Transitioning Technology to Naval Ships
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Agenda

• Technology Transition
• NGIPS Technology Development Roadmap
• Metrics
• Technology Transition Examples
• Recommendations
Technology

“The practical application of knowledge especially in a particular area”

Merriam-Webster Dictionary
Technology Transition

“Transfer of knowledge from those people that create it, to those people that require the knowledge to impact a change on a ship.”

– People have to be paid
– People generally are in different organizations

• Two aspects of Technology Transition
  – Transfer of Knowledge from one organization to another
  – Transfer of Fiscal Responsibility from one organization to another
Getting a new technology Component / System on a ship

- **New Construction**
  - Written into Ship Specifications
  - Engineering Change Proposal
  - Written into Component Specification / Standard

- **In Service**
  - Ship Change Document (Planned configuration change)
  - Alteration equivalent to Repair (AER)
  - Fit Form Function replacement of a repair part
    - Via Stock System
  - Alteration during Depot Maintenance
  - “requirements” for consumables (MRCs, TMs, etc.)
Getting a new Process / Tool Invoked

- Modify Process Documentation
  - Standards and Handbooks
  - Work Instructions and Standard Practices
  - Modify SOWs and specs
- Modify infrastructure
  - Tools
  - Software
  - Workspace layout
- Train Workforce
- Monitor and act on relevant metrics
Reasons to Adopt a new Technology

• Gap (Best way to fulfill an unmet operational requirement)
  – Advances in adversary capabilities
  – Changes in CONOPS
  – Changes in law and regulations
  – Loss of industrial base to reproduce existing system

• Opportunity (Perceived benefits outweigh the risks)
  – Acquisition Cost Reduction
  – Total Ownership Cost Reduction
  – Enable new CONOPS

• Risk Management
  – Improve Flexibility to react to potential future gaps (Requirements Risks)
  – Mitigate risk of disappearing Industrial Base or source of raw materials
  – Mitigate risk of a technology for another more critical program
Technology Transition Interactions
Technology Transition

**SHIP ACAT PROGRAM MILESTONES:**

- A: Material Solution Analysis
- B: Technology Development
- C: Engineering & Manufacturing Development
- Production & Deployment

**Technology Transitions**

- TRL 1 to 2
- TRL 2 to 3
- TRL 4 to 5
- TRL 5 to 7
- TRL 8
- TRL 9+

**Manufacturing Readiness Level Deskbook Draft 3 Jan 2010**

**References**

- DoD 5000.01 20 Nov 2007
- DoDI 5000.02 12 Dec 2008
- DoD FMR 7000.14-R (June 2006)
- ONR
- PEO / SYSCOM

**Technology Creation**

**Product Development**

**Ship Integration**
Traditional Technology Transition Model

- Observations
  - Serial (long) Process
  - Does not promote commonality across platforms
Alternate Technology Transition Model

- **Product Lines**
  - Provide capability to create and produce specific applications when needed.
  - Promote Commonality across Ship classes.
  - Decouple S&T from specific ship applications
    - Eliminate churn in aligning S&T and ship acquisition programs.
  - Capture knowledge in Specifications, Standards, Handbooks, Design Data Sheets, Rules, etc.

- **Technology Development Roadmaps facilitate communication**
Technology Transition Enablers

- Technology Transition Agreements
- Relationship Managers
- Metrics

Technology Transition Agreements

- “The agreements put in writing the technology and business-related expectations, such as specific cost, schedule, and performance characteristics that labs must demonstrate.”
- “The agreements also may require documenting manufacturing costs or specifying whether certain lab scientists will be loaned to the product line to provide continuity in technical knowledge.”

DEFINES A RELATIONSHIP BETWEEN TECHNOLOGY CREATION AND PRODUCT LINE DEVELOPMENT

SHOULD INCLUDE MUCH MORE THAN A COMMITMENT TO FUND FURTHER DEVELOPMENT
Relationship Managers

• Communicate across the labs and product lines to address transition issues.
• Ensure the right knowledge gets to the right person to make the final product a success.
• Facilitate feedback from the product development back to the technology developers to guide the creation of new technology.
Metrics

- **DOD Metrics**
  - Technology Readiness Level
  - Manufacturing Readiness Levels

- **Commercial Industry Metrics**
  - More Inclusive of all aspects of Technology Transition

