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Aviation Research Division
Atlantic City International Airport
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Adapting Data Collection Methodology in the COVID-19 Pandemic

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Final report

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16. Abstract

In March 2020, the COVID-19 global pandemic started to affect every aspect of our lives. Thus, federal research agencies, along with so many other business entities, were forced to cease operations or adapt to the constraints imposed due to the pandemic. In February 2020, the Federal Aviation Administration’s (FAA) Weather Technology in the Cockpit (WTIC) program was in the late stages of planning an activity that focused on crowdsourcing Alaskan aviation weather-camera information. The study intended to identify specific aspects of aviation weather-camera information such as obscurations, flight obstacles, and isolated areas of low visibility, which may be crowdsourced and is of value to pilots during flight operations. However, the sudden outbreak of COVID-19 disrupted the original plan to begin the evaluation in late March at the William J. Hughes Technical Center (WJHTC) Cockpit Simulation Facility (CSF) and FAA facilities in Alaska. This document describes how the Crowdsource Aviation Weather Camera study adapted to the challenges of conducting this study in the midst of the COVID-19 pandemic, including the adjustments that were made in order to proceed with data collection and the lessons learned for future efforts.

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Acronyms

Acronym	**Definition**
CSF	Cockpit Simulation Facility
EIT	Engineering and Information Technologies Inc
FAA	Federal Aviation Administration
GA	General Aviation
GUI	Graphical User Interface
IFR	Instrument Flight Rules
IRB	Institutional Review Board
VFR	Visual Flight Rules
VNR	VFR Not Recommended
WTIC	Weather Technology in the Cockpit

Executive summary

The COVID-19 pandemic presented challenges on a global scale that required creative solutions, including modifying research operations to adapt to constraints of the pandemic. Just prior to the stay-at-home orders, the Federal Aviation Administration's (FAA) Weather Technology in the Cockpit (WTIC) program was in the final stages of planning for a project, which explored the use of crowdsourcing to identify weather information via camera images in the Alaskan region. As the pandemic period extended, the WTIC research team decided to proceed, using on-line data collection.

The FAA's Aviation Weather Camera program uses webcams at remote locations across the Alaskan region to provide some means of weather information that is not otherwise available. These cameras take images at 10-minute intervals, which are accessible on the FAA's aviation camera website. An earlier study determined that using crowdsource workers (i.e., people trained to evaluate the camera images) was beneficial to gather and summarize visibility information for pilots. This follow-on study planned to explore whether crowdsource workers could evaluate the images for other types of information.

This document describes the planning and problem solving needed to conduct this study within the constraints imposed by the pandemic. In the early days of the pandemic, the situation was rapidly evolving with many unknown elements. This required thinking through contingencies and planning for worst case situations. The study ended up using an on-line data collection platform modeled after the aviation camera website. Researchers proctored the study using GoTo Meeting, which allowed the participants to interact with the software, enter their responses, complete questionnaires, and save the results on the researchers' local hard drives. The WTIC team was able to navigate the remote operational challenges and successfully completed the study.

This document describes the how researchers were able to successfully conduct the Crowdsource Aviation Weather Camera study despite the constraints posed by the pandemic, the challenges encountered with remotely conducting the study, the lessons learned, and the potential application for future efforts.

1 Introduction

In March 2020, the COVID-19 global pandemic started to affect every aspect of our lives. Federal research agencies, along with so many other business entities, were forced to cease operations or adapt to the constraints imposed by the pandemic. Prior to the onset of the pandemic, the Federal Aviation Administration's (FAA) Weather Technology in the Cockpit (WTIC) program was in the late stages of planning an activity that focused on crowdsourcing Alaskan aviation weather-camera information. The study intended to identify specific information from aviation weather cameras such as obscurations, flight obstacles, and isolated areas of low visibility that may be crowdsourced and is of value to pilots during flight operations. However, the sudden outbreak of COVID-19 disrupted the original plan to begin the evaluation in late March at the William J. Hughes Technical Center (WJHTC) Cockpit Simulation Facility (CSF) and FAA facilities in Alaska.

This document describes how the Crowdsource Aviation Weather Camera study adapted to the challenges of conducting the study in the midst of the COVID-19 pandemic, the adjustments we made in order to proceed with data collection, and the lessons learned for future efforts.

