



Large Space Mission Cost Distribution

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Large Mission Cost

- This presentation compares the WBS cost distributions of several large NASA missions
 - It also includes personal observations on cost from numerous concept studies and proposals
- NASA CADRe is the source for the data shown
 - Includes most large missions ($> \sim \$1\text{B}$) in CADRe
 - Does not include HST (too old for CADRe) or JWST (data embargoed until launch)
 - The missions span about a factor of 5 or 6 in total cost.



Large Mission Cost Percentages

WBS	Phase A-E WBS Percentages Formatted						Average	St. Dev.
	Spitzer	MSL	Cassini	Terra	Juno	MRO		
Phase A	1.13%	6.06%	Not Available	10.25%	0.15%	1.82%	3.88%	4.2%
01 Project Management								
02 Systems Engineering+12 Mssn Design								
03 Mission Assurance	2.59%	5.15%	2.79%	3.32%	7.02%	4.59%	4.24%	1.7%
04 Science	0.90%	0.73%	1.40%	1.35%	2.20%	1.29%	1.31%	0.5%
05 Payload	10.38%	8.32%	13.35%	11.79%	16.13%	17.71%	14.21%	3.8%
Telescope	7.62%							
06 Spacecraft +10 I&T	18.39%	55.63%	30.65%	25.63%	36.63%	36.48%	33.90%	12.7%
07 MOS/ 09 GDS	12.78%	3.24%	4.93%	9.54%	4.72%	3.76%	6.50%	3.8%
08 Launch Vehicle	5.18%	8.95%	17.28%	7.62%	17.12%	11.52%	11.28%	5.0%
Phase E	23.73%	9.74%	29.61%	30.51%	15.21%	22.83%	24.82%	11.3%
Uncategorized Cost	17.30%	2.18%	None	None	0.82%	None		
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%		



Large Mission Characteristics

	Mission Characteristics						HST	JWST
	Spitzer	MSL	Cassini	Terra	Juno	MRO		
Mission Class	A/B	A/B	A	A/B	B	A/B	A	A
Number of Instruments	3	13	11	5	9	7	5	4
Mission Design Life (months)	60	36	128	72	75	64	180*	60
Orbit/Destination	Heliocentric, Earth Trailing	Mars	Saturn	LEO	Jupiter	Mars	LEO	Earth-Sun L2

* Assumes servicing



Observations

- The data - costs are spread around the whole WBS as missions increase in scope
 - Mission class is a likely contributor since the cost distribution remains fairly constant with increased overall mission cost
 - High cost missions also are facility investments and must support many instruments and science objectives
 - This leads to more driving requirements and complicated systems engineering problems, both of which can raise costs across many WBS elements
- Instruments tend to grow in number and/or size with increased telescope aperture
- Operations are a significant portion of the overall mission cost
 - Large missions, unlike small missions, must often cover Guest Observer program costs
 - More instruments or instruments with larger focal planes drive up data volume and operations costs
- Spacecraft bus size and cost usually grows with the payload size
 - Larger telescopes often require more thermal power, larger reaction wheels, more propellant, greater data handling and communications capabilities, and more bus structure
- Larger telescopes require larger launch vehicles or, in the case of iSAT, several launch vehicles
- While ground-based assembly and test costs can be reduced with iSAT, the on-orbit assembly and test costs will appear as an increase in operations costs.
- Telescopes are not the biggest cost contributor to the mission