Department of the Air Force

Integrity - Service - Excellence

AFCAA Data Sets, Analysis, and Methods (DSAM) Increment 2

Study 26: Schedule Durations for Mission Payloads

Aka: The Search for Speed

2024 NASA Cost and Schedule Symposium
Greg Hogan – Air Force Cost Analysis Agency
Jenny Lampe, Michael Prater and Keith Robertson – Cobec Consulting

Study 26: Schedule Durations for Mission Payloads Background

- The Air Force Cost Analysis Agency (AFCAA) Data Sets, Analysis, and Methods (DSAM) Increment 2 Schedule Durations for Mission Payloads study is a follow-on effort to the AFCAA DSAM Mission Payload Duration Forecast Study completed in September 2021.

- Increment 1 results were limited due to challenges associated with the availability and consistency of the data sources. However, the study did produce several key findings including histograms of historical trends and preliminary insights into payload durations across key system characteristics such as mission type, older versus newer mission payloads, etc.

- The overall goal of the Increment 2 effort was to improve upon the Increment 1 work by focusing on the development of a more robust data set while also attempting to develop more formal parametric methods for predicting payload schedule durations. The specific objectives were to:
  - Provide an updated, documented data set,
  - Summarize trending metrics extracted from the data, and
  - Develop schedule estimating methodologies.

Study 26: Schedule Durations for Mission Payloads Background

- **This study is being performed in two phases. Phase 1 concluded in September 2023 and resulted in:**
  - An updated consolidated dataset of 117 data points consisting of payload instruments from two data sources, the "Air Force Sensor Dataset" and NASA's ONCE Database "NICM v10 Instrument Data".
  - Initial investigative schedule drivers: Weight, Power, Design Life, Heritage, Procurement Agency, and Mission Class were identified.
  - Preliminary analysis of fourteen different candidate Schedule Estimating Relationships (SERs), utilizing both single variable and multi-variate regression analysis, with various combinations of technical parameters was performed.
- **The Phase 2 efforts look to continue development and refinement of the SER analysis.**
  - Continuation of the multi-variate SER analysis
  - An assessment of the impacts of Mission Type as well as a temporal assessment of payload development times
  - Identify projects that are "better schedule performers" and conduct a more detailed analysis of payload development schedules with the goal of determining specific characteristics of better performing projects (The Search for Speed).

This Presentation provides a Status of our Efforts To-Date and a Summary of our Work To-Do …

Study 26: Schedule Durations for Mission Payloads
Phase 1 - "The Consolidated Dataset"

- **Data Sources**
  - AFCAA DSAM Mission Payload Sizing Data Set ("Sensor Dataset")
    - Technical parameters and limited schedule data for EOIR and Radar/Microwave mission payloads
    - 109 mission payloads
  - ONCE Database/CADRe Data Collection Initiative
    - NASA Instrument Cost Model (NICM) v10 ("NICM Dataset")
    - Cost, schedule, and technical data for NASA instruments
    - 292 instruments

Study 26: Schedule Durations for Mission Payloads Phase 1 - "The Consolidated Dataset"

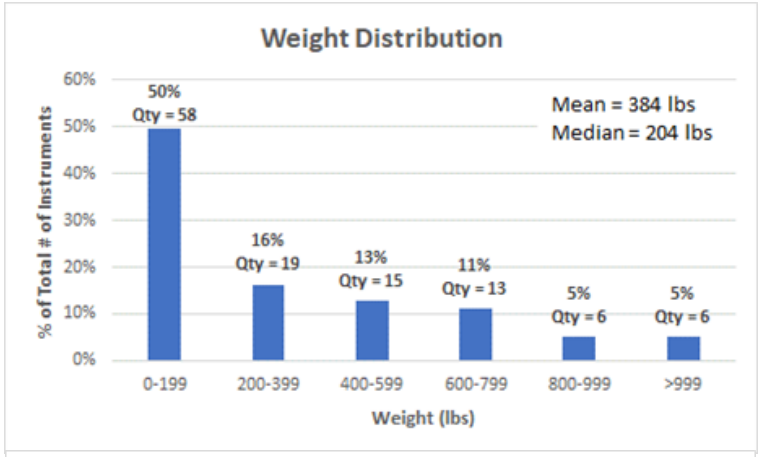
- **Data Collection and Normalization**
  - Analyzed the NICM and AFCAA Sensor data sets and merged into a single consolidated master file (raw data sets also included in master file)
  - Created homogeneous data set by performing several normalization steps:
    - Removed all non-earth orbiting data from the NICM data (169 data points).
    - Metric conversions to align NICM and AFCAA Sensor datasets
    - Removed cryocoolers in the NICM data as a separate line item and added the mass to the primary sensor (6 data points).
    - Removed telescopes in the NICM data as a separate line item and added the mass to the primary sensor (5 data points).
    - The original AFCAA Sensor Database included several NICM instruments. Removed these data points to avoid duplicate entries (22 data points).
    - Due to the scarcity of payload schedule data, the Increment 2 analysis leveraged the NASA BCD schedule durations as the primary schedule metric as found in the NICM data. As a result, the AFCAA Sensor Database schedule data for the non-NASA data points was normalized by adding 2 months to the ATP to Launch durations.
    - Finally, any data points that did not include either ATP to Launch schedule durations or BCD schedule durations were deleted from the final dataset (55 data points – 24 NICM data points and 31 Sensor Database data points).

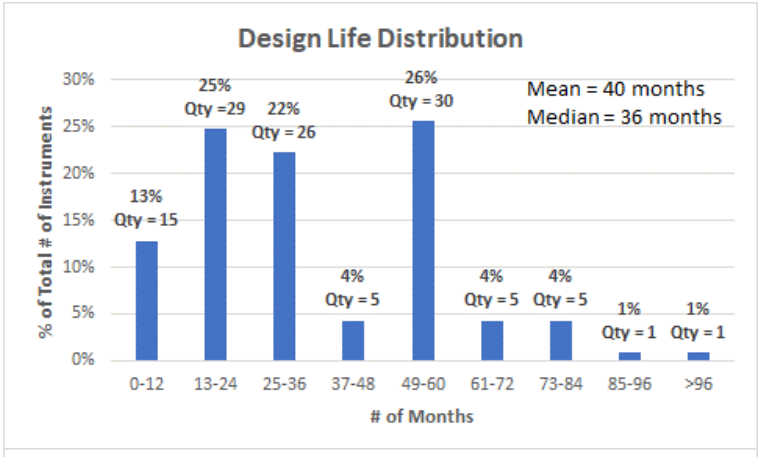
- **Resulted in total consolidated dataset of 117 data points (86 from NASA NICM data set, 31 from AFCAA DSAM Sensor Database)**

