Project MOA CDR

Brigham Young University

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All students are undergraduate students pursuing degrees and careers in user experience design.

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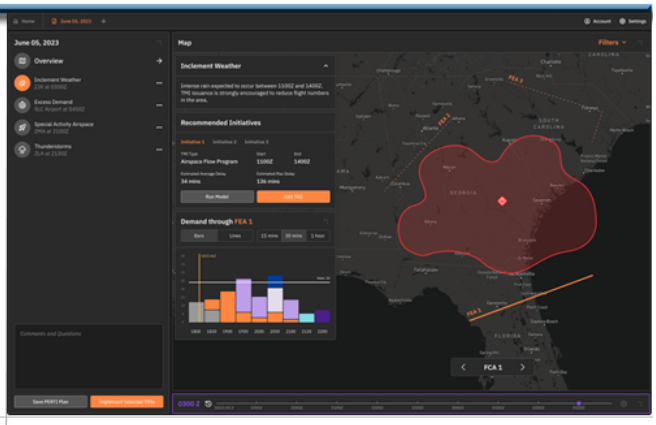
BYU *Project MOA – Brigham Young University*

TFM-AID
TRAFFIC FLOW MANAGEMENT - APPLICATION INTEGRATION DESIGN CHALLENGE

Project Description/Requirements

- Redesigning FMDS focused on clarity/unity.
  - Just-in-time info, hierarchy of info, prioritization of tasks
- Implementing modern UX standards and consistency
- Improved task-focused flow
- Integrated and standardized alerts system
- Permissions structure handling differing levels of user authority



Risks/Issues

- Limited access to TMU Personnel for design
- Time to develop refreshed frontend and backend.
  - We plan to use industry standard components in order to facilitate the transition process.
- Users adjusting to new interface layout and features.
- Relies more on recommendations and algorithmic analysis of problem areas.

Next Steps

1. Build out more of the program's features.
2. Prepare prototypes for more extensive usability testing
3. Conduct usability testing with heuristics professionals and SMEs
4. Refine prototype based on feedback from usability tests.
5. Work with programmers to begin building.

Technical Report

Summary Statement

Our project name is MOA. MOA serves as an acronym for Management of Airspace and is also the name of an extinct group of large, 12-foot, flightless New Zealand birds. We felt that the characteristics of the Moa bird reflected our goal and objectives:

1. Retire (or make extinct) the disparate systems used to manage air traffic and unify them under one comprehensive Flow Management Data and Services (FMDS) software.
2. To the maximum extent possible, get flightless birds (aka grounded aircraft) off the ground and in flight while accounting for weather, high traffic volume, and space launch/reentry events.
3. Empower air traffic controllers (ATCs), and notably Air Traffic Control System Command Center (ATCSCC) traffic managers, to manage flocks of planes by providing them with a tool that allows them to examine airspace regions; view flight demand; model Traffic Management Initiatives (TMIs); collaborate with other facilities and NAS users; notify, share, and communicate TMIs with other facilities and ATCs; implement TMIs and monitor effectiveness; modify and update TMI parameters as events develop and change; and log actions and results and conduct post-event analyses.

Our proposed design leverages design and psychology principles to create a unified, clear, and consistent system that aims to increase the efficiency, effectiveness, and experience for ATCSCC traffic managers when managing airspace. By surfacing important information to the top of the display, focusing on features that the user frequently visits, and reducing the amount of distracting elements, we believe that the aforementioned goals are attainable. **Our updated design solution also reduces training by leveraging familiar, modern interface conventions and utilizing frameworks that match the mental models of new and senior traffic controllers and managers.** Permission settings will allow top-level administration to grant appropriate interface views and access to individual air traffic controllers depending on levels of responsibility and management.

Project Description

Design Constraints and Guidelines

Our focus is to help Traffic Management Coordinators (TMCs) monitor demand, model TMIs, and measure effectiveness by improving the GUI of the new FMDS while accounting for the system's constraints and requirements such as screen size, customizable workspaces, and accessible designs including text color and size.

Keeping these requirements and considerations in mind, our top-level guiding principles are unity, clarity, and consistency. The current TFMS contains disparate features, operations, and systems. Our proposed design will unify the pieces, parts, and systems and consolidate them into one new FMDS software system. We will improve the clarity and transparency of events and actions by the right information at the right time in a task-focused system, which will ultimately benefit both new and seasoned users of the program.

Recognizing that the nature of air traffic control is a very time-dependent operation with many moving parts and players, the user must be up to date with everything they need at any given time. We plan to focus on just-in-time information to ensure that TFM personnel have the information necessary to create, communicate, implement, manage, and evaluate TMIs at the right moments in their workflows. Our design minimizes distractions and extraneous details that don't contribute to the task at hand, reducing the signal-to-noise ratio. This also plays into displaying pertinent information to the task at hand. We focused on showing relevant data to user tasks so they are best informed when they make decisions, reducing cognitive load and stress on the user.

