VCU College of Engineering

CS 25-308 SBSD Web Prototype & GPT

[Project Proposal]

Prepared for

willis.morris@sbsd.virginia.gov/VA Dept Small Business and Supplied Diversity

By

Zachariah Dellimore, Jacobo Ceballos, Nate Swetlow, and Victor Olivar

Under the supervision of

John Leonard

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Executive Summary

The large volume of user inquiries on the Virginia Department of Small Business & Supplier Diversity's (SBSD) website is a substantial difficulty that frequently causes confusion and delays in the retrieval of information. The department has used the ChatGPT API to create a chatbot in the past, but it had accuracy problems because the responses were often taken from outside sources and did not match the department's official records. In order to meet the requirement for a more efficient solution, this project builds a unique large language model (LLM) that is suited to the internal data of SBSD. The approach we selected is based on the Retrieval-Augmented Generation (RAG) paradigm, which combines real-time generative replies with document retrieval. This method guarantees accurate and flexible responses, giving users dependable, context-sensitive information. By implementing this methodology, SBSD will drastically cut down on the amount of routine questions that staff members get, enabling users to swiftly and effectively use self-service choices. The system will also be expandable, allowing it to accommodate future content expansions and more sophisticated user inquiries.

This project complies fully with Executive Order 30, which sets moral and responsible guidelines for the use of AI in all state agencies in Virginia. In accordance with the Virginia Information Technologies Agency's (VITA) principles for artificial intelligence in public service, the directive guarantees that AI systems are transparent, dependable, and safe. The chatbot solution is compatible with SBSD's current IT infrastructure and complies with Enterprise Architecture (EA) requirements, guaranteeing strong security, data privacy, and operational effectiveness.

Following these state-level regulations and making use of cutting-edge AI technologies, this project not only solves an urgent operational requirement but also acts as a prototype for upcoming AI-driven public sector service solutions. It establishes a new benchmark for raising citizen-government relations, expediting service delivery, and cutting expenses for SBSD and other state agencies.

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Section A. Problem Statement

The Virginia Department of Small Business & Supplier Diversity (SBSD) has identified a significant gap in how users access information on their website, which results in confusion and frustration for users trying to find the resources they need. This issue leads to an increased number of calls and emails to the department for basic inquiries that could otherwise be resolved through self-service, such as eligibility requirements for certifications, application procedures, and contact information for different divisions. As a result, small businesses seeking support experience delays in receiving guidance, and department staff face inefficiencies in managing these inquiries. In response to this problem, the department previously implemented a chatbot using the ChatGPT API. While the solution demonstrated potential, it faced several shortcomings, primarily due to its reliance on external information sources from the internet, which often led to inaccurate or misleading answers that did not align with the department's official resources. This issue, known as "hallucination" in natural language processing, diminished the chatbot's credibility as a reliable source of information.

To address this problem, our project aims to develop a custom large language model (LLM) tailored specifically to the Virginia SBSD's needs. Rather than relying on third-party APIs or external data, we will create and fine-tune an LLM using the department's own internal data and website content, ensuring that the chatbot provides accurate, up-to-date, and contextually relevant responses to user queries. This project falls under the fields of conversational AI and business intelligence, contributing to advancements in how government agencies can leverage artificial intelligence to improve public service accessibility. By creating a custom LLM trained on domain-specific data, we push the boundaries of existing chatbot solutions and set a precedent for other agencies facing similar challenges in information dissemination.

Historically, various solutions have been employed to improve information accessibility, ranging from static FAQ pages to traditional rule-based chatbots. However, these approaches often lacked the ability to understand context or provide nuanced responses, leading to poor user satisfaction. Commercially available chatbots, while more sophisticated, also face limitations when it comes to providing information highly specific to an organization's needs. Our project builds on these previous attempts by integrating cutting-edge natural language processing techniques with tailored training data, allowing the chatbot to serve as a more effective digital assistant for SBSD. In addition to addressing an unmet engineering need for the department, this project has the potential to reduce operational costs associated with handling basic inquiries, improve public perception of the department's digital resources, and create a blueprint for other government entities looking to implement AI-driven solutions. The primary stakeholders in this project include the Virginia SBSD, who will benefit from the reduced volume of basic inquiries and the enhanced user experience on their website, as well as the end users, which include small business owners, aspiring entrepreneurs, and other stakeholders seeking information about certification processes and services offered by the department. By the end of this project, we aim to deliver a chatbot solution that not only addresses the current limitations but also elevates the standard for public sector digital communication tools, ultimately enhancing the accessibility and efficiency

of information dissemination for the Virginia SBSD and providing a positive impact on the broader community it serves.

