National Aeronautics and Space Administration

Marshall Space Flight Center

Vehicle and Spacecraft Systems Engineering and Integration

Engineering the Journey

Vehicle and Spacecraft Systems Engineering and Integration (VS-SE&I) leads the integrated design, development, test/evaluation, certification, and sustainment of affordable, innovative spacecraft and vehicle system solutions for programs and projects of all sizes and types.

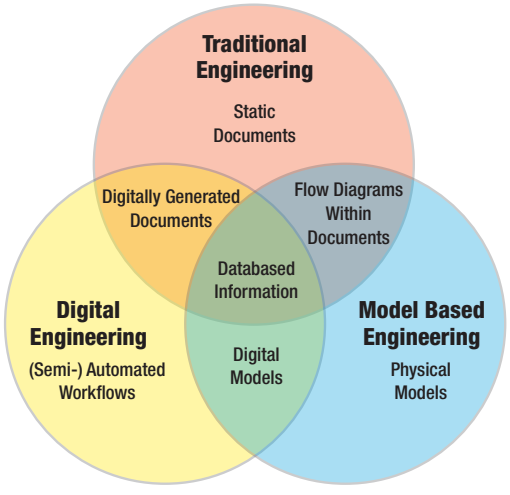
VS-SE&I provides customers value-added solutions to a broad spectrum of systems and integration challenges, from initial trade studies through sustaining engineering. The specialized and experienced technical staff applies sound and effective practices to all elements and hierarchical levels over the complete project lifecycle.

VS-SE&I brings together technologies, hardware, and software to create an efficient product that satisfies operational needs and is critical to the successful operation of any system comprised of multiple and interdependent subsystems and functions.

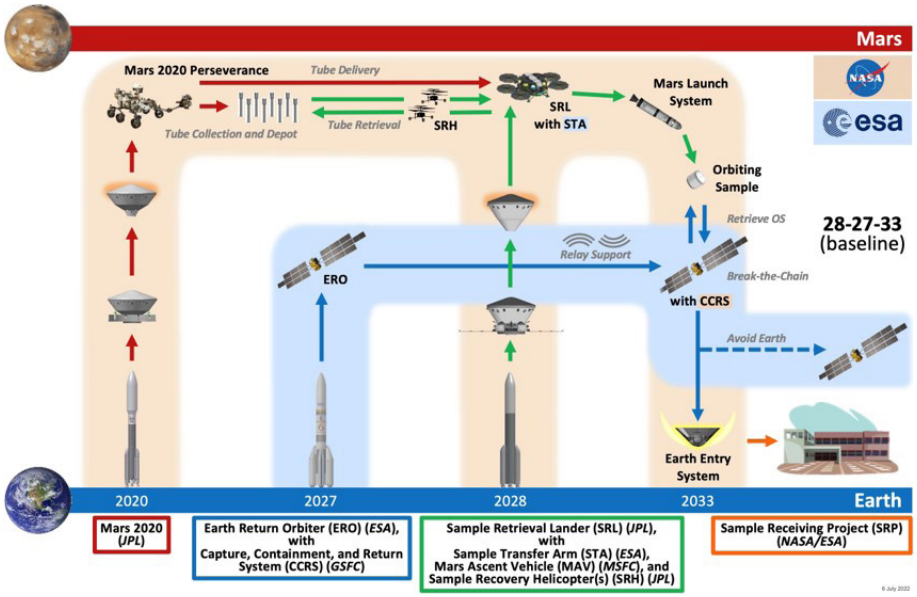
The specialized capabilities within VS-SE&I work effectively to provide a cohesive and comprehensive approach that enables clear, product-focused accountability to engineering for vehicle and spacecraft integration.