Additionally, we wanted to focus on the user's tasks in order to optimize for their workflow. A guiding principle of UX Design we plan to be cognizant of is the 80/20 Rule or the Pareto Principle. Within the context of software, it suggests that 80% of users' time within the program is spent on only 20% of its features, thus encouraging prioritization of those features. This prioritization of features will improve the user experience by ensuring that the time most spent is as optimized as possible.

User Personas

In our research, we strove to reach out to FAA personnel near our university and abroad who could provide an expert perspective into traffic management. We were able to better understand the processes and functions of different facilities through these interactions and it contributed to our knowledge for the final design. In the end, we were able to interface with more than 10 different people ranging from airline dispatchers, to TRACON managers, to Traffic Managers in the Salt Lake City Center. From these contacts, we were better able to understand our persona.

The primary persona we considered when designing this software was an experienced traffic control manager at the Command Center in Washington DC. Let's call this persona Jean. Jean has been working at the Command Center for over 10 years and knows all the ins and outs of the current system. Like many of her Command Center colleagues, Jean's common workflows include monitoring weather and other types of potential obstructions in the National Air Space (NAS), utilizing Flow Constrained Areas (FCAs) to monitor demand and capacity, and issuing Traffic Management Initiatives (TMIs) to help minimize congestion in the NAS and keep flights operating as efficiently as possible. Despite her experience with the TFMS system, Jean has many frustrations with the software. **Among those frustrations are 3 key issues:**

1. **Dated look and feel**

Compared to modern softwares, the current TFMS system is extremely dated, lacking adherence to current UX design trends and principles. Jean would not only want an upgraded face-lift in terms of the style of the software, but more workspace customization functionalities. Jean also wants the ability to toggle between light and dark modes.

2. **Lack of decision-support tools**

Many of the features in the current software provide the user with all the tools needed to monitor and implement TMI's but they are very inefficient at helping the user know what actions to take. The responsibility lies with the user to seek out the important data in order for them to make a fully informed decision.

3. **System-incohesiveness when attempting to perform actions.**

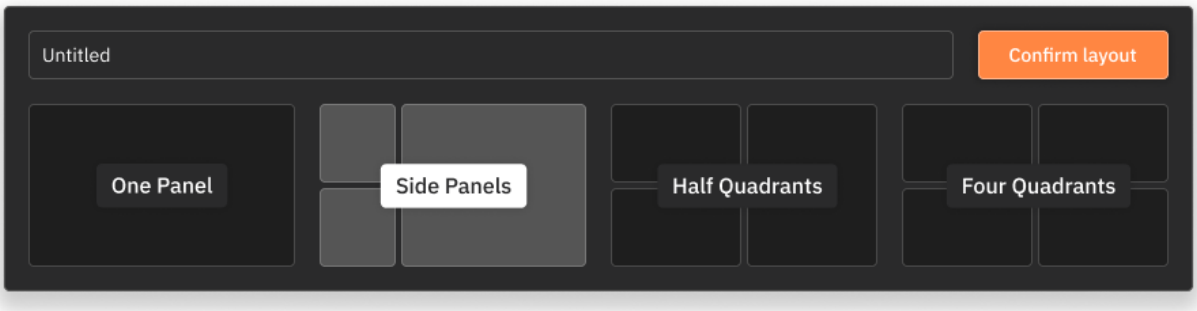
For Jean and many traffic managers like her, performing specific actions within TFMS requires many different views and windows spread across different monitors. This can be an extreme

headache, figuratively and literally, as paying attention to so many screens can become overwhelming. Instead of having to use many monitors to perform her work, Jean wishes she could have the flexibility to fit everything on one, with the option to drag windows out to more if she needs to.

Design Review

Our prototype design provides simplified interaction through its user-friendly interface layout. The prototype flow system contains redesigned aspects of the current NAS system to cater to experienced traffic managers while maintaining a simple, easy-to-learn flow for first-time users. Some feature highlights include:

a. With the space creation feature, visuals and icons next to buttons, suggested panel fillers, and predesigned layout systems aid users in efficiently customizing the architecture of their views. Such features can be viewed as prompts to guide new users to take action.



