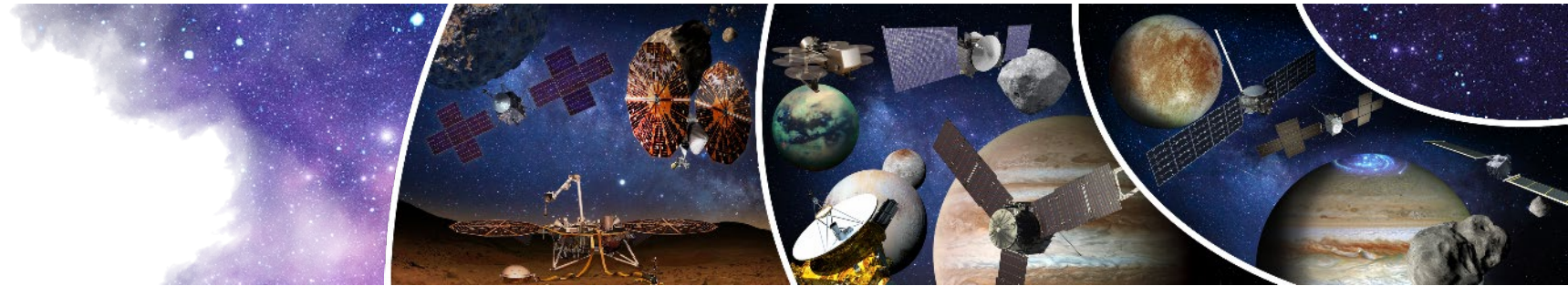# Planetary Missions Program Office
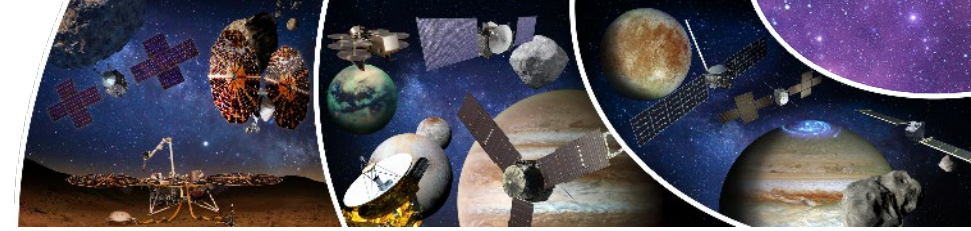

EVM Analysis Tool for Complex Projects with Varied Data Sources

May 3, 2023

Donald P. Rice, Jr. (donald.p.rice@nasa.gov)
EVM Analyst, Planetary Missions Program Office,
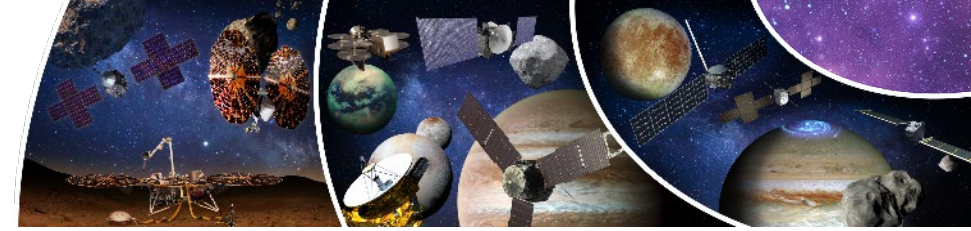NASA Marshall Space Flight Center

Analyzing Complex Multi-Contract Projects
Outline

- Problem definition

- Data sources description/tool development

- Monthly process

- What types of analysis can be done with this tool?

- What does the final product look like?

Analyzing Complex Multi-Contract Projects
Problem Definition

- Analysis of a complex project with multiple contracts that are reporting separately at a variety of different levels & need to provide consistent and meaningful analysis at the top and individual contract levels.
  - Complete IPMRs for two contracts
  - IPMR Format 1 data for six contracts
  - Empower data is only available for three contracts

- Empower will not work as a tool because, as noted, some contracts do not have Empower data

- While several of the contracts with minimal data are small, they also represent a significant portion of the remaining work and the majority of the project Cost/Schedule/Technical issues; so analysis will miss key issues because these issues are not included in the data

## Analyzing Complex Multi-Contract Projects
Data Sources Description/Tool Development
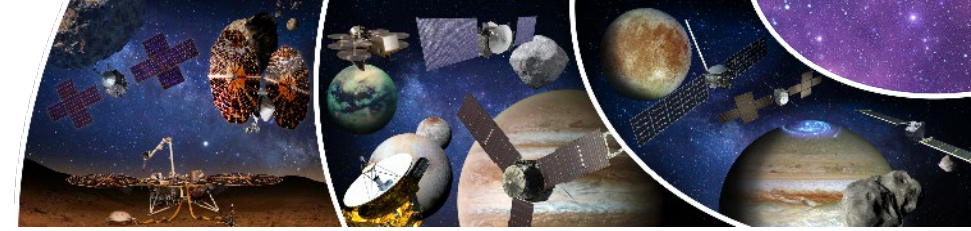
- With these varied data sources a tool was needed that:
  - Requires minimal data input
  - Allows for adjustments based on noted issues
  - Provides consistent and useful analysis for Mission Managers and PMPO leadership at the top level and at the individual contract level
- An existing tool analyzing the largest contract (about 70% of the budget) was already being used; tool meets the requirements above, but the tool needed to be modified to provide individual contract and total project analysis; these are the adjustments that were made:
  - The revised tool is a single Excel spreadsheet file with a tab for each of the Contracts
  - A summary tab was developed that automatically summarizes the data from the other contract tabs to provide top level Project analysis
  - Automatic chart generation is included in the spreadsheet tool

Analyzing Complex Multi-Contract Projects
Monthly Process – Adjusting the Data (1 of 4)
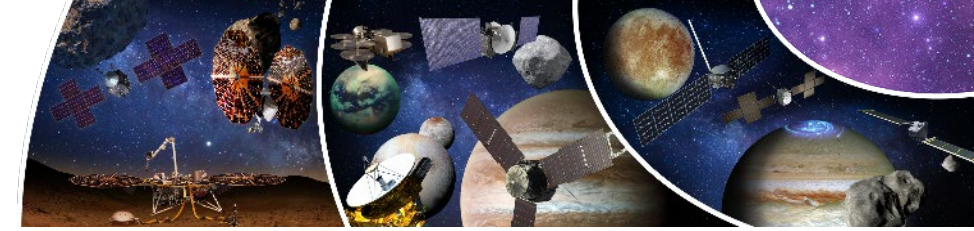
- Adjust the spreadsheet data and charts to ensure everything is being accurately presented for each of the **contract data tabs**
  - Add a row of data above the last month's row for each tab & update the dates – **For the Contract tabs**
  - Update the $CPI_{Ktr\ 6Mos}$ column, & Earned Schedule calculation for the current month and previous month
  - Update the charts to reflect the last 12 months of data
  - Lock in any specific adjustments made in the previous month

