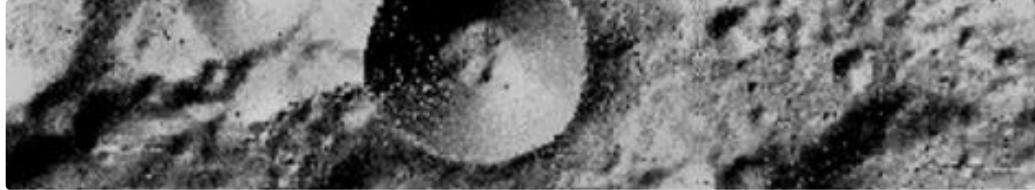


Overview Page: MBSE Avionics System Capstone	2
Open Questions for Next Meeting	5
Product Vision Statement / Statement of Work	6
Meeting Minutes	7
Sprint 1 (08/28/2023 - 10/03/2023)	8
Week 1	9
Week 2	10
Week 3	11
Week 4	12
Week 5	14
Tuesday Kathryn Meeting	15
Thursday Kathryn Meeting	16
Week 6	17
Week 7	18
Sprint 2 (10/10/2023 - 10/31/2023)	19
Week 9	20
Week 10	21
Week 11	22
Week 12	24
Sprint 2 Planning (10/04/2023 - 10/09/2023)	25
Week 8	26
Draft Stakeholder Needs	28
Capstone Class Information	29
Project Timeline	30
Public Class Project Description	31
Templates	32
Template - Project plan	36
Template - Meeting notes	38
Template - Weekly status report	39
Literature Review	40
MBSE and FMEA (Shawn)	41
MBSE and Avionics (Luke)	42
MagicGrid / MBSE in Space & Sys of Sys	44
References	46



Overview Page: MBSE Avionics System Capstone

MBSE Avionics System Capstone (MASC)

Blog Update



Goals for this Confluence

Shawn Merrick Miller posted on Sep 12, 2023

I'm hoping by the end of this project the confluence page will show our progress and a description of our work. I think a good end goal is being able to export this page information into an unofficial project report that contains all relevant information for someone who needs to review our work.

Page Structure:

- Meeting Minutes: *Record information from meetings with accomplishments and tasks.*
- Capstone Class Information: *Contains information on semester structure, deliverables, and assignments.*

About

This is a senior capstone project team from Embry-Riddle in Daytona Beach addressing topics inspired by work from NASA Johnson Space Center's Spacecraft Software Engineering Branch (ER6).

Project Information

Project to create a reusable MBSE Model representing a generic avionics subsystem for a notional exploration spacecraft. Specifically capturing hardware and software configurations derived from high-level system requirements. The model would be used in an effort to better analyze system behavior and identify failure modes for fault propagation to improve future system designs.

Team Information



Shawn Merrick Miller

merricks1@my.erau.edu

(321) 482-0215

B.S. Electrical Engineering,
Aerospace System Engineering Track



Luke Newcomb

newcombl@my.erau.edu

(321) 458-3637

B.S. Software Engineering



Walter Hernandez

hernanw4@my.erau.edu

(813) 970-9939

B.S. Computer Science,
Cybersecurity Track



William "Clay" Pate

patew@my.erau.edu

(252) 435-8568

B.S. Software Engineering

Open Questions for Next Meeting

09/19/2023

- What will your involvement look like in the first few weeks vs later on? (Email or call in the morning)
 - A: After this week, teaching 2 back to back SysML classes with night classes and can only communicate via teams IM or Outlook (09/25 - 10/06), Tagup and demo second week of October.
- Do you know for certain that you can still support us next semester
 - A: Yes.
- Is our final product still what we had before? Or do we need to shift more now?
 - A: Little change, modifying approach but still generating the same work.
- Can you review Product Vision Statement/ Statement of Work?
 - A: Yes.
- If different, What is our first and second semester tangible deliverables?
 - A: Fall will produce a foundational system model for a Spacecraft Avionics System where data-centric modelling is in mind.
- Can you review our backlog for sprint one (and help us determine deliverables?)
 - A: Conversation over email once we get the software up.
- Can we meet with Lui/NASA once a sprint to review our alignment to NASA standards (to see if we are getting off topic, what if he says "For reason A, B, and C, this isn't meaningful to us")
 - A: Yeah, depends, unclear. Focus on Dallas conference and Dublin.
- What if Lui can get us commercial licenses in the spring? Would this be a setback? (I don't know if this is a good idea but it's an option to look at)

09/15/2023

Questions for Lui:

- Product Vision Statement?
- Language and process, SysML and MagicGrid?
- Deliverables expected (semester 1 vs. semester 2)?
 - Sprint 1 (08/29 - 10/03)
 - **Note:** *Product Vision Statement and Product Back Log (PBL) First Drafts Due 09/19*
 - **Note:** *Software Requirement Specification (SRS) and Software Design Specification (SDS) First Drafts Due 09/29*
 - Sprint 2 (10/10 - 11/02)
 - Sprint 3 (11/07 - 12/07)
- How are MagicDraw projects normally stored/collaborated on? Is GitHub viable?
-

Product Vision Statement / Statement of Work

Guiding Question: What does it take to build a spacecraft avionics system, and can that model be used for data-centric Failure Mode and Effect Analysis (FMEA)?

"Project to create a MBSE Model representing a generic avionics subsystem for a notional exploration spacecraft. Specifically capturing hardware and software configurations derived from high-level system requirements. The model would be used in an effort to better analyze system behavior and identify failure mode effects analysis (FMEA); to potentially classify fault propagation, for improved future system designs."

Work Breakdown Structure:

Fall 2023:

- Collecting information on hardware and software components for spacecraft avionics subsystems
- Utilize hardware and software components to create a model which satisfies high level functional requirements
- Use system model to analyze and refine avionics subsystem behavior and design
- Use results to provide design review products typical of a NASA program (example: PDR or FMEA)

Spring 2024:

- Use system model to answer design specific questions (query system model for design specifications?)
- Utilize the model to perform system and behavior analysis (demonstrating failure mode analysis or fault propagation)
- Provide a generic hardware implementation to discover potential gaps in digital twins (stretch goal)

Meeting Minutes

Sprint 1 (08/28/2023 - 10/03/2023)

Sprint 1 was defined by Dr. Akbas's sprint schedule.

