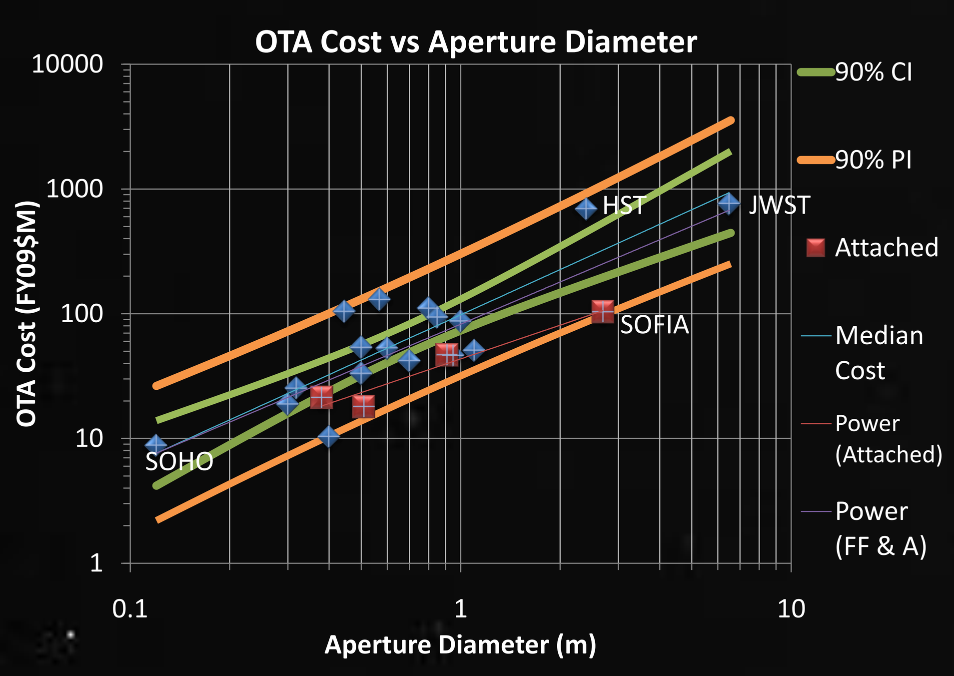
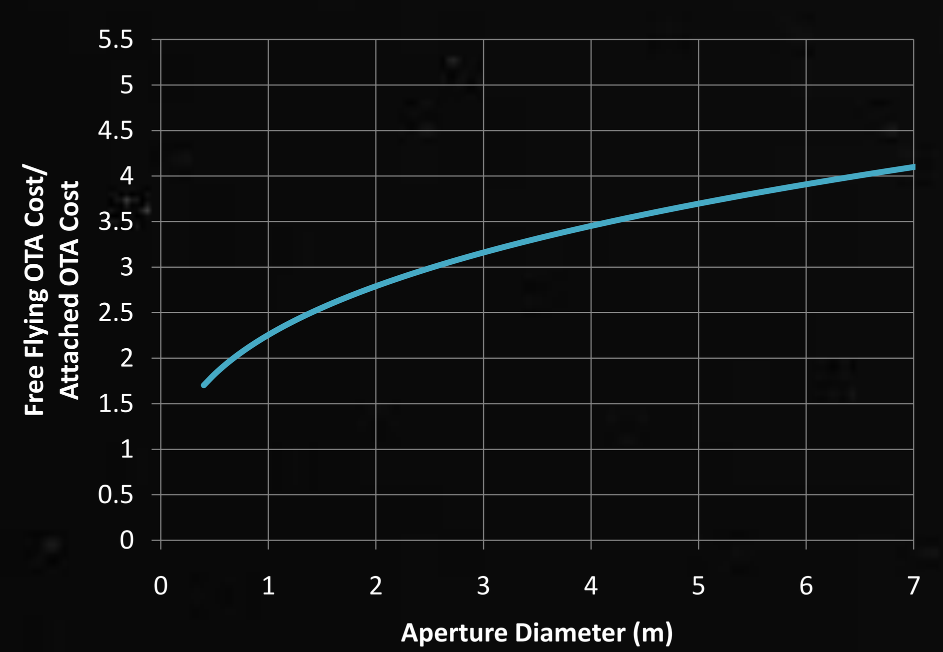
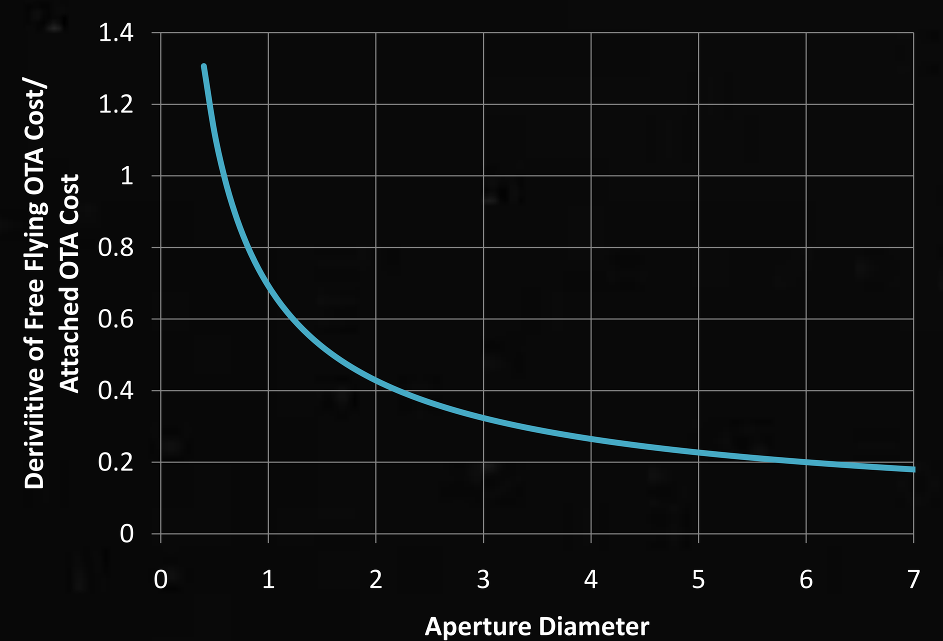
Development of a Multivariable Parametric Cost Analysis for Space-Based Telescopes