Previous Month's Spreadsheet
- Copy most recent month's row & past above
- Save as current month's spreadsheet

| DATA Month	BCWS	BCWP	ACWP	BAC	VAC_{KTR}	EAC_{KTR}
Feb-22	$ 1,359.80	$ 1,256.44	$ 1,498.21	$ 1,850.43	$ (257.89)	$ 2,108.32
Mar-22	$ 1,389.08	$ 1,290.90	$ 1,544.47	$ 1,851.11	$ (276.41)	$ 2,127.52
Apr-22	$ 1,419.85	$ 1,342.97	$ 1,586.87	$ 1,857.56	$ (287.23)	$ 2,144.79
May-22	$ 1,447.71	$ 1,372.78	$ 1,649.72	$ 1,882.67	$ (290.38)	$ 2,173.05
Jun-22	$ 1,468.35	$ 1,396.16	$ 1,687.87	$ 1,884.75	$ (299.53)	$ 2,184.27
Jul-22	$ 1,488.25	$ 1,430.85	$ 1,726.46	$ 1,885.75	$ (308.94)	$ 2,194.68
Aug-22	$ 1,520.41	$ 1,453.76	$ 1,754.22	$ 1,907.14	$ (368.55)	$ 2,275.70
Sep-22	$ 1,538.47	$ 1,478.05	$ 1,795.98	$ 1,910.48	$ (371.29)	$ 2,281.77
Oct-22	$ 1,559.65	$ 1,502.08	$ 1,834.19	$ 1,911.48	$ (379.62)	$ 2,291.10
Nov-22	$ 1,577.07	$ 1,519.76	$ 1,863.69	$ 1,911.95	$ (383.81)	$ 2,295.76
Dec-22	$ 1,591.99	$ 1,536.38	$ 1,894.02	$ 1,911.97	$ (386.81)	$ 2,298.78
Jan-23	$ 1,608.66	$ 1,560.91	$ 1,931.85	$ 1,913.96	$ (386.33)	$ 2,300.30

Current Month's Spreadsheet
- Highlight the 12th prior month - Update the date to the current month
- **Update the BCWS/BCWP/ACWP/BAC/EAC_{KTR} using contract data**

DATA Month	BCWS	BCWP	ACWP	BAC	VAC_{KTR}	EAC_{KTR}
Mar-22	$ 1,389.08	$ 1,290.90	$ 1,544.47	$ 1,851.11	$ (276.41)	$ 2,127.52
Apr-22	$ 1,419.85	$ 1,342.97	$ 1,586.87	$ 1,857.56	$ (287.23)	$ 2,144.79
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Dec-22	$ 1,591.99	$ 1,536.38	$ 1,894.02	$ 1,911.97	$ (386.81)	$ 2,298.78
Jan-23	$ 1,608.66	$ 1,560.91	$ 1,931.85	$ 1,913.96	$ (386.33)	$ 2,300.30
Feb-23	$ 1,622.27	$ 1,575.62	$ 1,962.70	$ 1,913.01	$ (425.82)	$ 2,338.83
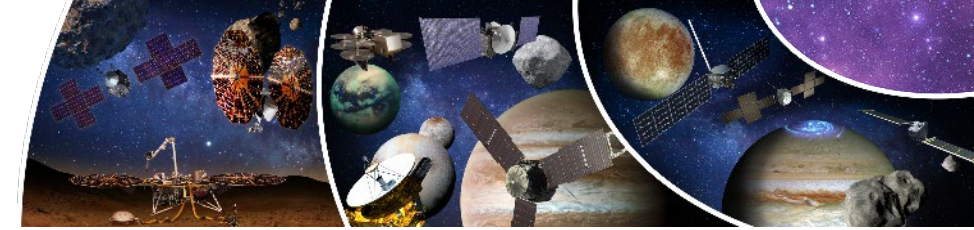
- Adjust the spreadsheet data and charts to ensure everything is being accurately presented for each of the **contract data tabs**
  - Add a row of data above the last month's row for each tab & update the dates – **For the Contract tabs**
  - Update the CPI_{Cur}, CPI_{6Mos}, & Earned Schedule calculation for the current month and previous month
  - Update the charts to reflect the last 12 months of data
  - Lock in any specific adjustments made in the previous month

Earned Schedule Formula Update
- Earned Schedule tracks schedule in terms of time
- It tracks where the BCWP falls between time period 32 & 33 and provides an ES value in terms of time
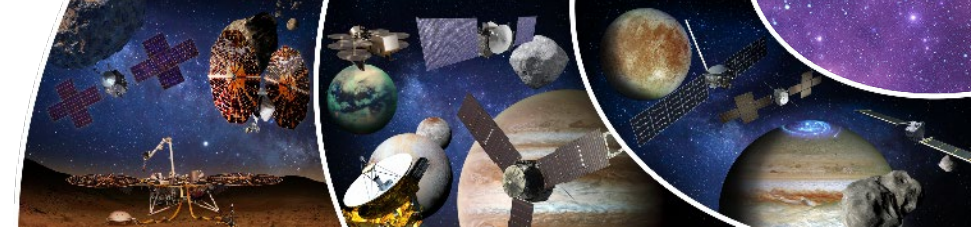
CPI_{Cur}
- (Current month BCWS - Previous month's BCWS)/ (Current BCWS-Previous Month's BCWS)=CPI_{Cur}
- Inserting the row changes the calculation

