Acquisition Research Program:
Creating Synergy for Informed Change

Improving Ship Maintenance with Collaborative Product Life Cycle Management and 3D Terrestrial Laser Scanning Tools:

Reducing Costs and Increasing Productivity

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Research Context

- Use of Integrated Risk Management approach to estimate:
  - Cost savings and future value from use of CPLM + 3D TLS
  - Application of Real Options, Monte Carlo simulation, and Modern Portfolio Theory
- Continuation of previous research (NPS-GSBPP-10-015)

3D Terrestrial Laser Scanning

- Laser scans space from highly articulated mount
- Software processes points into 3D image of the space (within 3/16”) ready for CADD, etc.
- Can be combined with 360^{o} camera
- Currently used in automotive, offshore construction and repair, civil and transportation, building construction, fossil fuel and nuclear power plants

Collaborative Product Lifecycle Management

- To “integrate people, processes, and information”
- Electronically integrates 3D TLS for participant collaboration across physical distances
- Common database of images and related data for improved access
- Common platform for program change management

Improved Modeling of Benefits and Costs

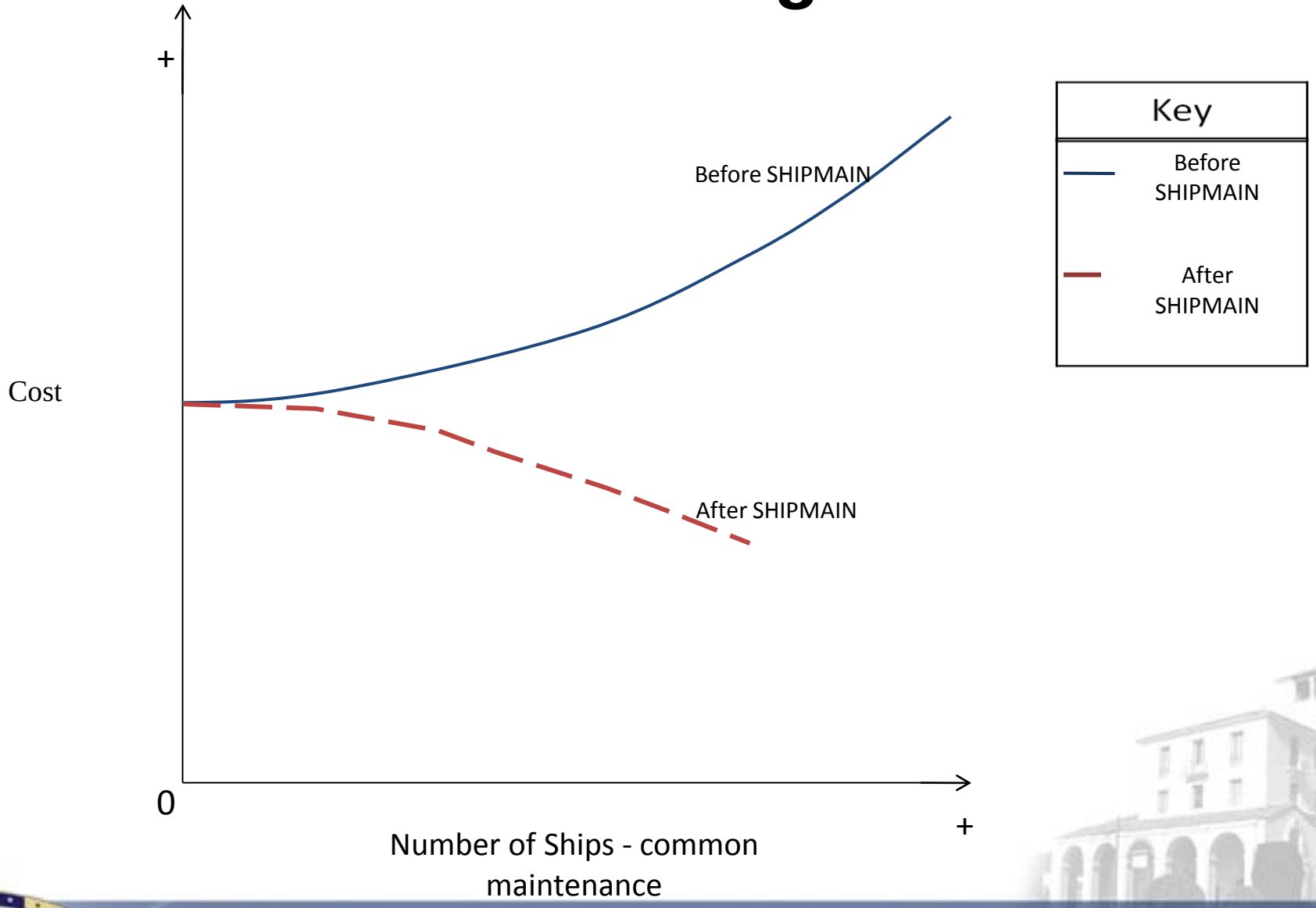
Benefits

- *More realistic description of possible benefits with different number of yards using* 3D-TLS + collabPLM
- Faster processes create increased ships processed if 3D-TLS + collabPLM are adopted due to the *reduced cycle time*
- *Lifespan* of use of 3D-TLS + collabPLM before adoption of a new technology – longer lifespan increases benefits

Costs

- *Initial costs* to purchase and install collab. PLM software and license users
- *Costs to install* 3D-TLS at the shipyards
- Reduced operations cost/ship due to faster processes

Production Learning Curve



Reduced Total Ownership Costs ($millions)