1.1 Study description

The FAA's Aviation Weather Camera Program maintains the website https://avcams.faa.gov (migrating to https://weathercams.faa.gov) which contains links to 230 weather cameras across the Alaskan region and a growing number in Colorado and Hawaii. These weather cameras are intended to provide situation awareness to improve safety and efficiency by providing pilots with near real-time, visual weather information. The camera images are updated every 10 minutes and have been critical in helping pilots make better safety decisions (Federal Aviation Administration, 2020).

In a previous effort (Rockwell & Collins, 2017), researchers trained crowdsource workers to evaluate visibility in aviation weather camera images, which they summarized and presented to pilots. In general terms, crowdsourced data is information gathered from a large group of individuals or detection/assessment mechanisms (i.e., the crowd) and forwarded to a central data server for processing, refinement, storage, and distribution (via the internet, hand-held devices, cockpit systems, etc.). In that study, Amazon's Mechanical Turk web service implemented and stored the crowdsource processing. Applying statistical analysis of the Mechanical Turk responses, researchers were able to produce visibility estimate averages and dispersions for many

Alaska weather camera images. As envisioned, such crowdsourced visibility results could be sent out to users or be available for display on various operator devices.

In the present context, we used Alaska pilots as subject matter experts in an Alaska weather camera visibility and image assessment task. The goal was to identify additional (beyond visibility) crowdsourced camera information like obscurations, flight obstacles, runway conditions, and isolated areas of low visibility (to mention a few alternatives) that is of value to pilots. The outcome of this task could yield important image features that, once evaluated in the crowd, could provide important information for pilots during flight planning, departures, en route operations, and arrivals.

2 Method

2.1 The original plan

Fortunately, this study was more readily adaptable to navigating the challenges presented by the COVID pandemic than our typical real-time, high-fidelity studies. Obtaining participants already familiar with the use of the weather cameras meant that our subject pool was located in Alaska (at the time of this study, Alaska was the only state operating weather cameras). Because our research budget did not include travel, we needed to devise a remote implementation method that enabled us to collect data with minimal researcher involvement. Our goal was to create a data collection platform that was self-contained and easy to use.

Our original plan was to send equipment with the software application for running the study already installed to a federal facility in Anchorage, Alaska. Sending our own equipment would allow us the opportunity to troubleshoot as needed to ensure the application worked as expected before sending it to the data collection site. It would also ensure that the application would be available on a dedicated system used exclusively for our data collection purposes. Sending our own equipment would also eliminate the risk of installation issues or unanticipated problems with the data collection setup. It also would allow us to control the way our material would be presented to the participants, in terms of screen size and configuration.

We designated a staff support specialist from Alaska Flight Services to proctor the data collection activity and perform necessary in-person duties such as getting the participant set up with the equipment, administering the consent form, ensuring the online connection, and troubleshooting any equipment issues. The research staff would remotely administer the study.

2.2 Problem solving

The situation, especially in the early days of the pandemic, was rapidly evolving with many unknowns. Plan A quickly changed to plan B, plan C, etc. As described in this section, we spent a lot of time planning, replanning, and coming up with multiple contingencies.

2.2.1 Location

With COVID restrictions facing federal facilities, our first problem was a location for the study. We began coordinating with a private aviation facility to host the study; however, additional restrictions as the COVID pandemic spread eliminated the facility as an option. We considered delaying the entire project. In the early days of pandemic, restrictions were tentatively slated for a few weeks subject to reevaluation. However, even early on it seemed likely that the pandemic restrictions would last longer than a few weeks.

Our next option was online collaboration with participants at their individual locations. We considered the possibility of requesting that participants download our study software onto their personal machines. This presented a number of potential challenges, including installation issues, system compatibility, and security issues. These challenges led us to explore other options. The next option we began to explore was to use an online collaborative application. We decided to use GoToMeeting (Version 7.6.0) since our team had an existing account and were already familiar with its functionality. Using GoToMeeting would enable us to run the software from our own machines. We could share our screen, allow the participant to interact with the software, enter their responses, complete questionnaires, and save the results to our local hard drives.