$CPI_{6\,Mos}$
- Update formula

DATA Month	BCWS	BCWP	ACWP	CPI_{Cur}	CPI-JPL (6Mos)	$TCPI_{FAC}$
Mar-22	$ 1,389.08	$ 1,290.90	$ 1,544.47	0.74	0.82	
Apr-22	$ 1,419.85	$ 1,342.97	$ 1,586.87	1.23	0.88	
May-22	$ 1,447.71	$ 1,372.78	$ 1,649.72	0.47	0.82	
Jun-22	$ 1,468.35	$ 1,396.16	$ 1,687.87	0.61	0.79	
Jul-22	$ 1,488.25	$ 1,430.85	$ 1,726.46	0.90	0.83	
Aug-22	$ 1,520.41	$ 1,453.76	$ 1,754.22	0.83	0.80	
Sep-22	$ 1,538.47	$ 1,478.05	$ 1,795.98	0.58	0.77	
Oct-22	$ 1,559.65	$ 1,502.08	$ 1,834.19	0.63	0.67	
Nov-22	$ 1,577.07	$ 1,519.76	$ 1,863.69	0.60	0.69	
Dec-22	$ 1,591.99	$ 1,536.38	$ 1,894.02	0.55	0.68	
Jan-23	$ 1,608.66	$ 1,560.91	$ 1,931.85	0.65	0.64	
Feb-23	$ 1,622.27	$ 1,575.62	$ 1,962.70	=(C25-C24)/(D25-D24)		

CPI_{Cur}	CPI-KTR (6Mos)	$TCPI_{FAC-KTR}$	$TCPI_{FAC-NASA}$
0.74	0.82	0.96	0.78
1.23	0.88	0.92	0.80
0.47	0.82	0.97	0.79
0.61	0.79	0.98	0.79
0.90	0.83	0.97	0.80
0.83	0.80	0.87	0.79
0.58	0.77	0.89	0.79
0.63	0.67	0.90	0.79
0.60	0.69	0.91	0.77
0.55	0.68	0.93	0.78
0.65	0.64	0.96	0.78
0.48	=(W20+W21+W22+W23+W24+W25)/6		

DATA Month	BCWS	BCWP	Time (AT)	Earned Sch. (ES)	SV(t)	SPI(t)
Mar-22	$ 1,389.08	$ 1,290.90	26	22.60	(3.40)	0.87
Apr-22	$ 1,419.85	$ 1,342.97	27	24.36	(2.64)	0.90
May-22	$ 1,447.71	$ 1,372.78	28	25.44	(2.56)	0.91
Jun-22	$ 1,468.35	$ 1,396.16	29	26.23	(2.77)	0.90
Jul-22	$ 1,488.25	$ 1,430.85	30	27.39	(2.61)	0.91
Aug-22	$ 1,520.41	$ 1,453.76	31	28.29	(2.71)	0.91
Sep-22	$ 1,538.47	$ 1,478.05	32	29.49	(2.51)	0.92
Oct-22	$ 1,559.65	$ 1,502.08	33	30.43	(2.57)	0.92
Nov-22	$ 1,577.07	$ 1,519.76	34	30.98	(3.02)	0.91
Dec-22	$ 1,591.99	$ 1,536.38	35	31.50	(3.50)	0.90
Jan-23	$ 1,608.66	$ 1,560.91	36	33.24	(2.76)	0.92
Feb-23	$ 1,622.27	$ 1,575.62	37	=AB20+((C25-B20)/(B21-B20))		

33.75

- Adjust the spreadsheet data and charts to ensure everything is being accurately presented for each of the **contract data tabs**
  - Add a row of data above the last month's row for each tab & update the dates – **For the Contract tabs**
  - Update the CPI$_{Ktr\ 6Mos}$ column, & Earned Schedule calculation for the current month and previous month
  - Update the charts to reflect the last 12 months of data
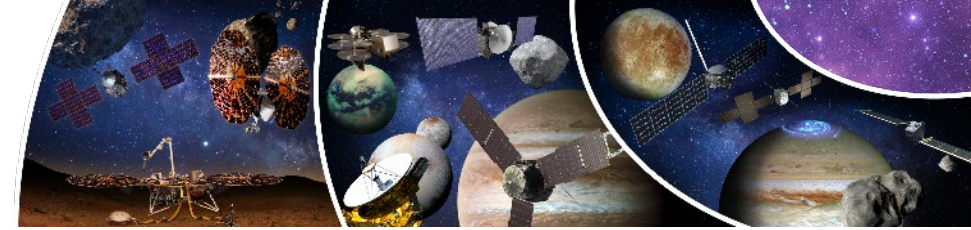 - Lock in any specific adjustments made in the previous month

Current Month's Spreadsheet (Feb 23 in this example)
- For each Contract Spreadsheet – select each chart
- Right click on each chart & select data
- Update range for the Axis label & data elements – to previous 12 months

- Adjust the spreadsheet data and charts to ensure everything is being accurately presented for each of the **contract data tabs**
  - Add a row of data above the last month's row for each tab & update the dates – **For the Contract tabs**
  - Update the CPI$_{Ktr\ 6Mos}$ column, & Earned Schedule calculation for the current month and previous month
  - Update the charts to reflect the last 12 months of data
  - Lock in any specific adjustments made in the previous month

Previous Month's Spreadsheet – One of the Contracts
- The Jan 23 Data set has an adjustment for the NASA EAC
- In this instance the KTR EAC was higher and used by NASA

Current Month's Spreadsheet – One of the Contract
- Lock in the adjustment made in the previous month – $0.2 from Jan 23
- Ensuring the previous month's adjustments are included in the summary chart

DATA	Plot Area EAC$_{CPI}$	Low - EAC$_{SPI}$	EAC$_{RFL}$	High - EAC$_{CRUSRL}$ NASA	EAC$_{SPI[t]}$	NASA VS. KTR
Oct-22	$ 19.23	$ 19.14		$ 19.23	$ 19.14	$ (0.01)
Nov-22	$ 19.30	$ 19.20		$ 19.30	$ 19.20	$ (0.15)
Dec-22	$ 19.29	$ 19.20		$ 19.29	$ 19.20	$ (0.16)
Jan-23	$ 19.25	$ 19.17		$ 19.25	$ 19.17	$ (0.20)
					NASA Adj	$ 0.20

ODAY fx =$D24+(($E24-$C24)/(J24*K24))+0.2

|	A	P	Q	R	S	T	U	V
	DATA Month	Low - EAC$_{SPI}$	EAC$_{RFL}$	High - EAC$_{CRUSRL}$ NASA	EAC$_{SPI[t]}$	NASA VS. KTR	% Diff	KTR vs Low
	Dec-22	$ 19.20		$ 19.45	$ 19.20	$ (0.00)	0.0%	$ 0.25
	Jan-23	$ 19.17		=$D24+(($E24-$C24)/(J24*K24))+0.2			0.0%	$ 0.28
	Feb-23	$ 19.15		$ 19.22	$ 19.15	$ (0.23)	-1.2%	$ 0.30
					NASA Adj	$ 0.23		

