
4. Given descriptions of the activities and end products in Research and Development (R&D) programs, identify the appropriate R&D categories.
5. Recognize the most likely phases in the life cycle to introduce new technologies.
6. Recognize the characteristics to include objectives, benefits and drawbacks, outcomes, regulation and oversight of Advanced Technology Demonstrations (ATD) and Joint Concept Technology Demonstrations (JCTD) as technology transition mechanisms.
7. Recall the purpose, roles, and acquisition program support provided by the Federally Funded Research Centers (FFRDC) and University Affiliated Research Centers (UARC).
8. Given market research and company data, assess technology maturity to determine technology readiness levels.

STUDENT PREPARATION

Student Support Material

1. None

Primary References

1. DoD 5000 Series
2. http://www.onr.navy.mil
3. http://www.dtic.mil/
4. DoD 7000.14R http://comptroller.defense.gov/fmr/
5. DoD Independent Technical Risk Assessment Framework for Risk Categorization, USD(R&E) Memo, June 2018

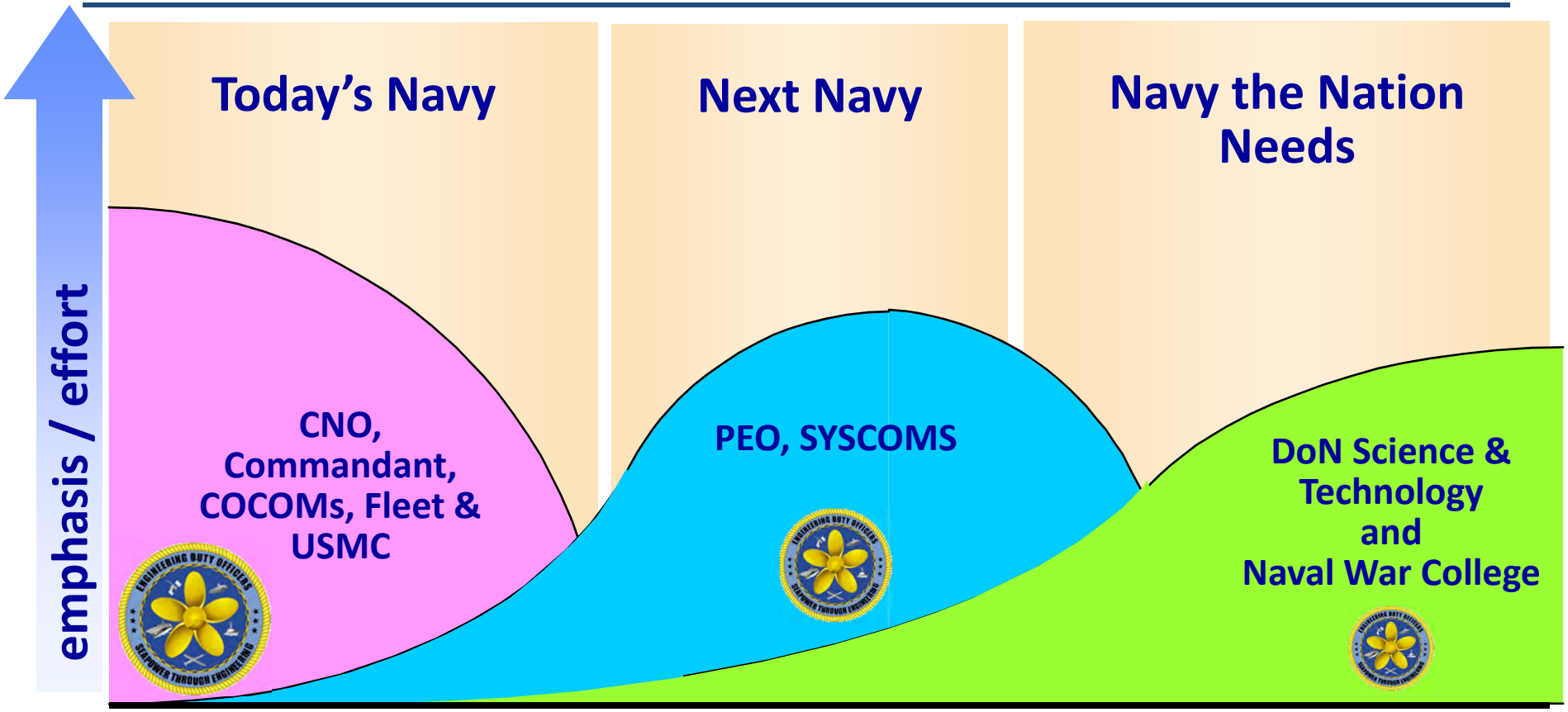
Additional References

1. None

Overview

- Introduction
- RDT&E and Defense Acquisition
- 7 Research and Development Categories
- ATDs and JCTDs

Research & Development (R&D) Perspective



Using Commercial Technology

- R&D budget pressures demand that DoD leverage industry investments
  - Navy Labs (NRL, NIWC, NSWC, etc.) retain a very large Science and Technology (S&T) role, including input into decisions regarding use of commercial technology
- DoD has initiated an increasing number of efforts to bring commercial technologies into defense systems
  - Open Systems Architectures (OSA)
  - Dual Use Applications Program (DUAP)
  - Independent Research & Development (IR&D)
  - Manufacturing Technology (ManTech)
  - Technology Transfer (T2)
  - S&T Affordability

Federal Government is increasingly dependent on Industry investments and commercial technologies

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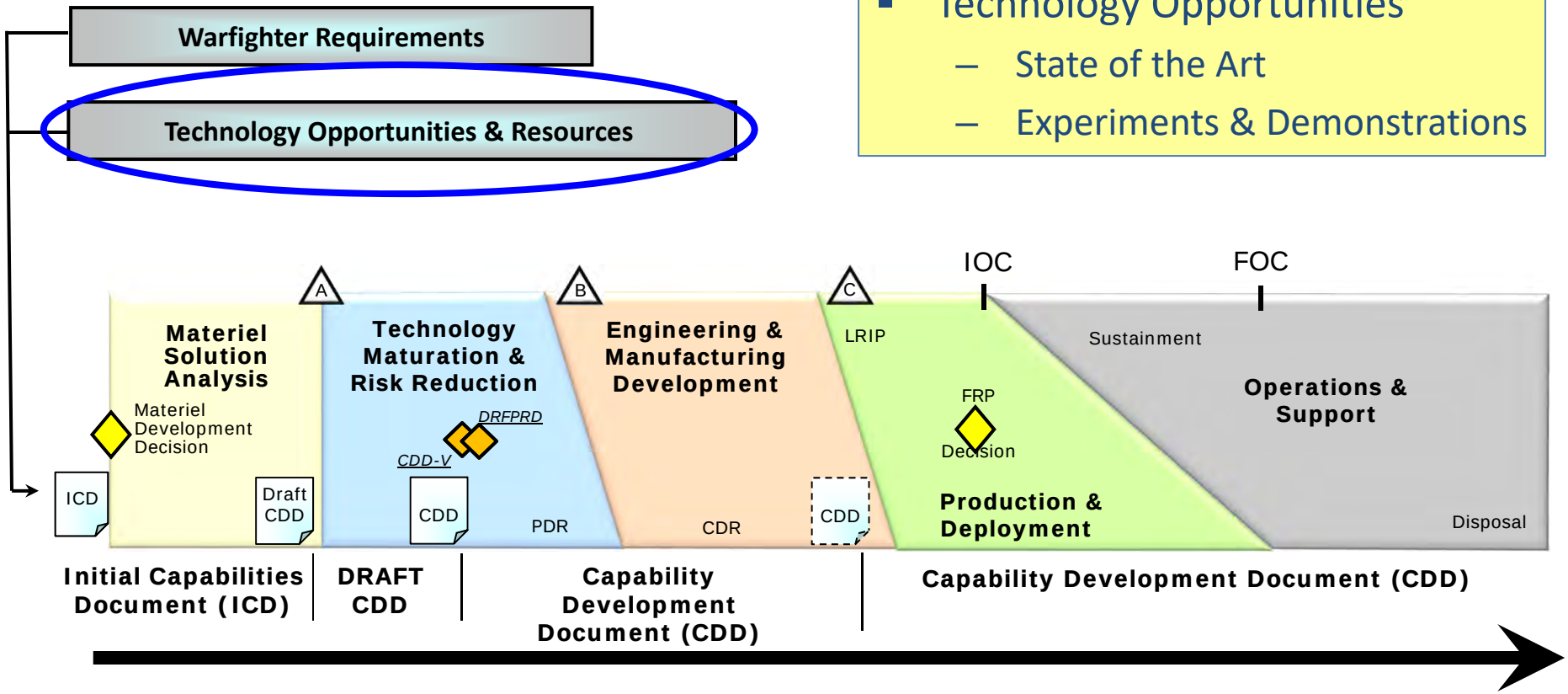
R&D in the Acquisition Framework