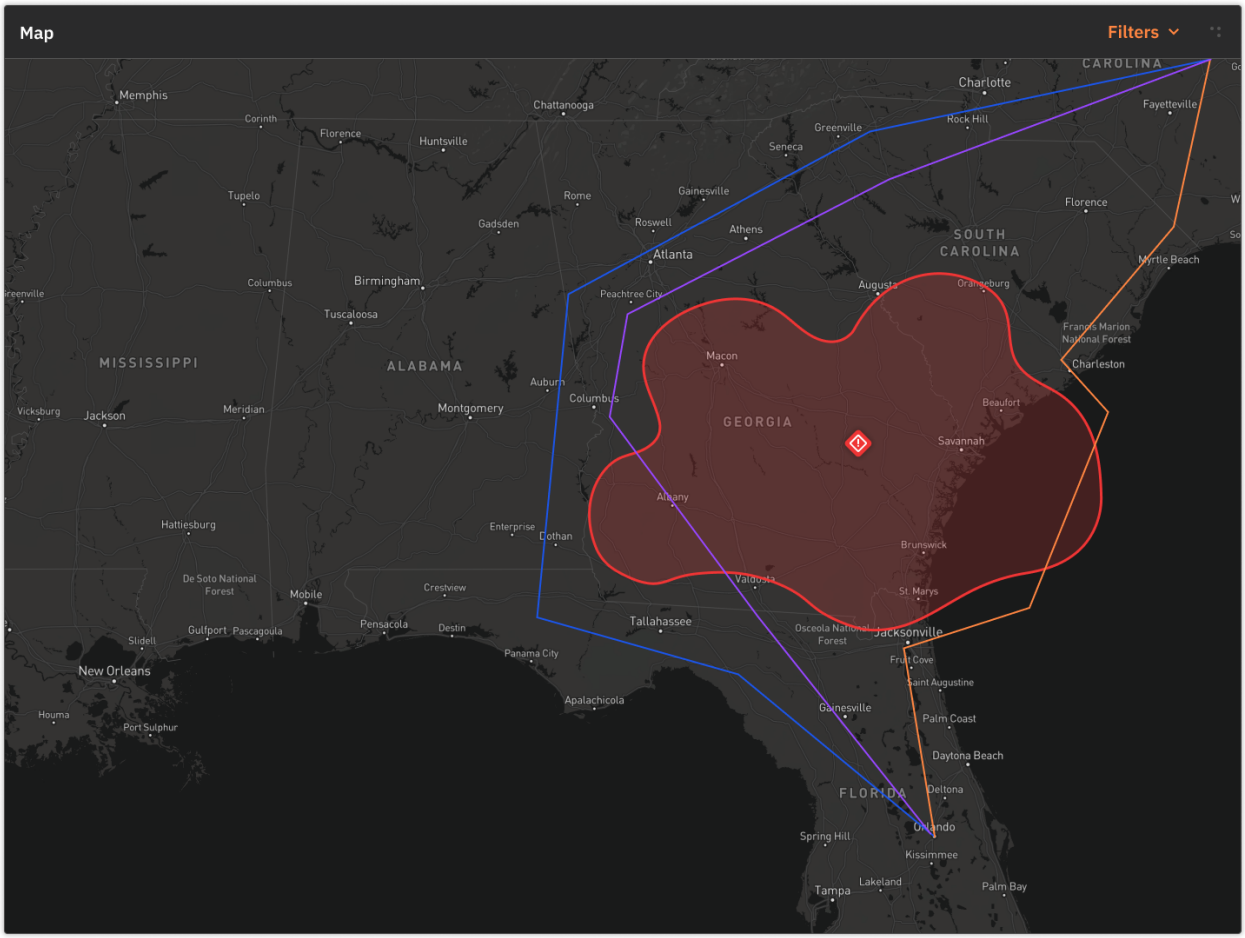
b. The home screen houses notifications, action lists, views, and advisories-which are organized so that all information is accessible and can be monitored at all times.

c. Upon implementing an action to accommodate an advisory, relevant information (such as affected airports and timing of an event) is attached to each alert with a complementing icon. The system is designed to help traffic managers make rapid and effective decisions. Recommended initiatives based on past playbook strategies aid users in creating an FCA and modeling TMIs with the click of a button. TMIs can be easily edited and tailored to any situation, thus allowing minimal manual user action.

d. A simplified bar graph shows users quickly where demand capacity exceeds the rate in an area of airspace. This graph can be expanded to show flight situations through time and at

several different locations. This feature include the Flight Schedule Monitor (FSM) and NAS monitor