Week 1

Meeting Minutes 09/01/2023 at 10:00 AM - 11:00 AM EST

Attendance: Shawn, Luke, Walter, Clay

Discussion:

- Met with Lui and Howard to introduce the team and discuss the project.

Week 2

Meeting Minutes 09/05/2023 at 2:30 PM - 3:30 PM EST

Attendance: Shawn, Luke, Walter, Clay

Discussion:

- Meet on Monday, 09/11 and set up a recurring time for team meetings to go over MBSE info from Lui and in the future do a weekly look ahead and identify our goals for the week.
- Identify recurring free times for a tag up with Lui:
 - Mondays 2:00 P.M. - 2:50 P.M. EST
 - Tuesdays 1:00 P.M. - 2:00 P.M. EST
 - Wednesdays 9:30 A.M. - 10:30 A.M. EST
 - Thursdays 1:00 P.M. - 2:00 P.M. EST
 - Fridays 9:30 A.M. - 10:30 A.M. EST
- Inquire with Akbas about how to select preferences and create official teams.
- Email Prescott POC about MagicDraw 2022x licensing and how to get rolling with software.

Week 3

Meeting Minutes 09/12/2023 at 2:30 PM - 3:30 PM EST

Attendance: Shawn, Luke, Walter, Clay

Discussion:

- We left class early to work in the library and plan ahead for the week prior to the meeting with Lui, et al.
- Dr. Akbas asked us to specifically identify the Product Vision Statement and address the questions associated with that task.
- We set up a Github for future implementation management with a project called MBSE for Avionics System Capstone (MASC).
- We setup up a Jira page for SCRUM management.

Week 4

Meeting Minutes 09/15/2023 at 9:30 AM - 10:30 AM EST

Attendance: Shawn, Luke, Walter, Clay, Lui Wang, Howard Wagner, Tatyana Rakalina, Kathryn, Soon Ong

Discussion:

- One SRS for model, one SRS for the software during the second semester. One SDS for the model, one SDS for the software later.
- Recurring meeting time is good
- FMEA
- OOSIM? Different MagicDraw process/plugin?
- MagicGrid free PDF download
- NASA already has methodologies for generating models
 - Uses activity diagrams which model the behavior of components
 - Runs the model and in real-time it detects faults from reliability information
 - None of it is hard-coded, it is generated from the plugin
- Goals:
 - Reference spacecraft system models to help train “newbies”
 - Reusable spacecraft system models
 - Library of avionics models
 - Talk to NASA's avionics people
 - Set of functions
 - Set of typical avionics architectures
 - Power distribution system models
 - Generation
 - Distribution
 - Storage
- Deliverables:
 - First semester:
 - Simplified power system
 - We develop a more detailed avionics system
 - Howard: Start by modeling a C&DH system that would control the TCS system?
 - Use existing TCS system from NASA
 - “System knowledge capture”
 - Design an avionics and C&DH system that could support:
 - Hierarchical control to manage the missions with multiple modules (2-3)
 - Spacecraft modules have different C&C strategies and report up the hierarchy of the execution status to the module manager and eventually up to the mission manager
 - the module will nominally be provided by the different vendors
 - Provide redundancy
 - How? Voting system? Other methods?
 - use time-trigger ethernet technology to connect all the avionics components
 - use the CFS framework
 - Reference paper by Julia Badger “A distributed hierarchical framework for autonomous spacecraft control”
 - TTT networking hardware TTTech.com TTTE-Avionics-Hosting-Unit-Flyer
 - First semester project suggested by Lui:

- Take a list of functions that is provided by NASA, then review it and look at it, and agree with NASA about what function we want the avionics system to have.
- Then discuss how we want to represent them in the model
 - Determine which way we want to model the system, using what process
- We could take the list of the generic EAM TCS functions and then model it using MagicGrid instead of NASA's process and see how that goes vs. the original models
- Second semester:
 - Explore how the model can be used to analyze the system
 - Find out what the models could be used for in practice
 - Software code generation?
 - Gap analysis?

Week 5

Meeting Minutes 09/19/2023 at 10:00 AM - 11:00 AM EST

Attendance: Shawn, Luke, Walter, Clay, Kathryn

Discussion:

- Modeling a software interface or a software system is more challenging than modeling a mechanical system
Kathryn recommends avionics in software focus since most people "aren't brave enough to venture there"
- Do a literature review to see what the current state of the art is
- Cyber SE Conference in Dallas / INCOSE in Dublin
- ASEP Certification Exam
- SysML Distilled
- After this week (these next two weeks) Teams is going to be the way to communicate with Kathryn
- Kathryn can support us next semester

Meeting Minutes 09/21/2023 at 1:00 PM - 2:00 PM EST

Attendance: Shawn, Luke, Walter, Clay, Kathryn

Discussion:

- Think about configuration management and version control
- PDR happens at step 9 "System Requirements" after the conceptual design is complete in the MagicGrid framework
- The solution domain contains the logical model
- First conceptual product is the BDD decomposition with a IBD for the SOI interfacing with the system context (maybe showing interfaces between the system and subsystems at a high level)
- Questions
 - Solution Agnostics (Step 16?) - Yes
 - NASA System Modelling Handbook - For reference
 - Stakeholder needs from Open Source? Can we use previous interview from Lui? Can we contact Lui as a stakeholder? - Let's use gateway space station as a reference and select one module as a generic System of Interest (white box) and model its avionics/power system and then have multiple black box modules that we can show the interface between (thus demonstrating systems of system)
 - The more innovative piece of this project is talking System of Systems to show interaction to external systems and users
 - Bounding the problem to the component level

Tuesday Kathryn Meeting

Meeting Minutes 09/19/2023 at 10:00 AM - 11:00 AM EST

Attendance: Shawn, Luke, Walter, Clay, Kathryn

Discussion:

Modeling a software interface or a software system is more challenging than modeling a mechanical system
Kathryn recommends avionics in software focus since most people "aren't brave enough to venture there"

Do a literature review to see what the current state of the art is

Cyber SE Conference in Dallas / INCOSE in Dublin

ASEP Certification Exam

SysML Distilled

After this week (these next two weeks) Teams is going to be the way to communicate with Kathryn

Kathryn can support us next semester

Thursday Kathryn Meeting

9/21/2023

Week 6

Meeting Minutes 09/26/2023 at 2:15 to 3:30 EST

Attendance: Shawn, Luke, Walter, Clay, Akbas

Discussion:

The SRS and SDD should be a document which describes our process for designing the system, not the system itself.