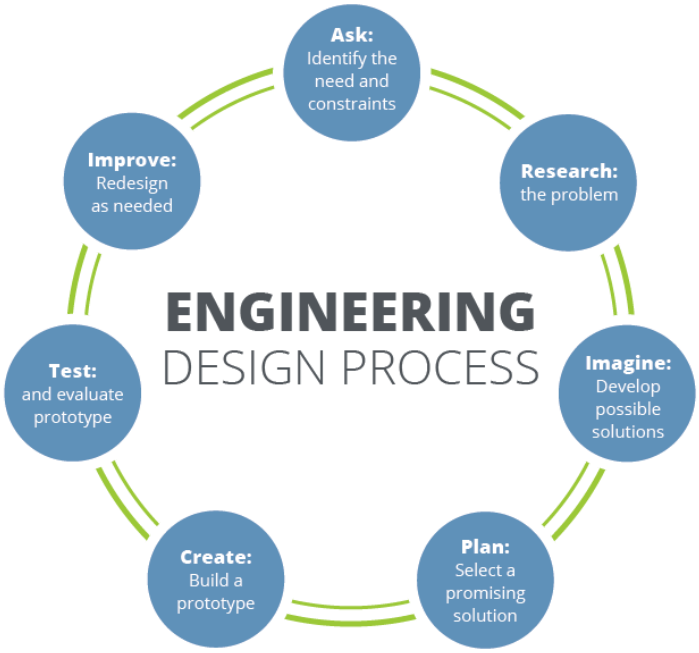


Figure 1. The iterative nature of the engineering design process [2].

Section B. Engineering Design Requirements

This section describes the goals and objectives of the project, as well as all **realistic constraints** to which the design is bound. Our goals are to create a chat-bot to help the Department of Small Business and Supplier Diversity site users navigate the site to find what they need. The chat-bot also has to follow Executive Order 30's rules for Commonwealth of Virginia AI systems. We will also have to develop a web interface for SBSD to test the chat-bot and ensure it meets their requirements.

B.1 Project Goals (i.e. Client Needs)

There are a number of goals that this project seeks to achieve when improving the chat-bot implementation from last year:

- To create a chat-bot that helps SBSD site users find the necessary information on the website.
- To create a chat-bot that follows Executive Order 30's rules on AI.
- To create a way of checking that the chat-bot is not hallucinating or misleading users.
- To implement a web interface so the sponsor's can test the chat-bot implementation.

B.2 Design Objectives

The following are a list of key objectives that we hope to achieve by the end of the spring semester:

- The chat-bot will give the correct information to questions users ask about the site.
- The chat-bot will not answer questions it does not have data on.
- The chat-bot will not break any of Executive Order 30's rules on AI.
- The chat-bot will have a way to be tested to ensure it gives correct responses.
- The design will include a web interface for users to test the chat-bot online.

B.3 Design Specifications and Constraints

The following are a list of constraints for the chat-bot design to ensure it can be used on the SBSD website without issue:

- The chat-bot must be fully compliant with Executive Order 30's rules on AI which can hamper the AI's we use and whether or not we use a local AI or not.
- The chat-bot must be able to be tested to ensure it gives the correct responses.
- The chat-bot must be low cost enough while also being able to give high-quality, fast responses.