Finance Plan: $1.6m for each of 4 yards = $6.4m total

20% CT reduction	Product Lifespan		
No. Yards Adopting	5 years	10 years	15 years
4	189.10	384.59	580.08
7	337.96	682.34	1026.68

40% CT reduction	Product Lifespan		
No. Yards Adopting	5 years	10 years	15 years
4	179.73	365.87	552.01
7	321.58	649.57	977.55

60% CT reduction	Product Lifespan		
No. Yards Adopting	5 years	10 years	15 years
4	**161.04**	328.48	495.92
7	288.86	584.13	879.40

Finance Plan: $3.2m for 4 yards = $3.2m total

20% CT reduction	Product Lifespan		
No. Yards Adopting	5 years	10 years	15 years
4	192.29	387.79	583.28
7	341.16	685.53	**1029.88**

40% CT reduction	Product Lifespan		
No. Yards Adopting	5 years	10 years	15 years
4	182.93	369.07	555.21
7	341.16	652.77	980.75

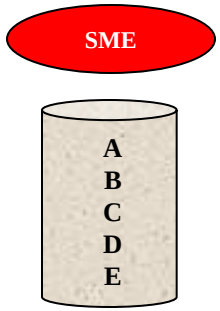
60% CT reduction	Product Lifespan		
No. Yards Adopting	5 years	10 years	15 years
4	164.24	331.69	499.10
7	324.78	588.94	884.23

- Net estimated cost savings:
  - From $161 million to $1.03 billion
  - cost savings increase with the number of yards adopting collab-PLM and 3D TLS across product life span
- Savings reduce with increased cycle-time reduction: increased throughputs increase costs, decreasing savings
- However, increased throughput capacity may prove critical for Navy:
  - Navy Secretary Mabus recently announced plans to build a 324 warship Navy by 2020
  - will require increased ship maintenance capacity
  - CPLM+3D TLS can help provide increased capacity

Integrated Risk Management

1 List strategies

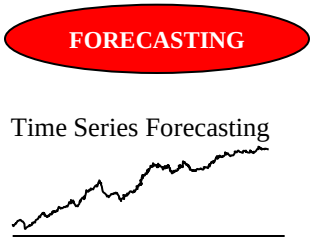
RISK IDENTIFICATION



Start with a list of projects or strategies to be evaluated… these projects have already been through qualitative screening

2 Predictive Analytics: projections for each scenario

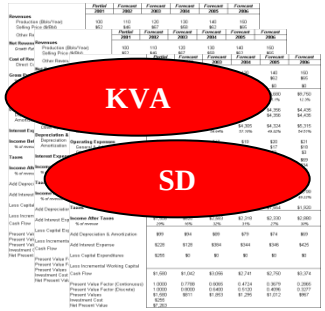
RISK PREDICTION



…with the assistance of time-series forecasting, future outcomes can be predicted...

