



SSRI KNOWLEDGE BASE RESOURCES FOR SMALLSAT SUCCESS

Small Satellite Reliability Initiative (SSRI) Knowledge Base Tool: Update and Future Direction

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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. A navigation bar includes "Explore", "About", and a "Resource Search" bar. Below the header, a paragraph describes the tool's purpose: "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 main content area shows "Resource Search Results" for the term "radiation". A filter bar at the top of the results section includes checkboxes for "Article", "Book", "Software Tool", "White Paper", "Standard", and "Website", followed by a "Filter" button. Below the filter bar, a purple banner encourages users to "Help Grow the Knowledge Base! Please contribute by rating resources and providing recommendations and feedback at the bottom of this topic page."

The topic page is titled "Mission Architecture Design" under the breadcrumb "MCF > Conceptual Design >". It includes a "Scope and Description" section, which states: "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." It also mentions that resources in this area are primarily traditional mission design references and case studies for specific smallsat missions, occasionally presented alongside novel methodologies for smallsat mission architecture design.

The "Best Practices and Lessons Learned" section includes 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."

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

Presentation Outline



- Introduction to the SSRI Knowledge Base
- Knowledge Base Structure
- Capabilities and Features
- Future Enhancements
- Summary
- Acknowledgements

Introduction to the SSRI Knowledge Base

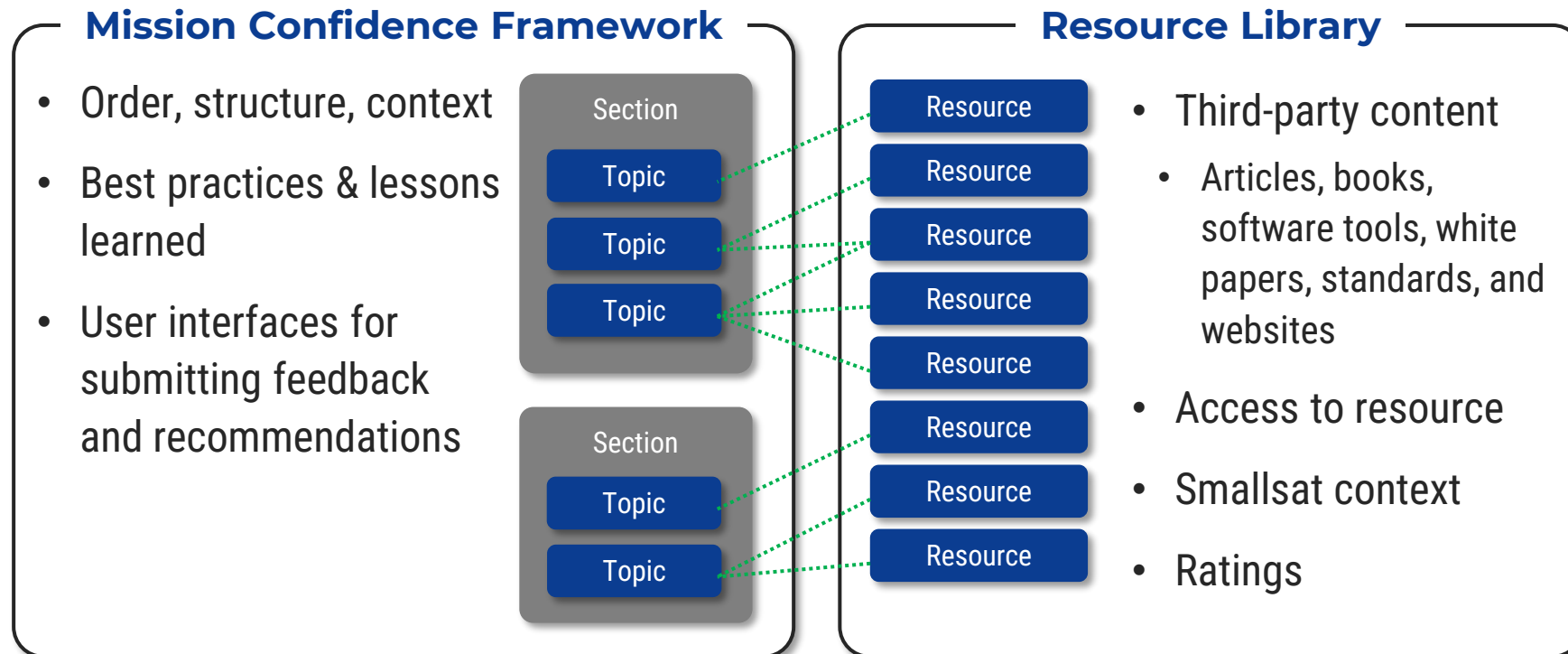


The **SSRI Knowledge Base** is a NASA website located at <https://s3vi.ndc.nasa.gov/ssri-kb>

- 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

Knowledge Base Structure

- Two primary elements: Mission Confidence Framework (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

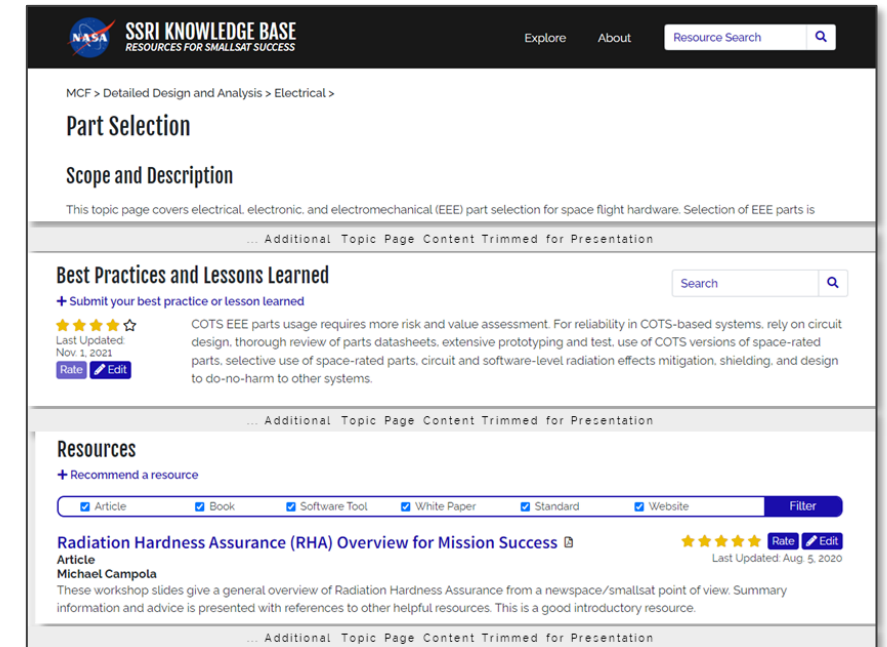
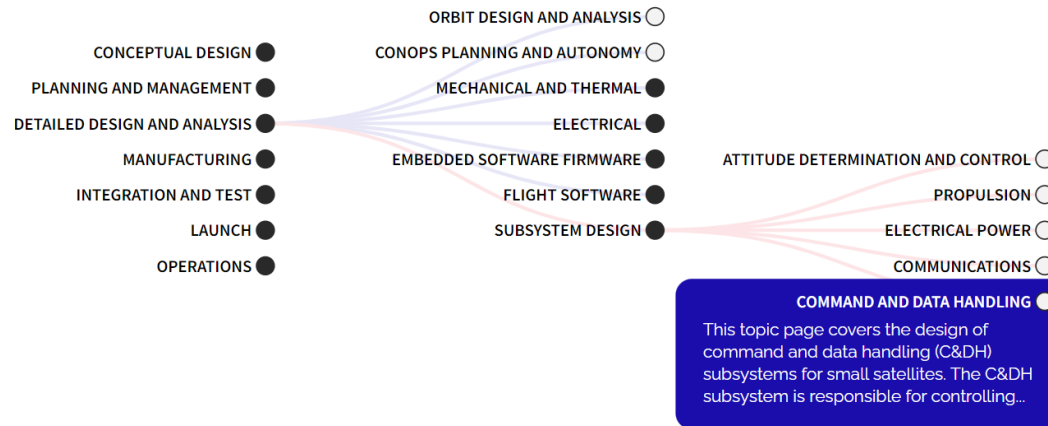


