



Small Satellite Reliability Initiative (SSRI) Knowledge Base Tool: Current Tool Functionality Review and Planned Future Enhancements

*Bruce D. Yost (1), Craig D. Burkhard (1), Robbie Robertson (2),
Catherine C. Venturini (3), Michael A. Johnson (4),*

(1) NASA Ames Research Center, USA

(2) Sedaro Corporation, USA

(3) The Aerospace Corporation, USA

(4) NASA Goddard Space Flight Center, USA

*2022 CubeSat Developers Workshop
Cal Poly, San Luis Obispo, CA*

The screenshot displays the SSRI Knowledge Base website interface. At the top, the NASA logo and the text "SSRI KNOWLEDGE BASE RESOURCES FOR SMALLSAT SUCCESS" are visible. Navigation links for "Explore" and "About" are present, along with a "Resource Search" bar containing the search term "radiation". Below the search bar, a message states: "This tool provides high-quality resources on topics that drive smallsat mission confidence. Explore the Mission Confidence Framework to find your desired topic page. The topic page will include best practices and lessons learned from experienced smallsat developers and will provide you with links to high-quality, curated resources (books, articles, software tools, websites, articles and white papers). You can also search the resource library directly using the search bar above." The "Resource Search Results" section shows a filter bar with options for Article, Book, Software Tool, White Paper, Standard, and Website. A purple banner encourages users to "Help Grow the Knowledge Base!" by rating resources. The main content area is titled "Mission Architecture Design" under the "Conceptual Design" category. It includes a "Scope and Description" section and a "Best Practices and Lessons Learned" section with a bullet point: "Smallsats lend themselves to distributed architectures - constellations, precision formations, or swarms that can provide larger effective apertures and improved resilience, coverage, or revisit times. The number of satellites, how they are distributed in orbit, and manner in which they are deployed (all at once, in batches, or individually) are all connected to mission performance and mission confidence."

Introduction to the SSRI Knowledge Base



The **SSRI Knowledge Base** is a NASA website located at <https://s3vi.ndc.nasa.gov/ssri-kb>

- Publicly available tool available for the entire SmallSat community
- Comprehensive and searchable online tool that consolidates and organizes resources, best practices, and lessons learned from previous small satellite missions sponsored by NASA, other government agencies, and academia
- Resources consist of but not limited to: Small Satellite Reliability Initiative (SSRI) working group generated documents and presentations in addition to existing guides, publications, standards, software tools, websites, and books
- SSRI is a collaborative activity with broad participation from civil, Department of Defense, and both national and international commercial space systems providers and stakeholders
- NASA's Small Spacecraft Systems Virtual Institute (S3VI) funds the SSRI Knowledge Base. The S3VI is jointly sponsored by NASA's Space Technology Mission Directorate and Science Mission Directorate

Presentation Outline

- 1) Motivation and Approach
- 2) SSRI Knowledge Base Approach
- 3) Capabilities and Features
- 4) Future Enhancements
- 5) Summary
- 6) Acknowledgements