Week 7

Meeting Minutes 10/03/2023 at 2:15 to 3:30 EST

Attendance: Shawn, Luke, Walter, Clay, Akbas

Discussion:

The licensing was acquired but they were all allocated to our team. Two of the licenses need to reach the other team and we should work with Kathryn to ensure they are re-assigned. For now, Clay and Shawn will work on the original license and Luke and Walter will need to get licenses via a personal purchase. Our literature review is complete in this sprint.

Sprint 2 (10/10/2023 - 10/31/2023)

Sprint 2 was defined by Dr. Akbas's sprint schedule.

Week 9

Meeting Minutes 10/09/2023 at 5:00 to 6:30 P.M. EST

Attendance: Shawn, Luke, Walter, Clay

Discussion:

Filled out PO for Kelli to acquire final 2 licenses. Discussed Sprint 2 backlog, targeting completion of the problem domain. Intending to use literature review and input from Kathryn to fill out stakeholder needs and subsequent steps.

Question for Kathryn: Are the views in the problem domain meant to be iterative (particularly, should we do a rough draft and move on or completely finish each viewpoint before moving on?).

Shawn's Personal Notes:

- Shoot for complete conceptual mode (problem domain) by December.
- Completing problem domain and Systems Requirements (#8) should have use ready for a PDR.
- The conceptual model should completely inform the logical model and the logical model should go very quickly.
- For test planning, which thread do you want to pull all the way to the component level (16,17,18,19) and completely explore with a narrow scope.
- Conceptual model of the entire System of Systems but only go deep on
- Focus on conceptual model structure
- What are the basic pieces. Don't think about the what ifs, keep it high level and basic to capture everything a spacecraft will contain
- Given a conceptual model, think about doing a trade (in the conceptual model we have a pressure vessel, and two logical pressure vessels were proposed by vendors, can we do a trade study with).
- Sprint 2 goal is conceptual model draft
- System Context Diagram (SOI and its external things and people)
- Focus on the structure column and flushing them out.
- Customer usually gives stakeholder needs.
- Don't focus on needs, go pull them from somewhere later.
- Maybe the future work would be the module interface because we are kind of looking at skylab and a vehicle versus like modules on the ISS working together to perform a function like firing thrusters.

Week 10

Meeting Minutes 10/16/2023 at 5:00 to 6:30 P.M. EST

Attendance: Shawn, Luke, Walter, Clay (Via Phone)

Discussion:

We finalized software installation for all the machines and got Luke and Walter set up. We also asked that the license keys be reallocated for the other MBSE team.

Meeting Minutes 10/18/2023 at 5:00 to 6:30 P.M. EST

Attendance: Shawn (Via Phone), Luke, Walter, Clay (Via Phone)

Discussion:

We worked on the Test Plan Draft.

Week 11

Meeting Minutes 10/23/2023 at 5:00 to 6:30 P.M. EST

Attendance: Shawn, Luke, Walter, Clay

Discussion:

We decided to move the weekly tag-up to Wednesdays at 7:00 PM to better accommodate our schedules. We also noted that we should be keeping better notes in our individual engineering notebooks. For this week, we are interested in completing the following tasks individually.

Walter - Evaluate best practices for using GitHub with Magic System of Systems Architect 2022x

Luke - Create rough draft of stakeholder needs

Clay - Create rough draft of subsystem definitions

Shawn - Create draft of system context

Update: Luke will handle all Git Merges for us to probably handle Git properly.

Meeting Minutes 10/25/2023 at 7:00 to 9:00 P.M. EST

Attendance: Shawn, Walter, Clay

Discussion:

We researched Deep Space Gateway system from the following references to identify and derive stakeholder needs considering the problem domain's black box perspective:

[1] <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7943624>

[2] <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8396541>

[3] https://www.nasa.gov/wp-content/uploads/2016/05/nss_chart_v23_tagged.pdf

[4] https://www.nasa.gov/wp-content/uploads/2016/05/cislunar-update-gerstenmaier-crusan-v5a_tagged_0.pdf

and specifically referencing [2] and [4], we drafted the following stakeholder needs:

🔗 Stakeholderneeds.txt

Meeting Minutes 10/27/2023 at 10:00 to 11:00 A.M. EST

Attendance: Shawn, Luke, Walter, Clay, Kathryn

Discussion:

We spoke with Kathryn about our stakeholder needs and system context diagrams. She provided positive feedback for both, and input for improvement. More specific notes are mentioned below.

- Needs are high level goals, "should statements".
- No first person, the Sol "should" do something. There also is no "must" or "need", because they are goals.
- By contrast to requirements, goals are verifiable.
- System requirements will ultimately meet the goals/needs.
- NASA document on writing good requirements.

