

Project Cost Estimating Capability (PCEC) v2 Plans and Status

NASA Cost Symposium

August 26, 2015

Andy Prince - MSFC/Engineering Cost Office

Brian Alford – Victory Solutions Team/Booz Allen Hamilton

Mark Pedigo – Victory Solutions Team/Booz Allen Hamilton

Mark Jacobs – Victory Solutions Team/TGS

Shawn Hayes – Victory Solutions Team/TGS

Richard Webb – Victory Solutions Team/KT Engineering



**Engineering
Cost
Office**





Topics



**Engineering
Cost
Office**

- **Where We are Today**
- **The Plan for v2**
- **Robotic Science**
- **Human Exploration**
- **The Way Forward**



PCEC Today



**Engineering
Cost
Office**

- Released Version 1.1.1 of the Interface and Version 1.2.1 of the Library (October 2014)
- 120 Confirmed Users
- Received Several Technology Transfer and NASA Group Achievement Awards
- MSFC Nominated PCEC for the NASA Software of the Year Award
- *PCEC v2 Released Concurrent with the Cost Symposium*



PCEC v2



**Engineering
Cost
Office**

PCEC v2 is a Radical Departure from NAFCOM12/PCEC v1.1.1

- **Estimates to the NASA Standard WBS**
- **New CERs for Estimating Spacecraft and Systems Level Costs**
- **New CERS for Estimating Crewed Vehicles and Launch Systems**
- ***Radical Change in Modeling Philosophy***



NAFCOM CER Issues



Engineering
Cost
Office

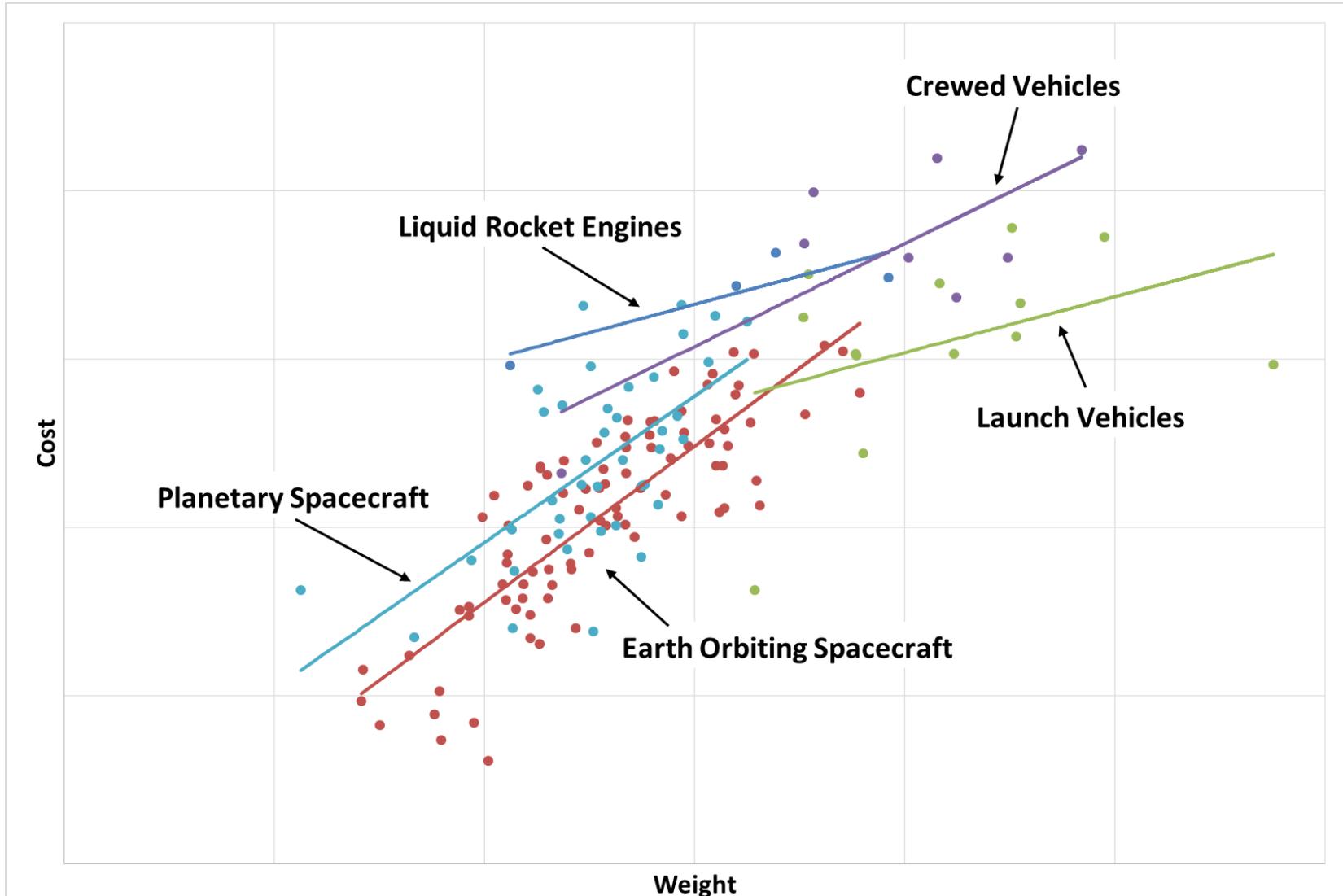
- **Non-Homogeneous** Data Set
- Input Parameters that are **Statistically Insignificant**
- Subjective Variables have Significant Explanatory Value
 - **No Documented Process for Assigning New Design Values or the Management Rating Inputs**
- Some CERs use Indicator Variables with only One or Two Data Points
- **Oversubscribed CERs:** Thrust Vector Control has 7 Data Points and 5 Input Variables
- In Several CERs Crewed, Crewed Launch Vehicle, and Shuttle Calibrated all Returned the same Costs
- **Nonsensical Results:** CC&DH CER Returns a D&D Estimate for an Uncrewed Launch Vehicle that is more than Two Times a Crewed Vehicle