Middle Plot: Demonstrates the ratio of Free Flying OTA Cost to Attached OTA Cost versus diameter. This shows how many more times cost is for free-flying versus attached telescopes.
Bottom Plot: Shows the rate of change or slope of the middle plot.

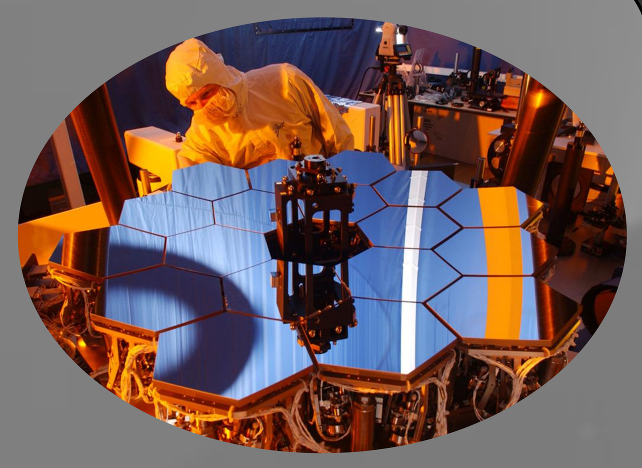
Abstract & Summary:

Over the past 400 years, the telescope has proven to be a valuable tool in helping humankind understand the Universe around us. The images and data produced by telescopes have revolutionized planetary, solar, stellar, and galactic astronomy and have inspired a wide range of people, from the child who dreams about the images seen on NASA websites to the most highly trained scientist. Like all scientific endeavors, astronomical research must operate within the constraints imposed by budget limitations. Hence the importance of understanding cost: to find the balance between the dreams of scientists and the restrictions of the available budget. By logically analyzing the data we have collected for over thirty different telescopes from more than 200 different sources, statistical methods, such as plotting regressions and residuals, can be used to determine what drives the cost of telescopes to build and use a cost model for space-based telescopes Previous cost models have focused their attention on ground-based telescopes due to limited data for space telescopes and the larger number and longer history of ground-based astronomy. Due to the increased availability of cost data from recent space-telescope construction, we have been able to produce and begin testing a comprehensive cost model for space telescopes, with guidance from the cost models for ground-based telescopes. By separating the variables that effect cost such as diameter, mass, wavelength, density, data rate, and number of instruments, we advance the goal to better understand the cost drivers of space telescopes.. The use of sophisticated mathematical techniques to improve the accuracy of cost models has the potential to help society make informed decisions about proposed scientific projects. An improved knowledge of cost will allow scientists to get the maximum value returned for the money given and create a harmony between the visions of scientists and the reality of a budget.