- For system context, be ready to come back and iterate on it.
- Forward Work:
 - Capture traceability when making Use Cases and MoE's this week
 - 5.0 Functional Analysis can be kind of nasty
 - Apply notes for 1 and 2
 - Use a REFINE from use case to need and a TRACE from MoE to need

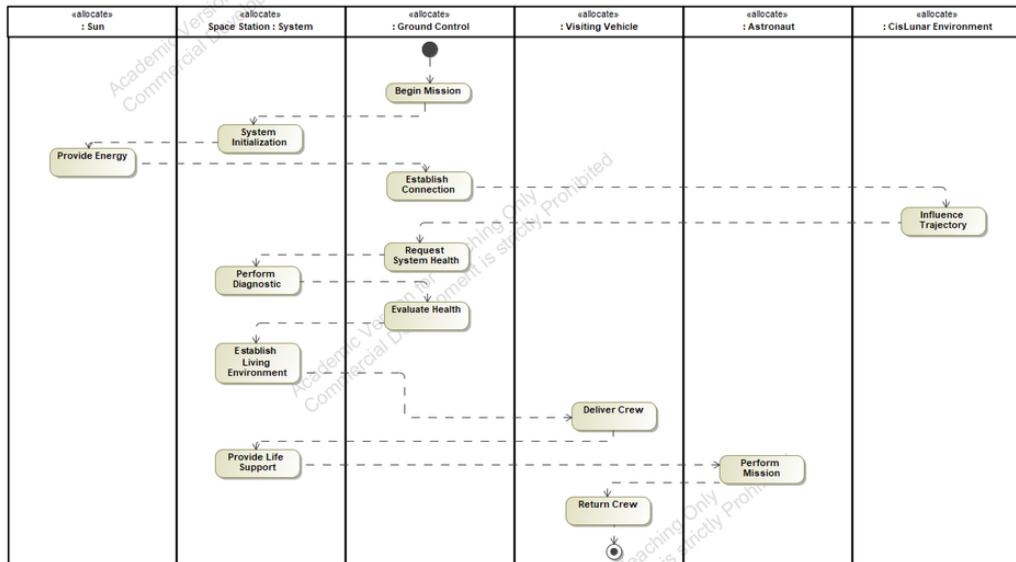
Week 12

Meeting Minutes 10/30/2023 at 6:00 to 8:00 P.M. EST

Attendance: Shawn, Luke, Walter, Clay

Discussion:

We implemented some changes that Kathryn suggested to the stakeholder needs and system context diagram. Specifically, we drafted a use case diagram for crewed cislunar operations. We tried referencing the vehicle climate control model, however, our system of interest proved to be much more complicated and difficult to implement in this fashion. We created a draft shown below:



Meeting Minutes 10/31/2023 at 3:00 to 5:00 P.M. EST

Attendance: Shawn, Luke, Walter, Clay

Discussion:

Today the system requirements specification and system design document are due, so after a brief scrum meeting with Dr. Akbas, will begin to evaluate our previous SRS and SDD draft to determine what sections are necessary to change. We were able to use comments from the first draft and some insight from Dr. Akbas to revise a couple important things like the product, scope and vision.

Sprint 2 Planning (10/04/2023 - 10/09/2023)

This is the planning section for Sprint 2 where we recap Sprint 1 progress and discuss Sprint 2 going forward.

Week 8

Meeting Minutes 10/09/2023 at 5:00 to 6:30 P.M. EST

Attendance: Shawn, Luke, Walter, Clay

Discussion:

Filled out PO for Kelli to acquire final 2 licenses. Discussed Sprint 2 backlog, targeting completion of the problem domain. Intending to use literature review and input from Kathryn to fill out stakeholder needs and subsequent steps.

Question for Kathryn: Are the views in the problem domain meant to be iterative (particularly, should we do a rough draft and move on or completely finish each viewpoint before moving on?).

Meeting Minutes 10/10/2023 at 12:00 to 1:00 P.M. EST

Attendance: Shawn, Luke, Kathryn

Discussion:

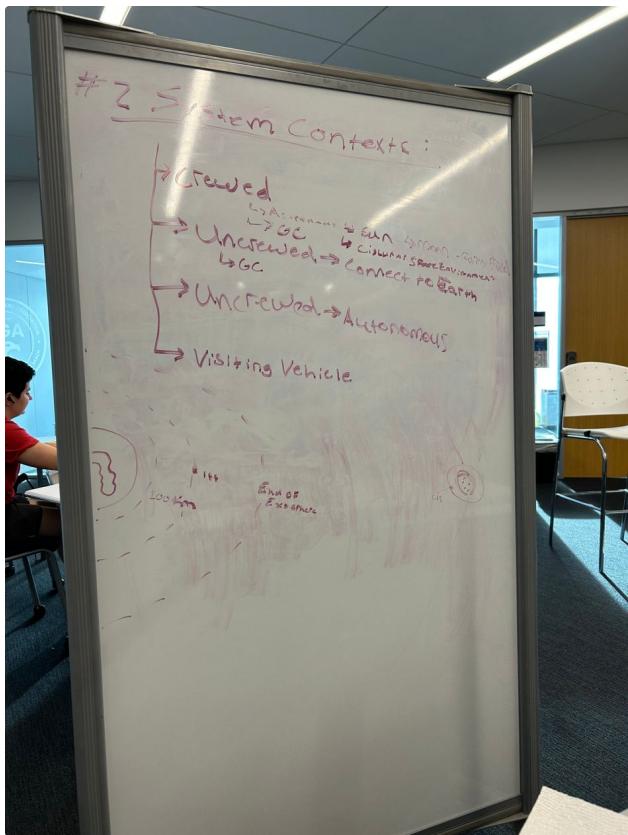
Clay and Walter went to the career fair, and Luke and I spoke with Kathryn about the backlog. Kathryn indicated we should aim to have the conceptual model complete during sprint 2, and we should focus more on the structure of the model. This means not following the numeric order, instead following the structural column and then branching out until the conceptual model is complete. A final draft that is well done should make the detailed model much simpler.

Meeting Minutes 10/10/2023 at 5:00 to 6:00 P.M. EST

Attendance: Shawn, Luke, Clay, Walter

Discussion:

The team discussed what Kathryn had mentioned, and we brainstormed the conceptual model on a whiteboard. The system context proved more difficult than we expected, and because Clay and I received the software last week, we are still learning the click-ology and we took notes on discord. The whiteboard images we took will be converted to model elements shortly.