### Table: MRL Definition Phase

<table>
<thead>
<tr>
<th>MRL</th>
<th>Definition</th>
<th>Phase</th>
<th>BA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Basic Manufacturing Implications Identified</td>
<td>Pre Materiel Solution Analysis</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Manufacturing Concepts Identified</td>
<td>Pre Materiel Solution Analysis</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Manufacturing Proof of Concept Developed</td>
<td>Pre Materiel Solution Analysis</td>
<td>2-3</td>
</tr>
<tr>
<td>4</td>
<td>Capability to produce the technology in a laboratory environment.</td>
<td>Materiel Solution Analysis(MSA) leading to a Milestone A decision.</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Capability to produce prototype components in a production relevant environment.</td>
<td>Early Technology Development Phase</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Capability to produce a prototype system or subsystem in a production relevant environment.</td>
<td>Prior to completion of Preliminary Design and the start of Contract Design</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Capability to produce systems, subsystems or components in a production representative environment.</td>
<td>Late Technology Development Phase leading to Milestone B</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Pilot line capability demonstrated. Ready to begin low rate production.</td>
<td>Engineering &amp; Manufacturing Development (EMD) leading to a Milestone C decision.</td>
<td>5 - SCN</td>
</tr>
<tr>
<td>9</td>
<td>Low Rate Production demonstrated. Capability in place to begin Full Rate Production.</td>
<td>Production &amp; Deployment leading to a Full Rate Production (FRP) decision.</td>
<td>5 - SCN</td>
</tr>
<tr>
<td>10</td>
<td>Full Rate Production demonstrated and lean production practices in place.</td>
<td>Full Rate Production/ Sustainment</td>
<td>SCN</td>
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</tbody>
</table>
# Boeing Technology Maturity Scoreboard

The Boeing Technology Maturity Scoreboard is a tool used to assess the readiness of technology for deployment. It evaluates technology based on several criteria and stages of development. Below is the breakdown of the criteria and their readiness levels:

<table>
<thead>
<tr>
<th>Criteria for readiness</th>
<th>Technology development</th>
<th>Technology transition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Discovery</td>
<td>Feasibility</td>
</tr>
<tr>
<td>1. Consistency with strategy</td>
<td></td>
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<tr>
<td>2. Technical validity</td>
<td></td>
<td></td>
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<td>3. Cost, benefit, risk assessment</td>
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<td></td>
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<td>4. Competitive technology assessment</td>
<td></td>
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<tr>
<td>5. Scalability</td>
<td></td>
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<tr>
<td>6. Collateral impact</td>
<td></td>
<td></td>
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<tr>
<td>7. People and organization readiness</td>
<td></td>
<td></td>
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<tr>
<td>8. Product line endorsement</td>
<td></td>
<td></td>
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<tr>
<td>9. Intellectual property protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Technology information</td>
<td></td>
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</tbody>
</table>

Source: GAO analysis based on The Boeing Company's scorecard.
Institutionalizing Technology

- Early Technology Demonstration
- Incorporation into Production Units
- Standardization of Architecture and Interfaces
- Standardization of Design Process
- Integration into Design Tools
- Full Implementation in Standards and Specifications
- Part of Engineering School Curriculum
NGIPS Technology Development Roadmap

- Developed in 2007
  - Coincident with establishing the Electric Ships Office

- What it Did
  - Defined the state of the technology
  - Defined the Need
  - Defined Architectures
  - Listed technology developments needed
  - Proposed a Business Model

- What it Did Not Do
  - Define an Execution Plan

Figure 1: NGIPS Technology Development Roadmap
Examples

- Advanced Enclosed Mast / Sensor System on LPD 17
  - Classic ONR to Ship technology transition
  - Technology not fully institutionalized

- Hybrid Electric Drive on LHD 8
  - Technology demonstrated in U.K. Navy, and developed by industry
  - Technology not fully institutionalized

- Integrated Power System on DDG 1000
  - Started as a product line approach developed by NAVSEA
  - Morphed into ship specific systems

- Next Generation Integrated Power System
  - Implement Product Line Approach
  - Not yet transitioned to a ship program

- Set Based Design on Ship to Shore Connector
  - Process transitioned from Toyota via University
  - Basic Process codified in Ship Design Manager Manual
Recommendations

- Promote the use of Product Lines and Associated Technology Development Roadmaps
- Employ more Robust Metrics
- Improve Technology Transition Agreements
- Fully Implement Relationship Managers
- Modify the DOD Financial Management Regulation (DODFMR) to include Technology Transition Activities in BA-3.
- Modify DODFMR to split BA4 into Product Line Development and Advanced Component Development and Prototypes
- Assign OPNAV N091 as the resource sponsor for Product Line Development in addition to S&T.