B.4 Codes and Standards

Creating the chat-bot for SBSD requires us to follow several Codes and Standards for Commonwealth of Virginia AI systems and web systems to ensure security. A list of Codes and Standards we need to follow are shown below:

- Executive Order 30 – Chat-bot must follow a strict set of rules to ensure it gives high-quality, correct responses and doesn't endanger user data.
- EA-225 – "Establishes direction and technical requirements which govern the acquisition, use and management of information technology resources by executive branch agencies." (ITRM, 2020, p.7)
- WEB – The goal of this standard is to guide the use of web system resources within the Commonwealth of Virginia (VITA, 2024, p.4)

Section C. Scope of Work

The project scope defines the boundaries of the project encompassing the key objectives, timeline, milestones and deliverables. It clearly defines the responsibility of the team and the process by which the proposed work will be verified and approved. A clear scope helps to facilitate understanding of the project, reduce ambiguities and risk, and manage expectations. In addition to stating the responsibilities of the team, it should also explicitly state those tasks which fall *outside* of the team's responsibilities. *Explicit bounds* on the project timeline, available funds, and promised deliverables should be clearly stated. These boundaries help to avoid *scope creep*, or changes to the scope of the project without any control. This section also defines the project approach, the development methodology used in developing the solution, such as waterfall or agile (shall be chosen in concert with the faculty advisor and/or project sponsor). Good communication with the project sponsor and faculty advisor is the most effective way to stay within scope and make sure all objectives and deliverables are met on time and on budget.

The scope of this project is to design and implement an improved chatbot for the Virginia Department of Small Business & Supplier Diversity (SBSD). The chatbot will be built using a custom large language model (LLM) trained on the department's internal data and website content. The following outlines the project resources, milestones, and deliverables.

The primary goal is to develop a chatbot that accurately answers user queries using information from the SBSD's website, improving access to resources without over-reliance on department staff for simple inquiries. The solution will be compliant with Executive Order 30's guidelines on AI, ensuring transparency, reliability, and data privacy.

C.1 Deliverables

The following deliverables will be produced throughout the project:

- A fully functional chatbot that can be tested via a web interface.
- Documentation detailing the system's design, implementation, and adherence to Executive Order 30.
- A testing framework to validate that the chatbot provides accurate, compliant answers.
- Capstone deliverables such as the team contract, project proposal, preliminary design report, fall poster, final design report, and Capstone EXPO presentation.

- What deliverables require access to campus? Which/how many students regularly access campus and are physically available to complete tasks?
    - The main deliverable that may require campus access is obtaining files or code for the old front-end of the chatbot. This may involve accessing specific servers or campus networks where these resources are stored. However, the majority of

work can be completed remotely, minimizing the need for physical campus presence.

- What work can be done remotely? What resources might be needed in order to ensure that remote work can be completed effectively (e.g. software licenses, shared drives/folders, etc.)?
    - All core work can be done remotely. Team members can collaborate using GitHub and other online platforms.
    - The only resource we may potentially require is faster hardware for model training and chatbot execution. This can be mitigated by using cloud computing platforms if necessary, although the current infrastructure may suffice.
- What deliverables require ordering from third-party vendors? Will any components potentially required extended lead times? What can the team do in order to mitigate potential supply chain disruptions?
    - There are no expected deliverables requiring orders from third-party vendors. Since the project involves software development and the use of internal SBSD data, no physical components are needed. The project will leverage in-house data and existing frameworks, such as the Retrieval-Augmented Generation (RAG) model, to build the chatbot without reliance on external sources.

C.2 Milestones

The following key milestones are identified for the project:

First Quarter:

- Initial setup, including material purchases for presentation, beginning chatbot development, and selecting a development model (e.g., Retrieval-Augmented Generation (RAG)).

Second Quarter:

- Complete core functionality of the chatbot, integrate testing, and build the web interface.

Third Quarter:

- Complete testing, address any performance issues, and prepare for the final presentation and report.

All milestones will be revisited regularly to ensure the project stays on track. The team will review progress in biweekly meetings with the sponsor and adjust the timeline as needed.

C.3 Resources

The following resources are needed to complete the project:

- **Development Tools**: Python, natural language processing (NLP) libraries (such as Hugging Face Transformers), IDEs like Visual Studio Code or PyCharm, and cloud computing resources if required.
- **Testing Resources**: Access to internal SBSD data and any operational databases for validation.
- **Collaborative Tools**: Version control (GitHub), cloud storage, and online collaboration platforms for remote work.