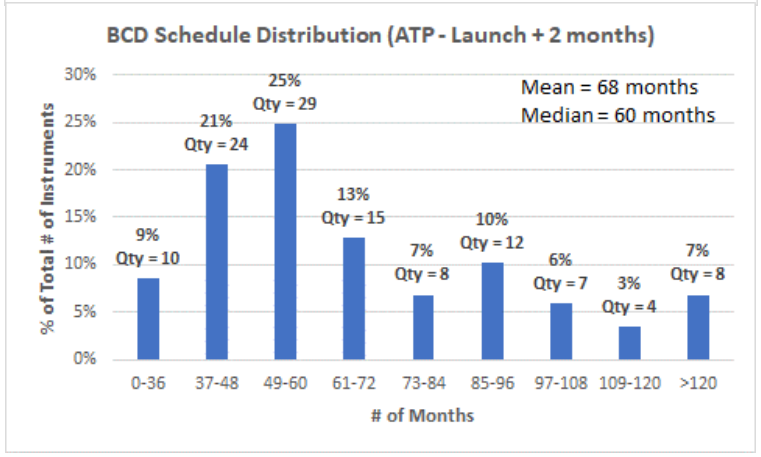
Study 26: Schedule Durations for Mission Payloads
Phase 1 - "The Consolidated Dataset"

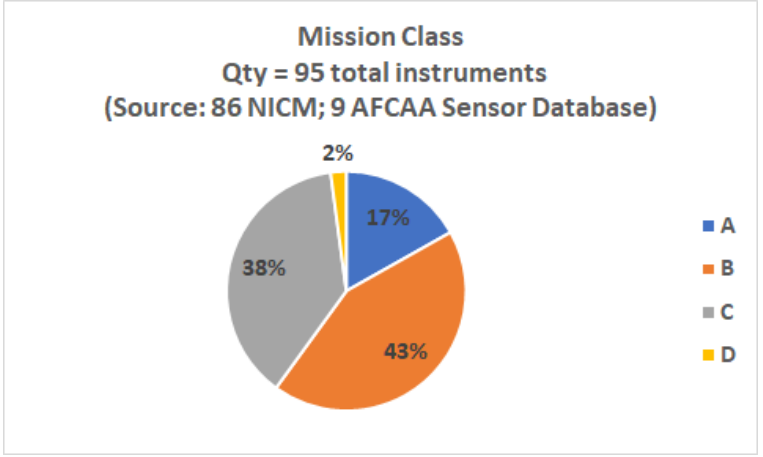
Dataset Characterization

- Consolidated data set composition charts by weight, BCD schedule, Design Life and Mission Class









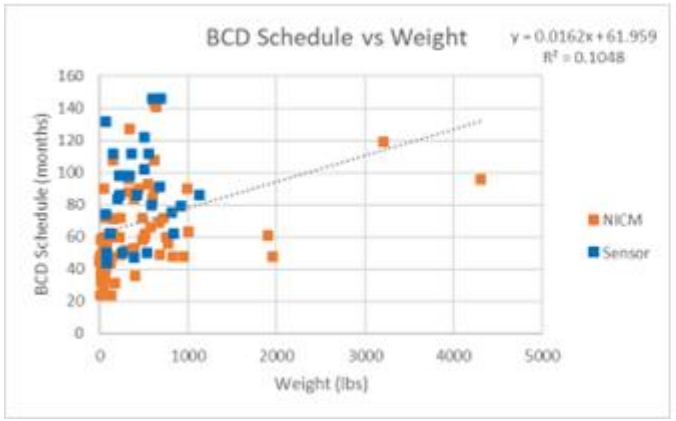
Study 26: Schedule Durations for Mission Payloads
Phase 1 - Data Analysis

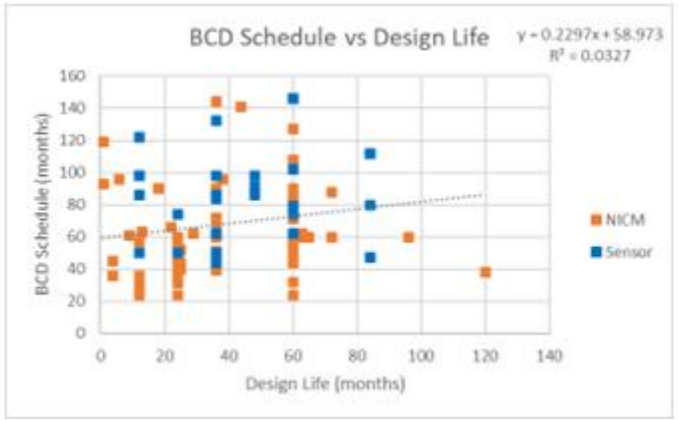
- **Schedule driver analysis**
  - Evaluated the significance of Schedule drivers – Weight, Power, Design Life, Heritage (y/n), "Agency" (Non-NASA y/n), Mission Class
  - Evaluated the statistical significance (utilizing single factor ANOVA test) of Heritage, "Agency", Mission Class, and Optical Mission Type as schedule drivers; with the following findings:
    - Heritage: no statistical difference between the means for projects that had an identified source of Heritage and those that did not
    - Mission Class: demonstrated statistical significance between Mission Classes; evaluated A and B, B and C, A and C (95 total instruments with Mission Class: 86 NICM, 9 Sensor Database)
    - "Agency": demonstrated statistical difference in mean schedules for NASA vs Non-NASA projects
    - "Optical" Instrument Type – not statistically significant

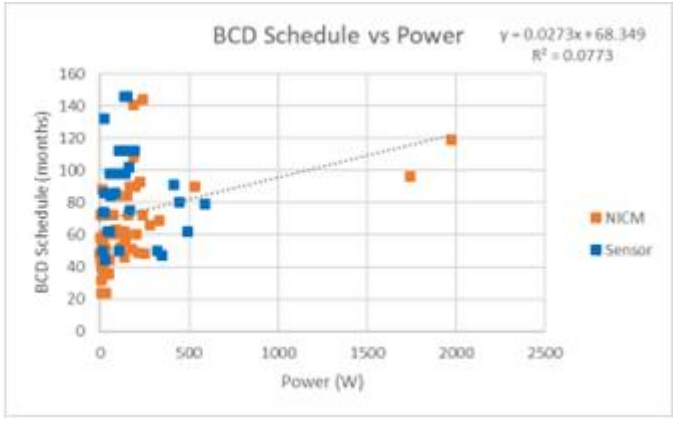
Study 26: Schedule Durations for Mission Payloads
Phase 1 - SER Development