Why NAFCOM Works



Engineering
Cost
Office





PCEC v2 Model Philosophy



Engineering
Cost
Office

- Use the **Best** Data Possible
 - Verified and Validated CASTS Data
 - CADRe Data for Spacecraft Model
- Total **Transparency** in the Analysis of the Data and the Development of the CERs
- **No Cherry Picking** the Data Points
- **Minimize or Eliminate Subjective Inputs**
 - Follow a Data Driven Process for the Derivation of Subjective Inputs
 - Allow the User to Follow the same Process for Determining Input Values
- **Emphasize Quality** of Input Parameters over Quantity
- Expect the User to Develop the **Rationale** for the Estimate
 - Know the Data



Key Things to Know with v2



**Engineering
Cost
Office**

What's the Same

- **Look and Feel**
- **General interface structure and modeling-building principles**
- **Emphasis on**
 - Traceability
 - Openness
 - Modularity of code
 - User-customization

What's New

- **All templates follow NASA Standard WBS, expanded under 5.0, 6.0, and 8.0**
- **New & Updated CERs**
- **Redesigned, tailored estimating templates**
- **NICM “Integration”**
- **Phasing Templates**
- **Many small features to help when building an estimate**
- **Under-the-hood efficiencies to make it more flexible and updateable**

These will be discussed in more detail at the PCEC v2 Demonstration on Wednesday afternoon