3 KVA and SD: Develop financial models

RISK MODELING

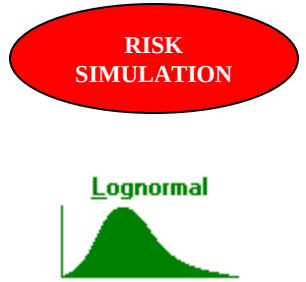


Traditional analysis stops here!

…the user generates a traditional series of static base case financial (discounted cash flow) models for each project…

4 Dynamic Monte Carlo risk simulation

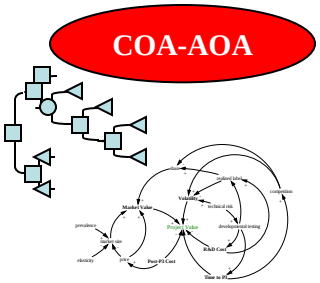
RISK ANALYSIS



…Monte Carlo simulation is added to the analysis and the financial model outputs become inputs into the real options analysis…

5 Framing Flexibility: Real Options

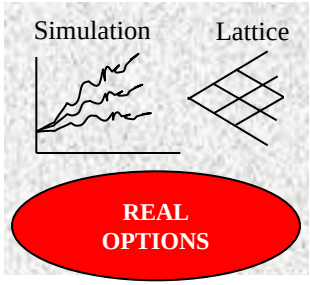
RISK MITIGATION



…the relevant projects are chosen for real options analysis and the project or portfolio real options are framed…

6 Options analytics, simulation, optimization

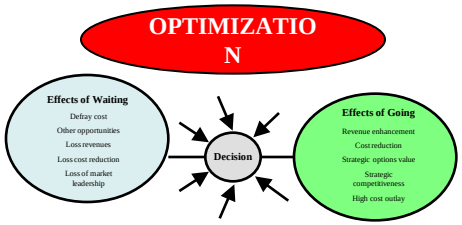
RISK HEDGING



…real options analytics are calculated through binomial lattices and closed-form partial-differential models with simulation…

7 Portfolio optimization and asset allocation

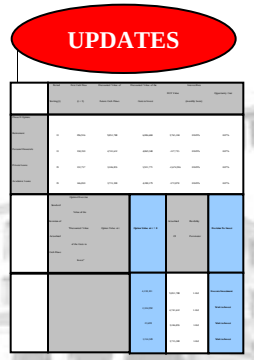
RISK DIVERSIFICATION



…stochastic optimization is the next optional step if multiple projects exist that require efficient asset allocation given some budgetary constraints… useful for strategic portfolio management…