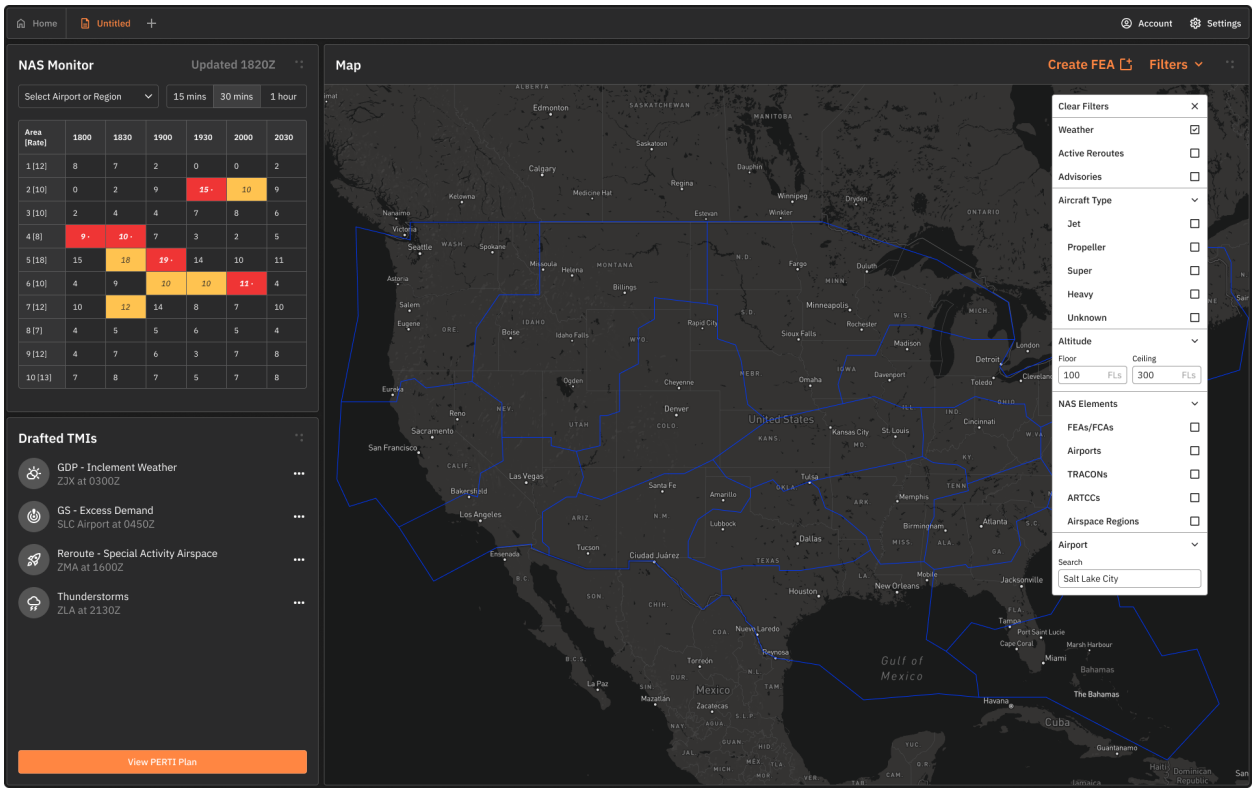
e. Certain TMIs now have an interactive visual feature on the map. The symbiotic relationship between the panel and adjacent map allows actions to be performed from either location. For example, in a situation of a modeled reroute, the map shows multiple possible routes around an FCA with average/maximum delay results listed on the panel. Users can click between routes and compare data to determine the fastest route without having to input data individually for each reroute.



f. Each modeled TMI has the option to add the selected initiative to a PERTI plan draft. Mimicking a shopping cart feature, traffic managers can add as many possible TMIs related to an advisory to their PERTI plan draft to be discussed and implemented in the next planning meeting.

g. The map also includes a time meter that allows the user to model different future times and dates on the map.

h. An interactive map allows the user to see a large portion of important information on the map. This entails a settings drop down window that allows the user to turn on and off whether, NAS elements including restricted airspaces and airspace regions, flights of varying types and at varying altitude levels, and other necessary visuals. The user can also mark areas where demand is high by creating Flow Evaluation Areas (FEAs) and later, Flow Constrained Areas (FCAs).



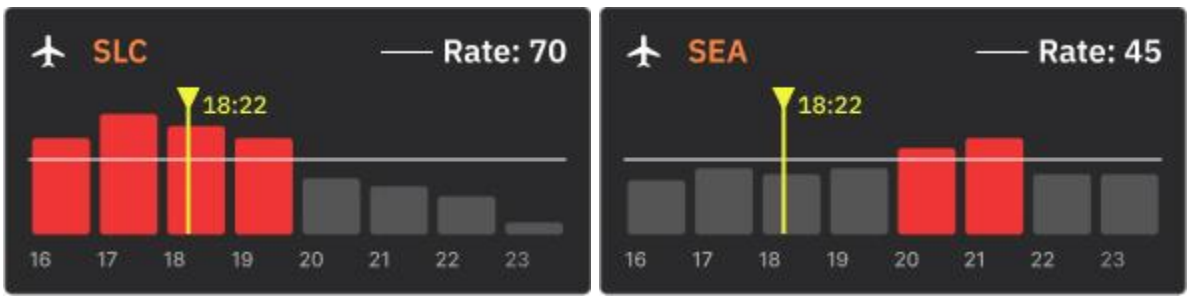
Project MOA uses innovative methods to update and replace aspects of the TFMS software. **Throughout our design work, we had the needs of the users in mind** by 1) defining parts of the current TFMS software that don't meet the user's base goals efficiently, and 2) Identifying aspects of the TFMS software that *do* efficiently meet user needs and thus, don't lack an innovative solution.