- Technology Opportunities
  - State of the Art
  - Experiments & Demonstrations



Role of Science & Technology (S&T) in Defense Acquisition

- Component S&T Executives shall:
  - Evaluate battlefield deficiencies and establish S&T projects to address priorities
  - Mature technologies to a readiness level to reduce risk for systems integration
  - Conduct independent technology assessments
  - Advise requirements and acquisition communities of new technology developments

- Transition Mechanisms
  - Advanced Technology Demonstrations (ATDs)
  - Joint Concept Technology Demonstrations (JCTDs)
  - Experiments
  - Conventional projects with transition requirements

Role of S&T in acquisition is to perform basic and applied research to address battlefield deficiencies and mature technologies to reduce risk for system integration

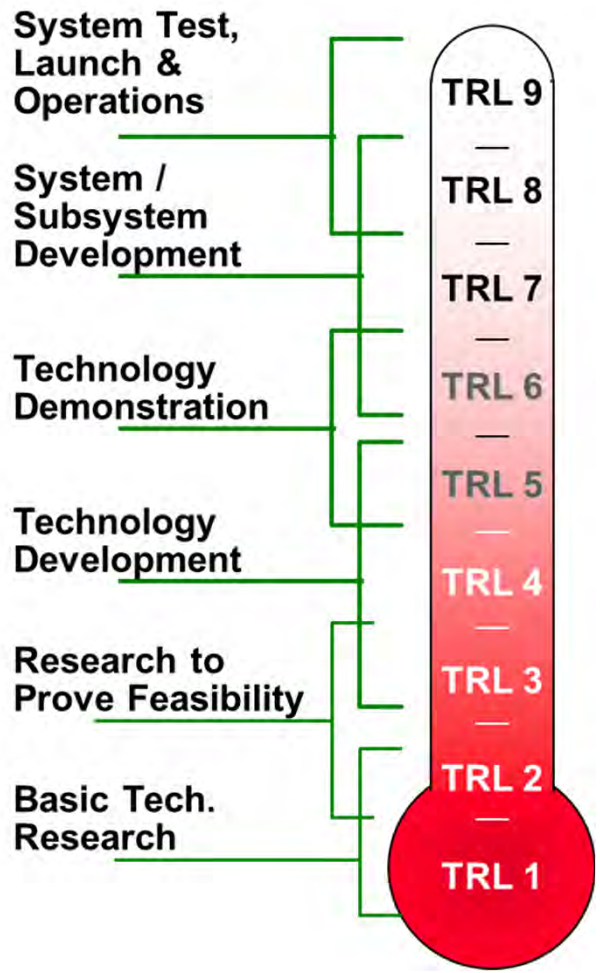
FFRDCs

- Federal Funded Research and Development Centers
  - An activity sponsored by a Government agency for the purpose of performing, analyzing, integrating, supporting, and managing basic or applied research and/or development
  - Drive innovation and problem solving by assisting the Government in conducting research, technology development, systems acquisition, and policy guidance
- Examples:
  - Jet Propulsion Laboratory
  - Lawrence Livermore National Laboratory
  - Los Alamos National Laboratory
  - Center for Naval Analyses
  - National Defense Research Institute