Draft Stakeholder Needs

Context: modular lunar space station.

ID	Name	Text
1.1	Local Data Control	Information from the spacecraft sensors must be temporarily stored locally.
1.2	Data Downlink	Information from the spacecraft sensors must be periodically transmitted to Earth.
1.3	Data Uplink	The spacecraft must execute commands sent from Earth.
1.4	Spacecraft Attitude Control	The spacecraft must maintain attitude control.
1.5	Spacecraft Thermal Control	The spacecraft must maintain its temperature within safe bounds.
1.6	Spacecraft Power Control	The spacecraft must maintain electrical power availability within safe bounds.
1.7	Spacecraft Commanding	The system must command onboard effectors.
1.8	Spacecraft Dataflow	The system must receive data from onboard sensors.
1.9	Spacecraft Computing	The system must provide real time processing.
1.10	Safe Mode	The spacecraft must return to a safe state when a command from Earth has not been received recently.
2.1	Element Avionics Architecture	The system must utilize a Distributed Integrated Modular Avionics architecture. [1]
2.2	Modular Element Interface	The system must provide modular (inter-element) network interfaces. [1]
2.3	Network Traffic Data	The system must support multiple data traffic types (Time Triggered, Rate Constrained, and Best Effort). [1]
2.4	Network Dual-Fault Tolerance	The system must support a three plane ethernet structure. [1]
2.5	Network Multipath Traffic	The system processors must connect to all three planes. [1]

1.# represents generic spacecraft functions (User Needs?)

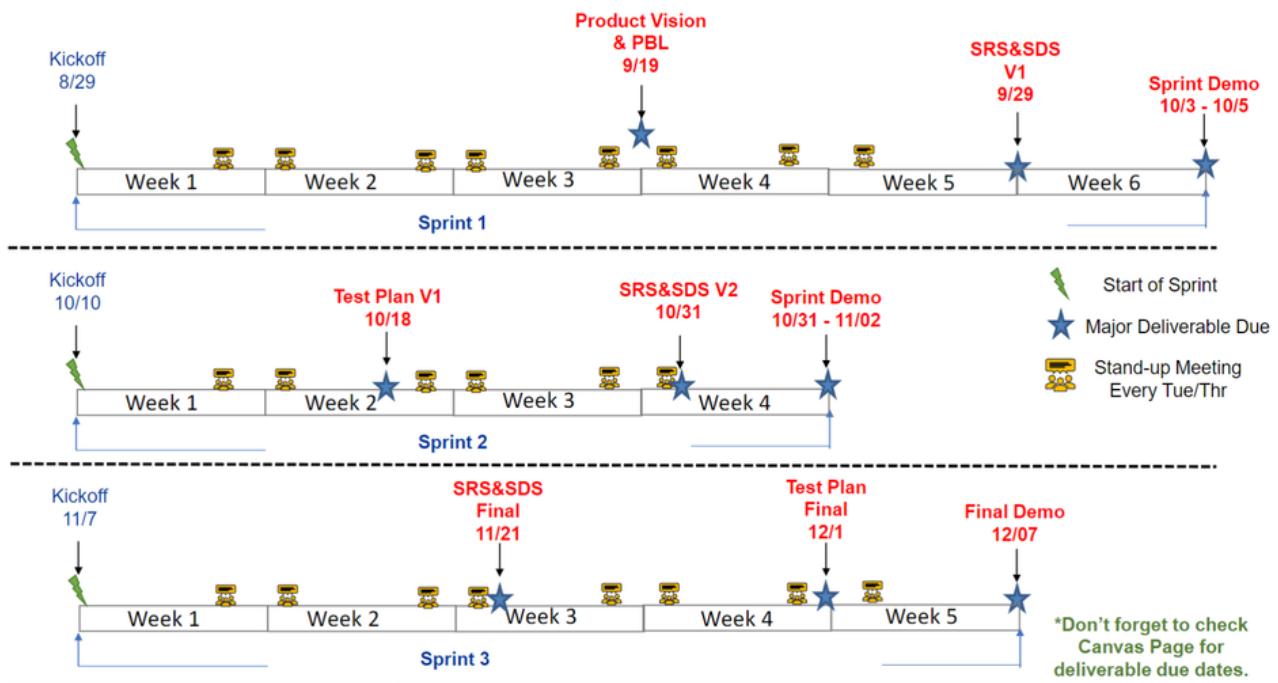
2.# represents mission specific functions (Design Constraints?)

References:

[1] <https://ntrs.nasa.gov/api/citations/20210009614/downloads/IEEE-Aero-2-9-1111.pdf>

Capstone Class Information

Project Timeline



Public Class Project Description

Guiding Question: *What does it take to build a spacecraft avionics system?*

"Project to create a reusable MBSE Model representing a generic avionics subsystem for a notional exploration spacecraft. Specifically capturing hardware and software configurations derived from high-level system requirements. The model would be used in an effort to better analyze system behavior and identify failure modes for fault propagation to improve future system designs."

Work Breakdown Structure:

Fall 2023:

- Collecting information on hardware and software components for spacecraft avionics subsystems
- Utilize hardware and software components to create a model which satisfies high level functional requirements
- Use system model to analyze and refine avionics subsystem behavior and design
- Use results to provide design review products typical of a NASA program (example: PDR)

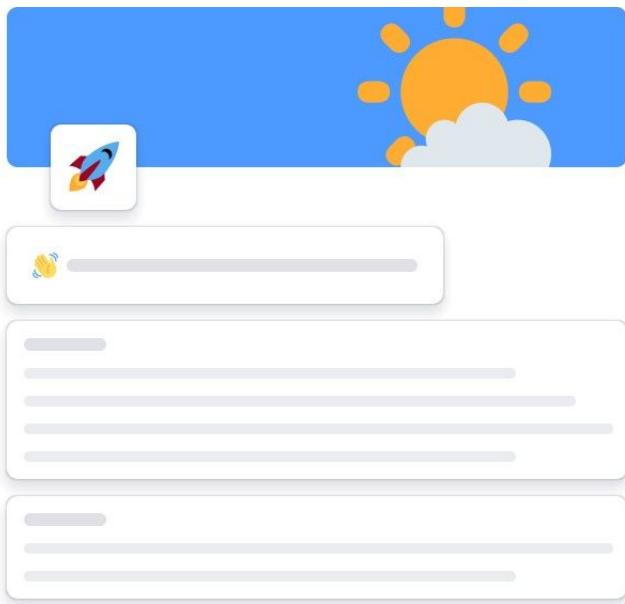
Spring 2024:

- Use system model to answer design specific questions (query system model for design specifications)
- Utilize the model to perform system and behavior analysis (demonstrating failure mode analysis or fault propagation)
- If possible, provide a generic hardware implementation to discover potential gaps in digital twins

Templates

Create a stellar overview

The overview is the first page visitors will see when they visit your space, so it helps to include some information on what the space is about and what your team is working on.



Add a header image. This gives your overview visual appeal and makes it welcoming for visitors.

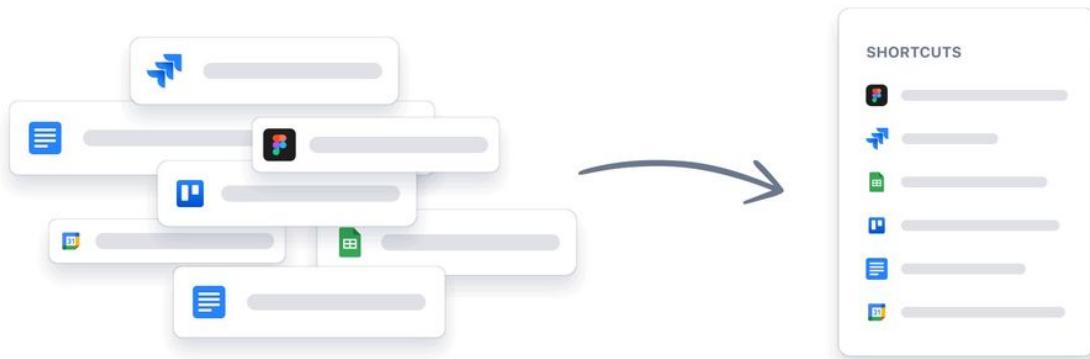
Explain what the space is for. Start by summarizing the purpose of the space. This could be your team's mission statement or a brief description of the kind of work you do.

Share team goals. Add links to your team's [OKRs](#), [project plans](#), and [product roadmaps](#) so visitors can quickly get a sense of your team's goals.

Tell people how to contact you. Share your timezone and links to Slack channels, email aliases, or other contact details your team uses so visitors can contact you with questions or feedback about your team's work.

Use shortcuts for easy access

Shortcuts are helpful for important pages that members of a space might need to get to often. These shortcuts are added and organized by the space administrator. Space admins can link to pages in the space, other related spaces, or relevant external web content as well as reorder the shortcuts as needed.



💡 Start discussions with inline comments

Thoughtful responses can get lost and lose context as email replies pile up. And if you neglect to copy someone or want to add them later on, it's difficult for them to get up to speed. [Inline comments](#) allow anyone (or everyone) to huddle around an idea while referencing key information on the project page.

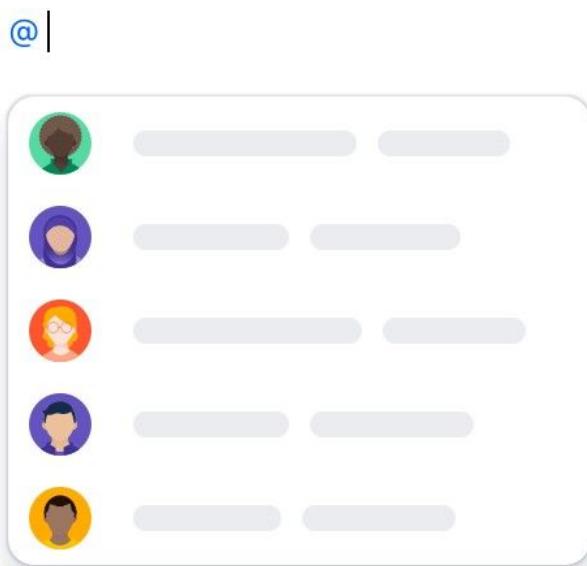
To leave an inline comment, highlight text on the page and the comment icon will appear.



Team members with permission to access the page can respond to any comment. Plus, when a comment thread comes to its natural conclusion, comments can be resolved and cleared away.

👏 Loop in team members with @mentions

[@mentions](#) on Confluence function like @mentions on social media platforms like Twitter, Instagram, and Slack. Type the @ symbol on a Confluence page or in a comment, begin spelling a team member's first name, and a list will appear. Select the individual to ask a question or assign a task.



👏 Endorse ideas with reactions

Use reactions when you want to support a comment or acknowledge you've seen one without clogging up the thread with another comment.

You can also use reactions on a page or blog post. The author of the content will be notified, and if enough team members react or add comments to the content, it'll be surfaced on Confluence home feed



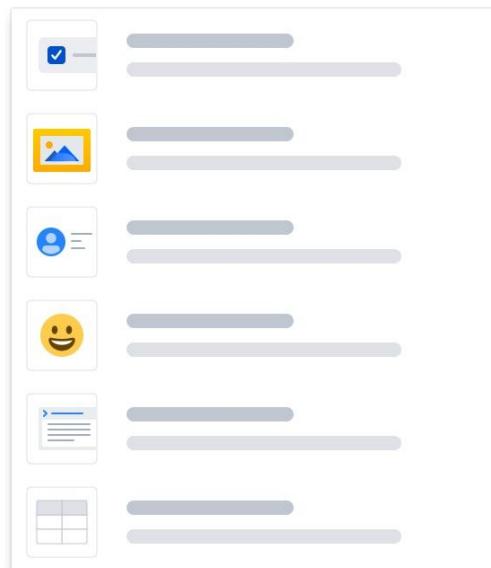
Take your Confluence space to the next level

Extend the capabilities of your Confluence pages by adding extra functionality or including dynamic content.