Single Variable Regression Results

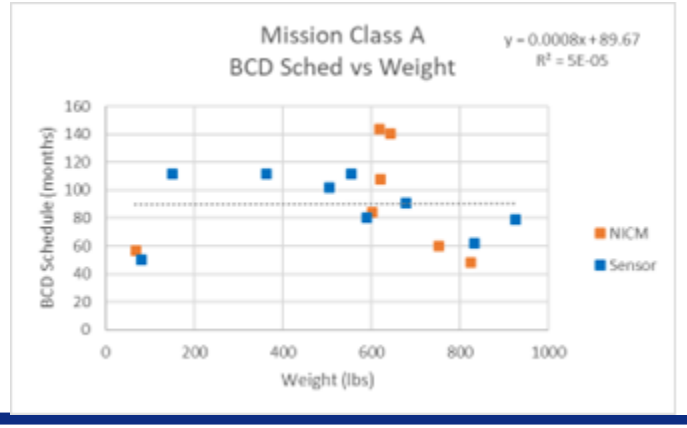
- BCD Schedule Single Variable Regressions with all applicable data points from NASA/ONCE and AFCAA Sensor Data

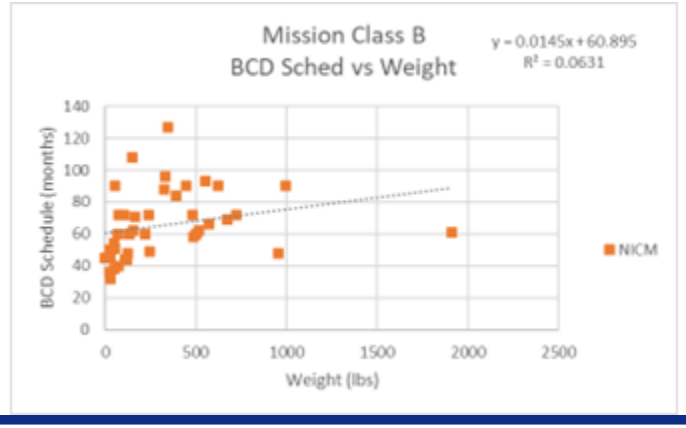






- Mission Class Single Variable Regressions: BCD Schedule vs Weight (NASA Only)





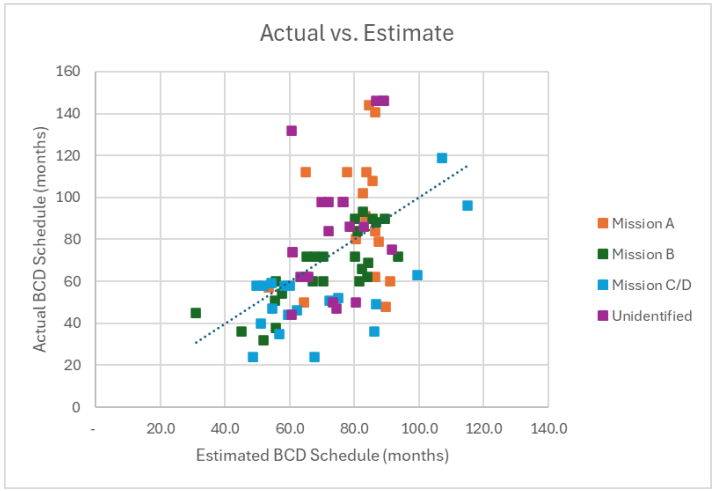
Study 26: Schedule Durations for Mission Payloads
Phase 1 - SER Development Multi-Variate SERs

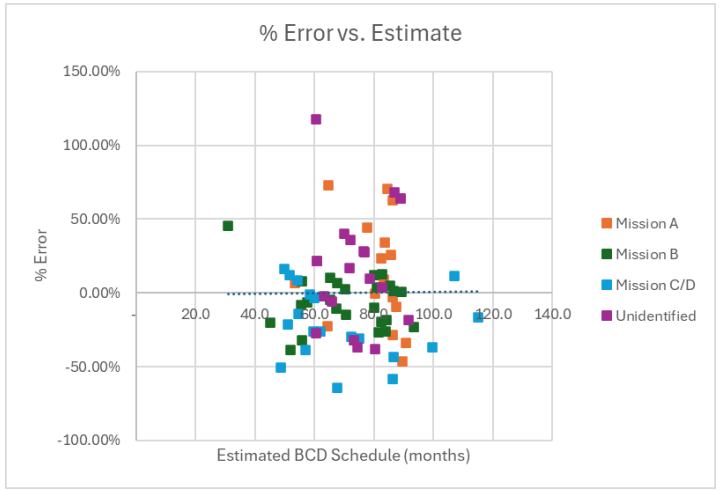
- **Multi Variate Regressions - BIG THANK YOU TO National Reconnaissance Office – Cost and Acquisition Assessment Group (NRO CAAG)** – Adapted their "CER" Development Tool for Schedule Estimating Relationships:
  - Performs multivariate regressions using the Linear Ordinary Least Squares method and Microsoft Excel Solver for optimization
  - Workbook consolidates the estimating relationship data into one tab for ease of determining the best regression model. This includes but is not limited to:
    - The SER equation
    - Degrees of Freedom
    - Percent Error
    - R-squared
    - Generates graphs to assess Estimate vs Actuals and bias of resultant regressions