  - Research and Development Corporation (RAND)

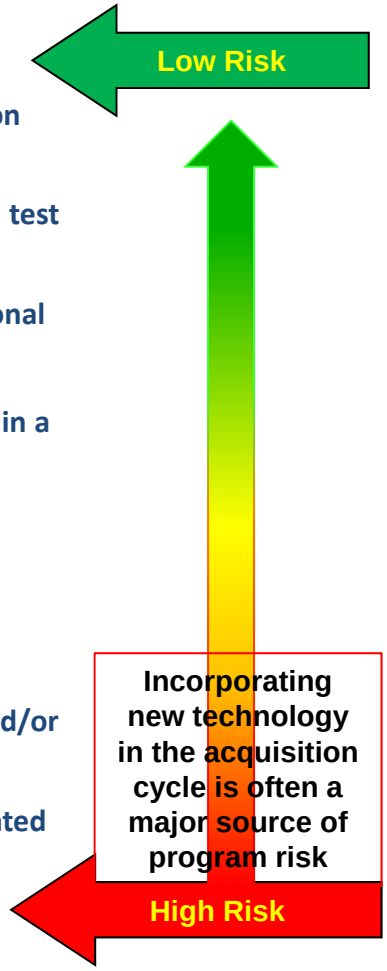
UARC

- University Affiliated Research Centers (special type of FFRDC)
  - Formally established in the mid-1990s to ensure the essential engineering and technology capabilities important to the DoD were maintained
  - UARCs benefit from leveraging education and research capabilities available at their universities to meet the needs of their sponsoring agency
  - Benefits: adaptability, objectivity, freedom from conflicts of interest, quick response capability, and long-term continuity
- Examples:
  - University of Southern California
  - Georgia Institute of Technology
  - Massachusetts Institute of Technology
  - Johns Hopkins University
  - Pennsylvania State University

Technology Readiness Levels (TRL)
Measuring Technology Maturity



- Actual system proven through successful mission operations
- Actual system completed and qualified through test and demonstration (IOT&E)
- System prototype demonstration in an operational environment (desired for MS/C)
- System/subsystem model or prototype demo'd in a relevant environment (desired for MS/B)
- Component and/or breadboard validation in relevant environment
- Component and/or breadboard validation in laboratory environment
- Analytical and experimental critical function and/or characteristic proof-of-concept
- Technology concept and/or application formulated
- Basic principles observed and reported



