
Implementation Assessment – Beyond the CBA

Evaluating Technology Gaps, Costs, and Life-Cycle Benefits

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Why do people do Cost Benefit Analysis and Environmental Assessment?

- ❑ To understand whether or not it makes financial and environmental sense to invest in a new technology
 - Implementation Assessment can be a powerful tool to understand the technical and financial implications
- ❑ As a sales tool to show how much money it will save and how much hazardous material it will remove
 - Implementation Assessment gives a full accounting of potential benefits
 - But remember it also gives a full accounting of up-front costs
- ❑ Because Chuck Pellerin told you to



What goes into the typical CBA and Environmental Assessment?

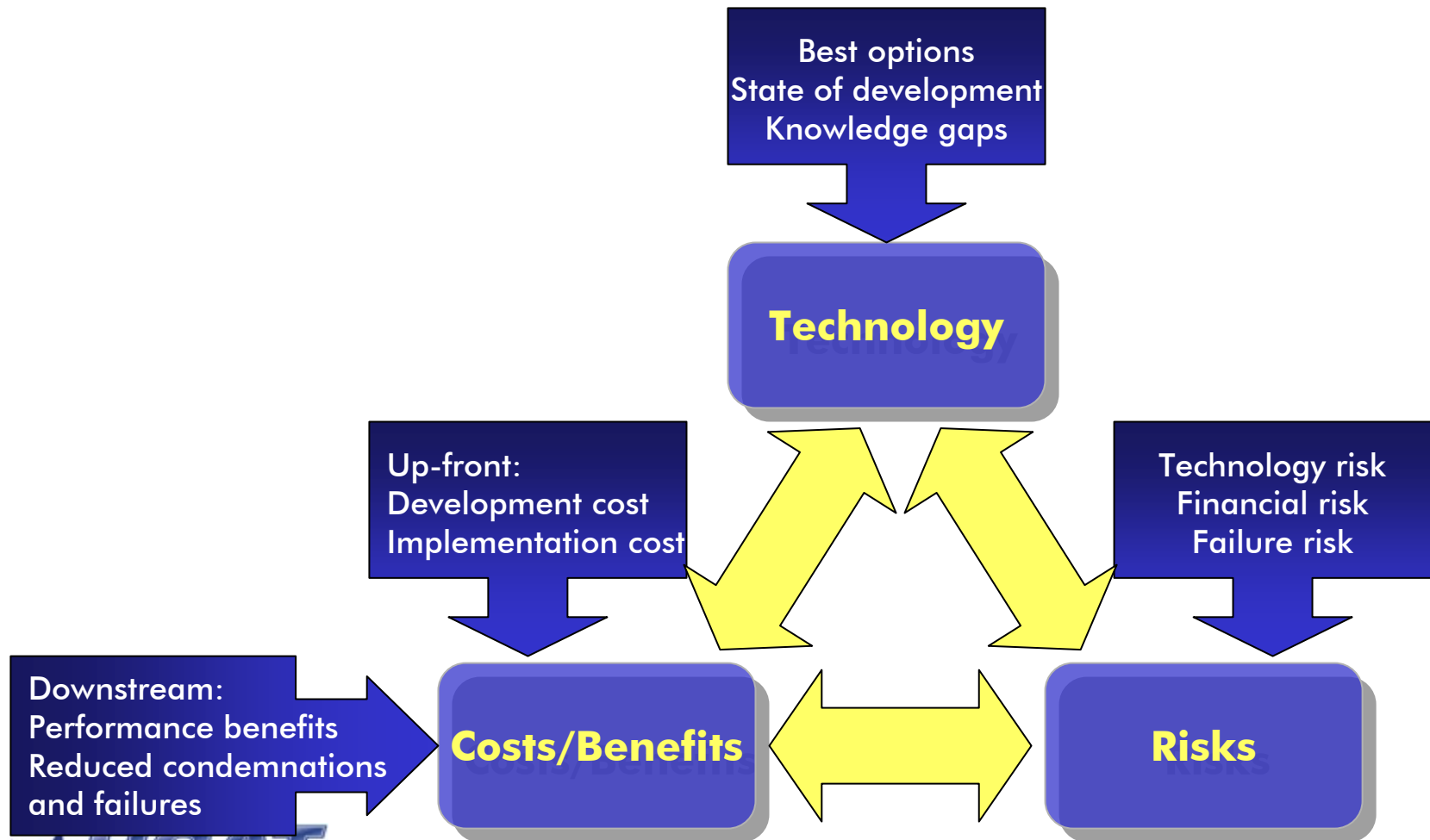
For analysis of a process or material change

- ❑ Detailed evaluation of relative materials costs
- ❑ Detailed evaluation of relative processing cost
- ❑ Detailed evaluation of ESOH costs
- ❑ Some accounting for expected savings from improved performance (e.g. longer repair cycle)
- ❑ Environmental impact of changes from reduction in use and discharge of hazardous materials

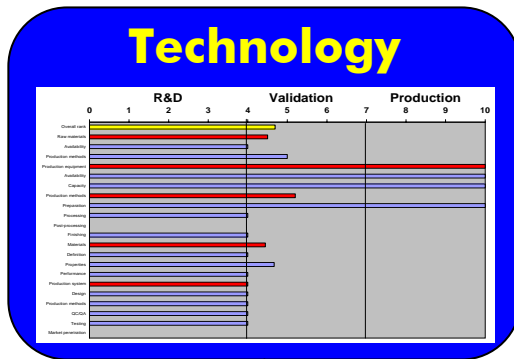
What does the typical analysis leave out?