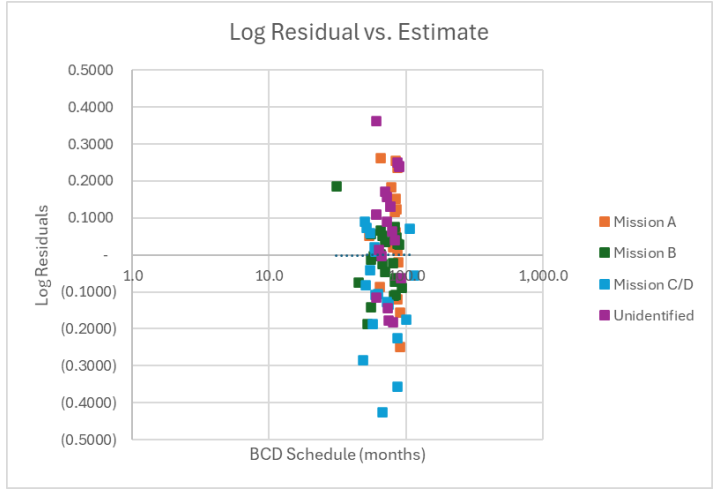
Study 26: Schedule Durations for Mission Payloads
Phase 1 - SER Development Multi-Variate SERs

Multi Variate Regressions – Example Results (SER summary table provided on next slide)

- Actual vs Estimate shows where the data falls around the regression line. Programs below the line are considered "better performers".
- % Error vs Estimate and Log Residual vs Estimate are visual representations of the zero bias and can be used to analyze potential improvements to the SER – additional explanatory variables or identification of potential outliers
- SER Tool Example Results: BCD Schedule = 28.46 * Weight$^{0.22}$ * Power$^{-0.06}$, R-squared 27%







Study 26: Schedule Durations for Mission Payloads Phase 1 SER Results

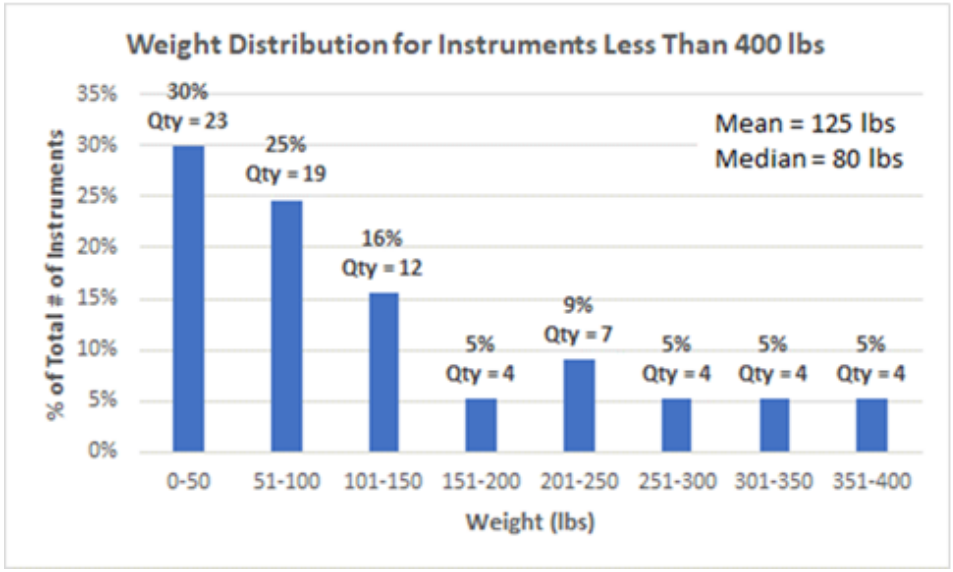
- Initial look at Multi Variate Regressions – Summary

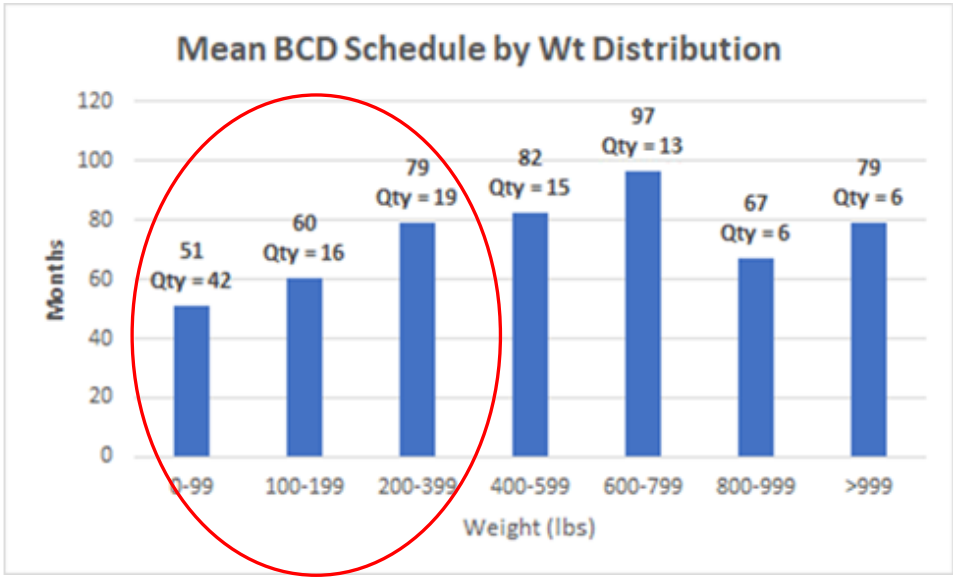
#	SER Candidate	SER	DOF	SPE	Bias	R^2	Lead Coefficient	b	c	d
1	Weight, Design Life	BCD Schedule = a * Weight^b * Design Life^c	97	34.6%	0.0%	0.29	27.65	0.15	0.02	
2	Weigh, Power	BCD Schedule = a * Weight^b * Power^c	77	34.0%	0.0%	0.27	28.46	0.22	-0.06	
3	Weigh, Power, Design Life	BCD Schedule = a * Weight^b * Power^c *Design Life^d	76	34.1%	0.0%	0.28	25.32	0.22	-0.06	0.03
4	Weight, Power (NASA Only)	BCD Schedule = a * Weight^b * Power^c	65	31.2%	0.0%	0.33	27.25	0.24	-0.08	
5	Weight, Power, Agency	BCD Schedule = a * Weight^b * Power^c * Agency^d	76	33.1%	0.0%	0.29	33.30	0.23	-0.07	0.84
6	Weight, Power, Mision A	BCD Schedule = a * Weight^b * Power^c * Mission Class^d	55	27.8%	0.0%	0.45	29.63	0.16	-0.02	1.29
7	Weight, Power, Mission B	BCD Schedule = a * Weight^b * Power^c * Mission Class^d	55	32.0%	0.0%	0.35	27.86	0.16	0.00	1.05
8	Weight, Power, Mission C	BCD Schedule = a * Weight^b * Power^c * Mission Class^d	55	29.5%	0.0%	0.43	33.08	0.16	-0.02	0.76