System Planning and Technical Leadership provides crosscutting engineering capabilities required to meet the challenges of current and future projects. The group:

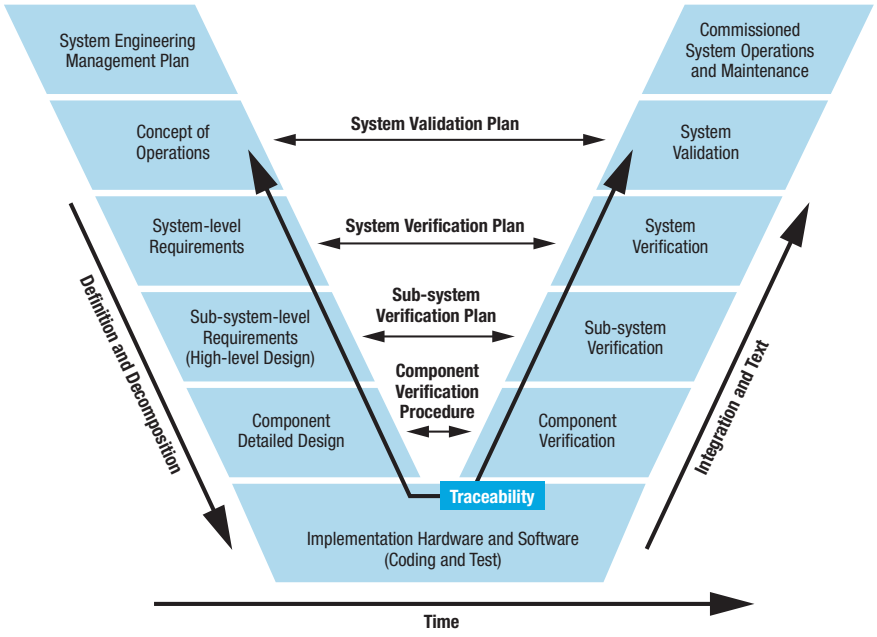
- Provides enterprise-level integration, coordinating and performing integration functions across multiple programs across agency and commercial partners
- Develops, documents, and communicates assigned project technical approaches. Coordinates the day-to-day engineering support, provides experienced lead systems engineers (LSEs) and technical leaders to coordinate and manage the development and implementation of the project systems engineering products, and measures performance
- Plans and executes technical/design reviews used to evaluate system maturity across the lifecycle and manage the resolution of identified discrepancies/deficiencies



Venn diagram of Systems Engineering and Integration Methodologies



Bat Chart of Mars Sample Return Mission Plan



System Engineering V-Diagram

Systems Analysis and Human Systems Integration provides supporting system analysis functions required throughout the project lifecycle and includes:

- Developing modeling/simulation strategies and defining system sensitivities, critical parameters, and critical models as the design advances
- Performing mass properties control, assessment, and analysis used to support various mission functions, e.g., guidance, navigation, and control.
- Performing and auditing flight hardware "as-built" measurements and refining uncertainty assessments
- Performing logistics and supportability analysis to evaluate system effectiveness across project lifecycles, especially during operations and sustainment

Systems Design and Verification provides expert discipline systems engineers and applies systems engineering principles, both traditional and model-based, to help solve the complex engineering challenges of projects.

- Develops and manages requirements, verification, and validation plans
- Conducts trade studies and establishes enterprise and system architectures
- Performs risk analysis/assessments, systems analysis and modeling, and logical decomposition of system and subsystem architectures and functions
- Develops and manages interface definition and control, use/need definitions, and operations concepts, both within the project as well as with external partners
- Performs and coordinates program/project or enterprise verification and validation activities to include employing digital tools and methods to manage and collect the data and support data exchange with commercial partners
- Provides ground support equipment planning, ground operations support, and technical resources to manage integration, assembly, and test activities at the launch site.
- Performing various imagery analyses and assessments to evaluate launch and ascent performance and debris identification and transport
- Performing comprehensive human factors engineering analysis to define human-machine interface requirements by combining both physical and virtual modeling with human-in-the-loop testing
- Developing in-house low- to high-fidelity prototypes and mockups of systems, ranging from avionics rings used to train technicians to high-fidelity mockups of lunar surface habitats

Utilization of Habitat Mockups to Test

Habitation Mockups for Design Analysis

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Doing Business With MSFC

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