

Reliable Method to Reason About Mass Growth

NASA Engineering and Safety Center
Technical Assessment Report

POC: jeffrey.a.cerro@nasa.gov

SAWE Missiles and Space – Industry Committee Meeting
2020.07.01

International Conference on Mass Properties - Technology Fair





Related NASA Organizations / Programs

➤➤ NASA Engineering and Safety Center , NESC, <https://www.nasa.gov/nesc>
what it does

➤➤ NASA Engineering Network, NEN, <https://nen.nasa.gov/web/nen>

The Systems Engineering Community - Task Initiators
Technical Fellow – Task Lead – Jon Holladay

➤➤ Recognizing the need for greater capabilities in and methods for a

Reliable Method to Reason About Mass Growth

Centers Represented:

Goddard; Marshall; Langley; Johnson; Headquarters; Jet Propulsion Laboratory

Programs represented:

Space Launch System, Mars Reconnaissance Orbiter, Juno, Multi-Purpose Crew Vehicle,
Exploration Flight Test-1



➤➤ Approach

- Analyze multiple past program lifecycle mass control / growth histories
- Provide recommendations to improve future program mass control



Some Recommendations

R-2. Maintain and expand a mass growth database as an Agency resource for use in mass properties control of future program/project development and mission planning activities. A follow-on effort should be able to obtain data for approximately 40 additional SMD and HEOMD spacecraft developments.

R-4. Require ANSI/AIAA S-120A-2015 for NASA AOs and procurement announcements, and when developing a program/project specific MPCPs.

R-10. Clarify the use of the term ATP in the ANSI/AIAA S-120A-2015 with respect to NASA's key decision points (KDPs).

... began definition of a shared database, which currently contains basic, predicted, and allowable mass on a monthly or quarterly basis over the life of the program/project, as available shows the percentage of design maturity for hardware items

- Apollo Program
- Space Launch System
- Mars Reconnaissance Orbiter
- Juno Project

»» CADRE / ONCE Website....

Initiate collaborative work across the NASA org's

- Cost centers, Programs, Engineering, Digital Transformation - MBSE
- Improve content, clarity, and accessibility of agency mass control knowledge
- Improve Interactions with suppliers using a model based digital format
- Increased focus on Human Exploration Programs



CADRe/ONCE - Data Collection and Database

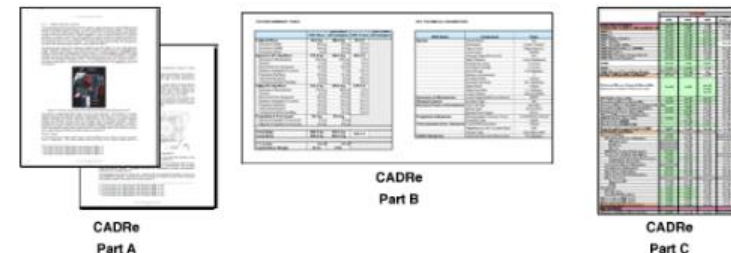


CADRe (Cost Analysis Data Requirement) is a 3 part document that describes a NASA project at each milestone, contains key technical parameters, and captures the estimated and actual costs in a WBS structure. The CADRe provides historical record of cost, schedule, and technical project attributes so that estimators can better estimate future analogous projects.

CADRe PART A: Describes a NASA project at each milestone (SRR, PDR, CDR Launch and End of Mission), and describes significant changes that have occurred.

CADRe PART B: Contains standardized templates to capture key technical parameters that are considered to drive cost. (e.g. Mass, Power, Data Rates, etc.)

CADRe PART C: Captures the NASA project's Cost Estimate and actual life cycle costs within the project's and a NASA Cost Estimating Work Breakdown Structures (WBS).





How Might the SAWE Missiles and Space Industry Committee Help / Benefit

Streamline the Gov't/Industry Acquisition Process with respect to Mass Properties Requirements and Deliverables

- Continued involvement in ANSI/AIAA S-120 maintenance
- Continued improvement of SAWE RP A-3 “Mass Properties Control for Space Vehicles” as a How-To supplement to ANSI/AIAA S-120
- Assist in the Industry Driven improved definition of Data and Process requirements for Missile and Space Vehicle Mass Control, including “a Digital Thread for Mass Properties Engineering”
 - Sample MPCP’s – based on program size / tolerance to cost/schedule/technical risks
 - Provide additional data for the NASA CADRE/ONCE database
 - Open programs – examine/utilize Data in the improved CADRE/ONCE database to assist in creating appropriate lifecycle phase based component Mass Growth Allowances
 - Standardize Digital Product/Process Definition in SAWE RP’s, ANSI/SAWE STD’s