- ❑ Pretty much all the big stuff!
 - Cost of developing the technology
 - Full cost of qualifying it and putting it into production
 - All the savings derived from performance improvements
 - Changes in (reduction of!) service failures
 - ◆ With all collateral costs involved
 - Reduction of component condemnation
 - ◆ With all collateral costs involved

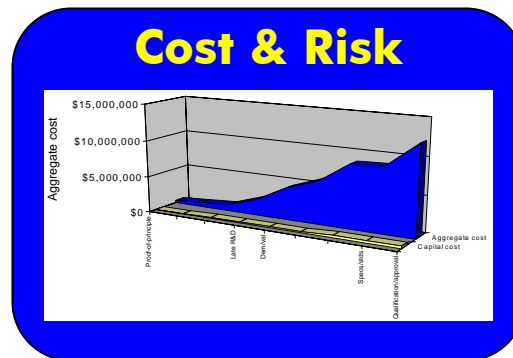
Putting it all together



Implementation Assessment structure



Degree of development
Technology gaps
Technology risk



R&D costs
Implementation costs
Environmental costs
Disposal costs
Risk reduction

Performance savings
Cost avoidance
ESOH/Hazmat reduction



Technology Assessment

Technology Analysis

- What technologies are available or in development?
 - How closely do they meet primary requirements?
 - Realism – where are they in the “Lab to Life Line”
 - ◆ Gleam in the eye
 - ◆ Well developed
 - ◆ Full production
 - How well do they fit with the production environment?
 - Do they offer potential improvements/life cycle cost savings over the existing technology?
 - How environmentally friendly are they?

LINKING GLOBAL TECHNOLOGIES WITH MARKETS

Final Report

Chrome Replacements
for
Internals and Small Parts

Contract #: F33615-95-C5615
Subcontract #: 440002135
Project #: 01-0824-38-5025-000

Principal Investigator: Keith O. Legg

UNCLASSIFIED NON-PROPRIETARY - Distribution Statement A

Technology Status Summary

- ❑ Semi-quantitative method developed under JSF funding for analyzing technology options
- ❑ Consider the production process
 - Assign each production requirement a rank based on standard production-readiness criteria
 - Graphical output of results quickly shows technology status and critical gaps