All resources will be utilized to ensure effective remote work, with no expected reliance on third-party vendors or additional purchases.

Section D. Concept Generation

Creating design ideas for the SBSD chatbot involved using various approaches. A blend of brainstorming was used, and reverse thinking techniques were applied, and existing solutions were examined for inspiration. Many different methods were reviewed for the chatbot's implementation, which led to the decision that was made that the Retrieval-Augmented Generation (RAG) model was most appropriate. The three most important design concepts were described, and evaluated by us for pros, cons, and any risks involved.

At first they thought of a rule-based chatbot that gave responses matching certain keywords or intentions from the user's questions. SBSD's resources were to be examined to identify frequently asked questions (FAQs), which would then be mapped to particular static responses. This design was seen as straightforward and relatively easy to implement. It operated on a fixed logic that made sure predictability, and easy validation. Yet in spite of allowing for quick, and low-cost deployment, large limitations were present. Its main shortcoming was a lack of flexibility. Handling variations in user phrasing or complicated queries beyond predefined patterns would be difficult for a rule-based chatbot. As a result, it would be prone to failure in many real-world scenarios, leading to user frustration. Additionally, updating the system with new FAQs would require manual changes, leading to increased maintenance over time.

For a second idea we thought about creating a chatbot using machine learning as part of a study focused on FAQs. This was designed with text similarity models, user queries could be matched to relevant FAQ entries. Embedded questions and answers from the FAQ database allowed the chatbot to handle user inputs, and identify the closest match based on semantic similarity. Therefore relying not just on keyword matching. This technique handles different phrasings, and more complicated queries better than rule-based models. Thus, more flexibility is offered, and it is more adjustable to users. Yet, increased complication in development and infrastructure was introduced. Machine learning models were implemented, and the FAQ database needed maintenance, with regular updates, and potential retraining of the model as FAQ content evolved. Accuracy was improved over rule-based methods. However, risks exist when irrelevant FAQs are retrieved due to ambiguous queries. More resources and development time were required for this model which led to higher costs.

The model we ended up selecting was the Retrieval-Augmented Generation (RAG) Model because it mixes finding documents with making new text. A query submitted by a user prompts the model to first retrieve relevant documents or FAQ entries. Then a generative model constructs a coherent and contextually appropriate response based on this information. This allows tailored responses that can be accurate and flexible. An advantage is that the model can handle complicated queries even when these queries have no exact match in the FAQ database. Responses are dynamically generated from real-time retrieval and thus nuanced, and contextually relevant answers can be offered. Because of this, the user experience is improved. Efficient scaling as the FAQ data volume increases is also aided by this design, reducing manual update needs to predefined rules.

The best solution for SBSD was the RAG model after looking at each design idea. While approaches like rule-based, and machine-learning-based retrieval chatbots offered lower costs, and could be implemented more quickly, adaptability, and scalability were missing to handle SBSD's complicated inquiries. The RAG model, with its blend of real-time document retrieval and generative responses, provides the flexibility, accuracy, and scalability needed to effectively manage diverse user queries and future expansions of the FAQ content.

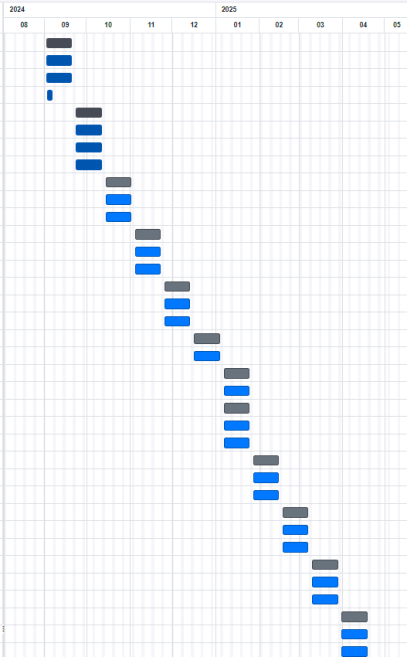
Appendix 1: Project Timeline

Here is our anticipated timeline for the SBSD Capstone project. This link will take you to a website to view the timeline in greater detail but we attached the image below for easier viewing.

