Implications of the AO Reserve Policy

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The cost information contained in this presentation is notional in nature and is for informational purposes only. It does not necessarily reflect the opinions of JPL and/or Caltech.

Joe's Budget Example

Joe builds an annual budget for his household each year. His budget in 2012 resulted in the following:

Expense	2012 Budget	Incurred	Remaining
Mortgage	10000	10000	0
Healthcare	2000	3000	-1000
Groceries	5000	4700	+300
Travel	3000	3300	-300
Entertainment	2500	2400	+100
Baseline Budget	$22,500	$23,400	-$900
Rainy Day Fund	$500	used $500 rainy day fund	used $500 rainy day fund
Total Budget	**$23,000**	**$23,400**	**-$400**

Emergency room trip for broken toe

Flew first class to Hawaii

Had to dip into savings account to cover overrun

What should Joe budget for 2013?

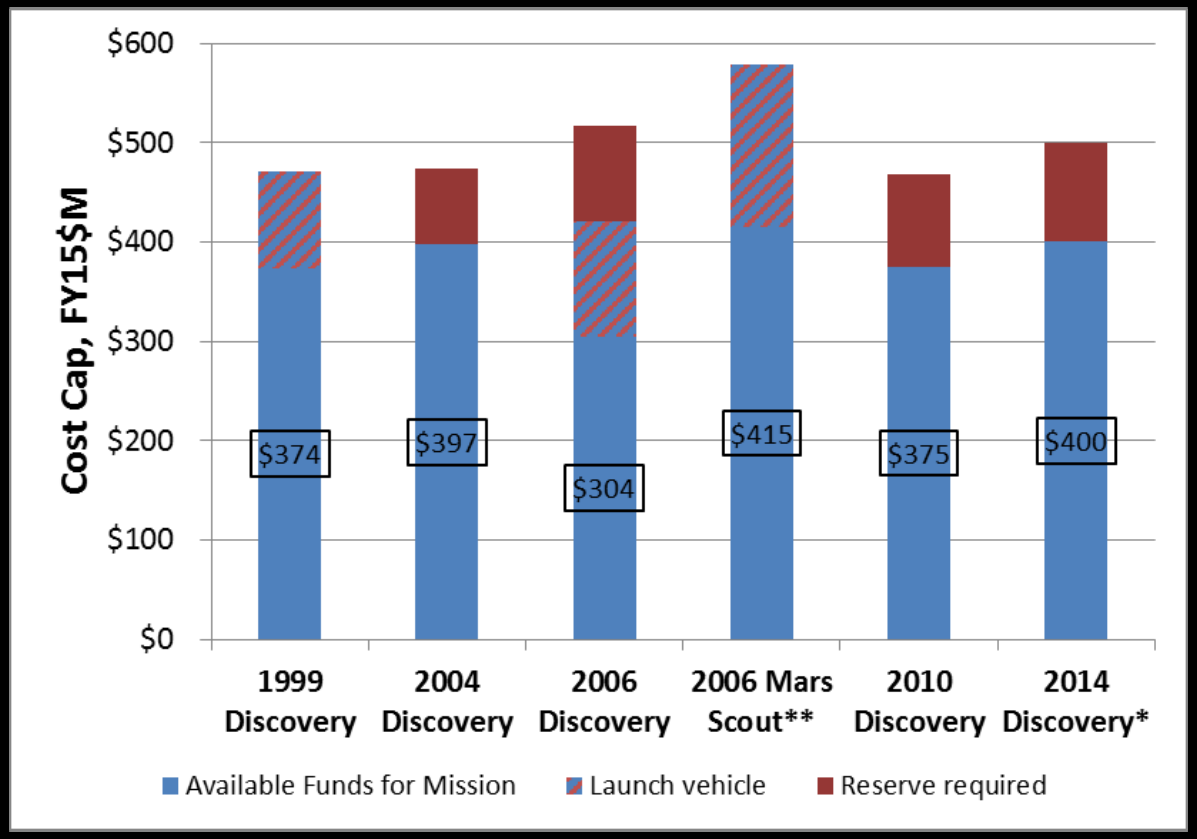
A. $23,000
B. $23,400
C. $23,400 plus 25%? → What are the effects of this reserve methodology?