- Phase 1 concluded with no statistically significant SER Candidates but several recommendations for continued analysis were endorsed by AFCAA

Study 26: Schedule Durations for Mission Payloads Phase 1 – Results

- One recommendation for continued analysis was to target “smaller” satellite/instruments consistent with the Space Warfighting Analysis Center’s (SWAC) pivot to more resilient architecture designs through initiatives known as “force designs”
  - Analysis of 77 instruments less than 400 lbs showed:
    - Mean BCD Schedule for “Smaller” satellites is 60 months (12% decrease from full consolidated dataset)
    - Mean Schedule significantly increases for instruments over 200 lb





Study 26: Schedule Durations for Mission Payloads
Phase 2 Study Plan

- Finalize evaluation of potential SERs using all candidate schedule drivers identified in this study
- Evaluate post-2004 NASA instruments (better data availability post 2004). Identify targeted list of projects to assess detailed schedule data and incorporate Space Development Agency (SDA) detailed payload development schedules
- Integrate available cost data into the Increment 2 data set
- Evaluate the characteristics of programs that perform better than the historical average for schedule duration
- Assess temporal aspects of payload development times, impact of Contract Type, Mission Type, Acquisition Complexity, Mission Assurance, etc. on payload schedule durations
- Review analysis with NASA and NRO and work to incorporate methods or findings they have previously determined; and possibly add additional data to overall dataset
- Assess the availability of commercial payload schedule data and work to incorporate into current data set for regression analysis

Study 26: Schedule Durations for Mission Payloads
Phase 2 SER Results to Date

- **Complete evaluation of potential SERs using all Candidate Schedule Drivers identified in this study**
  - 21 Total SERs have been developed so far …

#	SER Candidate	SER	DOF	SPE	Bias	R^2
1	Weight, Design Life	BCD Schedule = a * Weight^b * Design Life^c	97	34.6%	0.0%	0.29
2	Weigh, Power	BCD Schedule = a * Weight^b * Power^c	77	34.0%	0.0%	0.27
3	Weigh, Power, Design Life	BCD Schedule = a * Weight^b * Power^c *Design Life^d	76	34.1%	0.0%	0.28
4	Weight, Power (NASA Only)	BCD Schedule = a * Weight^b * Power^c	65	31.2%	0.0%	0.33
5	Weight, Power, Agency	BCD Schedule = a * Weight^b * Power^c * Agency^d	76	33.1%	0.0%	0.29
6	Weight, Power, Mision A	BCD Schedule = a * Weight^b * Power^c * Mission Class^d	55	27.8%	0.0%	0.45
7	Weight, Power, Mission B	BCD Schedule = a * Weight^b * Power^c * Mission Class^d	55	32.0%	0.0%	0.35
8	Weight, Power, Mission C	BCD Schedule = a * Weight^b * Power^c * Mission Class^d	55	29.5%	0.0%	0.43
9	Power, Design Life	BCD Schedule = a * Design Life^b * Power^c	77	36.6%	0.0%	0.17
10	Weight, Design Life, Mission A	BCD Schedule = a * Weight^b * Design Life^c * Mission Class^d	91	30.6%	0.0%	0.39
11	Weight, Power, Design Life, Mission A	BCD Schedule = a * Weight^b * Power^c * Mission Class^d * Design Life^e	54	27.9%	0.0%	0.45
12	Weight, Power, Mission Class	BCD Schedule = a * Weight^b * Power^c * Mission A^d * Design Life^e *Mission B^f * Mission C^g	52	27.5%	0.0%	0.50
14	Weight, Power, Design Life, Mission Class (<400 lbs)	BCD Schedule = a * Weight^b * Power^c * Mission A^d * Design Life^e *Mission B^f * Mission C^g	25	26.6%	0.0%	0.56
15	Weigth, Power, Design Life, Mission Class, Agency	BCD Schedule = a * Weight^b * Power^c * Mission A^d * Design Life^e *Mission B^f * Mission C^g * Agency^h	51	27.7%	0.0%	0.52
16	Weigth, Power, Design Life, Mission Class, Agency (< 400 lbs)	BCD Schedule = a * Weight^b * Power^c * Mission A^d * Design Life^e *Mission B^f * Mission C^g * Agency^h	24	24.3%	0.0%	0.72
17	Power, Design Life, Mission A	BCD Schedule = a * Weight^b * Design Life^c * Mission Class^d	56	30.4%	0.0%	0.40
18	Weight, Design Life (<400 lbs)	BCD Schedule = a * Weight^b * Design Life^c	74	33.9%	0.0%	0.28
19	Weight, Power, Mission A (<400 lbs)	BCD Schedule = a * Weight^b * Power^c * Mission Class^d	28	26.1%	0.0%	0.50
20	Weight, Design Life, Mission A (<400 lbs)	BCD Schedule = a * Weight^b * Design Life^c * MissionA^d	59	31.1%	0.0%	0.41
21	Weight, Power, Design Life, Mission A (<400 lbs)	BCD Schedule = a * Weight^b * Power^c * Mission Class^d *Design Life ^e	27	26.4%	0.0%	0.56

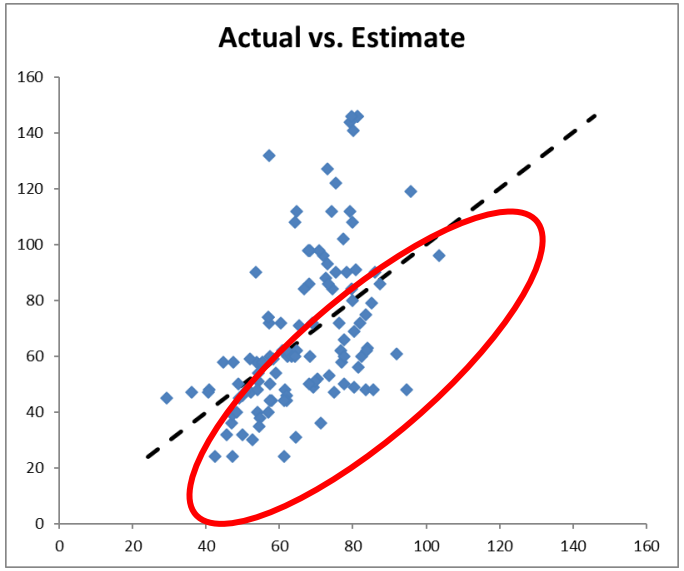
Study 26: Schedule Durations for Mission Payloads Phase 2 SER Results to Date