PCEC v2.0 Interface

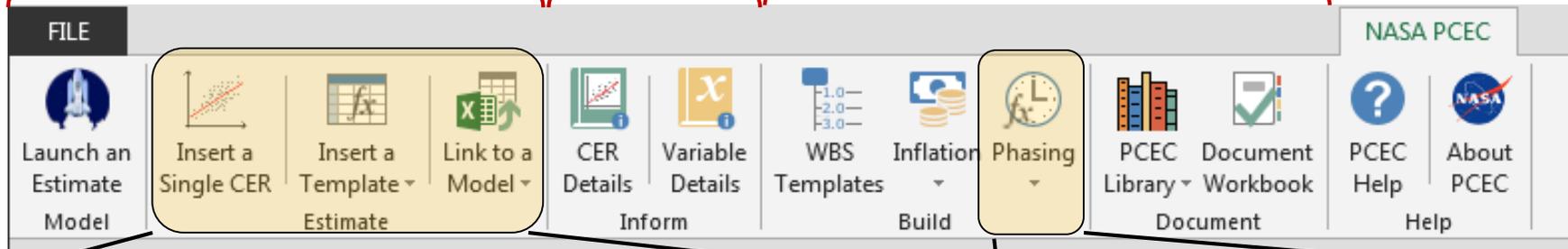


**Engineering
Cost
Office**

Primary Estimating Artifacts

Estimating Artifact Info

Supporting Estimating Artifacts



Selection	Details
Insert a CER	<ul style="list-style-type: none"> • Access to underlying set of CERs • Used for inserting a single CER directly into a worksheet • Single- and multi-variable, Power and Linear CERs
Insert a Template	<ul style="list-style-type: none"> • Access to pre-built templates for using CERs in more than a standalone fashion <ul style="list-style-type: none"> – Single-element Templates are 1 worksheet and estimate the total cost of a subsystem/component (single line in a WBS) – Multi-element Templates are 1-2 worksheets and estimate multiple items (multiple lines in a WBS) • Often combinations of multiple CERs and additional calculations • Sections for including sensitivity/uncertainty/risk
Link to a Model	<ul style="list-style-type: none"> • Models that are completely standalone and separately maintained • Often are multi-worksheet models with code involved in calculations • Results are linked or pasted from source model into a pre-formatted template in a PCEC model • May be in different units and have different types of outputs by default

Selection	Details
PER	<ul style="list-style-type: none"> • Mission-level phasing estimating relationships template from CAD-sponsored research • Based on Rayleigh distribution • Output by FY • Includes ability to look at obligations and expenditures
Beta Template	<ul style="list-style-type: none"> • Total-level phasing template using Beta distribution • Distributions with sets of pre-defined shape parameters • Output by FY, Quarters, Months
Beta Tables	<ul style="list-style-type: none"> • Set of Beta distribution phasing tables across for use across multiple periods and multiple levels • Distributions with sets of pre-defined shape parameters