Historical AO Reserve Policy

AO	Reserve Required	Applicable Phases
Discovery 1999 and prior	None	Show adequate reserves
Discovery 2004	25%	Phase B-D
Discovery 2006	25%	Phase B-D
Mars Scout 2006	None	Show adequate reserves
Discovery 2010	25%	Phase A-E

Reserves required have gone up, now requiring 25% reserves on Phases A-E.

What does this mean for missions?



NOTES:

*The 2014 Discovery cost cap is based on the recommendation from the Planetary Decadal Survey 2013-2022

** 1999 (and prior), 2006 Discovery ,and Mars Scout cost caps included the cost of the launch vehicle

- AO cost cap has remained relatively constant at ~$430M (FY15$ excluding LV)

On average, only ~$370M of funds available to fund a mission (excluding reserve and LV)

Implications of AO Reserve Policy

Is the reserve policy incentivizing poor behavior?

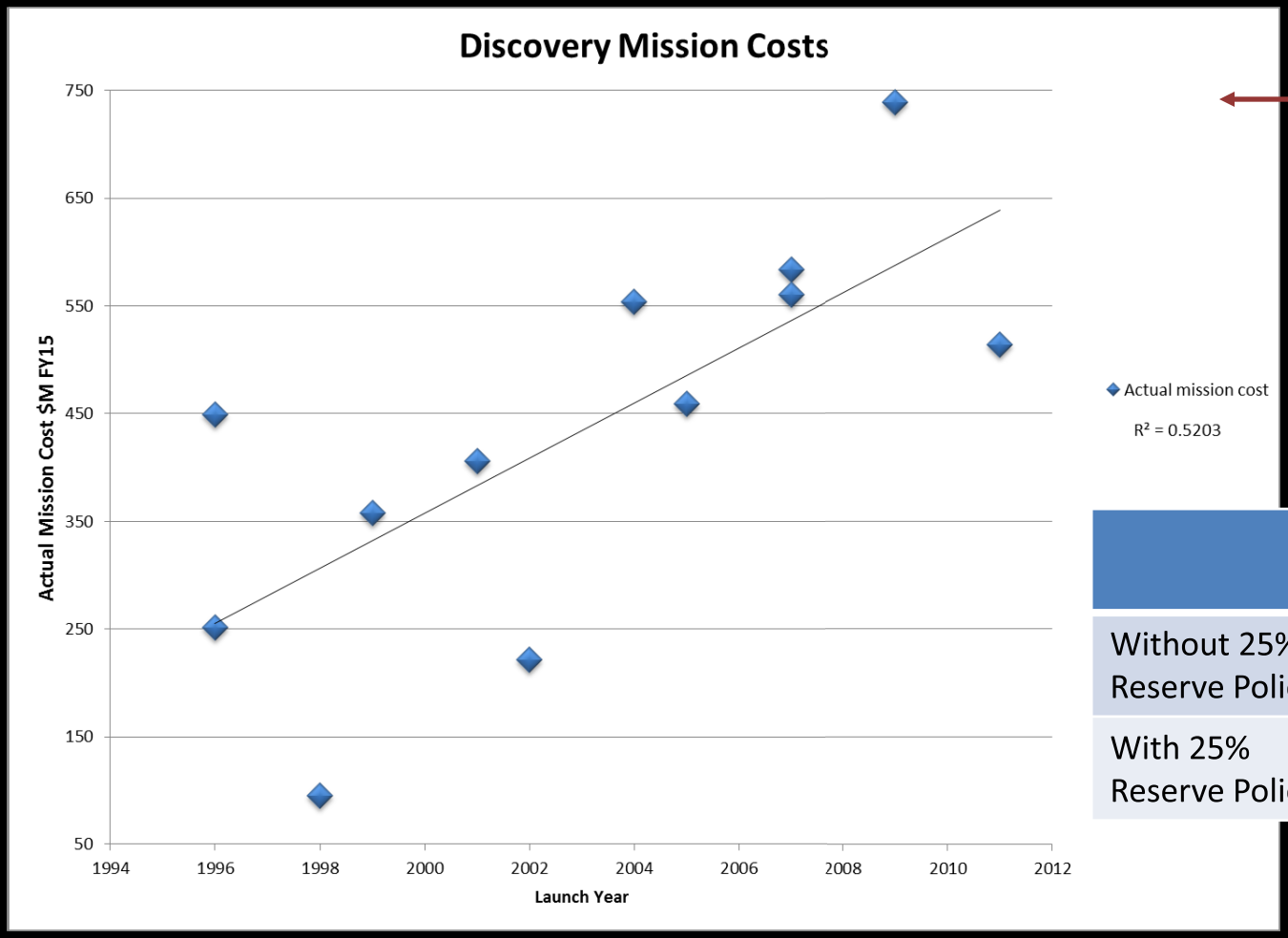
Projects have too much or too little reserves, depending on their risk posture