Analyzing Complex Multi-Contract Projects
Monthly Process – Adjusting Summary Spreadsheet
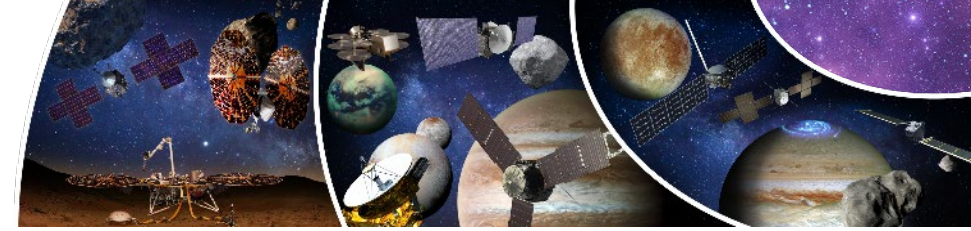
- Adjust the summary spreadsheet:
  - Add a row of data above the last month's row for each spreadsheet & update the dates – Summary data will automatically populate the chart – you don't input the **BCWS/BCWP/ACWP/BAC/EAC$_{KTR}$**
  - Update the spreadsheet formulas the same way they were updated for the 8 contract spreadsheets
  - Update the CPI$_{Ktr\ 6Mos}$ column, & Earned Schedule calculation for the current month and previous month
  - Update the charts to reflect the last 12 months of data – Exactly like what was done for the 8 contract spreadsheets
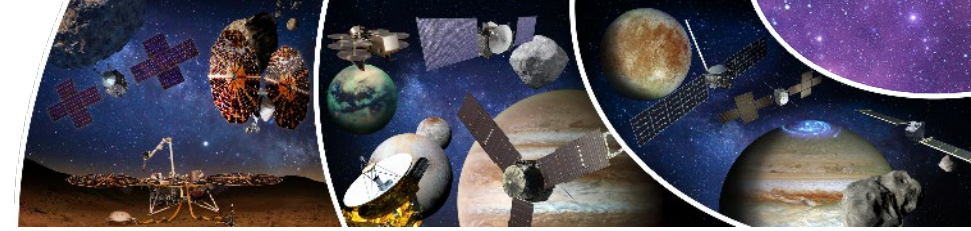
Current Month's Spreadsheet (Feb 23 in this example)
- For each Contract Spreadsheet – select each chart
- Right click on each chart & select data
- Update range for the Axis label & data elements – to previous 12 months
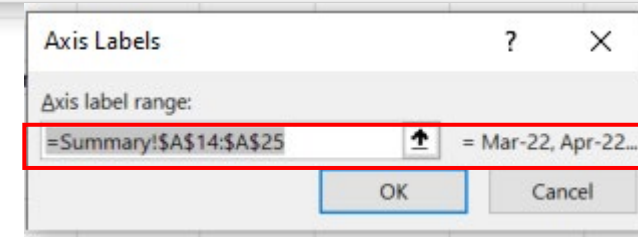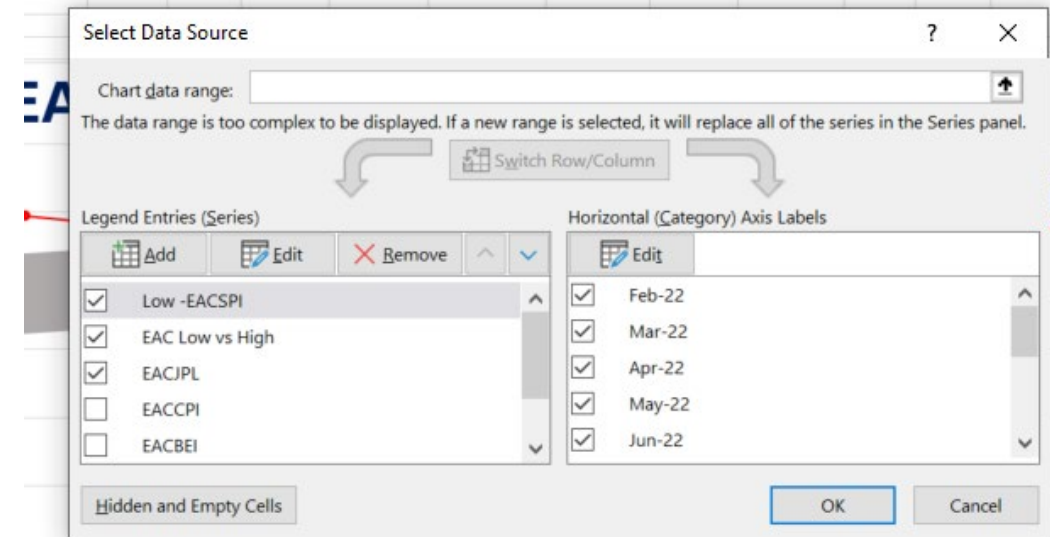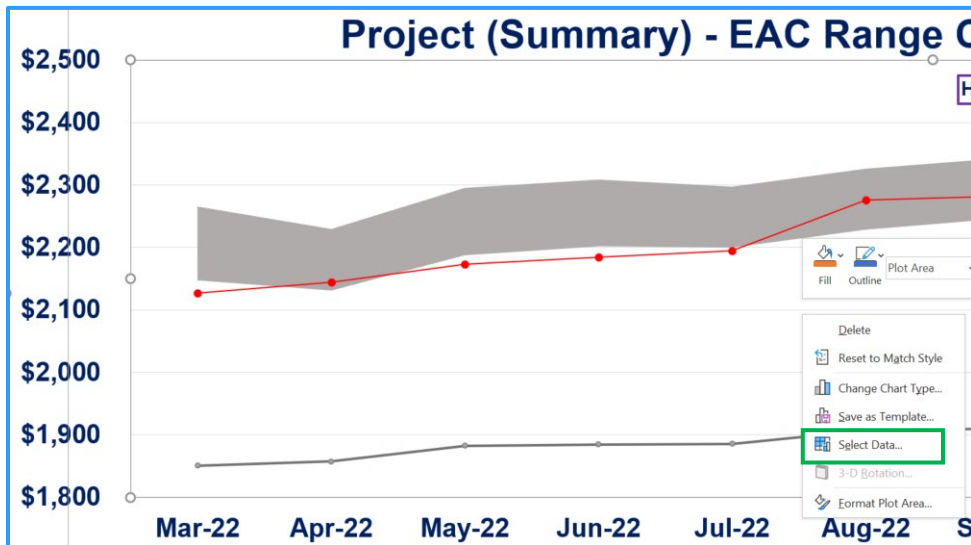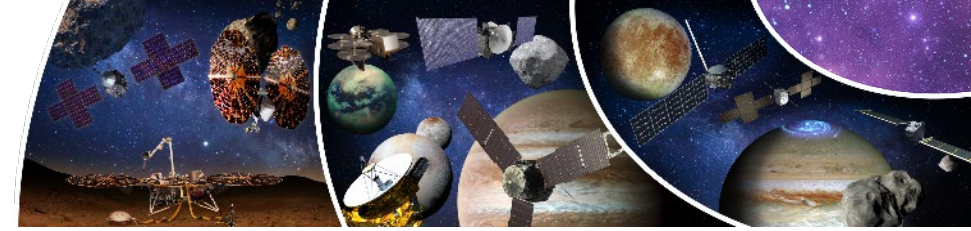
Analyzing Complex Multi-Contract Projects
What Type of Analysis Can Be Performed?