Raw materials

Production equipment

Production methods

Materials

Properties

Performance

Production system

Market penetration

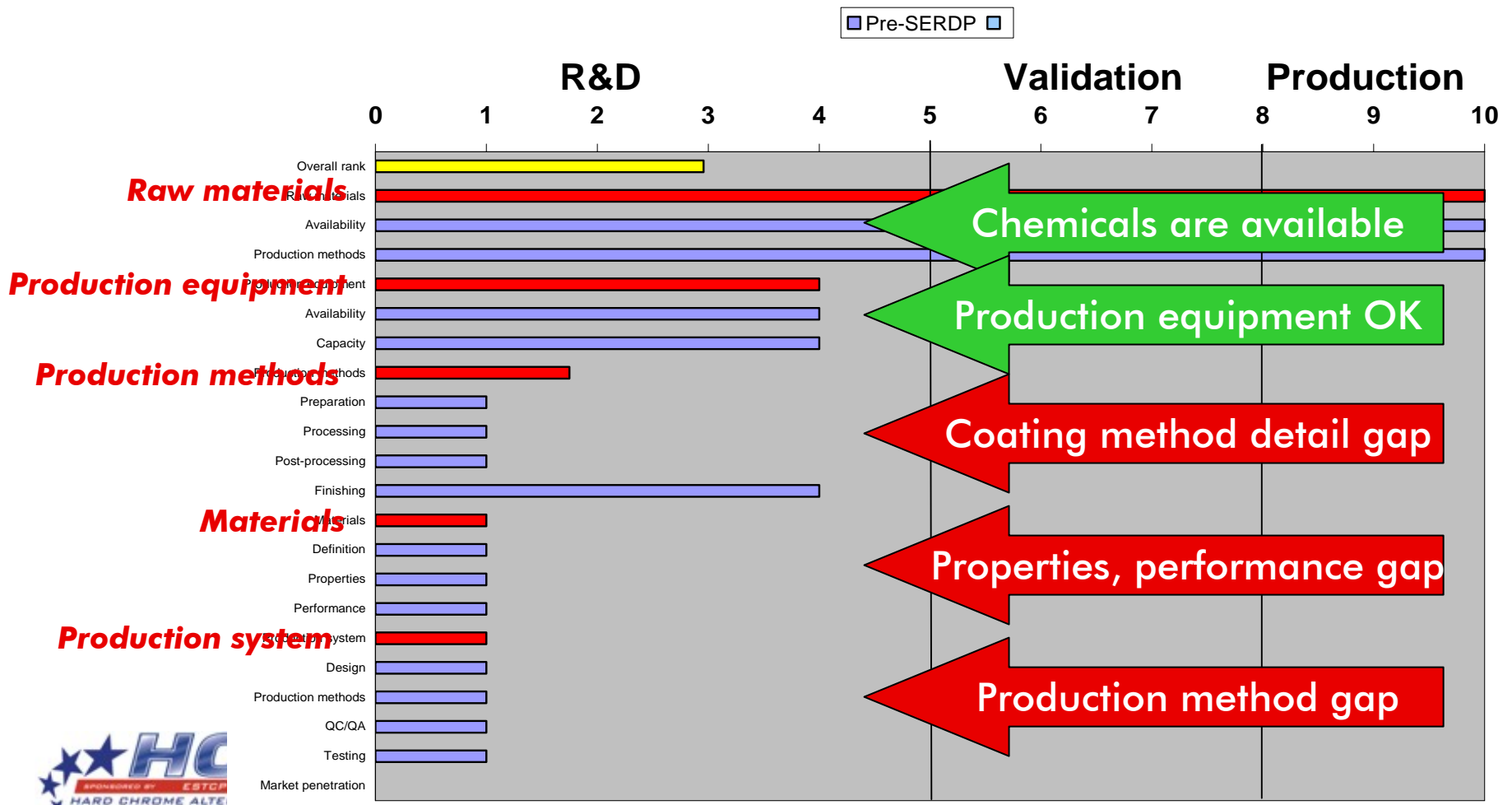
Technology Status Summary criteria

Rank	Description	Ranking criteria
0	Not possible with reasonable manufacturing approach	Fundamental reason why it cannot be done
1	Initial concept	Initial concept with backup reasoning
2	Early R&D - basic methods and properties	Demonstrated lab production, initial data
3	Proof-of-principle	Demonstrated lab production - equipment design viable, performance requirements appear attainable
4	Late R&D	Demonstrated lab scale; acceptable performance in most critical areas; no show stoppers
5	Acceptable performance demonstrated	Acceptable performance demonstrated in all critical areas using lab-scale equipment
6	Production demonstrated/ validated	Demo'd full scale; full data sets obtained; acceptable performance in all critical areas
7	Specs, standards developed	General specs or standards issued, or commercial specs exist
8	Qualification/ approval obtained	Approved for production
9	Early commercial	Commercial production of a few (<~20) different items
10	Market acceptance	>10% of general market, or well-defined niche



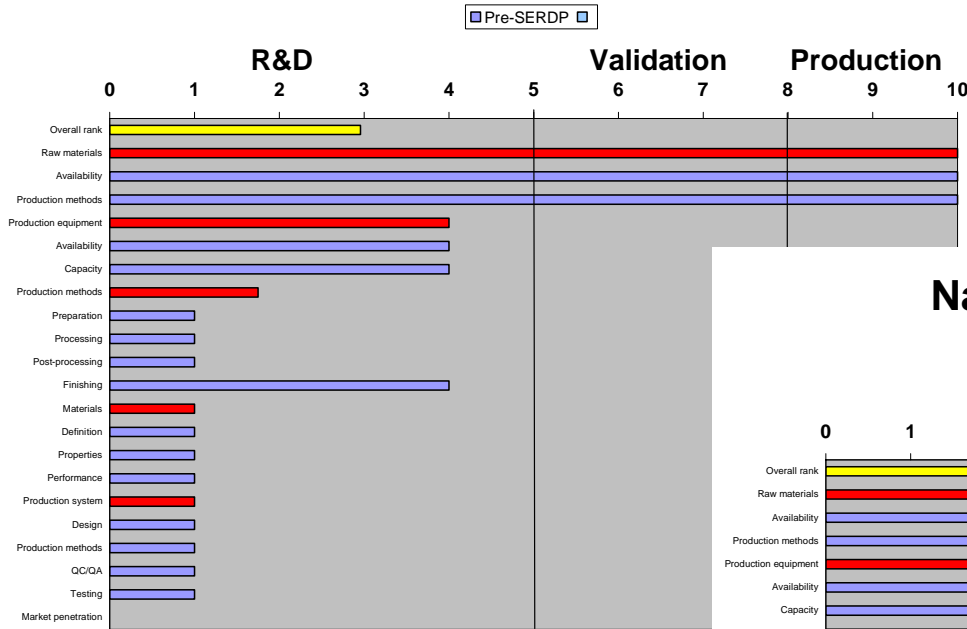
Example – Technology Status Summary for nanophase electroplates prior to SERDP Project #1152