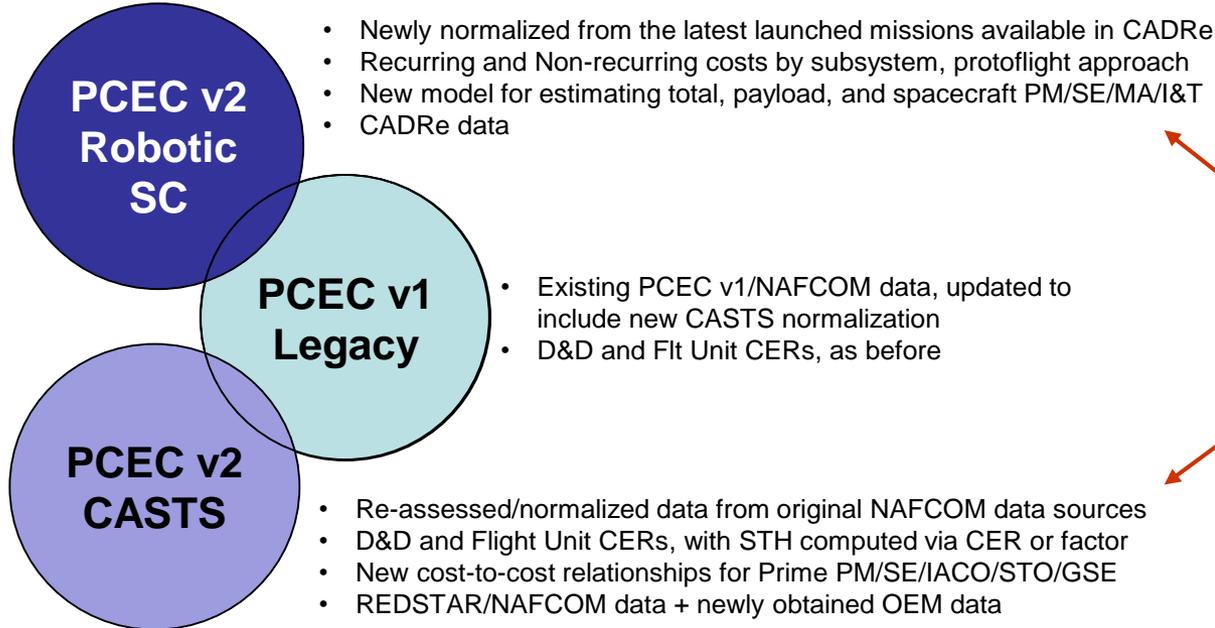


PCEC v2.0 Modeling Construct



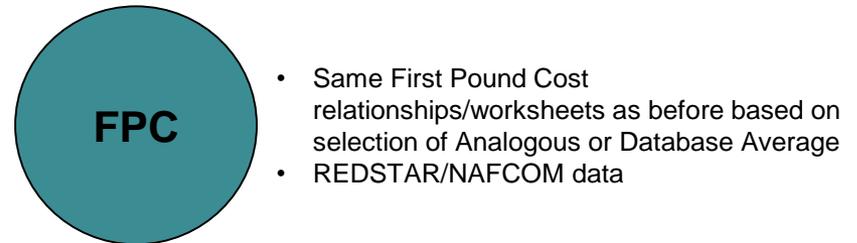
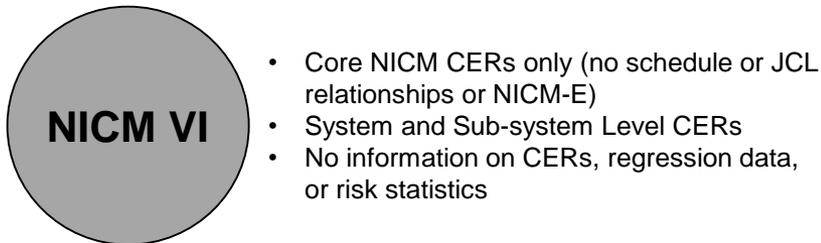
Engineering
Cost
Office