Motivation and Approach

Motivation

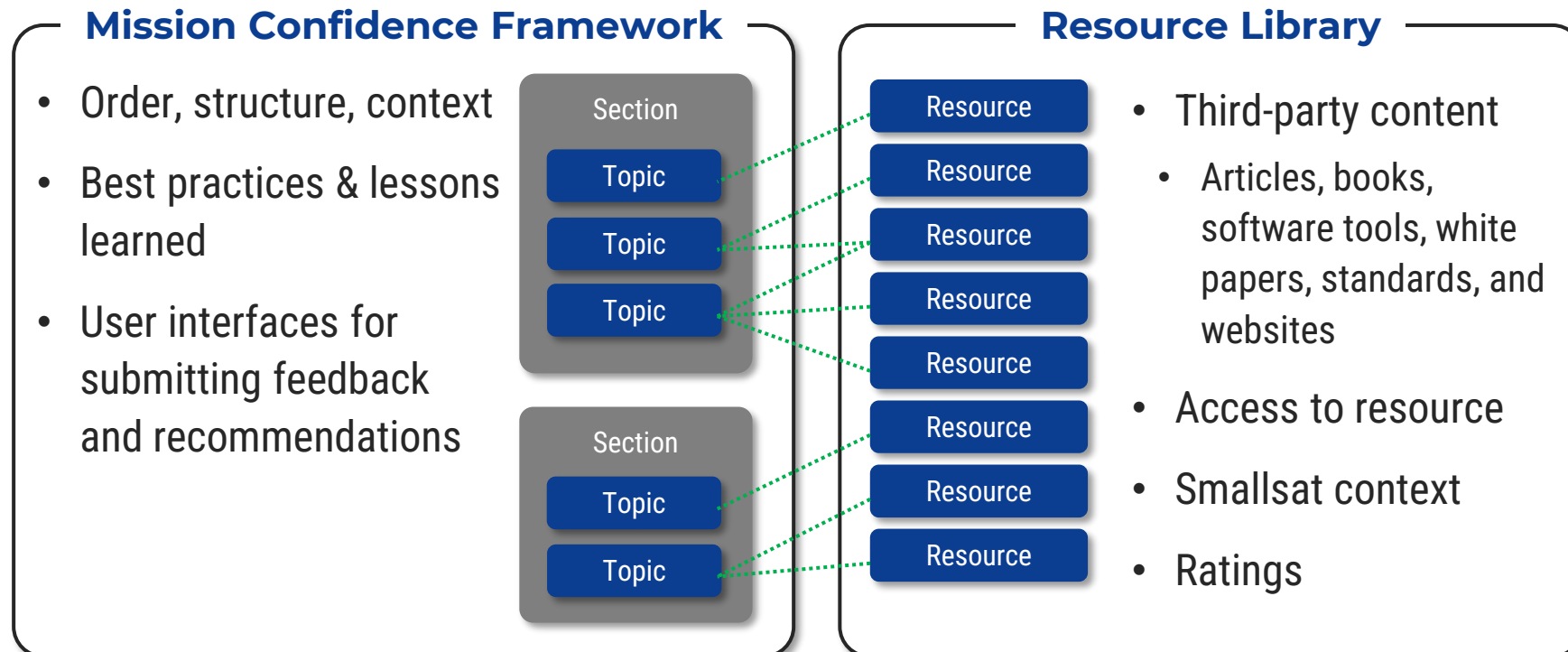
- **Too many small satellite missions fail**
- High failure rates are significantly driven by:
 - 1) Many smallsat team members and other stakeholders lack standard processes and institutional knowledge
 - 2) There is no quality, public forum where for accessing and sharing best practices and quality, vetted resources.

Approach

- Traditional approach involves document-based communication
 - Standards and other documents are slow and expensive to prepare, maintain, and update.
 - Constant change in small spacecraft technology presents additional challenges to document-based communication
- Embrace digital transformation by creating a **web-based tool**
- Efficient knowledge sharing and a solution that can **keep up with the constant change** and innovation in small spacecraft engineering
- **Completely public** to engage the entire community and enable cross-pollination
- Leverage an **open, collaborative** approach to content generation