Nanophase Co alloy electroplate



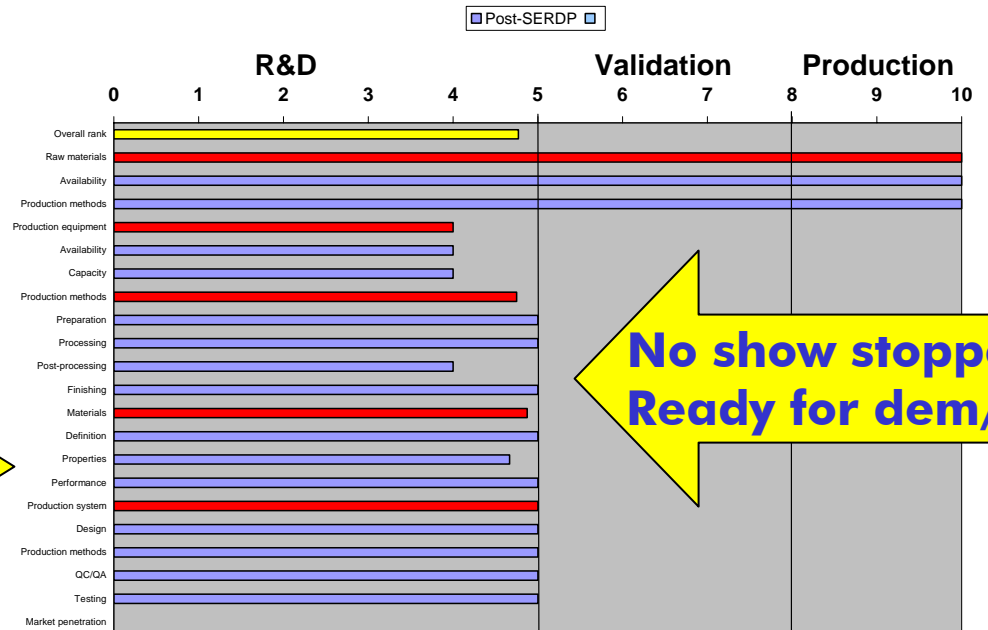
After completion of SERDP Project #1152

Nanophase Co alloy electroplate



Pre-SERDP

Nanophase Co alloy electroplate



No show stoppers!
Ready for dem/val

Post SERDP

Technology Risks – Gap Analysis

- ❑ Technology Status Summary + experience + analysis of the engineering field
 - Where are the technology gaps?
 - ◆ Are they problems of engineering or fundamental science?
 - What is the likelihood of serious or insurmountable deficiencies in any critical area?
 - ◆ Are some gaps particularly large or difficult?
 - ◆ Do we have sufficient resources to bridge the gaps?
 - ◆ Are competing technologies likely to come to production first?
 - Implementation Assessment provides a picture of the overall technology readiness and risks

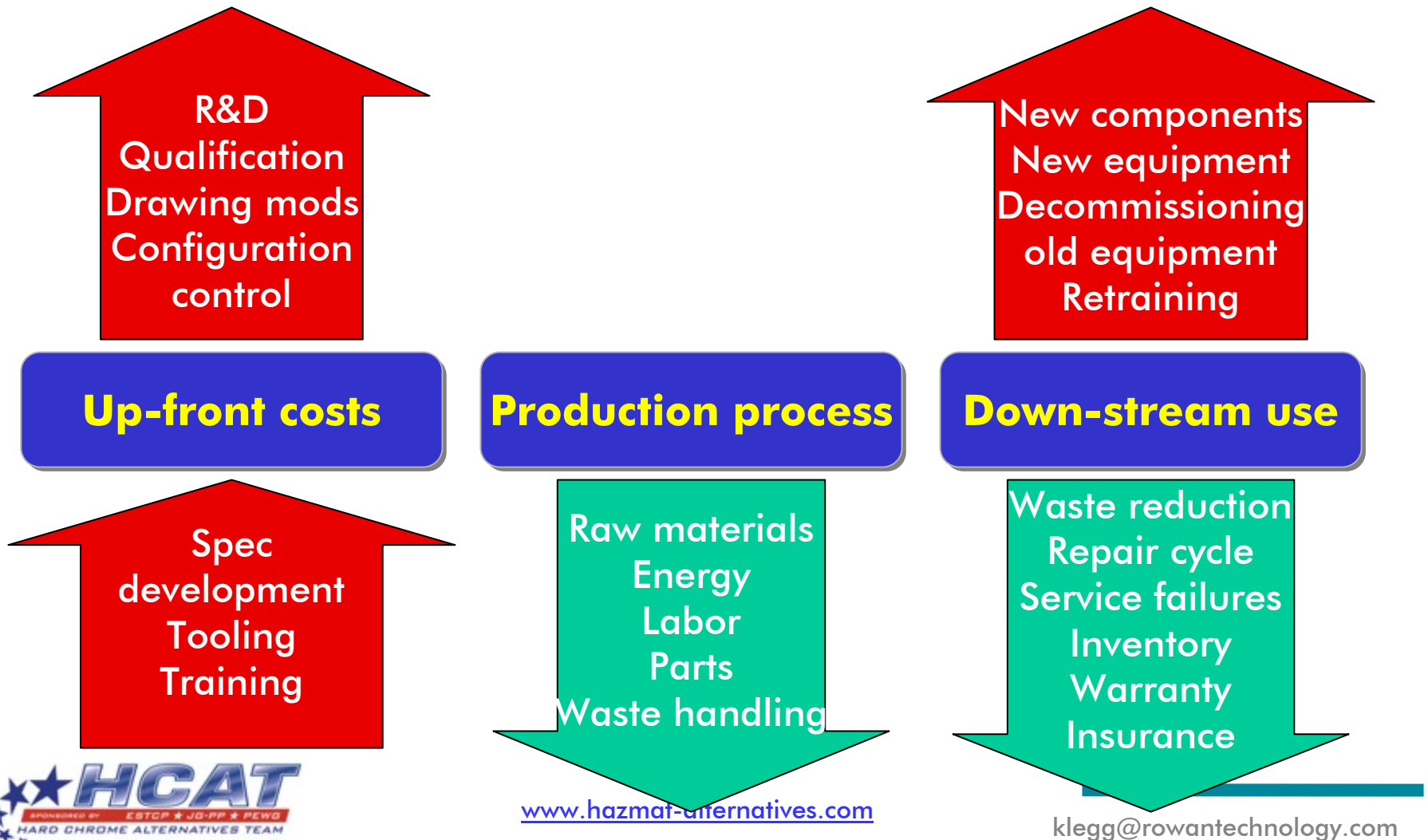
Financial assessment

Cost Benefit Analysis – the C-MAT tool



- ❑ Calculation for Material Alternative Technologies
- ❑ Decision Tool funded by SERDP for Stainless Steel Landing Gear program (Project # PP-1224)
 - Designed primarily for analysis of materials and process substitutions
 - Very extensive inclusion of up-front costs and down-stream benefits
 - Inclusion of data accuracy estimates to assess financial risk
 - Standard financial measures (Cash Flow, NPV, ROI, Payback Period)
- ❑ C-MAT does not just measure the cost/benefit of using the new technology vs the cost of using the old – it measures what you really do:
 - **It measures the full costs and benefits of moving to the new technology vs the costs and benefits of continuing to use the old**