- While none of the SERs are recommended as a good fit, the R-squared shows improvement based on further refinement of the data (i.e, smaller vs larger instruments) and differing functional forms
- Further data scrubbing may lead to improved results:
  - Analysis of the Regression and Residual plots
  - Identify true outliers – data points with Standard Errors greater than 2 standard deviations; evaluate metrics such as “Months/Lb”
  - Attempt to identify appropriate Mission Class for “Sensor” data points
  - Idea isn’t to cherry pick the data, rather to identify data points that should be further analyzed
- Continue evaluating potential SER candidates, for example: SERs with Design Life vs Power, expand data set to include Planetary instrument missions and explore candidate SERs, further refine “smaller” satellites to less than 200 lbs, …
- Our analysis in this regard is on-going …

Study 26: Schedule Durations for Mission Payloads Phase 2 Analysis

- **Evaluate post-2004 NASA instruments (better data availability post 2004). Identify targeted list of projects to assess detailed schedule data and incorporate SDA detailed payload development schedules**

- **Integrate available cost data into the Increment 2 data set**
  - Actual vs. Estimate: BCD Schedule vs Weight and Design Life– Better Performers are below the line (i.e., actual schedule was less than what was estimated by the SER)



Subset of Full Data Table

NICM/ Sensor	Satellite/Mission Name	Sensor/Instrument Name	Launch Date	BCD Schedul	Weight (lbs)	Power (W)	Design Life	Misson Class	BCD Cost (FY 04$K)	$ per pound (FY04 $K/lb)	Instrument Type
NICM	ACRIMSAT	ACRIM III	12/20/1999	32							
NICM	ADEOS I	NSCAT	8/17/1996	144							
NICM	ADEOS II	SeaWinds	12/14/2002	90							
NICM	AIM	SOFIE	4/25/2007	44							
NICM	AIM	CIPS	4/25/2007	40							
NICM	Aqua	AIRS	5/4/2002	84							
NICM	Aqua	AMSU-A	5/4/2002	60							
NICM	Aura	HIRDLS	7/15/2004	58							
NICM	Aura	EMLS	7/15/2004	90							
NICM	Aura	TES Aura	7/15/2004	72							
NICM	C/NOFS	CINDI	4/16/2008	32							
NICM	Chandra	ACIS	7/23/1999	72							
NICM	Chandra	HRC	7/23/1999	49							
NICM	CHIPS	CHIPS	1/12/2003	30							
NICM	CloudSat	CPR	4/28/2006	66							

Study 26: Schedule Durations for Mission Payloads Phase 2 Analysis

- Evaluate characteristics of instruments that perform better than the historical average for schedule duration
  - Requested detailed schedule information via NASA “Part A CADREs”
    - Post-2000 NASA instruments, less than 400 lbs, and less than 60 months design life

Better Performer?	Post 2004 Programs?	Dependent Var (Actual)	Estimate	%Error	Satellite/Mission Name	Sensor/Instrument Name	Launch Year	Weight (lbs)	BCD Cost (FY04 $K)	$K per pound (FY04)	Power (W)	Design Life	Misson Class	Instrument Type	Request?
Yes/No	Yes/No	BCD Schedul	BCD Schedul				Manual Entry								
Yes	Yes	69	80.28	-14.05%	SMAP	SMAP	2015								
No	Yes	96	71.99	33.35%	GPM	GMI	2014								Y
Yes	Yes	48	85.47	-43.84%	LDCM	OLI	2013								
Yes	Yes	53	73.42	-27.81%	NuStar	NuStar	2012								Y
Yes	Yes	60	62.23	-3.58%	Glory	APS-Glory	2011								Y
No	Yes	71	65.30	8.73%	Suomi-NPP	ATMS	2011								Y
No	Yes	108	64.28	68.01%	Suomi-NPP	OMPS	2011								Y
No	Yes	127	73.05	73.85%	Suomi-NPP	CrIS SuomiN	2011								Y
No	Yes	57	55.29	3.09%	ISS	VCAM ISS	2010								Y
Yes	Yes	60	63.30	-5.22%	SDO	EVE	2010								
Yes	Yes	62	64.75	-4.24%	SDO	HMI	2010								
Yes	Yes	52	70.27	-26.00%	OCO	GSPEC-OCO	2009								Y
Yes	Yes	63	83.89	-24.90%	WISE	WISE	2009								
Yes	Yes	32	45.49	-29.66%	C/NOFS	CINDI	2008								Y
Yes	Yes	35	54.49	-35.77%	IBEX	IBEX	2008								Y
Yes	Yes	54	54.29	-0.53%	Jason 2	AMR	2008								
Yes	Yes	44	57.87	-23.97%	AIM	SOFIE	2007								Y
Yes	Yes	40	53.92	-25.81%	AIM	CIPS	2007								Y
Yes	Yes	47	50.62	-7.16%	THEMIS	EFI THEMIS	2007								Y
No	Yes	47	40.65	15.63%	THEMIS	ESA THEMIS	2007								Y
No	Yes	47	35.97	30.67%	THEMIS	SST	2007								Y
Yes	Yes	66	77.68	-15.04%	CloudSat	CPR	2006								
No	Yes	45	29.19	54.18%	ST5	MAG-ST5	2006								

Representative table of requested instrument schedule details

Study 26: Schedule Durations for Mission Payloads Phase 2 – "More Detailed Schedule" Analysis

- Requested more detailed schedule data for 27 NASA instruments
  - Initial request was primarily to assess the availability and useability of the data
  - Received various milestone "Part A CADREs" for 25 of the requested instruments
    - For some instruments, summary excel files were also provided with the additional schedule details
  - Assessed the CADREs to determine what detailed schedule data could be obtained
  - Moving forward, the goal is to use this more detailed instrument data to develop:
    - Schedule duration trends; typical PDR, CDR, duration to vehicle duration
    - SERs that are aligned to various instrument milestone dates
    - Trends of schedule durations associated with "better" performers; for example, better schedule performers typically reach their "??" milestones in "??" months or opposite trends for poor performers