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Mission Confidence Framework

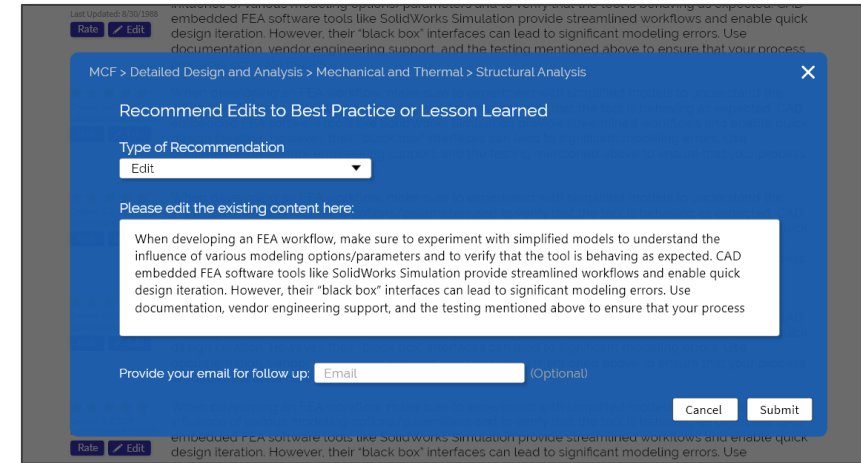
- Hover over or click a **section** node to expand its children
- Hover over a **topic** node to preview the topic and click to open



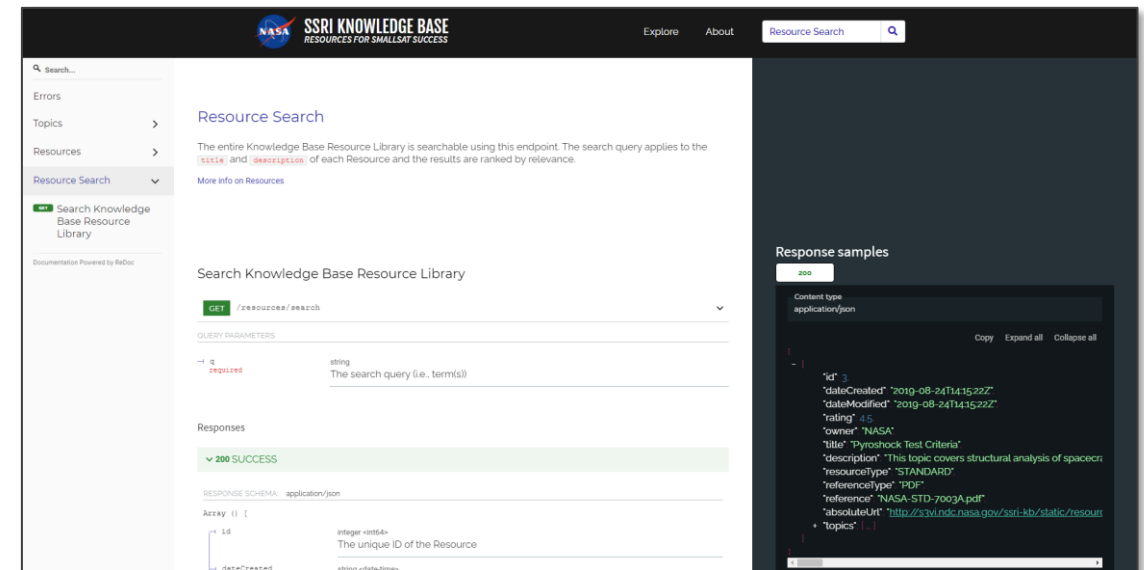
The screenshot shows the SSRI Knowledge Base website interface. The header includes the NASA logo, the site name 'SSRI KNOWLEDGE BASE', and the tagline 'RESOURCES FOR SMALLSAT SUCCESS'. Navigation links for 'Explore', 'About', and 'Resource Search' are present. The main content area displays the 'Part Selection' page, which is part of the 'MCF > Detailed Design and Analysis > Electrical' path. The page title is 'Part Selection' and the subtitle is 'Scope and Description'. A brief description states: 'This topic page covers electrical, electronic, and electromechanical (EEE) part selection for space flight hardware. Selection of EEE parts is...'. Below this, there is a section for 'Best Practices and Lessons Learned' with a search bar and a list of resources. The first resource is 'Radiation Hardness Assurance (RHA) Overview for Mission Success' by Michael Campola, last updated on Aug 5, 2020. The page also includes a 'Resources' section with a search bar and a list of resources.