Some of the ways we prioritized innovation include:

- **Using a knowledge of modern UI/UX techniques** that have proven to provide better solutions for users. We often talked about common UX solutions as a team and implemented many of them into our design.
- **Focusing on in-person user research** as much as possible in order to correctly define the areas where innovation is needed. Throughout the project we contacted and met with more than 10 different people who have experience using the TFMS software or have been involved with flight traffic management in some way.
- **Meeting often as a team to review ideas** with one another. All the features in our project have been explored by multiple people. This allows out solutions to take into account different user ideas and thus, improves innovation.

One example of user experience innovation in **our software includes the ability for a user to model scenarios.** Users of our software monitor in order to identify problem areas and then they use several methods to brainstorm solution ideas. Project MOA provides users with an ability to assemble different Traffic Management Initiatives (TMIs) and compare their results thus, **aiding the user in deciding the best initiative before implementing it.** This will speed up the user's work while providing a less stressful experience.

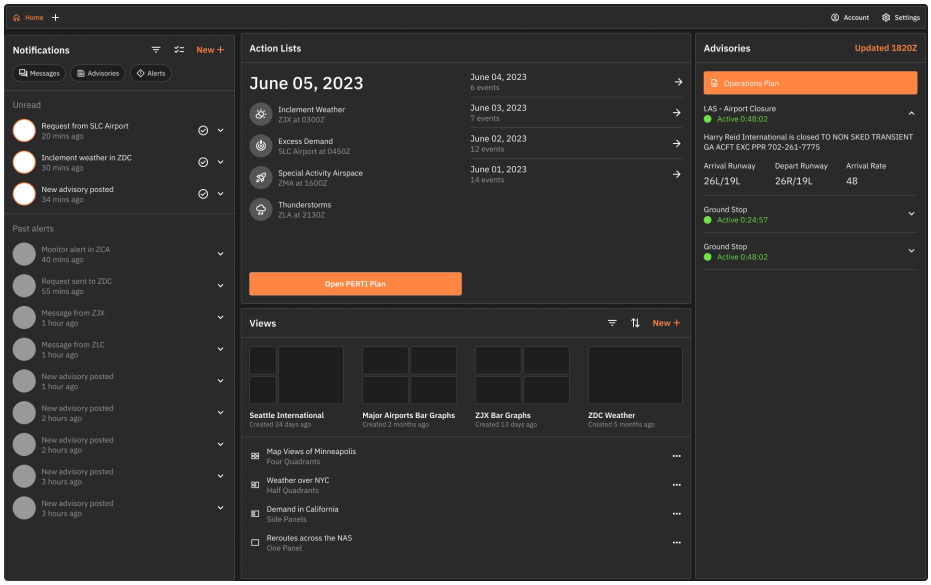
Besides the user experience, the UI design uses innovative techniques to improve readability and confusion. For example, **a version of the Flight Schedule Monitor (FSM) requires less analysis from the user** (see figure below). Rather, it aids the user by pointing out clearly where demand levels exceed the rate limit at an airport. Innovative use of color ensures that the user doesn't rely entirely on the color hue to determine difference between the bars. Rather, the red is significantly brighter in color value than the gray meaning even a user who fails to distinguish between two colors, can see clearly the difference.



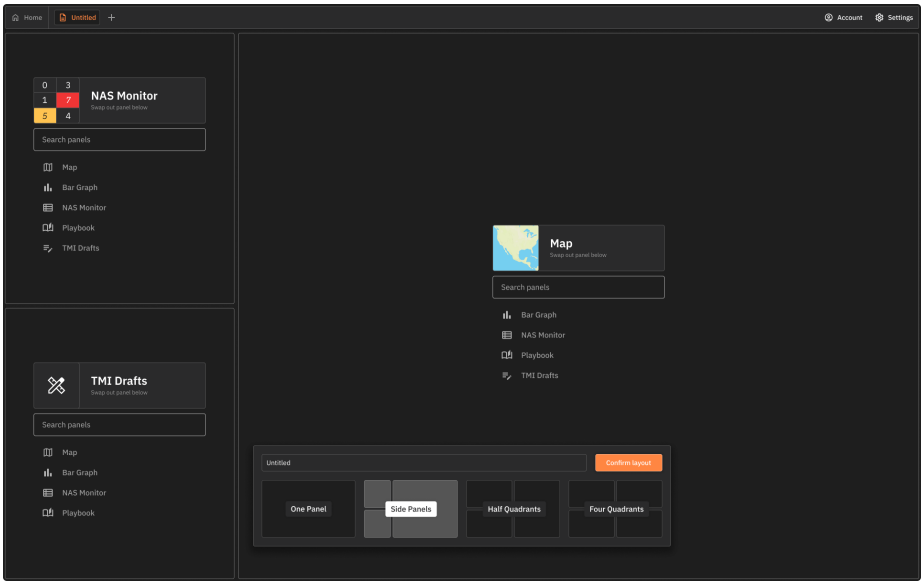
Another example of our innovative UI solution is the use of certain signifying colors. For example, **a vibrant shade of purple always signifies that an element is being modeled in the future.** When a user modeles time on the map, the time scrubber shows a purple border so as to prevent the user from mistakenly thinking the map is displaying current time.