Costs and Benefits



The critical question

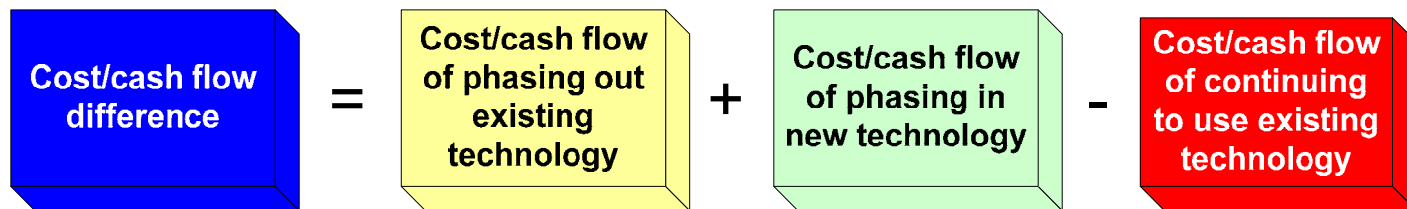
□ Why do you want to change?

- The real answer is rarely “Because Cr/Cd/name-your-poison is bad and we want to quit using it”
- It is usually an engineering, cost, worker safety, or availability issue:
 - ◆ Ogden would like to replace Cd-plated landing gear because of the frequent corrosion and stress corrosion cracking failures associated with Cd-plated 300M
 - The primary driver is service failure cost, with all its collateral damage costs and risks to personnel
 - ◆ NADEP Cherry Point would like to replace chrome-plated prop hub parts with HVOF-sprayed parts because it will extend the service life of parts that are no longer made
 - The primary driver is avoiding part condemnation and ensuring readiness – keeping planes flying

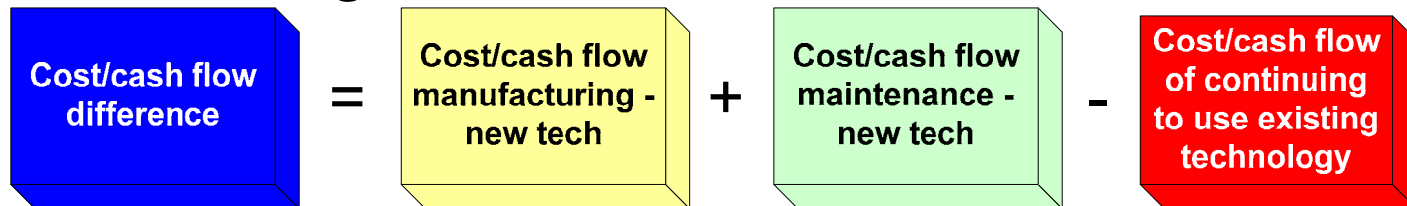
Computation

- The heart of the C-MAT approach is the Scenario
 - The Scenario models the way the new technology is to be phased in and used, or how the old is to be phased out
 - Can work with Cash Flow or Cost

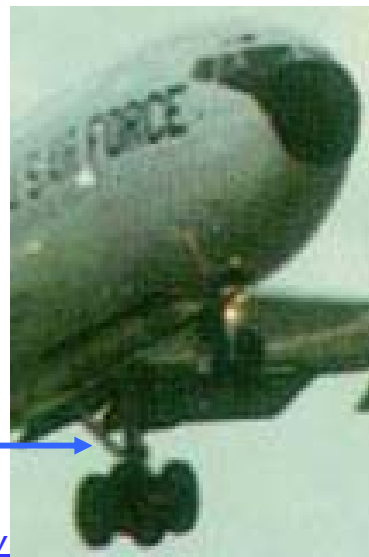
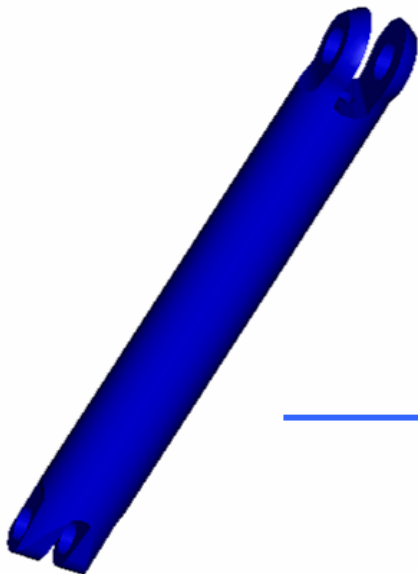
- Manufacturing or MRO:



- Manufacturing AND MRO



C-MAT example – KC-135 drag brace strut

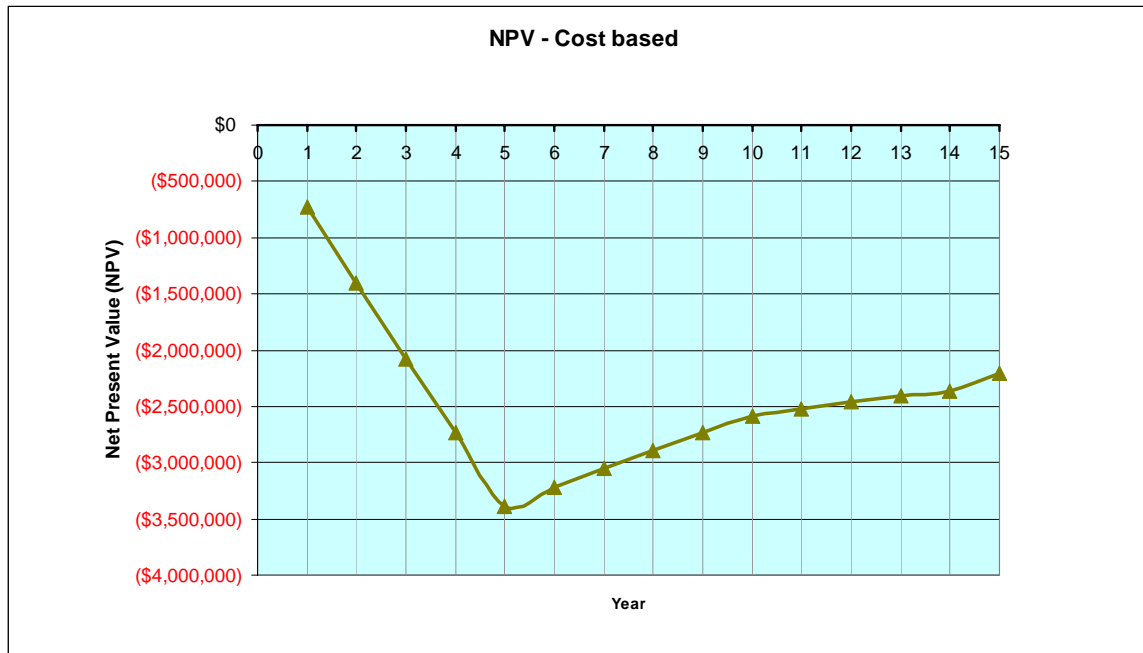


www

KC-135R is re-engined for more lift and better fuel performance. Non-R (i.e. KC-135) models are older and use 4330 drag brace strut. Problem is corrosion inside hollow strut.

A simple cost comparison

Initial calculation for stainless part based solely on replacement cost vs overhaul cost

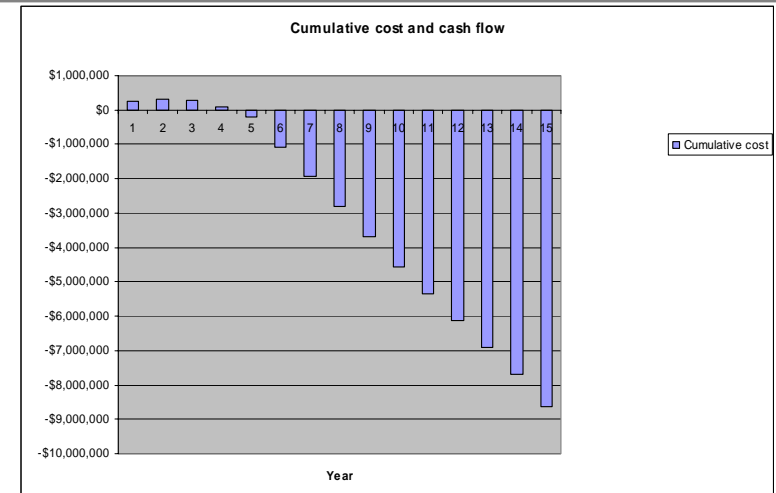
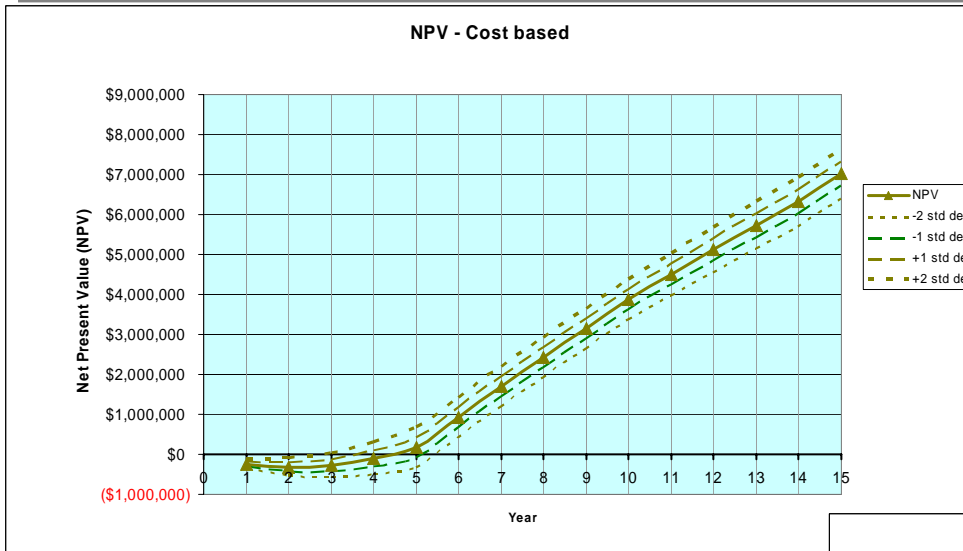


