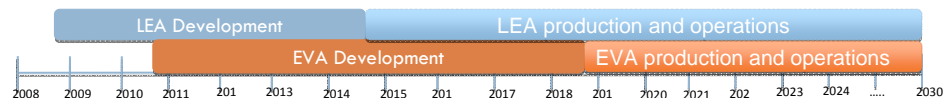


ANALYSIS OF COMMON AND INDEPENDENT SUIT DESIGNS

Richard Rhodes

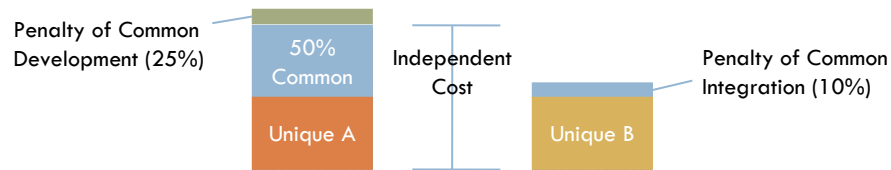
Background

- Vision for Space Exploration
 - ▣ Lower Earth Orbit (LEO) for 2014
 - ▣ Man on the moon by 2020
- Space Suit Needs
 - ▣ Suit for Launch, Entry, and Abort (LEA)
 - Light suit that is mobile and comfortable
 - ▣ Suit for microgravity and surface extravehicular activities (EVA)
 - Life support, thermal regulation, control, and surface mobility



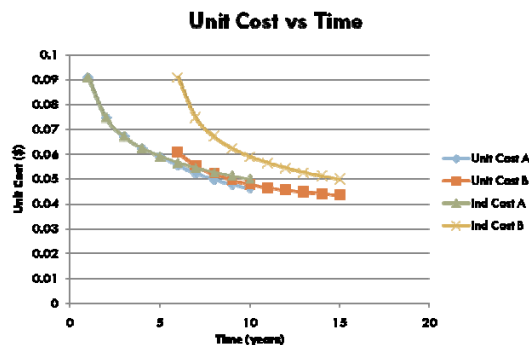
Opportunity to Reduce Lifecycle Costs

- Opportunity
 - ▣ Common Components - Any components that are reused or shared between the two suits. Provides benefits to development, production, and operations
- Affects of Commonality on Development
 - ▣ Penalty of common development on LEA suit
 - ▣ Penalty of component integration on EVA suit



Opportunity to Reduce Lifecycle Costs

- Affects of Commonality on Production
 - ▣ Penalty of excess capability (10%)
 - ▣ Economies of scale
 - ▣ Learning curve
- Operations Cost
 - ▣ Reduced 30%

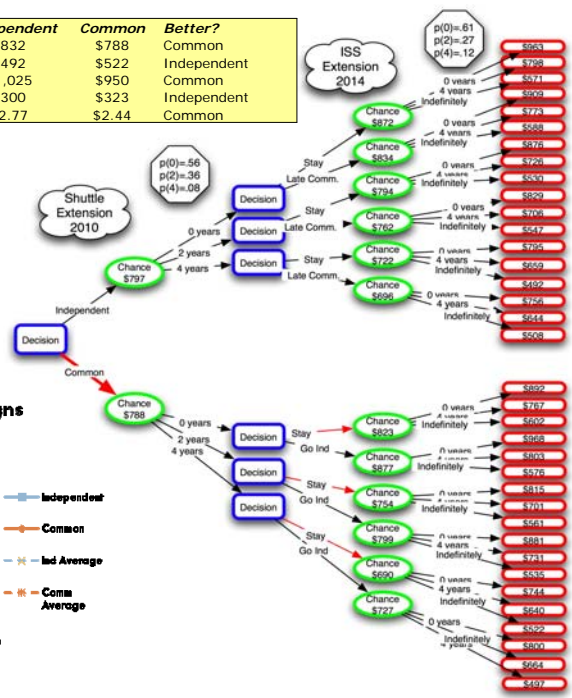


Political Uncertainty

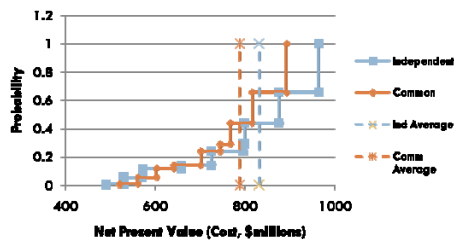
- Resources could be pulled away from exploration
 - Space Shuttle Extension (0, 2, 4 year extensions)
 - 109th Congress voted on NASA programs 83 times, of those 47 failed (56%) same percentage is used for possibility of shuttle not being extended
 - Exponential curve for extension of 2 and 4 years
 - International Space Station Extension/Exploration Cancellation (0, 2, 14 year extension)
 - Vision for space exploration passed by 81%, last ISS funding bill passed by 61%. Possibility of ISS extension/Exploration cancellation is in between
 - Exponential curve for extension of 2 and 14 years