Study 26: Schedule Durations for Mission Payloads Phase 2 – "More Detailed Schedule" Analysis

- Summary of what we have so far…

		Instrument						Vehicle Level					
Satellite / Mission Name	Instrument Name	ATP	SRR/SDR	PDR	CDR	Instrument Pre-Ship Review	Ready for Vehicle Integration	Pre Ship / Operational Readiness Review	Mission Readiness Review	Launch Readiness	Launch	ATP to Pre Ship Review/Ready for Int (mos)	BCD Schedule (mos)
GPM	GMI	3/22/2005		11/16/2006	6/25/2009	1/30/2012	3/5/2012	11/12/2013		2/27/2014	2/27/2014	83	96
NuStar	NuStar	2/25/2008		7/30/2008	9/16/2009	3/31/2011	4/25/2011	1/26/2012	2/21/2012	6/13/2012	6/13/2012	38	53
Suomi-NPP	ATMS		3/15/2000	7/1/2000	5/1/2002	9/1/2005		8/24/2011	9/6/2011	10/28/2011	10/28/2011	65	71
Suomi-NPP	OMPS		3/15/2000		3/1/2003	11/1/2008		8/24/2011	9/6/2011	10/28/2011	10/28/2011	103	108
Suomi-NPP	CrIS		3/15/2000		8/1/2003	6/15/2010		8/24/2011	9/6/2011	10/28/2011	10/28/2011	123	127
Glory	APS-Glory	2/15/2004		2/4/2005	4/11/2006	2/26/2009		12/1/2010	1/28/2011	2/23/2011	3/4/2011	60	60
ISS	VCAM	7/11/2005	10/11/2005	6/10/2006	3/22/2007			8/26/2009		4/5/2010	4/5/2010		57
OCO	GSPEC	7/1/2003		7/26/2004	10/4/2005	3/13/2008	3/18/2008	11/6/2008	1/28/2009	2/23/2009	2/24/2009	56	52
IBEX	IBEX	5/15/2005		12/15/2005			9/28/2007	4/15/2008	9/1/2008		10/19/2008	28	35
AIM	SOFIE			1/13/2004	10/8/2004	10/27/2006	12/2/2006	2/19/2007	3/29/2007	4/24/2007	4/25/2007		44
AIM	CIPS				10/5/2004			2/19/2007	3/29/2007	4/24/2007	4/25/2007		40
THEMIS	EFI	3/3/2003	5/2/2003		4/19/2004			10/6/2006	1/5/2007	2/14/2007	2/17/2007		47
THEMIS	ESA	3/3/2003	5/2/2003		4/19/2004			10/6/2006	1/5/2007	2/14/2007	2/17/2007		47
THEMIS	SST	3/3/2003	5/2/2003		4/19/2004			10/6/2006	1/5/2007	2/14/2007	2/17/2007		47
CHIPS	CHIPS	6/20/1999			10/16/2000		6/30/2002	10/9/2002	11/15/2002	12/18/2002	1/12/2003	36	30
RHESSI	RHESSI	1/30/1998		7/28/1998	11/17/1998		1/15/2000	2/21/2001		2/5/2002	2/5/2002	23	51
JASON-1	JMR			1/16/1997	1/15/1998	4/14/1999		7/20/2001	11/8/2001	12/7/2001	12/7/2001		51
TIMED	TIDI			1/1/1997				5/14/2001		12/7/2001	12/7/2001		59
TIMED	SEE			2/1/1997				5/14/2001		12/7/2001	12/7/2001		58
TIMED	SABER			12/1/1996	10/1/1997			5/14/2001		12/7/2001	12/7/2001		60
TIMED	GUVI			1/1/1997				5/14/2001		12/7/2001	12/7/2001		59
EO-1	LAC							8/15/2000	10/15/2000	11/15/2000	11/21/2000		36
IMAGE	HENA	5/1/1996		12/9/1996	7/9/1997	12/1/1998	3/31/1999	8/15/1999	2/15/2000	3/24/2000	3/25/2000	34	47
IMAGE	MENA	5/1/1996	9/10/1996	1/13/1997	7/1/1997	2/1/1999	3/31/1999	8/15/1999	2/15/2000	3/24/2000	3/25/2000	34	46
IMAGE	RPI	5/1/1996		1/9/1997	8/5/1997	1/12/1999	3/31/1999	8/15/1999	2/15/2000	3/24/2000	3/25/2000	34	46

Better Performers

Dates in Red are "inferred" dates base on Schedule Milestone charts documented in Part A CADRes

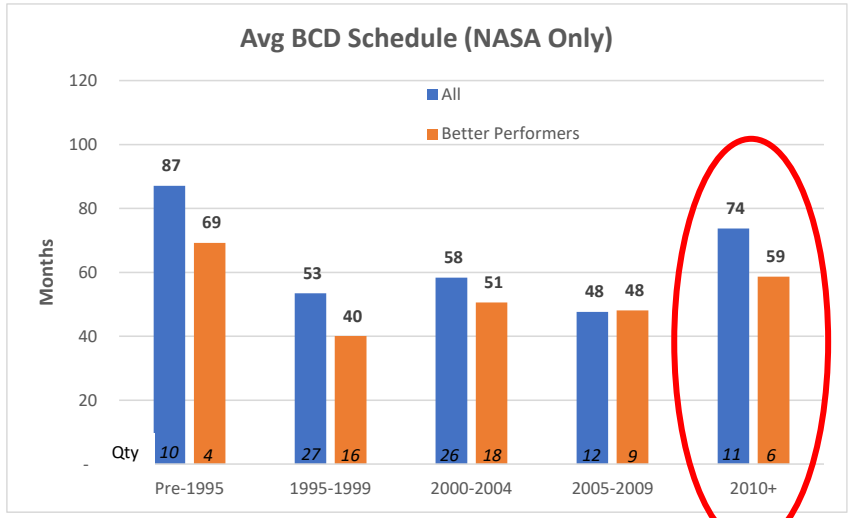
Takeaway: A lot of good data obtained from the CADRe's;