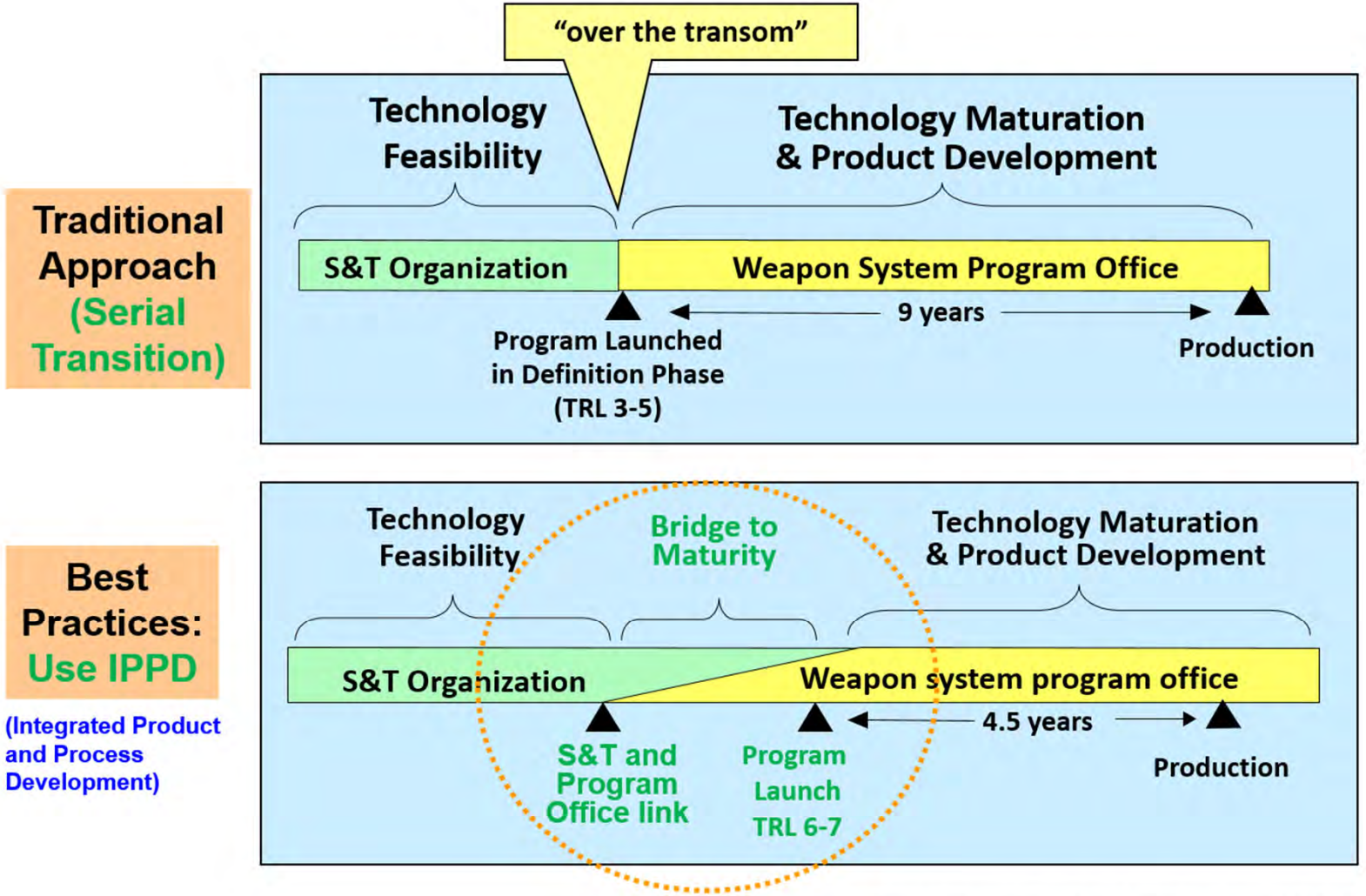
TRL Exercise

- Review the information contained in the Request for Information (RFI) Responses and the Market Research Report
  - Use it to evaluate the technical maturity of the engines
- Complete the TRL template on the next page

TRL Exercise

	Augusta	Bulldog	Cosmos	Decatur
Based on the RFI data, what is the assessed engine TRL?				
What was the rationale used to determine the TRL?				
At what point in the acquisition life-cycle could the engine be integrated based on the technology?				
Additional Notes				

Technology Transition



Source: BEST PRACTICES: Better Management of Technology Development Can Improve Weapon System Outcomes (GAO/NSIAD-99-162) July 1999