- In cases where 25% (average ~$90M per mission) is too much reserve, causing a project to squeeze into the cost cap…
  - Proposal cost estimates must be optimistic (technical, cost, or schedule risk taken from onset)
  - Science must be descoped; international contributions are often sought to fit under cap
  - Missions are deemed infeasible
- Reserves are spent if they are available (Moral Hazard)

"Findings demonstrate strong positive correlation between total mission cost increases and total dollars reserved"

– Shinn, Stephen and Whitley, Sally. *The Economics of NASA Mission Cost Reserves*. IEEE, 2012.

Could the Reserve Policy be Contributing to Cost Growth?



Discovery Mission costs are growing

Discovery cost growth is growing

	Average Cost Growth (FY15)	% Cost Growth
Without 25% Reserve Policy	$58M	18%
With 25% Reserve Policy	$148M	32%

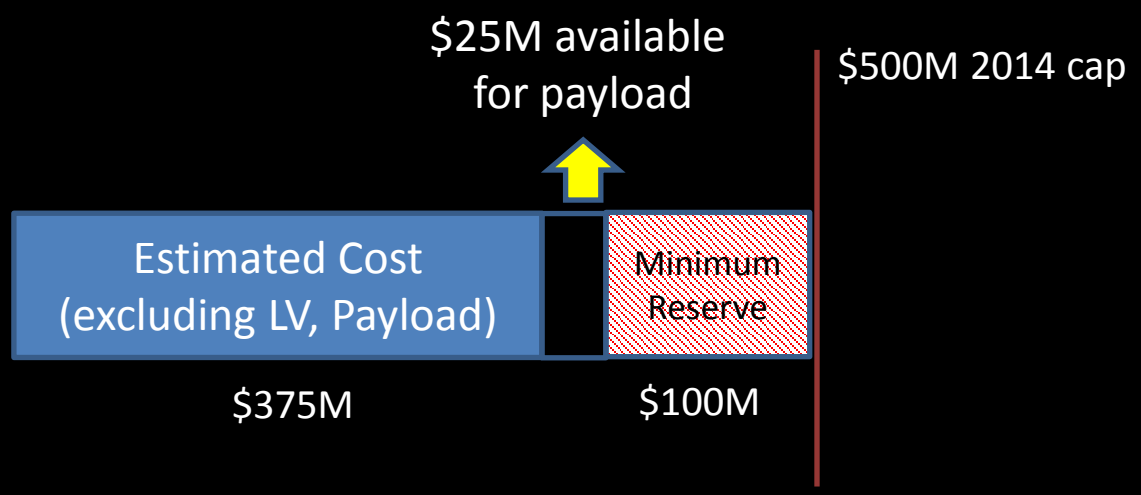
Source: CADRe

Reserves are always used and missions overrun, so how could more reserves result in higher cost? Moral Hazard and lack of a balanced Principal-Agent agreement