- At the top and individual contract level several analysis charts are generated:
  - EAC reasonableness
  - Trends Analysis – Including but not limited to $SPI(t)_{Cum}$, SPI_{Cum}, and CPI_{Cum}
  - TCPI Targets Analysis – Including but not limited to $TCPI_{EAC\text{-}Ktr}$ & $TCPI_{EAC\text{-}NASA}$
  - Summary Analysis – Tracking a mix of Trends and TCPI Targets for comparison
  - Earned Schedule (ES) vs. Actual Time (AT)

- Narrative is developed for the presented charts based on available briefing and reporting data

Analyzing Complex Multi-Contract Projects
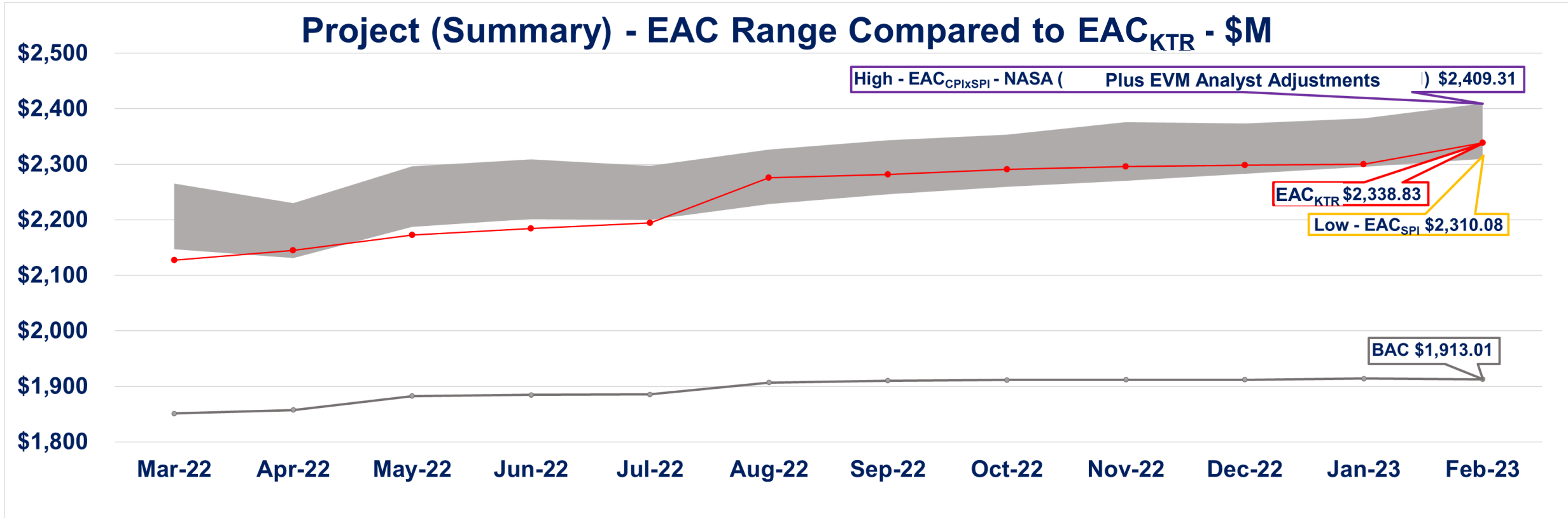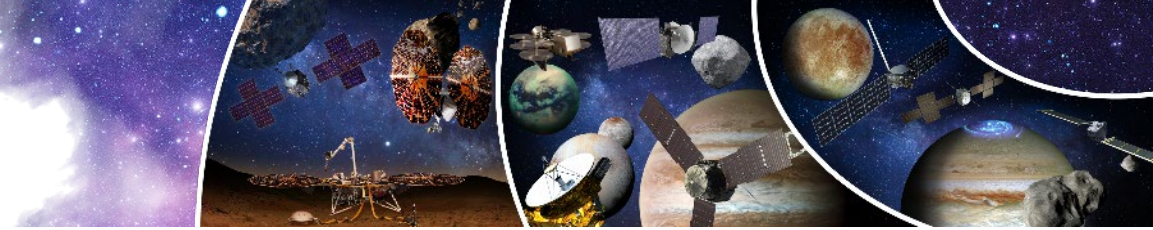## Final Product: Narrative Development

- Review all charts to get a feel for the trends at the top & contract level

- Talk to Mission Manager
  - What are the issues? What are the impacts of the issues? Where are they impacting?
  - What are the risks? Where are the risks? How likely are these risks? What is the potential impact?

- Look at the reports – What has changed from last month?
  - Do the reports match what's in the data?
  - Are the VAR's & explanations understandable by a layman?