General Information		
Confidence Level	90%	How likely the interval is to contain the parameter
$s_{log\$}$	0.62	Measure of "noise" in log-space. Noise is an unwanted perturbation to a wanted signal
n	17	Number of data points.
r^2	75%	Measure of Goodness of fit
r^2_{adj}	73%	Measure of Goodness of fit that takes into account the number of data points and number of estimated coefficients.
SPE	80%	Measure of "noise" in real space.
p-value	0%	P-value from the coefficient t-test.
OTA		Optical Telescope Assembly

Background:

- Most previous cost models apply to ground-based telescopes.
- Previous space-telescope cost models do not include data from recent large space telescopes.



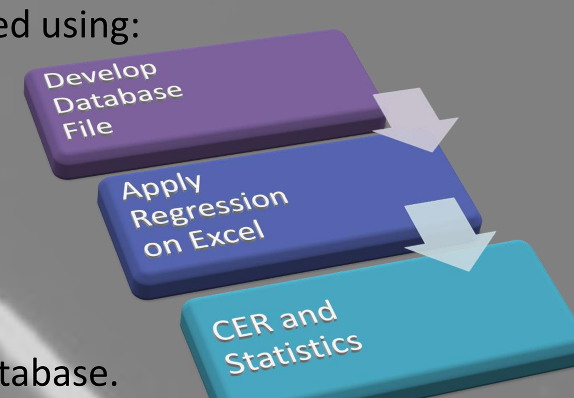
Data Collection:

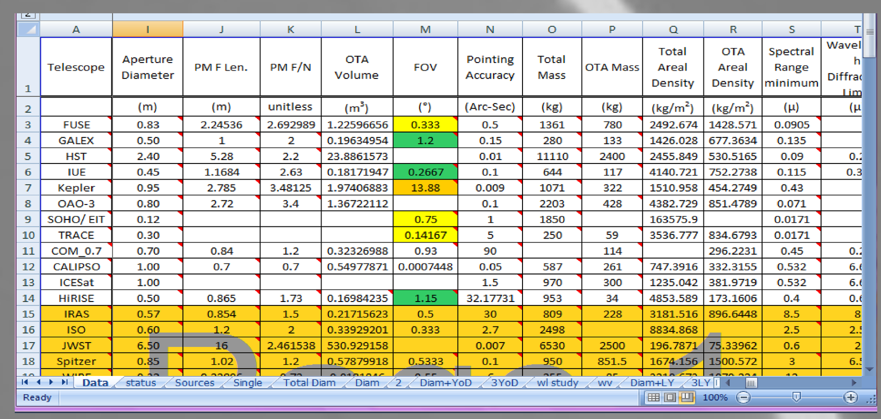
Data on space telescopes and cost was gathered using:

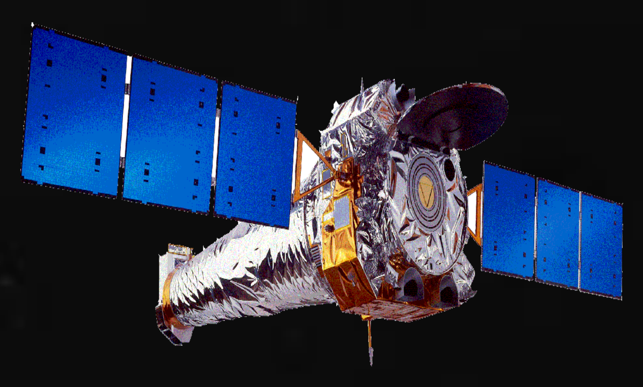
- Work Breakdown Structures (WBS)
- Research Data Storage and Retrieval(Redstar)
- Redstone Arsenal Information Center(RSIC)
- Cost Acquisition Data Report(CADRe)
- Interviews with project managers
- NASA websites.

Collected data was then added to our Excel database.
Data falls into four categories:

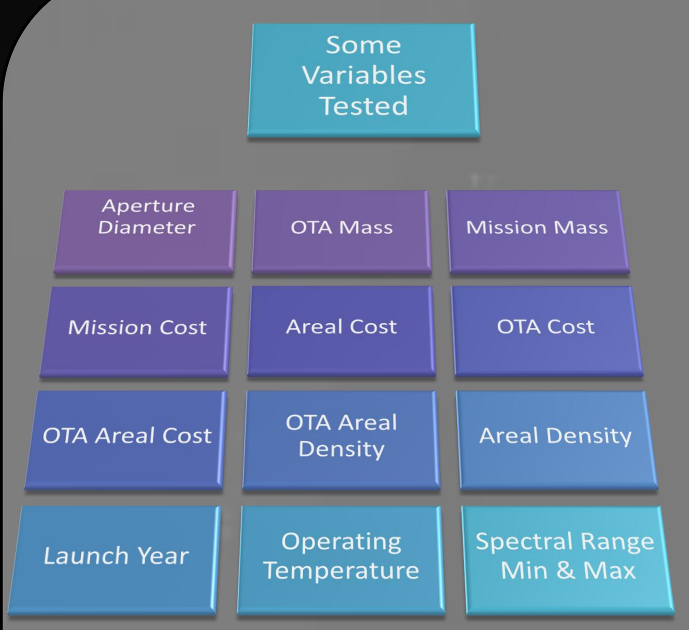
- Programmatic
- Primary Mirror
- Mission
- OTA Data