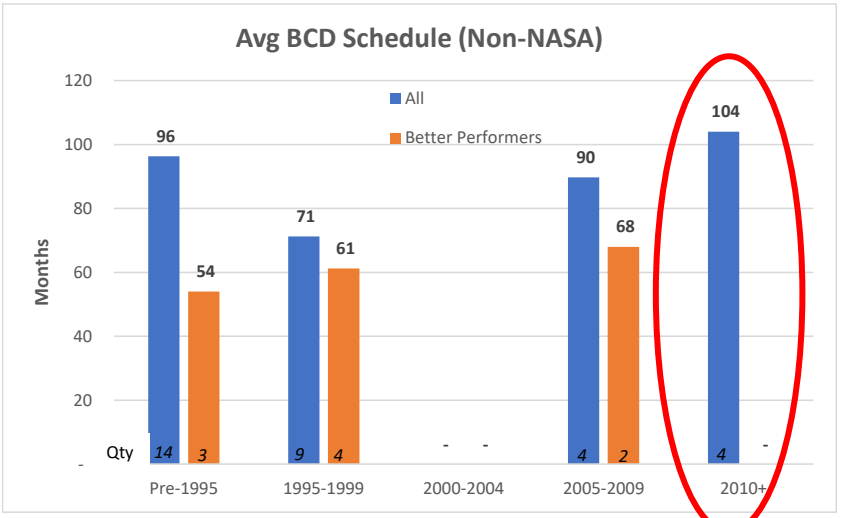
Working to collect additional CADRe's to expand detailed dataset

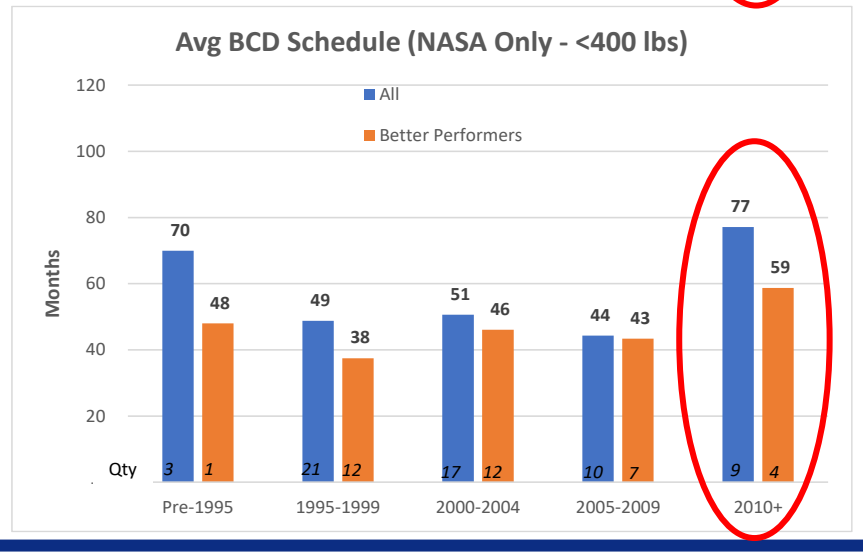
Study 26: Schedule Durations for Mission Payloads Phase 2 Analysis

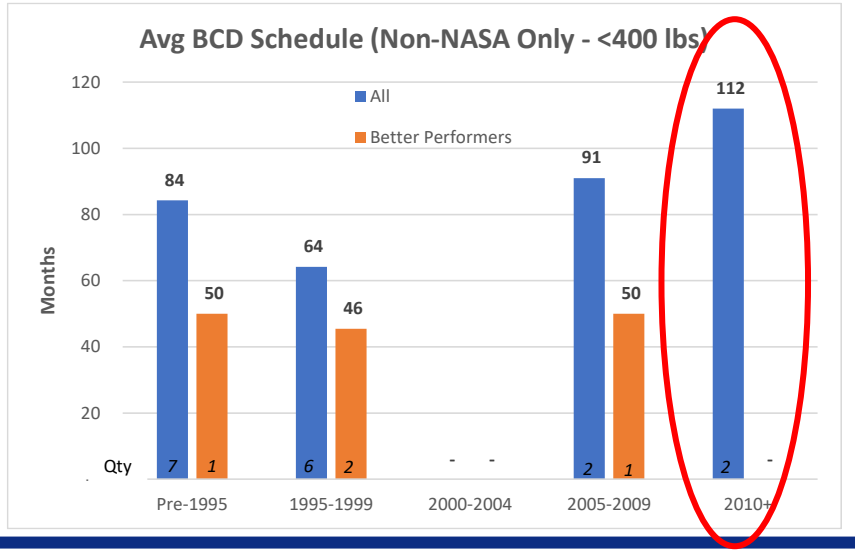
- **Assess temporal aspects of payload development times, impact of Contract Type, Mission Type, Acquisition Complexity, Mission Assurance, etc. on payload schedule durations**
  - Completed initial analysis of schedule durations over time (existing dataset)
    - Post 2010 Instrument/Payload BCD (NASA and non NASA) Schedules on average are longer than 1995-2010 timeframe
      - See next slide …
    - Expand dataset to include Planetary missions and see if trends are consistent
  - Continuing to research impacts of Mission Assurance (Mission classes) as first priority and then Contract type (Acquisition Complexity) if data/information is available

Study 26: Schedule Durations for Mission Payloads Phase 2 Analysis









Study 26: Schedule Durations for Mission Payloads Summary - Initial Observations

- Schedule Performance for different Mission Classes does vary, trends are what we would expect – Mission Class A longer than B longer than C

- NASA Instruments tend to have on average better schedule performance than non-NASA payloads in our dataset
  - Work to identify the “appropriate” Mission Class for non-NASA Instruments
  - If those instruments are mostly equivalent to Mission Class A’s – maybe there isn’t a difference in “similar” instrument development schedules

- Post 2010 Instrument/Payload BCD (NASA and non-NASA) Schedules on average are longer than 1995-2010 timeframe

Study 26: Schedule Durations for Mission Payloads Summary – Work to Do …

- **We have quite a bit of work left, but a lot of data to help ☺**
  - Continue to develop and evaluate candidate SERs
  - Evaluate the characteristics of programs that perform better than the historical average for schedule duration
  - Continue to assess temporal aspects of payload development times, impact of Contract Type, Mission Type, Acquisition Complexity, Mission Assurance, etc. on payload schedule durations
  - Review analysis with NASA and NRO and work to incorporate methods or findings they have previously determined; and possibly add additional data to dataset (to include commercial payload schedules if possible)

Study 26: Schedule Durations for Mission Payloads

Big thank you to Vicky Nilsen, James Johnson, and Charley Hunt – Spirit of Collaboration is amazing