SBSD Timeline

Expand all | Collapse all | Zoom in | Zoom out | Zoom to fit

ID	Task Name	Start	End	Duration	Progress %	Dependency	Resources	Color
1	Week 1-2	2024-09-02	2024-09-20	15 days	100			
2	Define Project Scope and objectives	2024-09-02	2024-09-20	15 days	100			
3	Identify Stakeholders and target audience	2024-09-02	2024-09-20	15 days	100			
4	Deliverable #1	2024-09-02	2024-09-06	4.12 days	100			
5	Week 3-4	2024-09-23	2024-10-11	15 days	100			
6	Deliverable #2	2024-09-23	2024-10-11	15 days	100			
7	Gather Requirements	2024-09-23	2024-10-11	15 days	100			
8	Finalize Technology Stack	2024-09-23	2024-10-11	15 days	100			
9	Week 5-6	2024-10-14	2024-11-01	15 days	0			
10	Identify data sources	2024-10-14	2024-11-01	15 days	0			
11	Collect and aggregate data	2024-10-14	2024-11-01	15 days	0			
12	Week 7-8	2024-11-04	2024-11-22	15 days	0			
13	Clean and preprocess data	2024-11-04	2024-11-22	15 days	0			
14	Index documents for retrieval	2024-11-04	2024-11-22	15 days	0			
15	Week 9-10	2024-11-25	2024-12-13	15 days	0			
16	Develop and implement the Retrieval Component	2024-11-25	2024-12-13	15 days	0			
17	Poster Presentation	2024-11-25	2024-12-13	15 days	0			
18	Week 11-12	2024-12-16	2025-01-03	15 days	0			
19	Develop the Generative Component (fine-tunethe model).	2024-12-16	2025-01-03	15 days	0			
20	Week 13-14	2025-01-06	2025-01-24	15 days	0			
21	Integrate retrieval and generative components. Begin unit...	2025-01-06	2025-01-24	15 days	0			
22	Week 15-16	2025-01-06	2025-01-24	15 days	0			
23	Start user acceptance testing (UAT) with a small group of ...	2025-01-06	2025-01-24	15 days	0			
24	Conduct integration testing	2025-01-06	2025-01-24	15 days	0			
25	Week 17-18	2025-01-27	2025-02-14	15 days	0			
26	Prepare deployment environment (cloud setup)	2025-01-27	2025-02-14	15 days	0			
27	Implement logging and monitoring tools	2025-01-27	2025-02-14	15 days	0			
28	Week 19-20	2025-02-17	2025-03-07	15 days	0			
29	Conduct performance testing and optimization	2025-02-17	2025-03-07	15 days	0			
30	Finalize user documentation	2025-02-17	2025-03-07	15 days	0			
31	Week 21-22	2025-03-10	2025-03-28	15 days	0			
32	Deploy the chatbot to production	2025-03-10	2025-03-28	15 days	0			
33	Monitor initial performance and gather user feedback	2025-03-10	2025-03-28	15 days	0			
34	Week 23-24	2025-03-31	2025-04-18	15 days	0			
35	Analyze feedback for improvements	2025-03-31	2025-04-18	15 days	0			
36	Plan for future enhancements and maintenance	2025-03-31	2025-04-18	15 days	0			



Appendix 2: Team Contract (i.e. Team Organization)

Step 1: Get to Know One Another. Gather Basic Information.

Task: This initial time together is important to form a strong team dynamic and get to know each other more as people outside of class time. Consider ways to develop positive working relationships with others, while remaining open and personal. Learn each other's strengths and discuss good/bad team experiences. This is also a good opportunity to start to better understand each other's communication and working styles.