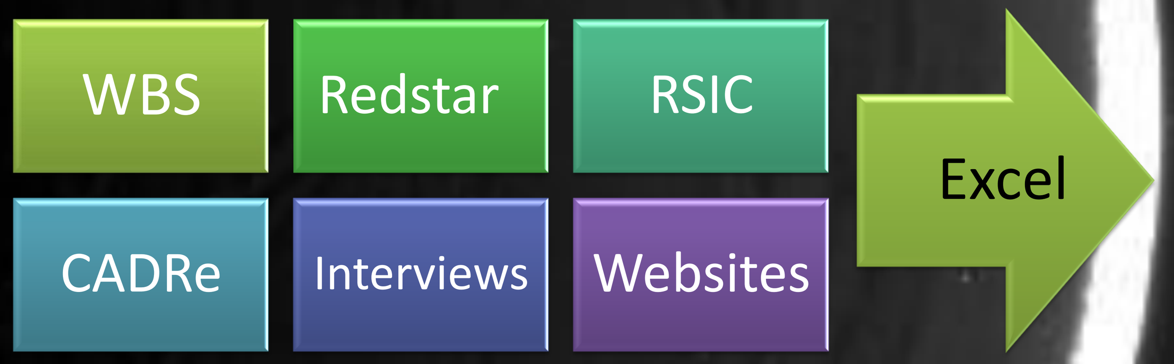


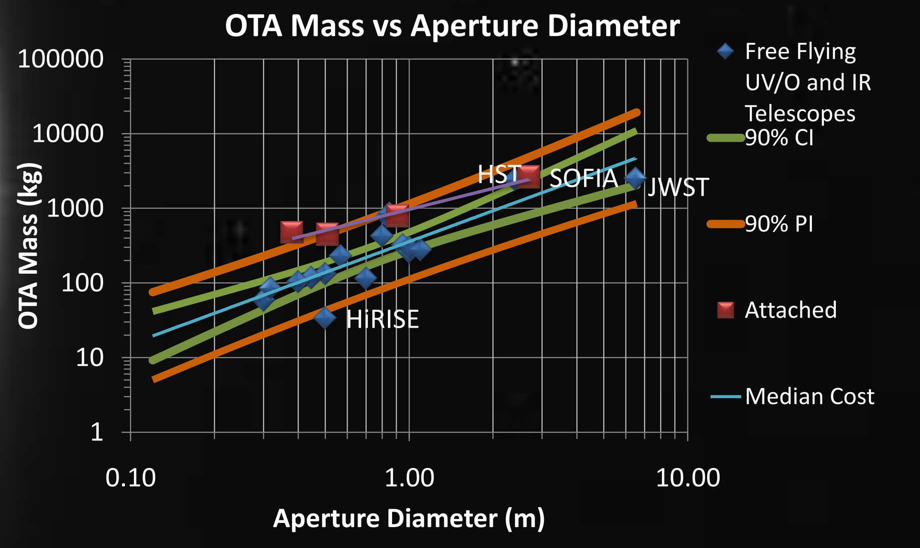


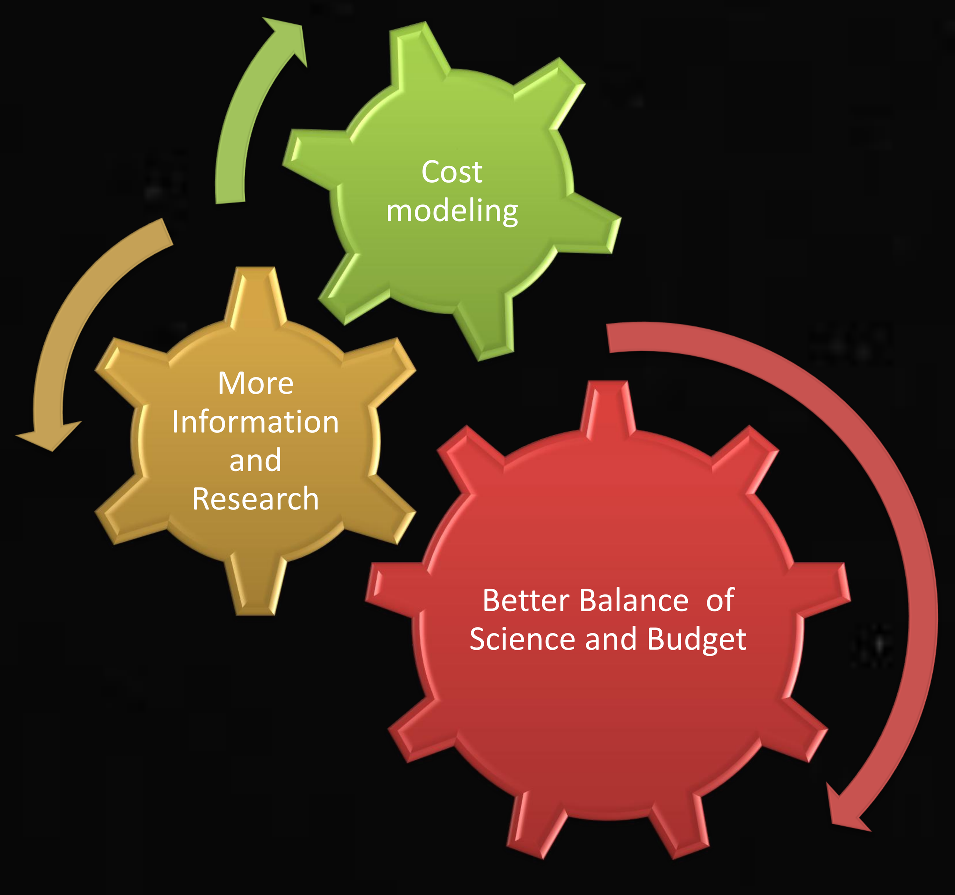
Methodology:



- Using statistical methods and selected information from the database, regressions and residuals for variable analysis were created.
- Plots were analyzed for significance in affecting cost.
- Over 20 variables were tested.
- Variables tested thus far were chosen based upon how important they were thought to be, using logic to determine if their engineering significance would affect cost.







Conclusions:

Although cost models must evolve as new technology becomes available and as program objectives are modified, the research and analysis done in this project have improved the foundation upon which cost models for future space telescopes will be based. Major results from my research include confirmation of the relationship` between OTA cost and diameter, and OTA Cost and OTA mass. As diameter increases, so does OTA Cost and OTA Mass, both increasing in similar ways. This shows that mass is still the most significant factor in cost and provides graphical evidence that we are taking the rights steps towards a cost estimate by separating the variables that influence mass and cost. Research on the variables that affect cost will continue in the future in an effort to create the most updated and accurate cost model for space telescopes possible.

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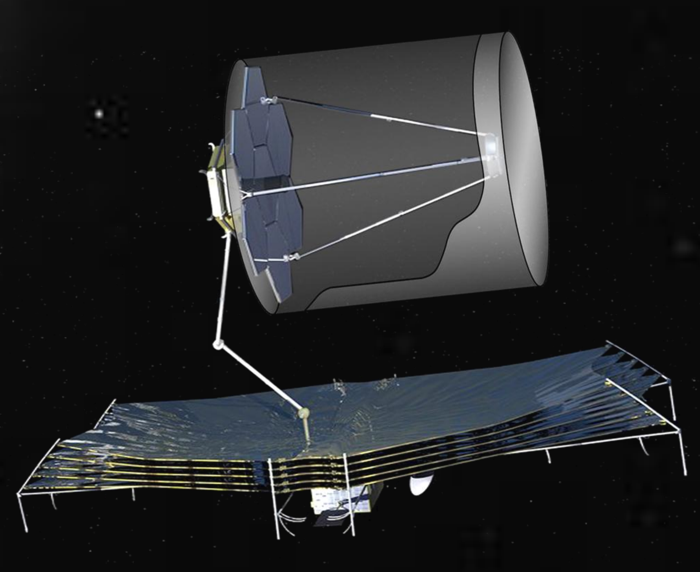

"Far and away the best prize that life has to offer is the chance to work hard at work worth doing."
Theodore Roosevelt

References:
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