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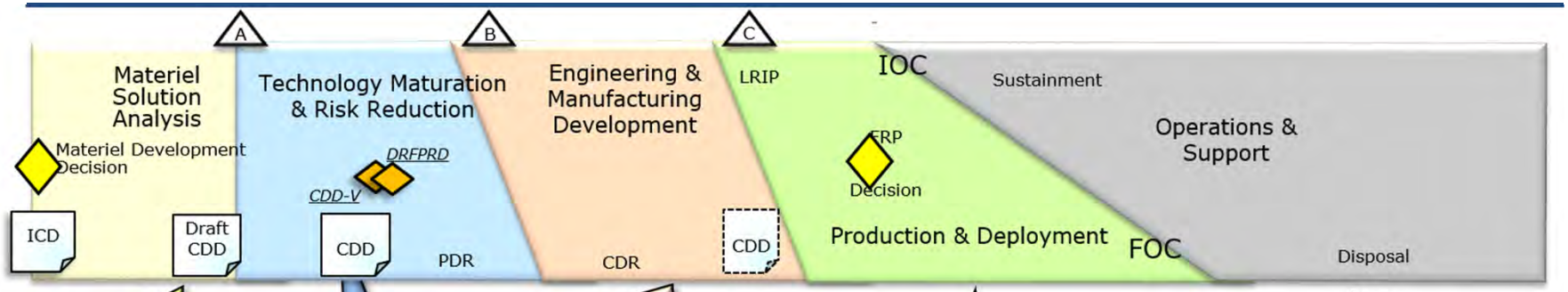
RDT&E Budget Activity Summary

Activity	Activity Name	Applicability	Who	When	Results
0601	Basic Research	Sciences: Physical, Engineering, Environmental,.....	Labs and Universities	Pre MS-A	Studies and reports
0602	Applied Research	Specific mil requirement related research to breadboard hardware	Labs and Universities	Pre MS-B	Materiel, Devices, Systems, or Methods
0603	Advanced Technology Demonstrators (ATD)	ATDs and ACTDs in simulated or relevant environment	Labs and Programs	Pre MS-B	Proof of feasibility, operability, and producibility
0604	Advanced Component Development and Prototypes (ACD&P)	Technology, models or prototypes in realistic environment	Labs and Programs	Pre MS-B	Risk reduction; Proof of maturity prior to system integration; TRL 6 or 7 achieved;
0605	System Development and Demonstration (SDD)	Engineering Development Models	Programs	MS-B to FRP	Support MS-C, LFT&E, and IOT&E
0606	RDT&E Management Support	Ranges, Test Aircraft, Test Ships and Test Facilities	Labs and Ranges	Various	Sustain and modernize test installations; Operations of T&E
0607	Operational Systems Development	Fielded Programs	Labs & Programs	Post MS-C	RDT&E of fielded or systems in production

RDT&E budget activities (0601 to 0607) fund S&T continuum categories from basic research to advanced technologies

Technology Insertion



Exploration of innovative technologies highly desired

Program vulnerable to adverse budget decisions if schedule or cost increases – new & unplanned technology insertion is dangerous

Modernization frequently requires tech insertion due to obsolescence and/or matching system performance to current threat/ requirements

Elimination of high risk technology desired – search for advantageous but MATURE technology

After FRP, Program is at less risk of performance issue – but waiting until next increment preferred. Program may be required part of a pre-planned product improvement program

New technologies may be introduced in any phase; however, they are most likely inserted prior to M/S B

Integration Readiness Level (IRL) or System Readiness Level (SRL)

Level	TRL	IRL/SRL
1	Basic principles observed and reported	An interface between technologies has been identified with sufficient detail to allow characterization of the relationship
2	Technology concept and/ or application formulated	There is some level of specificity to characterize the interaction between technologies through their interface
3	Analytical and experimental critical function and/or characteristic proof of concept	There is compatibility between technologies to orderly and efficiently integrate and interact
4	Component and/or breadboard validation in laboratory environment	There is sufficient detail in the quality and assurance of the integration between technologies
5	Component and/or breadboard validation in relevant environment	There is sufficient control between technologies necessary to establish, manage, and terminate the integration
6	System/subsystem model demonstration in relevant environment	The integrating technologies can accept, translate, and structure information for its intended application
7	System prototype demonstration in relevant environment	The integration of technologies has been verified and validated with sufficient detail to be actionable
8	Actual system completed and qualified through test and demonstration	Actual integration completed and mission-qualified through test and demonstration in the system environment
9	Integration is mission proven through successful mission operations	Execute a support program that meets operational support performance requirements and sustains the system in the most cost-effective manner over its total life-cycle