- ❑ NPV is value today of an income stream (savings)
- ❑ NPV depends on how long you take it over
 - The longer you go the more the savings build
- ❑ At 15 years still has large negative Net Present Value
- ❑ Payback period = 27 years
 - We'll have bright new B767s long before then (maybe – or maybe not)

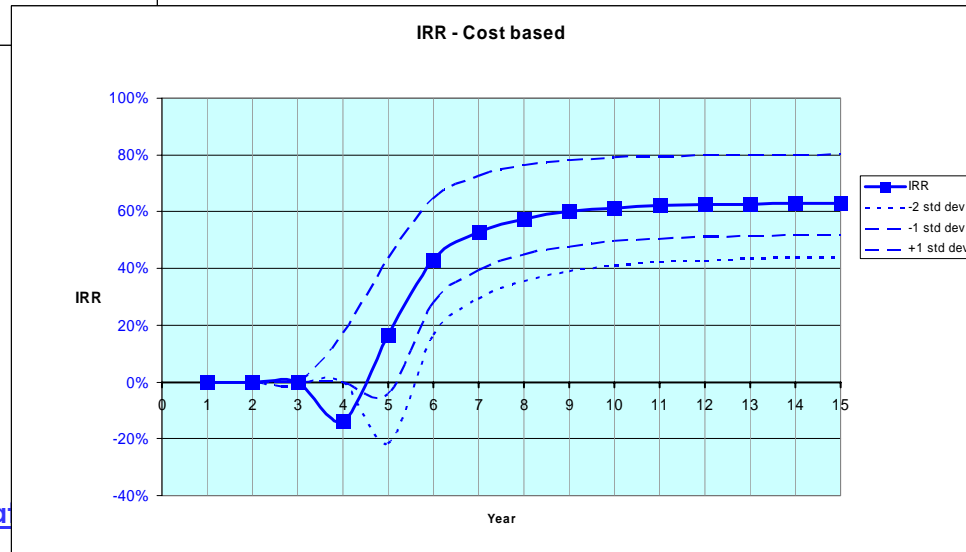
But where are the really big savings?

- ❑ Again, we ask the critical question
 - **“Why do you want to make this change?”**
 - ◆ Answer: “Because most of our problems are corrosion and SCC, which leads to unpredictable service failures.”
 - ◆ This component is prone to ID corrosion and very difficult to inspect
 - Only 1 major failure past 10 years – Class B (>\$500,000 collateral damage)
 - But concern that we are sitting on a time bomb that will lead to more unpredictable major failures as system ages
 - So, S-53 high strength stainless steel has 2 major expected cost and risk avoidance impacts:
 - ◆ Reduction or elimination of corrosion-related condemnation, so greatly reduced new component purchase downstream
 - ◆ Reduction or elimination of service failures related to corrosion and SCC and hydrogen embrittlement (all difficult or impossible to detect)
 - Eliminates ongoing corrosion failures and consequent need to condemn parts
 - Eliminates major failures and their collateral damage
 - Therefore the Scenarios should include performance impacts on the cost of service failure
 - ◆ One can only come up with estimates based on historical costs and reasonable estimates for future failures (risk)

Effect of including failure costs and more reasonable component cost



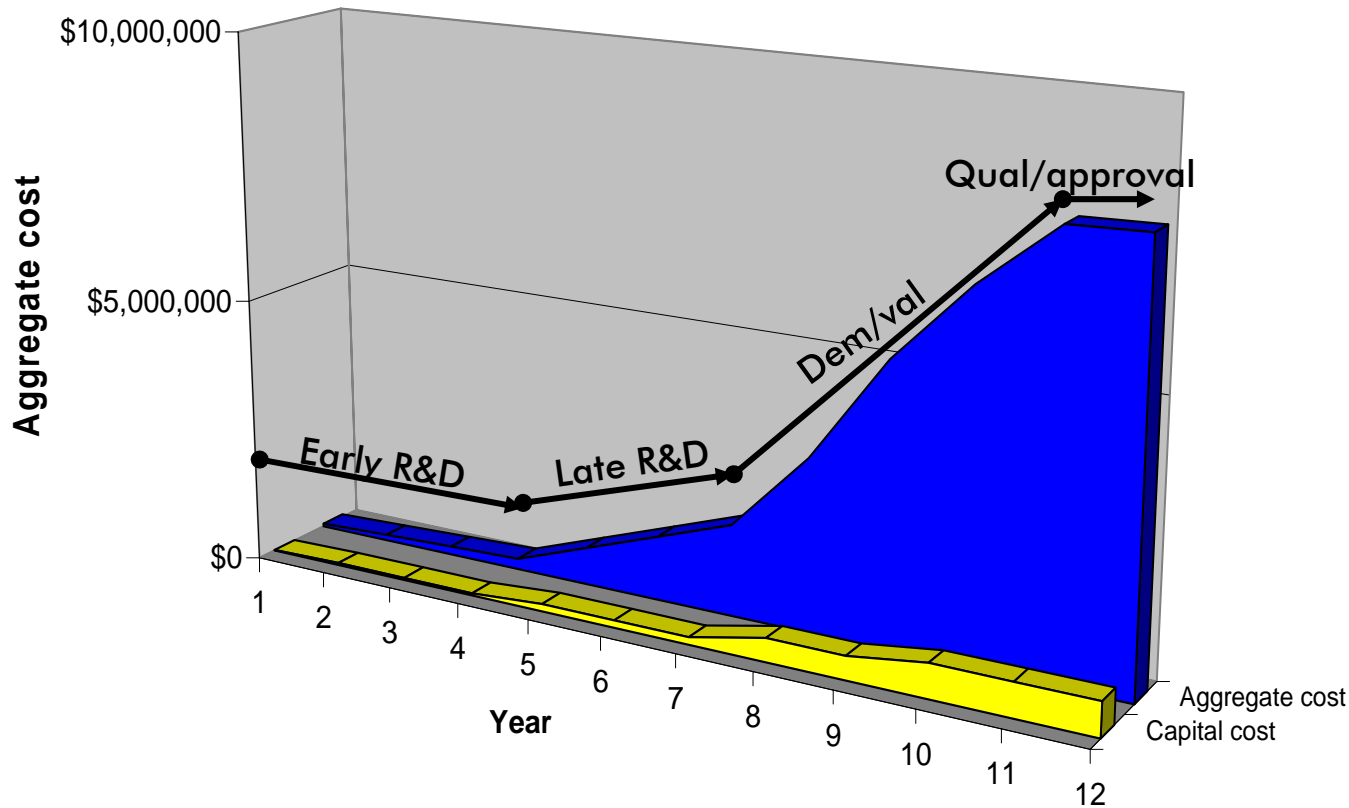
- Payback period 3 - 6 yrs
- NPV is \$6.5 - \$7.5 million over 15 years on non-R KC-135 alone when we use a more reasonable component cost and include the likely cost of service failure