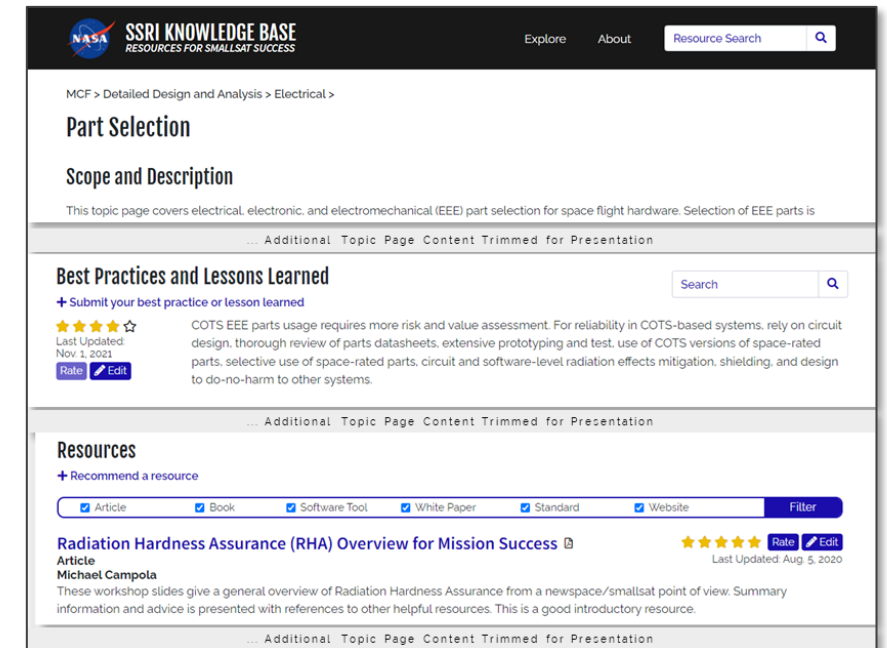
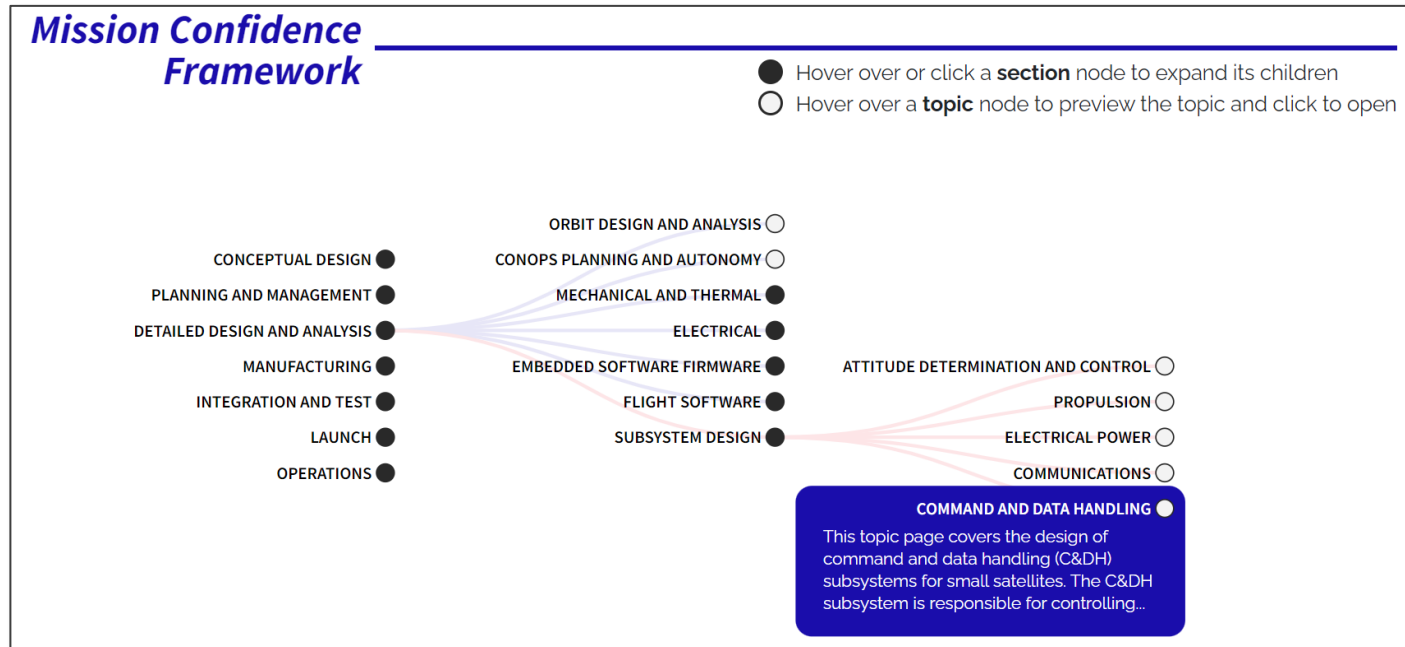
Knowledge Base Structure

- Two primary elements: MCF and Resource Library
- **Resource library** contains all third-party content: articles, books, software tools, white papers, standards, and websites
- **MCF** is a structured set of topic pages which reference resources in the resource library and provide order, structure, and context