8 Reports presentation and update analysis

RISK MANAGEMENT

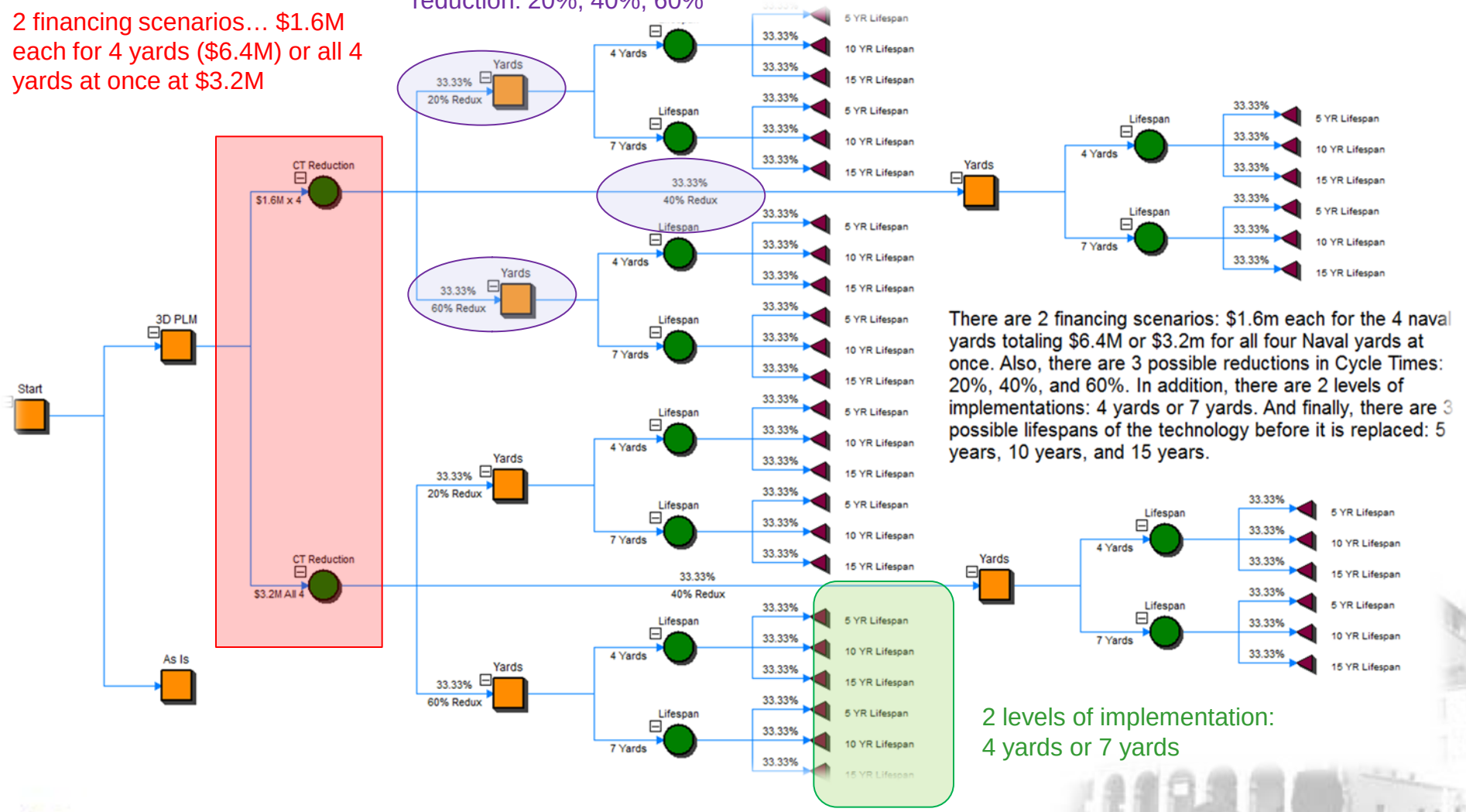


…create reports, make decisions, and do it all again iteratively over time…

Data Requirements and Scenarios

2 financing scenarios… $1.6M each for 4 yards ($6.4M) or all 4 yards at once at $3.2M