What if.....?

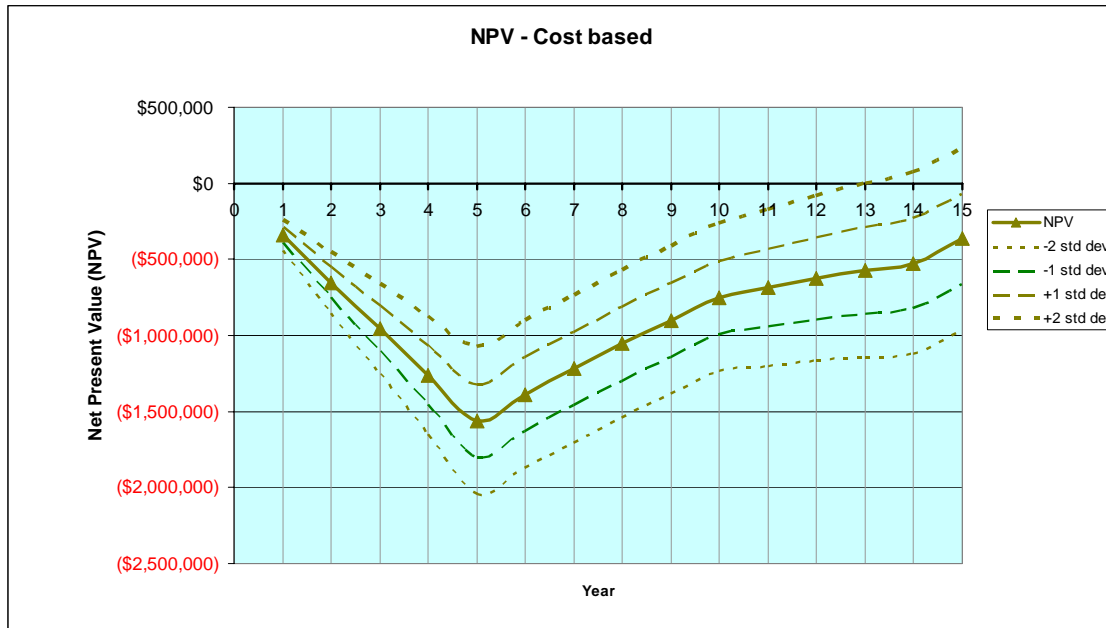
- ❑ The Scenario was built on the assumption that we would replace each old drag brace strut at overhaul with a brand new stainless strut
- ❑ But what if
 - We started seeing lots of SCC failures and wanted to replace in the field as fast as possible?
 - We just replaced them whenever they failed or had to be condemned?
 - The Air Force decided to scrap the KC-135 fleet over the next 10 years?
 - Combat operations mean they start seeing a lot more corrosion?
- ❑ Each new Scenario can be quickly built from the original Scenarios to provide a means of quickly evaluating the impact of different decisions

Assessing costs and risks at different stages of development



- ❑ Cost estimates from current stage of development
- ❑ Based on Technology Status Summary + costs of development, testing, validation, etc.
- ❑ Financial risk combines aggregate cost with technology gaps

Financial risk



- Uncertainties in quantities and costs give spread in total investment needed and payback period
- We can calculate the probability of
 - never getting a payback
 - having to put in more money than expected

Summary

- ❑ No matter what the stage of development an Implementation Assessment can give a picture of the total cost and technical/financial risk of replacing an old technology with a new one
- ❑ Technology status and development cost can be combined with the cost and risk of different Implementation Scenarios to decide on the best approach, for example
 - Lowest cost
 - Lowest risk
 - Fastest implementation