Knowledge Base Structure

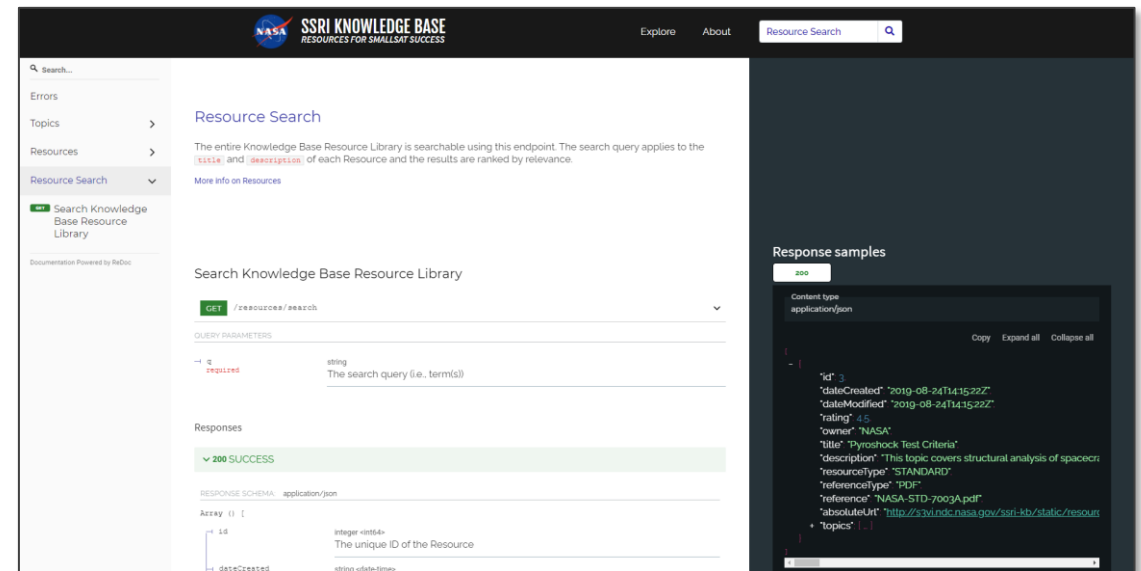
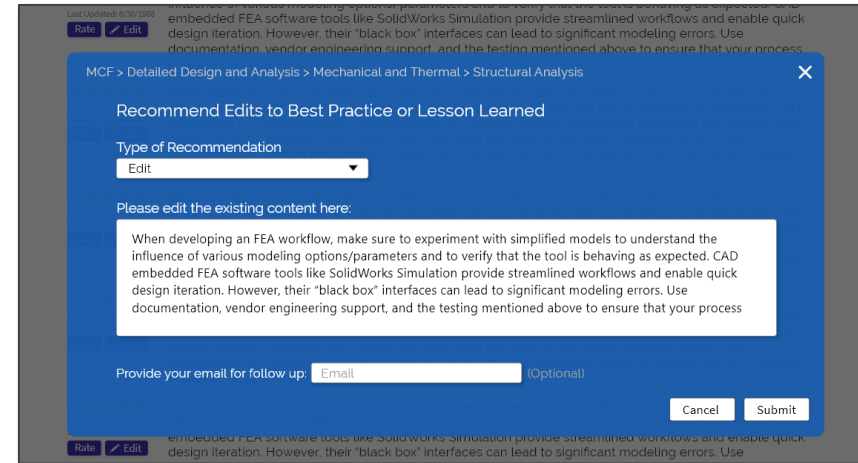
- Two primary elements: MCF and Resource Library
- **Resource library** contains all third-party content: articles, books, software tools, white papers, standards, and websites
- **MCF** is a structured set of topic pages which reference resources in the resource library and provide order, structure, and context



The screenshot shows the SSRI Knowledge Base website interface. The top navigation bar includes the NASA logo, the site name 'SSRI KNOWLEDGE BASE', and the tagline 'RESOURCES FOR SMALLSAT SUCCESS'. There are links for 'Explore' and 'About', and a search bar labeled 'Resource Search'. The main content area is titled 'Part Selection' and is part of the 'MCF > Detailed Design and Analysis > Electrical >' path. It includes a 'Scope and Description' section with a paragraph about electrical, electronic, and electromechanical (EEE) part selection. Below this is a 'Best Practices and Lessons Learned' section with a search bar and a list of resources. One resource is highlighted: 'Radiation Hardness Assurance (RHA) Overview for Mission Success' by Michael Campola, with a 5-star rating and a 'Last Updated: Aug 5, 2020' date. The bottom of the page indicates that additional content has been trimmed for presentation.