Decision Tree Lifecycle Cost

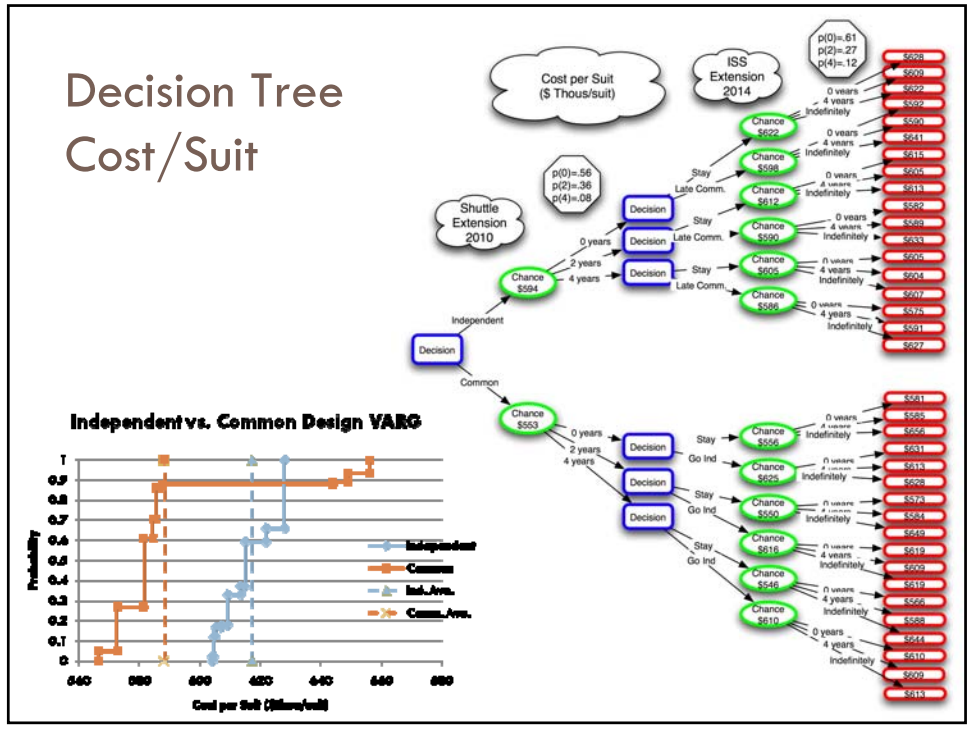
(\$, million)	Independent	Common	Better?
ENPV	\$832	\$788	Common
Minimum NPV	\$492	\$522	Independent
Maximum NPV	\$1,025	\$950	Common
Initial CAPEX	\$300	\$323	Independent
NPV/CAPEX	\$2.77	\$2.44	Common



Independent vs Common Designs

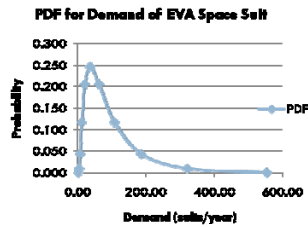


Decision Tree Cost/Suit



Lattice Development

- Uncertainty
 - ▣ Demand of EVA suits
- Assumptions
 - ▣ Demand would start at 32 per year with no expected growth
 - ▣ EVA suits have a benefit of \$2.5 million, LEA of \$640,000
 - ▣ Development of EVA suits will begin at the end of year 5
 - ▣ Common LEA suits are more expensive to produce, but EVA suits have cheaper fixed costs and production costs



Lattice Development Options

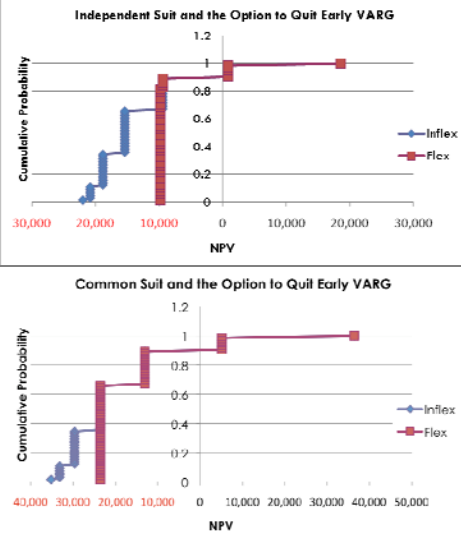
- Contractor Options
 - Opt out of EVA suit production
 - To begin production of EVA suit early
- Independent
 - NPV=-\$82million
- Common
 - NPV=-\$26million

Option to Start EVA Production Early

- Independent
 - NPV = -\$24 million
 - Value = \$58 million
- Common
 - NPV = -\$12 million
 - Value = \$15 million

Option to Opt out of EVA Production

- The VARG for the option to opt out is biased against the Common option because the VARG only covers the first 6 years and you do not begin getting benefits of commonality until year 6



Option to Start EVA Production Early

- Independent
 - NPV = -\$82 million
 - Benefit = \$0
- Common
 - NPV = -\$17 million
 - Benefit = \$10 million