Notice:

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Summary

Purpose:
- To provide the Ada Joint Program Office with a cost-effectiveness study on Ada

Strategy:
- Update previous studies on cost-effectiveness of Ada
- Investigate impact of Ada in DoD's software development life cycle.

Findings:
- Significant MCCR software savings possible
  - Due to software reuse, and
  - Due to software effort reduction
- Reduced requirements for software labor
- High degree of capitalization required

Caveat:
- Acquisitions changes needed to achieve projected savings
Approach

Investments in Ada divided into three phases

- Standardization Phase
  - begins in 1970's with language design efforts

- Technology Insertion Phase
  - current time period
  - begins with general availability of compilers

- Changed practices phase
  - capital investments in place
  - workforce has been upgraded
Standardization Phase

- Period prior to general availability of compilers, 1970's to 1985
- Included studies, experimental developments, reviews, and research
- Approximate estimates provided for the costs of achieving standardization
- Useful in determining costs borne by a language standardization program
- Benefits accrue in Technology Insertion phase
  - Standardization expenses trivial compared to potential benefits
Technology Insertion Phase

Phase where initial benefits begin to accrue

- Ada features support software code reuse
- Ada institutionalizes modern practices
- Ada brings modern environment and tools
- Capital investments in hardware and software made
- Training expenses accrued
- Business practices changed
Expenditures Analysis

Expenditures forecast for technology insertion phase ($B)
Personnel Forecast

Workforce sizing needed to forecast costs of introduction of technology

- Breakdown of billable professional man/year used to identify
  - direct professional (software) labor
  - indirect professional (software-related) labor
  - technical support labor
  - administrative support labor

- Forecast based on Expenditure Analysis, reduced base after savings
  - identifies direct, indirect, and vocational labor

- Rough estimates made for
  - Other professional, systems & test labor
  - DoD personnel
Personnel Forecast

Workforce forecast (K people)
Costs Analysis

Costs of insertion of new technology

- **Assumptions**
  - Lowest reasonable cost hardware for all as needed
  - Software tools licensed at market value
  - Company and project investments "tailor" tools

- **Capitalization**
  - Hardware to support APSE (SEE)
  - Operating Systems (including KAPSEs)
  - Ada Compilers
  - Compile/Debug toolsets (code development)
  - SW Productivity toolsets (incl. other life cycle phases)

- **Expenses**
  - APSE (SEE) installation and maintenance costs
  - Continued Training, professional workforce
  - Continued Training, vocational workforce
  - Schools, upgrading coursework & staff

- **Maintenance of technology base**
Costs of New Technology

Costs of insertion of new technology ($B)
Capitalization

- APSE/SEE Hardware
  - User workstations (professionals)
  - User terminals (vocationals)
  - Hosts

- APSE Software
  - Operating System
  - Ada compiler - hosts
  - Ada compiler(s) - targets
  - Compile/Debug toolsets
  - SW Productivity toolsets
Capitalization
Environment

Necessary minimal environment for forecasted savings
Expenses

- Operating Expense Categories
  - APSE/SEE maintenance
  - Training, Technical Professional Workforce
  - Training, Managerial and Admin. Workforce
  - Schools, curricula and workforce upgrade
  - Civil service upgrade
  - Military service upgrade
  - Pay rate increases
Benefits Analysis

Primary benefit factors (reduce quantity of software)

- Improved acquisition practices
  - Reusability

Secondary benefit factors (reduce effort)

- Improved technical practices
  - Modern methods and practices
  - Tool support and automation
  - Distributed workstation environment (turn-around time)
  - Training and experience improvement

- Improved vocational practices
## Technical Practices Savings

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<th>Technological Benefit</th>
<th>Effort Multipliers</th>
<th>Years to Max. Benefit</th>
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<td>Tools</td>
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<td>Turn-around</td>
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<td>Savings (%)</td>
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Savings Due to Technology
Experience Factor Savings

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<td>Applications experience</td>
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<td>Tool experience</td>
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<td><strong>product π</strong></td>
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## Sensitivity Analysis

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