Capabilities and Features

- 58 Topic Pages
- 533 Unique Resources
- Crowdsourcing features
 - Rate existing content
 - Recommend changes to content
 - Recommend new content
 - Provide general feedback
- Application programming interface (API) to support integration with other online tools



Future Enhancements

- SSRI Knowledge Base can be continuously improved and expanded
- Enhancements to the Knowledge Base are driven by feedback from the user community
- Near-term priorities include improved linking to PDF documents and interfacing with other online tools via the new Knowledge Base API
- Soliciting feedback and recommendation for relevant sources and capabilities from the domestic and international SmallSat communities to be incorporated into the tool to make it an all-encompassing resource

The SSRI Knowledge Base is a public NASA website that shares resources, best practices, and lessons learned on small spacecraft development.

- Goal of this tool is to become the initial starting point to research information on a wide variety of small satellite topics and resources
- Publicly available tool is available to the entire SmallSat community
- Constantly being updated with new topic pages, resources, best practices, and enhancements to meet the needs of the small satellite community
- Soliciting the small satellite community to provide feedback and relevant sources and capabilities

Acknowledgements

- A big thanks to the Small Satellite Reliability Initiative Working Group for the support and dedication in the development and implementation of the SSRI Knowledge Base Tool
- NASA's Space Technology Mission Directorate (STMD) and Science Mission Directorate (SMD)



Questions

The image displays three overlapping screenshots of the SSRI Knowledge Base website. The top screenshot shows the homepage with a search bar and a brief description of the tool. The middle screenshot shows search results for 'radiation', with filters for Article, Book, Software Tool, White Paper, Standard, and Website. The bottom screenshot shows a detailed article page for 'Mission Architecture Design' under the 'Conceptual Design' category. The article includes a 'Scope and Description' section and a 'Best Practices and Lessons Learned' section with a bullet point about distributed architectures.

SSRI KNOWLEDGE BASE
RESOURCES FOR SMALLSAT SUCCESS

Explore About Resource Search

This tool provides high-quality resources on topics that drive smallsat mission confidence. Explore the Mission Confidence Framework to find your desired topic page. The topic page will include best practices and lessons learned from experienced smallsat developers and will provide you with links to high-quality, curated resources (books, articles, software tools, websites, articles and white papers). You can also search the resource library directly using the search bar above.

SSRI KNOWLEDGE BASE
RESOURCES FOR SMALLSAT SUCCESS

Explore About radiation

Resource Search Results

Article Book Software Tool White Paper Standard Website Filter

SSRI KNOWLEDGE BASE
RESOURCES FOR SMALLSAT SUCCESS

Explore About Resource Search

Help Grow the Knowledge Base! Please contribute by rating resources and providing recommendations and feedback at the bottom of this topic page.

MCF > Conceptual Design >

Mission Architecture Design

Scope and Description

This topic covers the conceptual design of all high-level elements of a smallsat mission. This includes payload, spacecraft bus, launch system, orbit, ground system, and mission operations. The trade space in which to architect a satellite mission can be huge. This is especially true for smallsats which, compared to traditional space missions, can more readily take advantage of innovative technologies, commercial components, and distributed architectures. The goal of mission architecture design is to pare down this large trade space, evaluate alternative mission concepts, and arrive at a mission architecture that satisfies mission requirements with minimal cost, schedule, and risk of failure.

Resources in this topic area are primarily traditional mission design references and case studies for specific smallsat missions - occasionally presented alongside novel methodologies for smallsat mission architecture design. Note that because this is an overarching task involving every element of a given mission, completing it may require you to reference content from throughout this knowledge base.

Best Practices and Lessons Learned

- Smallsats lend themselves to distributed architectures - constellations, precision formations, or swarms that can provide larger effective apertures and improved resilience, coverage, or revisit times. The number of satellites, how they are distributed in orbit, and manner in which they are deployed (all at once, in batches, or individually) are all connected to mission performance and mission confidence.