Use Case

The user would start on the home screen where they are able to get a high level view of the current advisories in effect, upcoming events, and any alerts they've received. We also see this as a central place from which the user can launch into tasks for the coming day or open a view where they can monitor different regions of the NAS.

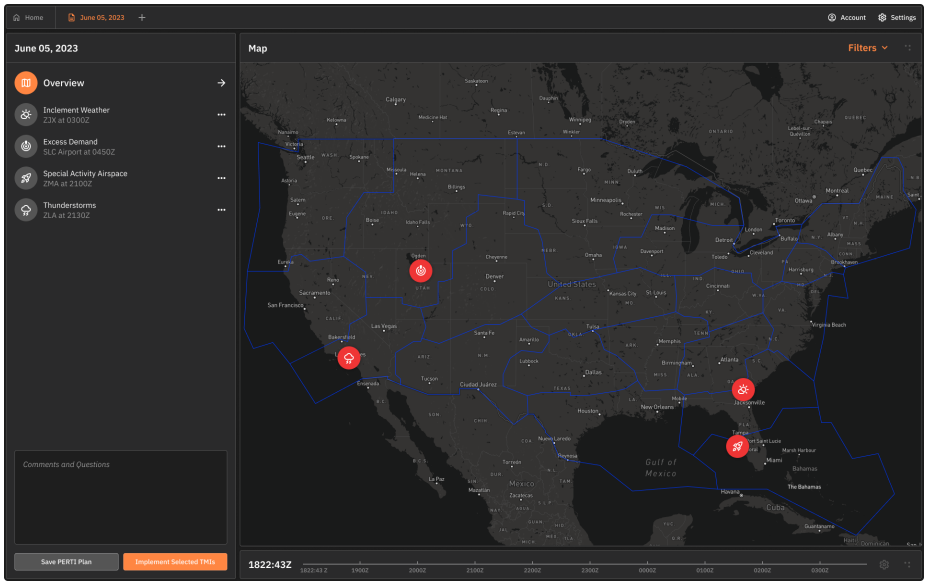


Opening into a new tab, the user is presented with an array of panels that can be customized to show the information they are interested in. Implementing a handful of layout options, a variety of panels ranging from the NAS Monitor to the map to the bar graph can be placed according to preference. For example, if a user wanted to monitor demand in several areas on the NAS, they could set up a view with a number of bar graphs or a number of maps simultaneously.

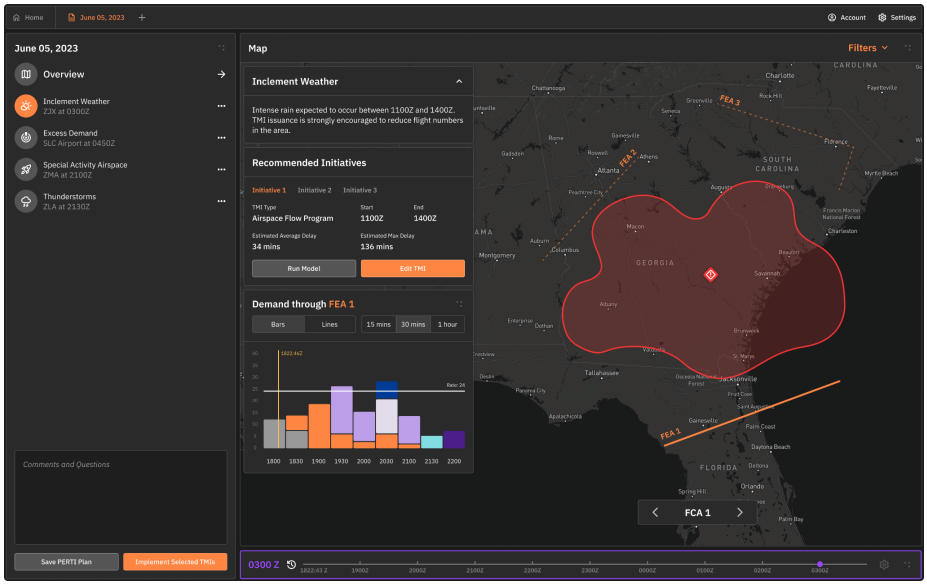


Monitoring views are designed to give traffic managers insights into the NAS that helps inform their decisions as well as make use of full interaction with the map. Here, the user can filter out regions, airspaces, flights, airports, weather, etc. as well as create and monitor FEAs in the NAS. These views are opened as tabs and can be saved and pinned for future reference.