/

To add functionality:

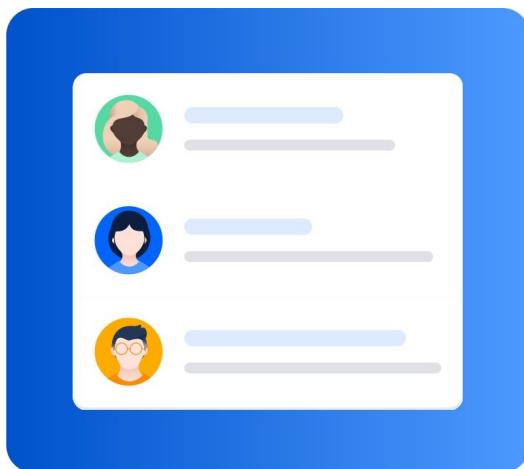
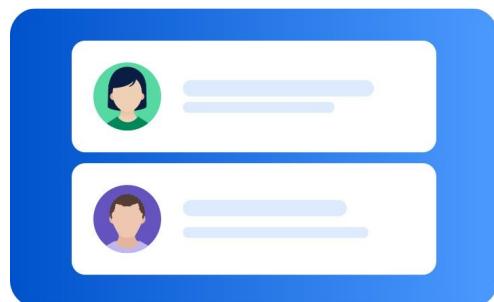
1. Type '/' to open the list of items available to use
2. Find the item to be inserted and select it
3. Select **Insert**



Useful elements for Team space

Introduce the team

Add [user profiles](#) to display a short summary of a given Confluence user's profile with their role, profile photo and contact details.

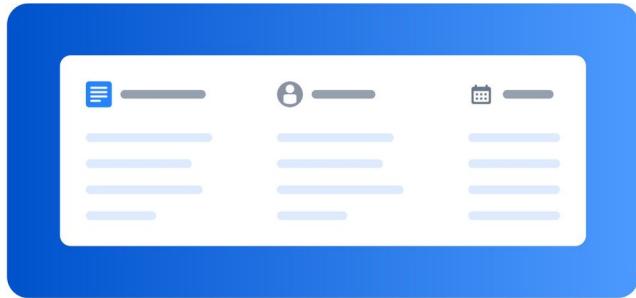


Share news and announcements with your team

Display a stream of latest [blog posts](#) so your team can easily see what's been going on.

Display a list of important pages

Paste in page URLs to create smart links, or use the [content report table](#) to create a list of all the pages in the space.



😎 Template - Project plan

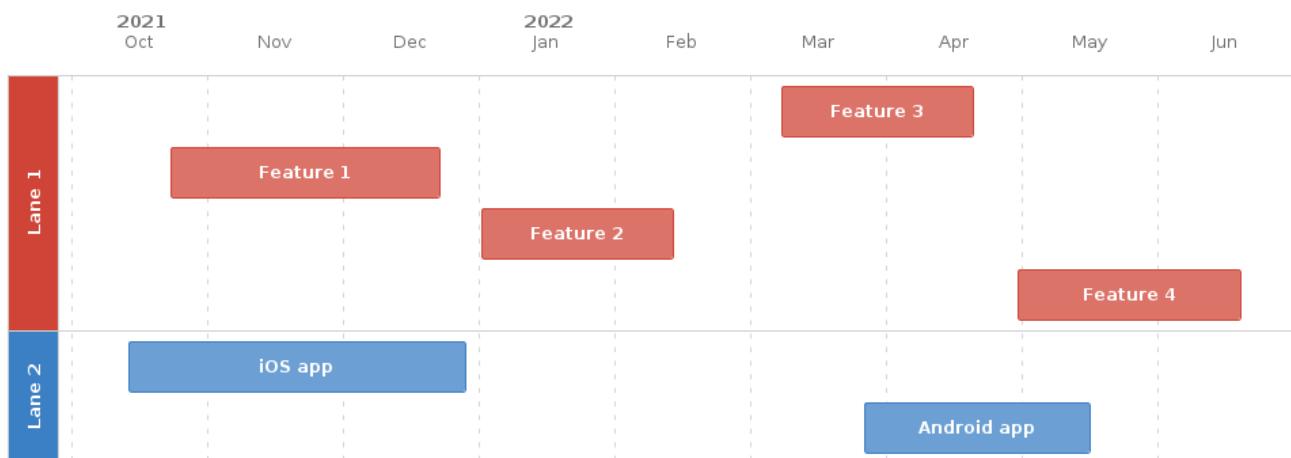
Driver	
Approver	
Contributors	
Informed	
Objective	
Due date	
Key outcomes	
Status	NOT STARTED / IN PROGRESS / COMPLETE

🤔 Problem Statement

🎯 Scope

Must have:	<ul style="list-style-type: none">••
Nice to have:	<ul style="list-style-type: none">••
Not in scope:	<ul style="list-style-type: none">••

📅 Timeline



► Milestones and deadlines

Milestone	Owner	Deadline	Status

🔗 Reference materials

Template - Meeting notes

Date

Participants

-
-

Goals

-

Discussion topics

Time	Item	Presenter	Notes
			•

Action items

-

Decisions



🎯 Template - Weekly status report

💡 Copy and paste this section for each week.

✓ Win

- 1.
- 2.
- 3.

✗ Needs input

- 1.
- 2.
- 3.

▢ Focus

- 1.
- 2.

Notes	
Important Links	

Literature Review

Format

Paper #	Topic	Paper Name	Search Terms	Summary (Paragraph)	Link
1				What the source discusses, What the results demonstrates, and how it aligns to your topic and how it aligns to the overarching project.	
2				What the source discusses, What the results demonstrates, and how it aligns to your topic and how it aligns to the overarching project.	
3				What the source discusses, What the results demonstrates, and how it aligns to your topic and how it aligns to the overarching project.	
...				What the source discusses, What the results demonstrates, and how it aligns to your topic and how it aligns to the overarching project.	