PCEC v2.0 Core Estimating Artifacts



PCEC v2 will primarily push users through these elements

PCEC v2.0 Additional Artifacts

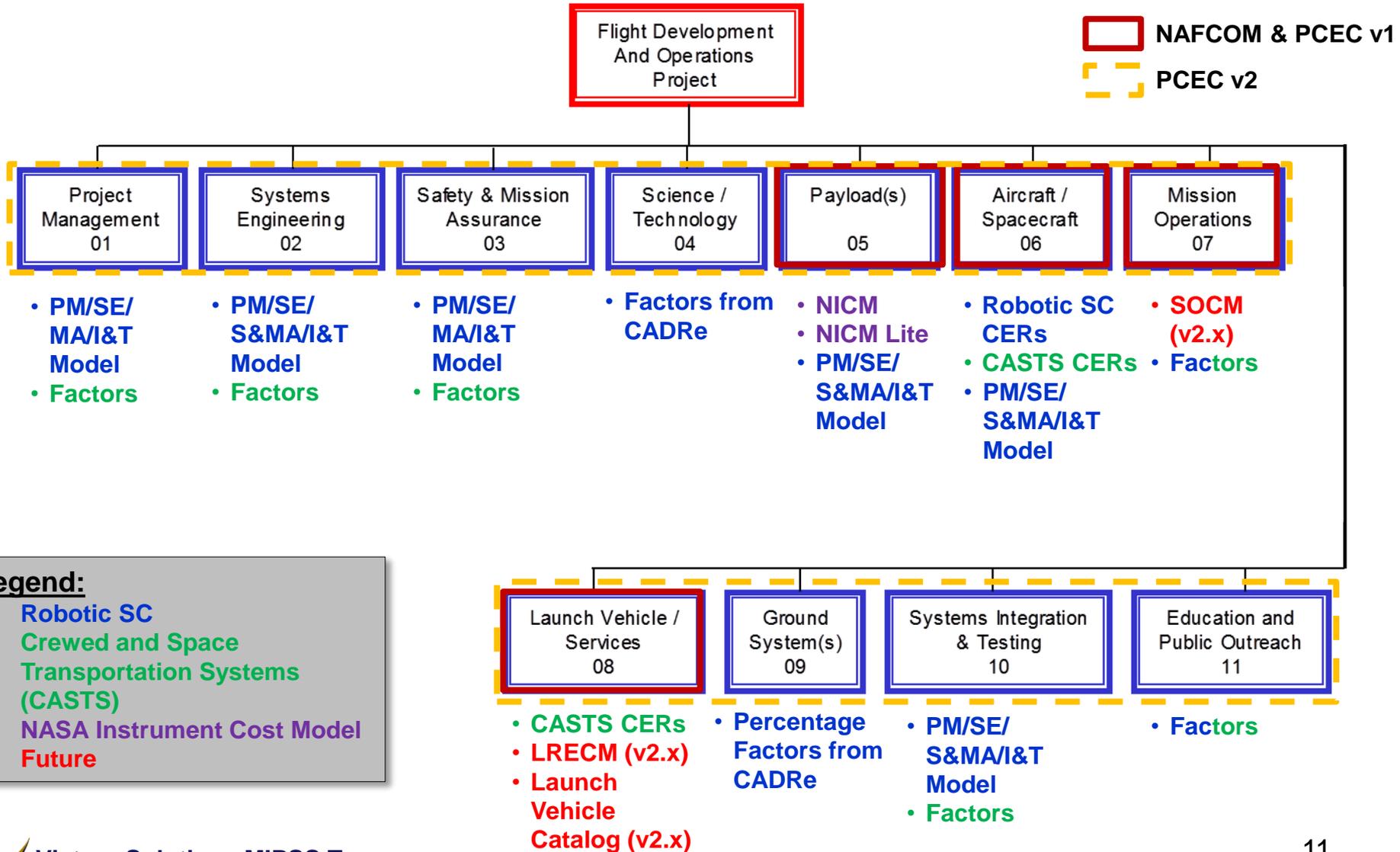




PCEC v2 & NASA WBS



Engineering
Cost
Office



Legend:

- Robotic SC
- Crewed and Space Transportation Systems (CASTS)
- NASA Instrument Cost Model
- Future



PCEC Development Next Steps



**Engineering
Cost
Office**

- Integration / Incorporation with other Models
 - Liquid Rocket Engine Cost Model (LRECM)
 - Space Operations Cost Model (SOCM)
 - Operations Cost Model (OCM)
- Launch Vehicle Catalog
- Other CERs / Models / Tools
 - Ground Systems
 - PM/SE/MA/I&T Cost-to-Cost CERs
- Updates to CASTS and Robotic SC Elements
- Easier entry of user's own CERs in Interface
- Support Review for more General Release Beyond US Citizens

PCEC v2.x development will involve re-engaging the PCEC Steering Committee to prioritize focus of development team



Summary



**Engineering
Cost
Office**

- PCEC v2.0 is a departure from the modeling construct in PCEC v1 and NAFCOM that will align with the NASA WBS
- New Robotic SC and CASTS estimating elements will drive us towards more defensible estimates due to transparency and lack of overly subjective inputs
- PCEC v2 will continue to evolve to include more estimating artifacts, enabling life cycle estimating and more user-customization of the data available via the Interface

For More Information

- **Demo Session: Wednesday Afternoon (3-4pm, Room 105/106)**
- MSFC-PCEC@mail.nasa.gov



Backup



**Engineering
Cost
Office**