Case Study: A Proposer's Dilemma

2014 Discovery AO

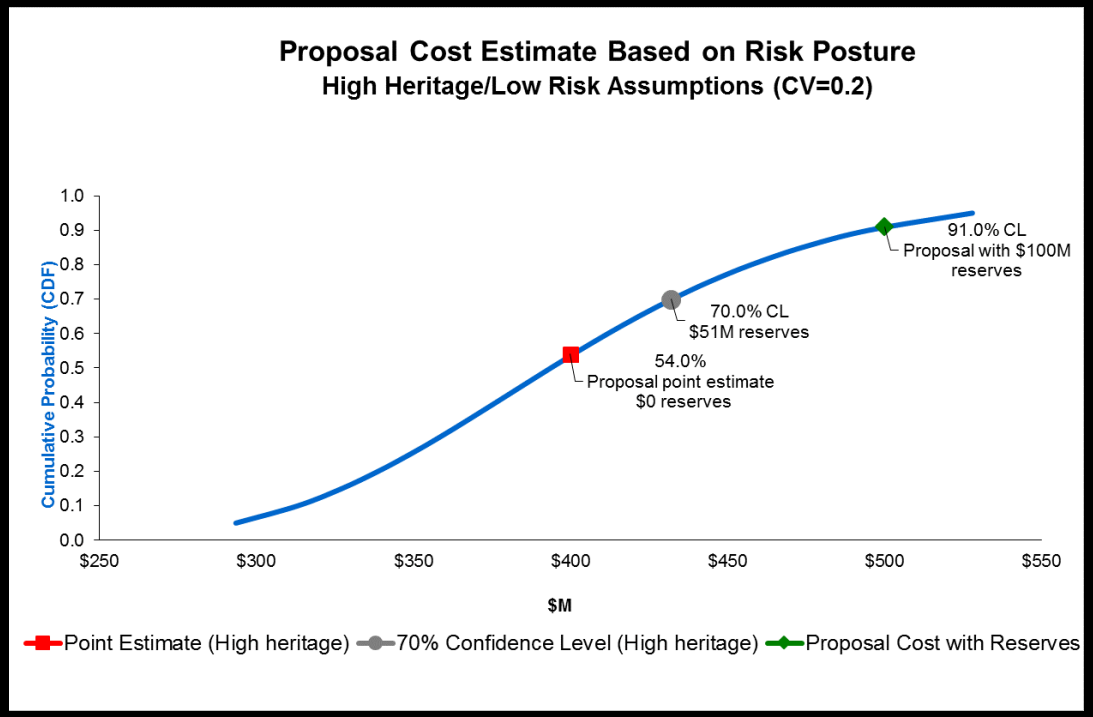
- Cost Cap: $500M; $100M reserves required (25% minimum)
- Mission has high heritage = lower risk posture
  - Shouldn't this imply a lower reserve requirement?



Proposing this mission in Discovery will require payload or other contributions from international partners, which *increases* delivery risk (and cost risk?).

What if Reserves were Allocated Based on Mission Risk?

- Missions with high heritage or low risk could take advantage of reserve savings and preserve the option to perform science in-house



With $100M in reserves, this proposal's cost confidence level is ~91%. Moral Hazard says the $100M will be spent; would it have been spent if the project were never required to have $100M in reserve?

Parting Thoughts

- Is the AO reserve policy consistent with best practices, as defined by NASA and GAO?
- Are we properly incentivizing spending with the current reserve policies?
- Given that cost growth is correlated to reserve level, could the AO reserve policy be driving higher mission costs?
- Could the AO reserve policy be affecting the state-of-the-art science on which NASA prides itself by forcing mission contributions?

Back-up

Recommendation

- Align required cost reserve with NASA/GAO best practice.
  - "The amount of contingency reserve should be based on the level of confidence with which management chooses to fund a program, based on the probabilities reported in the S- curve …" p.158

GAO-09-3SP. *GAO Cost Estimating and Assessment Guide*. March 2009

  - "The level of unallocated future expense/reserves…should be selected based upon achieving a particular level of confidence from the resultant cost S-curve for the entire program/project. The appropriate level of confidence is chosen by the Program/PM after the analysis, and the resulting unallocated future expense/reserves should be identified as the recommended level at all Confirmation Reviews." p. I-40

2008 NASA Cost Estimating Handbook