Team Member Name	***Strengths each member bring to the group***	***Other Info***	***Contact Info***
Zach Dellimore	*Web development experience, AI development experience, Industry experience*	*I enjoy coding and make lots of personal projects for fun. AI is something I've been wanting more experience with.*	*dellimorez@vcu.edu* *540-394-8593*
Victor Olivar	I have experience in AI making machine learning about stocks and data analysis.	I enjoy coding to create projects that will help me with my everyday necessities. This project is really good for me because I've been looking forward to experiencing more work related to AI.	olivarvf@vcu.edu 804-647-5826
Jacobo Ceballos	I keep people on track and will make sure we are staying on task, not leaving things to the last minute. Discipline, web development experience, I have experience building and deploying AI models. Full stack programming experience	I'm looking forward to working on this project. Over the summer I worked on both web development and AI projects so I hope to bring some of that experience into the table.	ceballosj@vcu.edu 804-418-1199
Nate Swetlow	Good with many different coding languages as well as a background in data analytics.	I like to work on coding projects related to finance and data. I have experience with Tableau too.	Swetlownt@vcu.edu 703-582-2759

Other Stakeholders	***Notes***	***Contact Info***
John Leonard	*Met with Prof Leonard on 9/5 did a brief overview of the project and the path we are going down.*	*jdleonard@vcu.edu*
Willis Morris	*Sent out an email to set up a meeting with Mr. Morris and go over the project.*	Willis.Morris@sbsd.virginia.gov

Step 2: Team Culture. Clarify the Group's Purpose and Culture Goals.

Task: Discuss how each team member wants to be treated to encourage them to make valuable contributions to the group and how each team member would like to feel recognized for their efforts. Discuss how the team will foster an environment where each team member feels they are accountable for their actions and the way they contribute to the project. These are your Culture Goals (left column). How do the students demonstrate these culture goals? These are your Actions (middle column). Finally, how do students deviate from the team's culture goals? What are ways that other team members can notice when that culture goal is no longer being honored in team dynamics? These are your Warning Signs (right column).

Resources: More information and an example Team Culture can be found in the Biodesign Student Guide "Intentional Teamwork" page (webpage | PDF)

Culture Goals	***Actions***	***Warning Signs***
Teamwork	- *Help each other with work* - *provide assistance to work you may know* - *Step up for each other.*	- *Student need to contribute or else a warning* - *If student fail to contribute at least once a week, it'll be a warning.*
Open Communication	- *Keep team informed on your tasks status* - *Ask for help if you need it*	- *Student shows up for weekly meeting with no considerable work done* - Team members feel out of the loop consistently on the status of other team members task
NO PROCRASTINATION	- stay on top of all due lates - absolutely no late turn ins - work ahead of schedule and not leave things for the last minute	- if we miss a due late, there will be a team meeting to discuss time management - if we somehow miss two due dates, meeting with advisor to seek guidance

Step 3: Time Commitments, Meeting Structure, and Communication

Task: Discuss the anticipated time commitments for the group project. Consider the following questions (don't answer these questions in the box below):

- What are reasonable time commitments for everyone to invest in this project?
- What other activities and commitments do group members have in their lives?
- How will we communicate with each other?
- When will we meet as a team? Where will we meet? How Often?
- Who will run the meetings? Will there be an assigned team leader or scribe? Does that position rotate or will same person take on that role for the duration of the project?

Required: How often you will meet with your faculty advisor, where you will meet, and how the meetings will be conducted. Who arranges these meetings?
See examples below.

Meeting Participants	***Frequency Dates and Times / Locations***	***Meeting Goals Responsible Party***
Students Only	*As Needed, On Discord Voice Channel*	*Update group on day-to-day challenges and accomplishments (Zach will summarize these for the weekly progress reports and meetings with advisor)*
Students Only	*Every Thursday, in library or discord if no in person spaces available*	*Actively work on the project and update the team on what we accomplished that week. (Zach will document these meetings by taking photos of whiteboards, documents, etc, then post on the Discord channel and update Capstone Report)*
Students + Faculty advisor	*Once or twice a month on Thursdays at, or around, 6:00pm via Discord*	*Update faculty advisor and get answers to our questions (Zach will scribe; TODO will create meeting agenda and lead meeting)*
Project Sponsor	*Once or twice a month, via Zoom/Google Meet. If we need to update meeting times we will update the sponsor via Email*	*Update project sponsor and make sure we are on the right track (Zach will scribe; TODO will create meeting agenda and lead meeting; Team will present project developments)*

Step 4: Determine Individual Roles and Responsibilities

Task: As part of the Capstone Team experience, each member will take on a leadership role, ***in addition to*** contributing to the overall weekly action items for the project. Some common leadership roles for Capstone projects are listed below. Other roles may be assigned with approval of your faculty advisor as deemed fit for the project. For the entirety of the project, you should communicate progress to your advisor specifically with regard to your role.