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



A screenshot of a web form titled "Recommend Edits to Best Practice or Lesson Learned". The form is part of a "MCF > Detailed Design and Analysis > Mechanical and Thermal > Structural Analysis" workflow. It includes a "Type of Recommendation" dropdown menu set to "Edit". Below this, a text area contains a pre-filled recommendation: "When developing an FEA workflow, make sure to experiment with simplified models to understand the influence of various modeling options/parameters and to verify that the tool is behaving as expected. CAD embedded FEA software tools like SolidWorks Simulation provide streamlined workflows and enable quick design iteration. However, their 'black box' interfaces can lead to significant modeling errors. Use documentation, vendor engineering support, and the testing mentioned above to ensure that your process". At the bottom, there is an optional email field labeled "Provide your email for follow up:" and "Cancel" and "Submit" buttons.



A screenshot of the SSRI Knowledge Base API interface. The page title is "Resource Search". It explains that the entire Knowledge Base Resource Library is searchable using this endpoint, with search queries applying to the 'title' and 'description' fields. The interface shows a search bar with the text "Search Knowledge Base Resource Library". Below this, the "QUERY PARAMETERS" section shows a GET request to "/resources/search". The "Responses" section displays a "200 SUCCESS" status. The "RESPONSE SCHEMA" is shown as an array of objects, with a sample object containing fields like "id", "dateCreated", "dateModified", "rating", "owner", "title", "description", "resourceType", "referenceType", "reference", "absoluteURL", and "topics". On the right side, there is a "Response samples" section showing a JSON response for a specific resource.

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 recommendations 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
- Identify Knowledge Base API integrations with a diverse array of online tools to further the SSRI mission of educating SmallSat developers
- Soliciting the international SmallSat community to provide feedback and relevant sources and capabilities utilizing the “Recommend a Resource” and “General Feedback” features

Acknowledgements

- Thanks to the Small Satellite Reliability Initiative Working Group for their 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)



SSRI KNOWLEDGE BASE

RESOURCES FOR SMALLSAT SUCCESS

Questions

The image displays three overlapping screenshots of the SSRI Knowledge Base website. The top screenshot shows the homepage with the NASA logo, the title 'SSRI KNOWLEDGE BASE RESOURCES FOR SMALLSAT SUCCESS', and a search bar. The middle screenshot shows the 'Resource Search Results' page with a search bar and filters for Article, Book, Software Tool, White Paper, Standard, Website, and Filter. The bottom screenshot shows a detailed article page for 'Mission Architecture Design' under the 'MCF > Conceptual Design' category. The article includes a 'Scope and Description' section, a 'Best Practices and Lessons Learned' section, and a list of resources.

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.

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.