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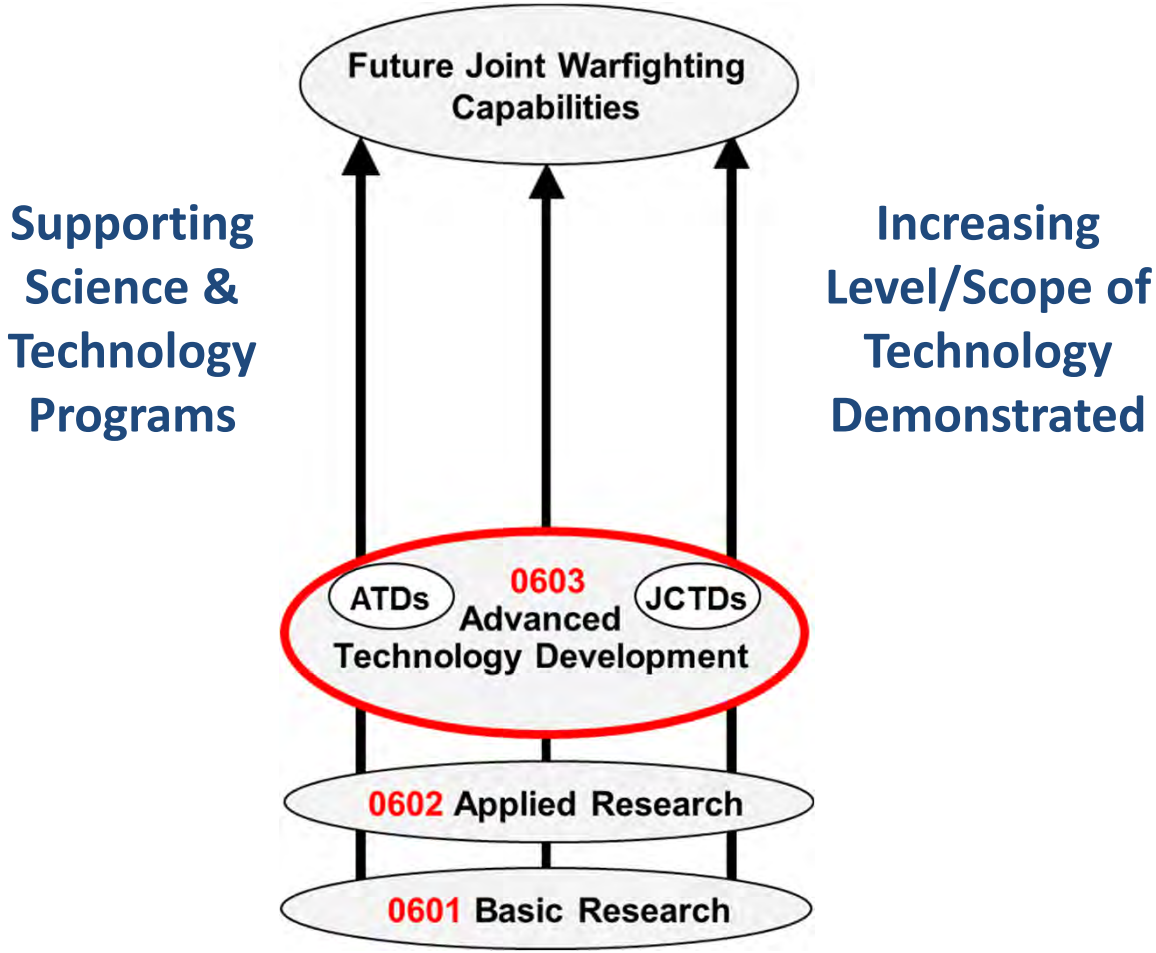
Science & Technology Program Evolution