In contrast, we have also built a special view relating to the PERTI Plan. These **views are organized into days and tasks since the PERTI Plan is built and refined every day.** Upon opening the PERTI Plan view, the user is shown an overview of expected problems in the near future including sector alerts, expected problematic weather, and special activity airspace such as rocket launches.

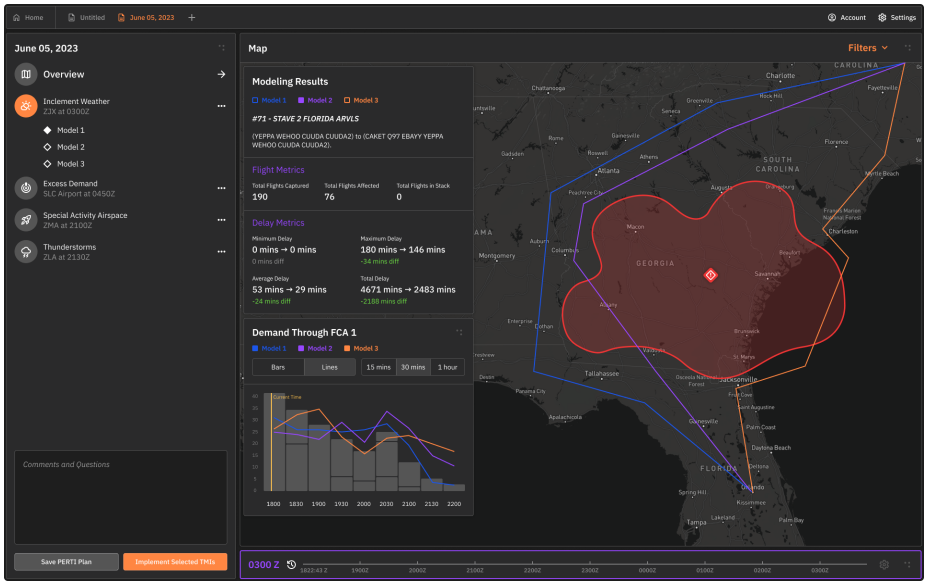


In this Action View, the user is now presented with all the pertinent problems that the system has identified. They then can go through and analyze which TMI would be best suited for each situation. As they approach each problem, **relevant information, such as a bar graph and modeling results, is prominently surfaced alongside the map in order to provide more context**. We also envision a fully interactive map, allowing the user to make changes in the panel that are reflected in the map and vice versa.

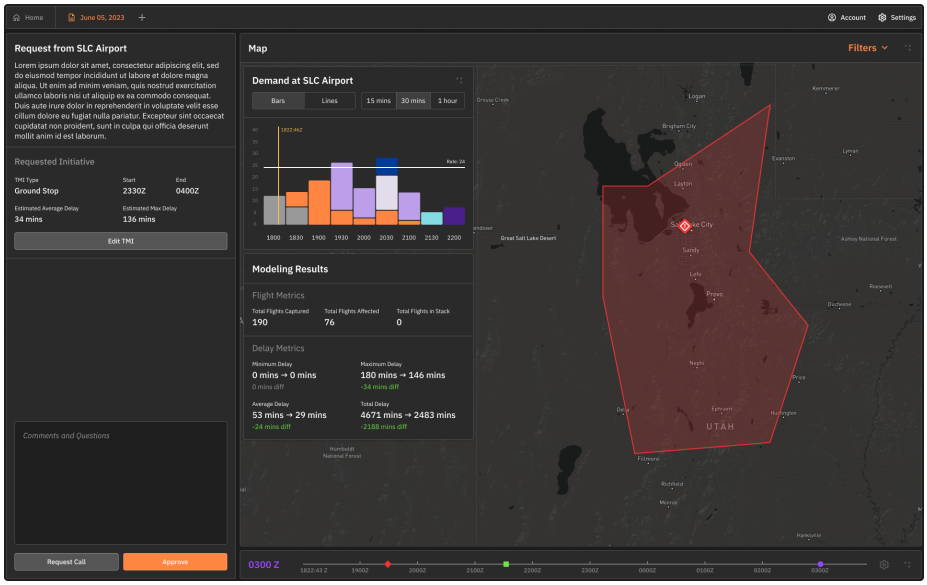


After reaching a satisfying set of conditions with the TMI, the user can choose to save it to the drafts as part of the PERTI Plan or implement it. These saved models can be sent to other

facilities and brought up for review during planning webinars in order to decide the best course of action. Additionally, we see added functionality in creating multiple drafts. After the user has established multiple potential TMIs, **they have the capability to enter a compare mode showing their individual routes, metrics, and influences side by side.**