MBSE and FMEA (Shawn)

Paper #	Topic	Paper Name	Search Terms	Summary (Paragraph)	Link
1	Traditional FMEA, FTA, and MBSE.	HOW TO BUILD FMEA AND FAULT TREE ANALYSIS WITH MBSE	MBSE FMEA	Explains traditional FMEA and how to perform FMECA using a fault tree with MBSE. However, this source is largely trying to demonstrate a solution using their software.	Link
2	Focuses on how failure analysis can be more deeply integrated as a part MBSE models.	Failure Risk Analysis: Insights from Model-Based Systems Engineering	MBSE FMEA	This source explains FMEA and the different viewpoints D,P, and A - FMEA in the context of a system modelling containing the system description and information.	Link
3	Uses Magic System of Systems Architecture to explore failure analysis efficacy.	A DIGITAL TWIN MODEL-BASED SYSTEM ENGINEERING APPROACH TO FAILURE ANALYSIS FOR AN ENGINE SYSTEM	MBSE FMEA	Research to use system model to create digital twin and generate failure analysis and link specific failures to their requirements.	Link
...		Fault Injection Analytics: A Novel Approach to Discover Failure Modes in Cloud- Computing Systems	MBSE FMEA	What the source discusses, What the results demonstrates, and how it aligns to your topic and how it aligns to the overarching project.	Link
		Failure Modes Effects Analysis in MBSE	MBSE FMEA	What the source discusses, What the results demonstrates, and how it aligns to your topic and how it aligns to the overarching project.	Link

MBSE and Avionics (Luke)

Paper #	Topic	Paper Name	Search Terms	Summary (Paragraph)	Link
1	Attitudes toward MBSE in an avionics application	The long and winding road: MBSE adoption for functional avionics of spacecraft	MBSE Avionics	This paper discusses the various current problem points in adopting MBSE as a functional method of design as opposed to DBSE (Document-Based Systems Engineering). It isn't extremely technical, but it underscores the benefits that could come from applying MBSE. It concludes that MBSE could be most helpful when applied to: organisation modelling; early functional validation; communication and consistency; template model framework development. The latter is what we are focusing on.	Link
2	Applying MBSE to verification and validation of a spacecraft avionics system	Investigating the Flexibility of the MBSE Approach to the Biomass Mission	MBSE avionics spacecraft	This source discusses the process by which the Biomass ESA mission was planned and a functional model of the spacecraft avionics system and mission were developed using MBSE. They used the model in conjunction with Matlab and Excel to generate a behavioral simulation of the data handling portion of the spacecraft which they used to validate earlier requirements.	Link
3				What the source discusses, What the results demonstrates, and how it aligns to your topic and how it aligns to the overarching project.	
...				What the source discusses, What the results demonstrates, and	

			how it aligns to your topic and how it aligns to the overarching project.	
--	--	--	---	--

MagicGrid / MBSE in Space & Sys of Sys

Paper #	Topic	Paper Name	Search Terms	Summary (Paragraph)	Link
1	MBSE in Space	Research on satellite Modeling and Real-time Simulation Monitoring Based on MBSE	MBSE magicgrid integrations	Good paper on the design process this team took for a satellite system. They explain their methods of design and even use an example with the power subsystem. Overall, the paper gives good insight on the design process, models to use and even a verification framework to simulate the diagrams made.	Link
2	MBSE with aircraft and spacecrafts	MBSE for Civil Aircraft Scaled Demonstrator Requirement Analysis and Architecting	MBSE magicgrid space	This paper is very similar to Paper 1 in many of the development processes. The difference, other than the system being designed, is that they try new techniques of designs and even mention that in some areas, the framework still needs some work. A technique mentioned on the paper was to divide the stakeholders needs by stakeholders needs and stakeholder requirements, they explain the difference. It may be a good paper to have another design process view.	Link
3	SysML modeling methods	System modeling process with SysML assuming the use of models	MBSE magicgrid spacecraft	Gives good info about SysML specifically with avionics of a spacecraft. Proposes a general model that tries to be informative and adaptable to changing components but not too far as to be unusable to the engineer. They basically cover the foundation for our project, but seem to stop before using the model to identify possible faults and such, so we could use this as a launching point.	Link
					https://link.springer.com/content/pdf/10.100

				7/978- 3-030- 27486- 3_59- 1.pdf
...			What the source discusses, What the results demonstrates, and how it aligns to your topic and how it aligns to the overarching project.	

References

White Papers for Literature Review:

- <https://arxiv.org/pdf/2010.00331.pdf>
- <https://apps.dtic.mil/sti/trecms/pdf/AD1201821.pdf>
- https://www.omgwiki.org/MBSE/lib/exe/fetch.php?media=mbse:patterns:pbse_wg_meeting_dec_17_2014_attachment_2.pdf
- [◆ How to Build FMEA and Fault Tree Analysis with MBSE](#)
- [☒ Quick Reference Guides](#)
- [!\[\]\(7ba12b557ada9c31845f4c0e90db27eb_img.jpg\) Peter Fortescue, Graham Swinerd, John Stark - Spacecraft Systems Engineering \(Aerospace Series\) -Wiley \(2011\).pdf @Luke Newcomb](#)
- [!\[\]\(762edb4f0585f9d7bda376d3729181b9_img.jpg\) Space_mission_eng_new_SMAD_ch_14.pdf @Luke Newcomb](#)
- [!\[\]\(305a503ec9e0139a35b7c7119622d1db_img.jpg\) Space_mission_eng_new_SMAD_ch_20.pdf @Luke Newcomb](#)
- [!\[\]\(59491dca1804e55c6488dfa65f141b3f_img.jpg\) Space_mission_eng_new_SMAD_ch_21.pdf @Luke Newcomb](#)
- [!\[\]\(3f357f64ccb4802b97d2cb6758a00759_img.jpg\) 2022-10-14-NASA-HDBK-1009.pdf](#)