Advanced Technology Demonstration (ATD)

- ATDs are hardware and software prototypes:
  - For testing and evaluating non-system-specific solutions to refine basic and applied research
  - For preparing technology for systems development by demonstrating the feasibility and maturity of an approach at a relatively low cost
  - Usually funded by ONR (0603 Activity funds)
  - ***Leave-behind capability is not an objective***
  - Prototypes
  - Limited or no user involvement
  - Usually pre-M/S B efforts

DDG-1000 Deckhouse

- DDG-1000 Deckhouse Engineering Design Model (EDM) used to demonstrate key technologies associated with deckhouse construction

DDG-1000 ¼ Scale Model

- DDG-1000 ¼ Scale Engineering Design Model (EDM) used to demonstrate key technologies associated with the hull
  - Sea Jet is an Advanced Electric Ship Demonstrator located in NSWC Carderock, detachment Bayview Idaho (Lake Pend Oreille)

Joint Capability Technology Demonstrations (JCTDs)

- Develop Military Utility Assessment (MUA) of concepts and technologies
  - Document to capture lessons learned during JCTD
  - MUA can substitute ICD for M/S A
  - Done by users (COCOMs & Independent Operational Assessors)
- Objective is to provide for more informed acquisition decisions
  - Establish realistic requirements
  - ***Evaluate military utility***
  - Explore Joint and combined solutions
  - Develop real ***CONOPS and doctrine***
  - Can result in new program without ICD
- Aim for early transition to acquisition or sustainment
  - User and service decision
  - Accelerate acquisition process
- ***Leave a Go-to-War interim capability where appropriate***
  - Try before buy
  - Can be used immediately
  - Viable and supportable CONOPs

Acquisition Program vs. ATD & JCTD

	Acq Program	ATD	JCTD
Objective	•Develop, produce, field and support systems •Meet Cost, schedule, performance	•Assess feasibility and maturity of technologies •Risk reduction	•Evaluate military utility •Develop CONOPs & doctrine •Accelerate Acquisition •"Go to War" capability
Benefits/ Drawbacks	Fully supported systems / Expensive and Time Intensive	Reduce technical risks at relatively low cost / No immediate utility	Quickly fielded technologies / Systems are not fully supported
Rqmts	ICD/CDD/CPD	Not required	User Sponsor/ JROC prioritization
Oversight	MDA	Labs/ R&D centers	DUSD(AS&C) Oversight Panel
Funding	Fully FYDP funded	RDT&E	RDT&E
Configuration & Testing	system/subsystem prototypes DT/OT	technology demonstrations	tech demonstrations fielded environment with users
Rules and Regulations	DoD 5000 series/FAR	informal/FAR/OT Plan	Mgmt Plan/FAR/OT Plan
Role of User	Max involvement	Some involvement	Max involvement
End Goal	IOC/FOC Fully supported system	Successful demonstration applied to future systems	Interim leave behind capability or New program

Small Business Innovation Research (SBIR)

- Small Business Innovation Research is a competitive program that encourage small business to engage in Federal Research and Development with the objective to
  - Stimulate technological innovation
  - Meet Federal research and development needs
  - Foster and encourage participation in innovation and entrepreneurship by women and socially or economically disadvantaged persons
  - Increase private-sector commercialization of innovations derived from Federal research and development funding
- Three-phase process

Summary

- What is the U.S. technology posture in relation to defense acquisition?
- What is the role of S&T in defense acquisitions?
- When during the acquisition life-cycle are we most likely to introduce new technologies?
- Key characteristics of ATD?
- Key characteristics of JCTD?