3 scenarios of cycle time reduction: 20%, 40%, 60%

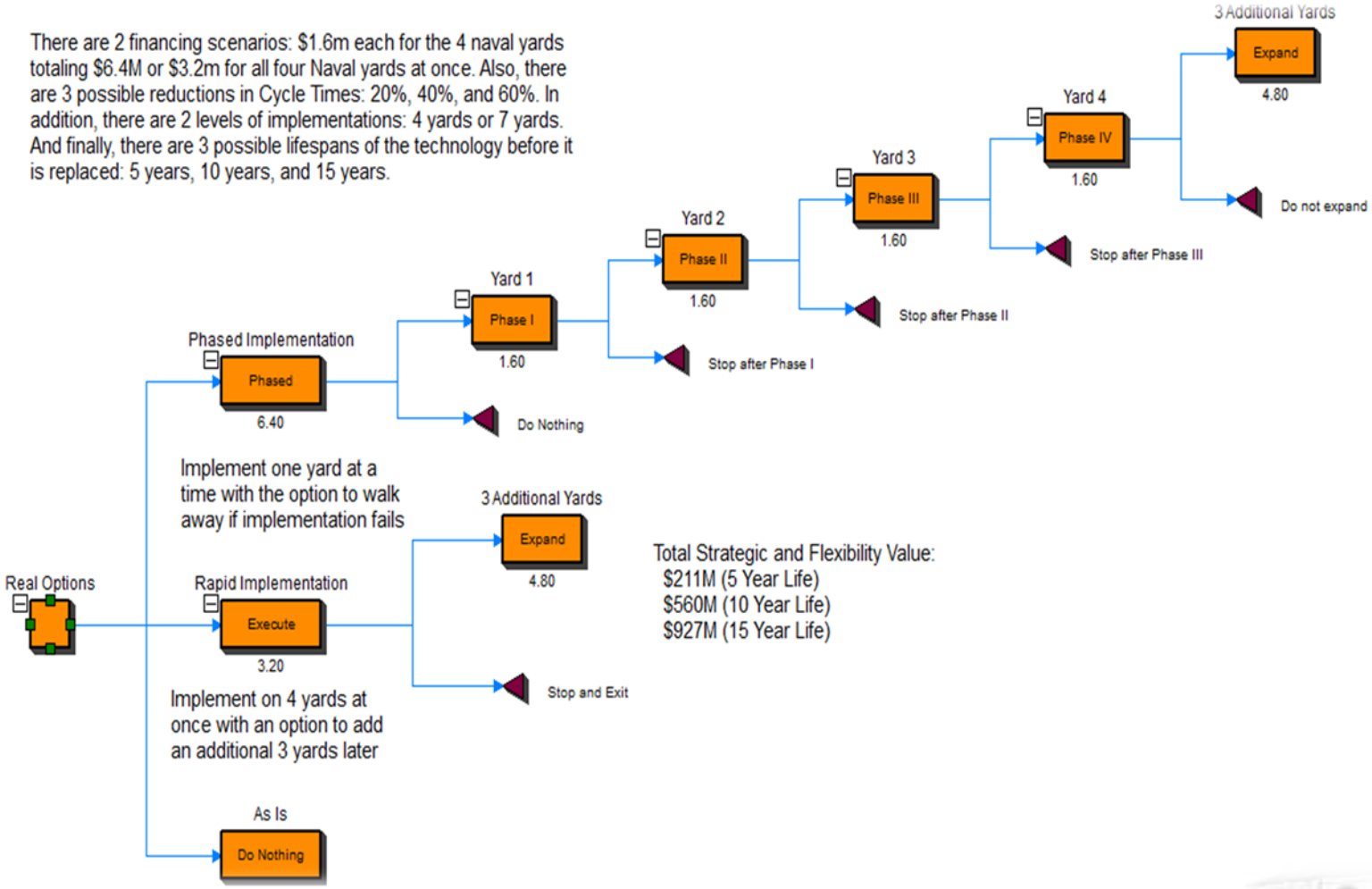


There are 2 financing scenarios: $1.6m each for the 4 naval yards totaling $6.4M or $3.2m for all four Naval yards at once. Also, there are 3 possible reductions in Cycle Times: 20%, 40%, and 60%. In addition, there are 2 levels of implementations: 4 yards or 7 yards. And finally, there are 3 possible lifespans of the technology before it is replaced: 5 years, 10 years, and 15 years.

2 levels of implementation: 4 yards or 7 yards

Strategic Real Options (COA/AOA): Value of Flexibility

There are 2 financing scenarios: $1.6m each for the 4 naval yards totaling $6.4M or $3.2m for all four Naval yards at once. Also, there are 3 possible reductions in Cycle Times: 20%, 40%, and 60%. In addition, there are 2 levels of implementations: 4 yards or 7 yards. And finally, there are 3 possible lifespans of the technology before it is replaced: 5 years, 10 years, and 15 years.



Total Strategic and Flexibility Value:
$211M (5 Year Life)
$560M (10 Year Life)
$927M (15 Year Life)

Total Strategic and Flexibility Value
$195M (5 Year Life)
$553M (10 Year Life)
$921M (15 Year Life)

Conclusions: CPLM+3D TLS for Ship Maintance

- very large cost savings can be expected
- increase in shipyard capacity for ship maintenance
- Navy will have greater flexibility in adding or reducing capacity using the two technologies
- no logical reason for delaying implementation of two technologies based on the results of this study and the previous studies

Questions?
Comments?
Discussion?