- Have another person review your briefing

- Remember your audience – don't explain everything just the key things & avoid technical jargon

Analyzing Complex Multi-Contract Projects
Final Product: EAC Analysis

Project (Summary) - EAC Range Compared to EAC_{KTR} - $M

High - $EAC_{CPIxSPI}$ - NASA (Plus EVM Analyst Adjustments) $2,409.31

EAC_{KTR} $2,338.83

Low - EAC_{SPI} $2,310.08

BAC $1,913.01

Chart values: $2,500, $2,400, $2,300, $2,200, $2,100, $2,000, $1,900, $1,800

Months: Mar-22, Apr-22, May-22, Jun-22, Jul-22, Aug-22, Sep-22, Oct-22, Nov-22, Dec-22, Jan-23, Feb-23

- Project summary EAC range comparison captures a range of EACs based on a low and high EAC
- Allows analyst to identify current status and last year of trend information for the Project in relation to low and high EACs to begin to determine the reasonableness of the Project EAC
- A color rating is assigned based on how well the Project EAC compares to NASA's EAC

Analyzing Complex Multi-Contract Projects
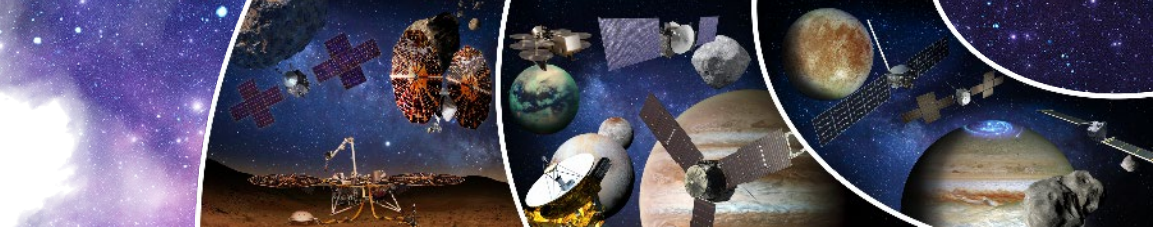## Final Product: Top Level SPI(t)/SPI/CPI

Project (Summary) - SPI(t)$_{Cum}$/SPI$_{Cum}$/CPI$_{Cum}$ Trends

SPI$_{Cum}$ 0.97
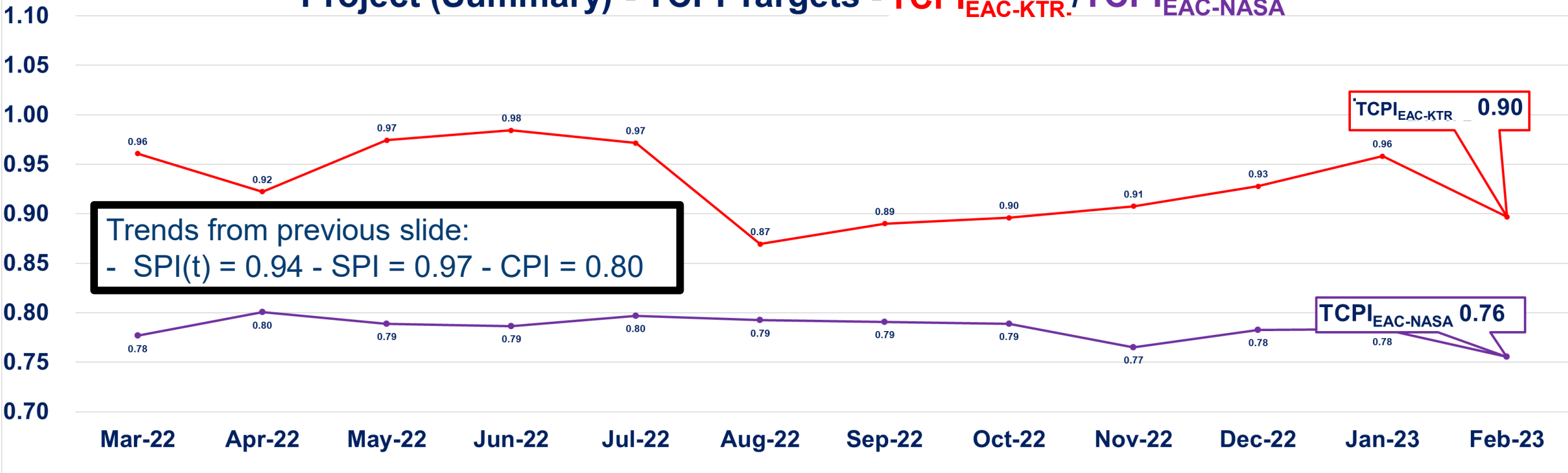SPI(t)$_{Cum}$ 0.91
CPI$_{Cum}$ 0.80
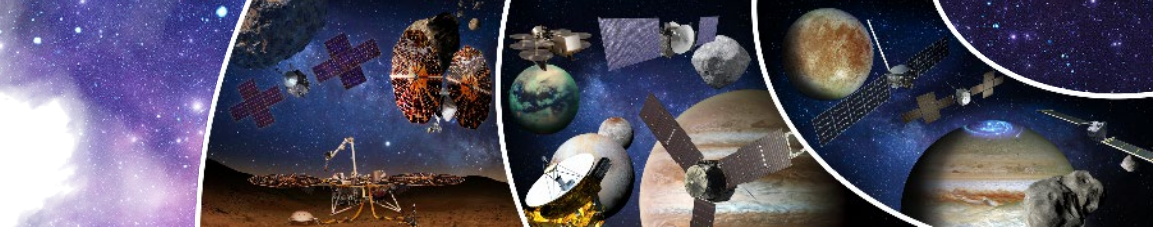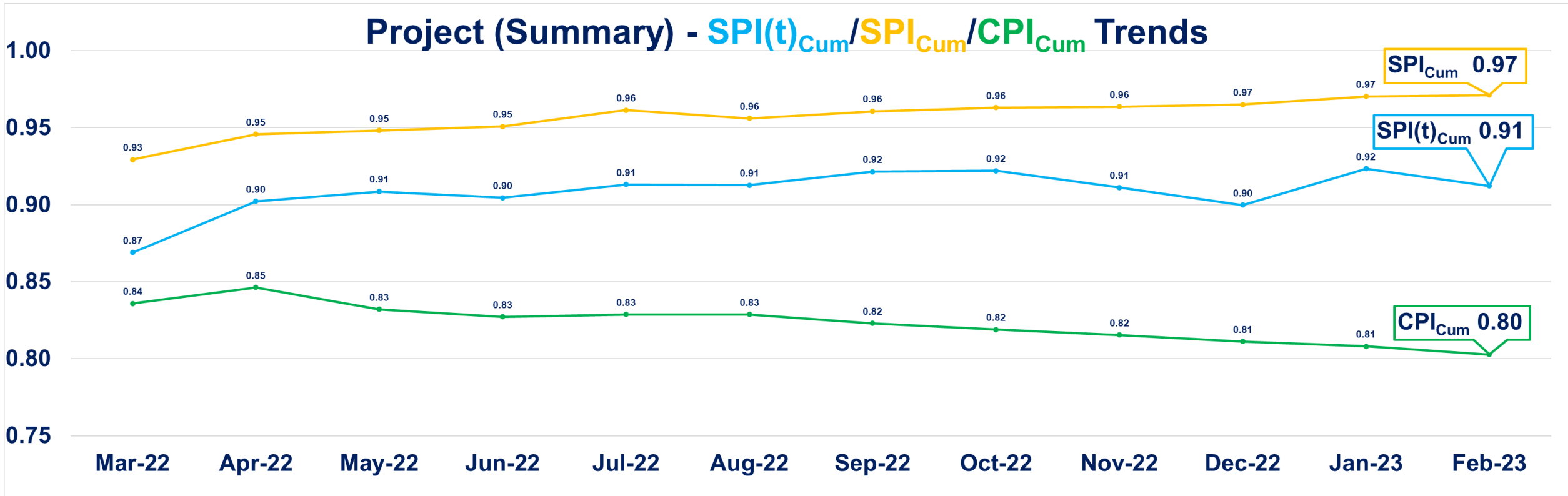
- CPI & SPI under 1.0 indicates that Project is spending more than planned without improving schedule performance
- At the summary level, we need to answer the question "What TCPI target matches most closely with the trends?"
- The same data and charts are available for additional targeted analysis for all contracts