- **Before meeting with your team**, take some time to ask yourself: what is my "natural" role in this group (strengths)? How can I use this experience to help me grow and develop more?
- **As a group,** discuss the various tasks needed for the project and role preferences. Then assign roles in the table on the next page. Try to create a team dynamic that is fair and equitable, while promoting the strengths of each member.

Communication Leaders

TODO: Assign a team member to be the primary contact for the client/sponsor. This person will schedule meetings, send updates, and ensure deliverables are met.

TODO: Assign a team member to be the primary contact for faculty advisor. This person will schedule meetings, send updates, and ensure deliverables are met.

Common Leadership Roles for Capstone

1. **Project Manager:** Manages all tasks; develops overall schedule for project; writes agendas and runs meetings; reviews and monitors individual action items; creates an environment where team members are respected, take risks and feel safe expressing their ideas.
   Required: On Edusourced, under the Team tab, make sure that this student is assigned the Project Manager role. This is required so that Capstone program staff can easily identify a single contact person, especially for items like Purchasing and Receiving project supplies.
2. **Logistics Manager:** coordinates all internal and external interactions; lead in establishing contact within and outside of organization, following up on communication of commitments, obtaining information for the team; documents meeting minutes; manages facility and resource usage.
3. **Financial Manager:** researches/benchmarks technical purchases and acquisitions; conducts pricing analysis and budget justifications on proposed purchases; carries out team purchase requests; monitors team budget.
4. **Systems Engineer:** analyzes Client initial design specification and leads establishment of product specifications; monitors, coordinates and manages integration of sub-systems in the prototype; develops and recommends system architecture and manages product interfaces.
5. **Test Engineer:** oversees experimental design, test plan, procedures and data analysis; acquires data acquisition equipment and any necessary software; establishes test protocols and schedules; oversees statistical analysis of results; leads presentation of experimental finding and resulting recommendations.

6. **Manufacturing Engineer:** coordinates all fabrication required to meet final prototype requirements; oversees that all engineering drawings meet the requirements of machine shop or vendor; reviews designs to ensure design for manufacturing; determines realistic timing for fabrication and quality; develops schedule for all manufacturing.

Team Member	***Role(s)***	***Responsibilities***
Nate	Researcher Design	● Coordinates all tasks and ensures deadlines are met. ● Breaks down the project into manageable tasks. ● Analyzes information and presents findings to the group.
Victor	Test Engineer	● Main responsibility is to make sure the final project is stable, reliable, and of high quality. ● Test planning to analyze what the project's requirement for testing ● Test execution to find bugs and issues and report it to the group and also to ensure that the changes don't affect the previous working functions.
Zach	Systems Engineer	● Takes notes on client design specifications and will create presentations/notes on our product specification. ● Plan out system architecture and how each system will interact with each other in compliance with the EO 30.
Jacob	Project Manager	● Keeping the group on task, coordinated and up to date with all the information from advisor and sponsor ● Making sure that all the deliverables are on time ● Ensuring that everyone is doing their fair share ● time management, financial budget, planning and defining scope

Step 5: Agree to the above team contract

Team Member: Zach Dellimore *Signature: Zachariah Dellimore*

Team Member: Jacobo Ceballos *Signature: Jacobo Ceballos*

Team Member: Nate Swetlow *Signature: Nathan Swetlow*

Team Member: Victor Olivar *Signature: Victor Olivar*

References

[1] VITA. *Commonwealth of Virginia Enterprise Architecture Standard (EA-225) Enterprise Solutions Architecture [ESA] Web Systems*. Commonwealth of Virginia, 28 May 2024, https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiv8qfv8YSJAxXK6skDHU_MKAMQFnoECBMQAQ&url=https%3A%2F%2Fwww.vita.virginia.gov%2Fmedia%2Fvitavirginiagov%2Fit-governance%2Fea%2Fdocs%2FEA-Solutions-Web-Systems-Standard.

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