After a decision has been made, the user can implement individual TMIs or all of the desired TMIs from the PERTI Plan with one button. These TMIs are then sent to the corresponding facilities with the same layout that the creator of the TMI had so they can see all the same information. When a request is sent from one facility to another, they receive a full screen showing all the contextual information in order for the traffic manager to make an informed decision. They can accept or request a call as well as leave comments.



Overall, we envision a more unified system that will aid the user in quickly making well-informed decisions with greater efficiency and clarity.

Technical Risks

As a fully functional software, project MOA would improve the user experience of ATCs in the 3 main ways:

1) Its innovative and modernized Interface design, would decrease the learning curve for new learners of the software.
2) Our software's decision support tools and modeling capabilities will aid the users in making the correct decision, making the users face a less stressful traffic management experience.
3) Integrated communication abilities will speed up the process of communicating initiatives and requesting between facilities.

Recognizing the sheer amount of work required to develop for both UX designers and product engineers, our new FMDS system leverages current, modern industry standards and conventions so that front-end developers can use existing frameworks as a foundation to build upon when implementing our proposed solution. As we continue to explore, define, and test FMDS ideas, concepts, and solutions, we will conduct a cost-benefit analysis for all ideas that may be difficult to build using existing standards or frameworks or that we recognize will require significantly more technical expertise and time.

Testing

Using a design thinking method called journey mapping, we thought through the user flow by imagining each task a user would need to do from start to end of a day. We relied primarily on teammate feedback to test the validity of our designs. This usually entailed rethinking through the flow over and over to ensure all aspects of the designs fit within it fluidly.

Team Description

Garrett Johns (Student Lead) - A Senior in the Design BA program with an emphasis in UX Design, Garrett has worked designing interfaces for a number of years. He plans to pursue a career either in UX Design or Branding. Over the previous school year, he worked with BYU Sandbox, a tech startup incubator, attempting to start a tech business with a group from class. While this opportunity didn't pan out, it allowed him to participate in the FMDS Interface Design Challenge which he is exceptionally grateful for.

Adam Shumway - A Sophomore, going into the Design BA program with an emphasis in UX. Adam works professionally as a graphic designer for BYU Athletics and has worked as a UX designer for school and side projects. He plans to pursue a career in UX design and research, hoping to be on the forefront of product innovation.

Claire McGregor - A Junior in the Design BA program with an emphasis in UX Design. Claire has utilized her UX skills through her participation in BYU's Sandbox Hackathon and with various school projects. She plans to continue to hone her skills with an internship this coming summer. Claire hopes to continue her education and pursue a career in UX design- hopefully one day working for a large corporation like Amazon.

Jackson Ringger - A Junior with a background in graphic design and video production who discovered the field of UX design last fall. Jackson recently made a change to major in Design with a UX emphasis, moving full steam ahead in pursuing a career in the field. He currently works in multiple roles as a UX Designer for BYU's Center for Learning, and a UX Design intern for a local startup. Jackson will also be working this coming year with a Sandbox team (BYU's startup incubator program) to lead the design and launch of a software product.

Seth Christensen (Faculty Advisor) - Assistant professor who researches and teaches user experience design. He also has a decade of industry experience designing interfaces and user experiences for complex software tools and business-to-business applications, including:

- A mobile device management software system that manages fleets of mobile devices, primarily for large retailers.
- An event management software for large-scale events (with anywhere from thousands to tens of thousands of attendees).
- Business tools for Natural Language Understanding (NLU) Analysts and Data Scientists to manage machine learning models and create customized digital agents for clients.

Project Plan Execution

We executed well on our proposed plan:

1. We completed more than five significant revisions and refinements of the initial solution concept.
2. We met with an HCI or UX expert at least once every two weeks. HCI/UX experts used the Luma Institute's heuristic review framework (https://www.luma-institute.com/heuristic-review/) to review and provide feedback on design concepts. They also offered additional input based on their academic and industry experiences and used human-centered design principles to contextualize their feedback.
3. We met with more than 10 experts with traffic experience, which helped us understand this problem space much better. However, we could not test the proposed design solutions with air traffic experts due to various concerns (e.g., employment agreements) about providing feedback on designs.