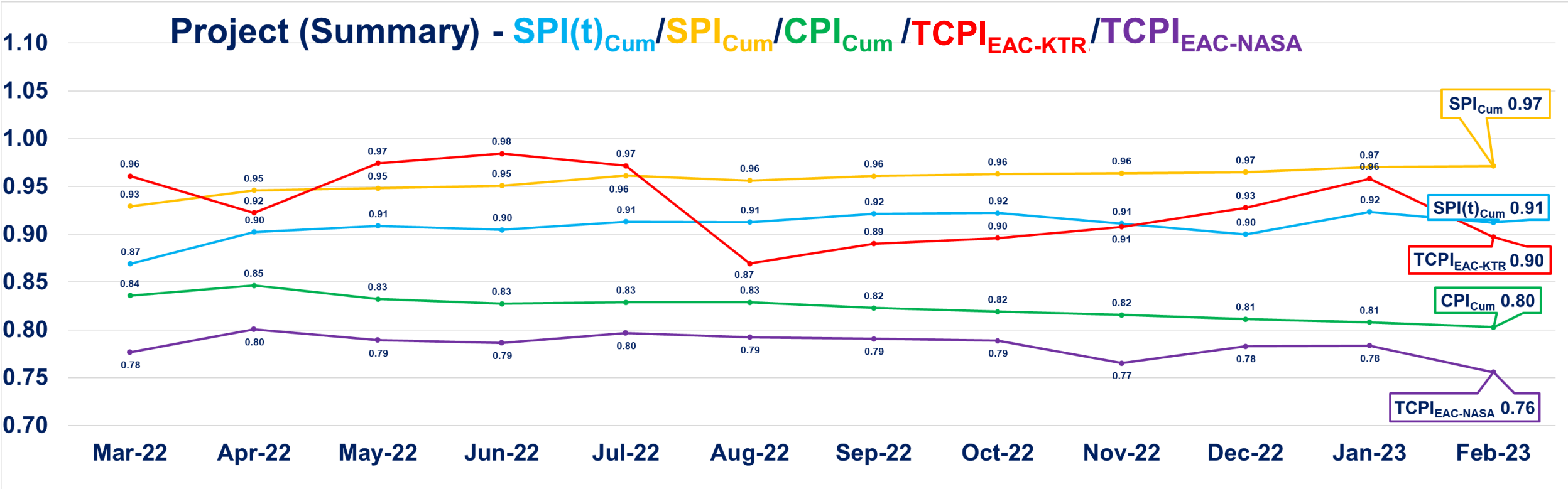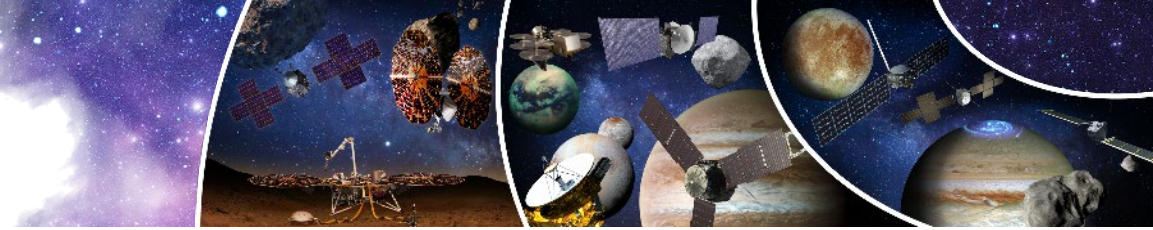# Analyzing Complex Multi-Contract Projects
Final Product: Top Level TCPI

Project (Summary) - TCPI Targets - $TCPI_{EAC-KTR}$/$TCPI_{EAC-NASA}$

Trends from previous slide:
- SPI(t) = 0.94 - SPI = 0.97 - CPI = 0.80

$TCPI_{EAC-KTR}$ **0.90**

$TCPI_{EAC-NASA}$ **0.76**

Red line ($TCPI_{EAC-KTR}$): 0.96, 0.92, 0.97, 0.98, 0.97, 0.87, 0.89, 0.90, 0.91, 0.93, 0.96, 0.90

Purple line ($TCPI_{EAC-NASA}$): 0.78, 0.80, 0.79, 0.79, 0.80, 0.79, 0.79, 0.79, 0.77, 0.78, 0.78, 0.76

X-axis: Mar-22, Apr-22, May-22, Jun-22, Jul-22, Aug-22, Sep-22, Oct-22, Nov-22, Dec-22, Jan-23, Feb-23

- TCPI trends track the cost performance required to reach EAC targets
- This chart allows the analyst to determine the conservativeness of the EAC_{NASA} and the EAC_{KTR}
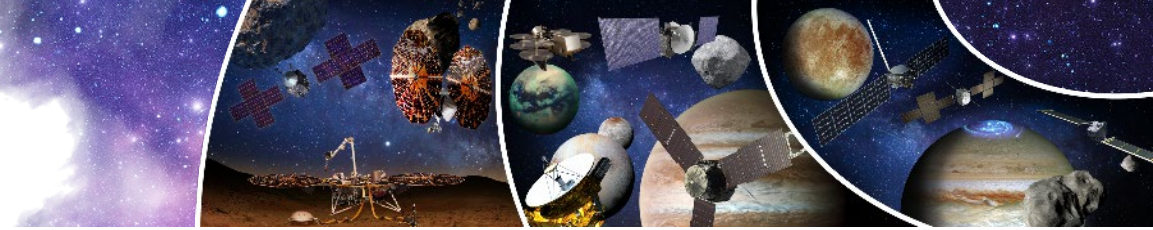
Project (Summary) - SPI(t)$_{Cum}$/SPI$_{Cum}$/CPI$_{Cum}$ /TCPI$_{EAC-KTR}$/TCPI$_{EAC-NASA}$

SPI$_{Cum}$ 0.97
SPI(t)$_{Cum}$ 0.91
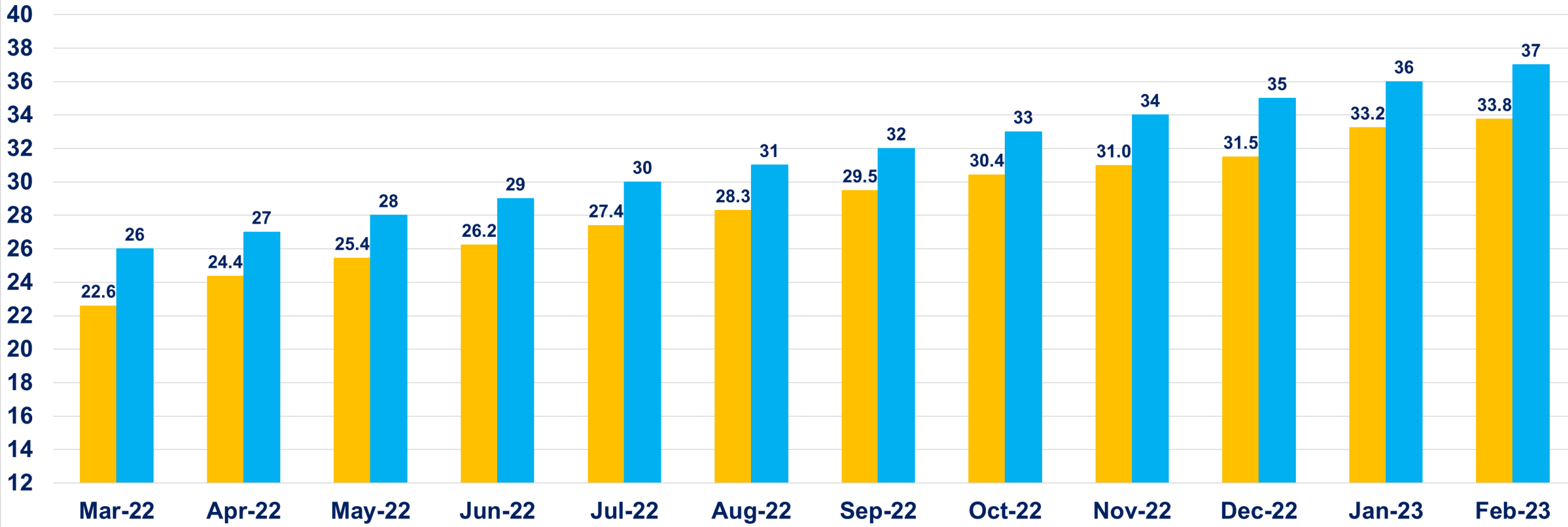TCPI$_{EAC-KTR}$ 0.90
CPI$_{Cum}$ 0.80
TCPI$_{EAC-NASA}$ 0.76

- All of the most relevant trends are shown here to perform intercomparison of all of the metrics to help determine the reasonableness of the Project and NASA analyst EACs

Analyzing Complex Multi-Contract Projects
## Final Product: Earned Schedule Trend Chart

Project (Summary) - Earned Schedule (ES) vs. Actual Time (AT)

Month	ES	AT
Mar-22	22.6	26
Apr-22	24.4	27
May-22	25.4	28
Jun-22	26.2	29
Jul-22	27.4	30
Aug-22	28.3	31
Sep-22	29.5	32
Oct-22	30.4	33
Nov-22	31.0	34
Dec-22	31.5	35
Jan-23	33.2	36
Feb-23	33.8	37

- Earned Schedule trends allow tracking of how much progress a project is making against their baseline schedule
- Ideally, a project would accomplish 1.0 months of work each month

Analyzing Complex Multi-Contract Projects
Summary
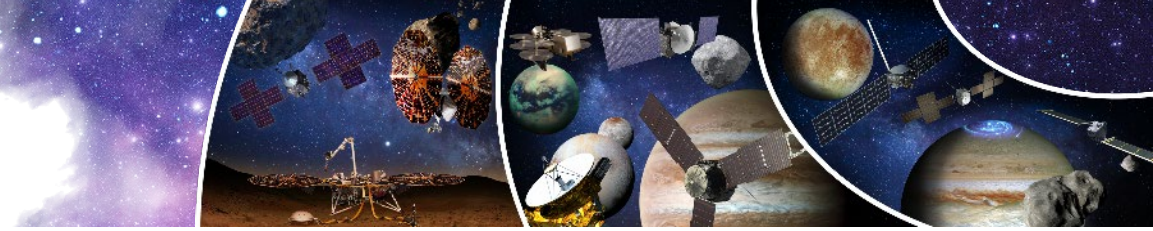
- A single spreadsheet tool that includes individual tabs for different contracts and a top level Project summary was created to address an issue for a complex project where all Contractor data is not available in Empower

- Relatively straightforward steps are taken to update each Contract tab each month and easily generate a set of charts to support a monthly analysis deliverable for the Planetary Missions Program Office at NASA Marshall Space Flight Center

- Examples of the analysis charts and their use were provided for a sample project

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