2.2.2 Institutional Review Board (IRB) and consent

After we decided on some of the logistical details, we needed to resubmit our Institutional Review Board (IRB) protocol to gain approval for the changes, most significantly, the change in venue. We also needed to determine how to best administer the consent forms. These require a witness of signature. We were able to work out a process with our local IRB representative to administer the consent form via email exchange.

2.2.3 System requirements

When we recruited participants, we emphasized the importance of using the largest screen available to them for this study. We assumed the participants would be limited to one screen; therefore, we wanted to have all the components of each scenario on one page. We created an application that looked similar to the weather camera website but added an input panel for participant data entry. This allowed the participant to enter their feedback without having to switch to a different window. Participants were able to keep the images in their view while entering data. This was of particular importance since the primary goal was to identify areas of interest in the images. We required that the participants use a regular computer with a monitor and not an iPad or mobile device. Co-locating the images and feedback panel on the same page, however, made us concerned with the size of the available viewing area. Similar to the weather camera site, the application functioned so that if the participant clicked on a thumbnail, it brought that image into a larger viewing area. Figure 1 is a snapshot from https://avcams.faa.gov/ showing the landing page for the cameras at Kodiak. Figure 2 shows our emulation of the website tailored for data collection. Participants also completed a biographical questionnaire and a post-study questionnaire via GoToMeeting.

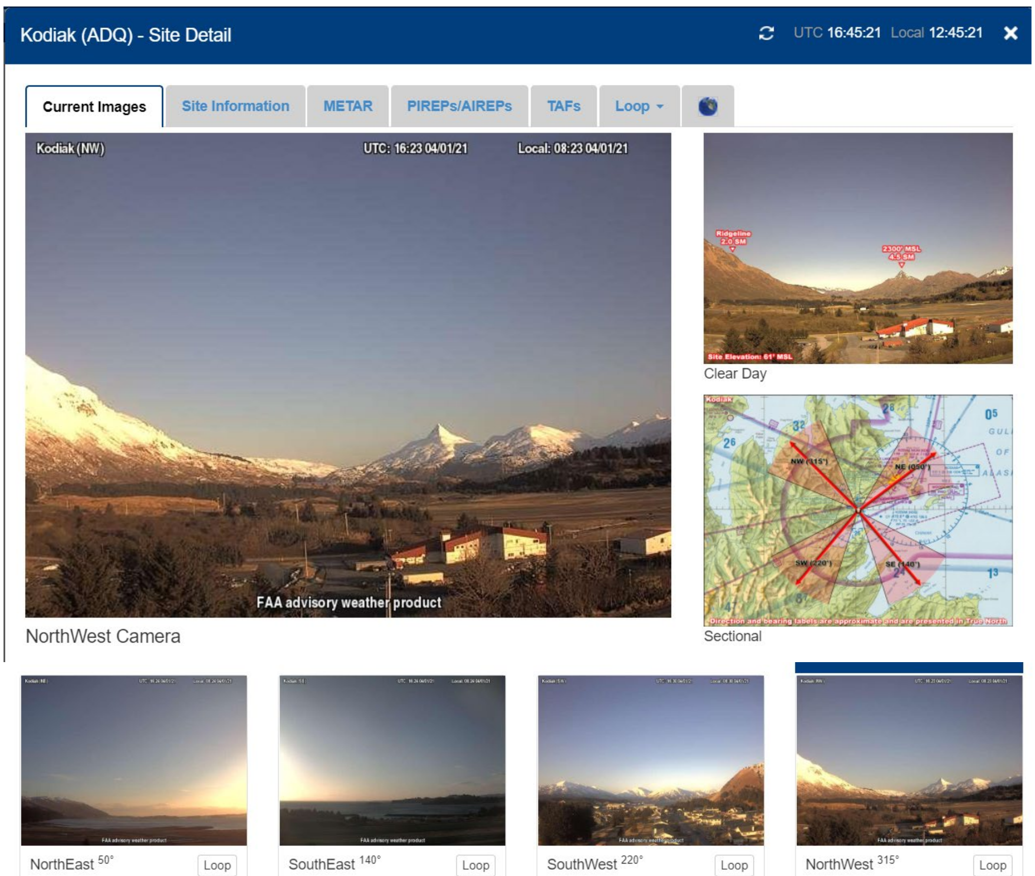


Figure 1. Example from the FAA aviation camera website

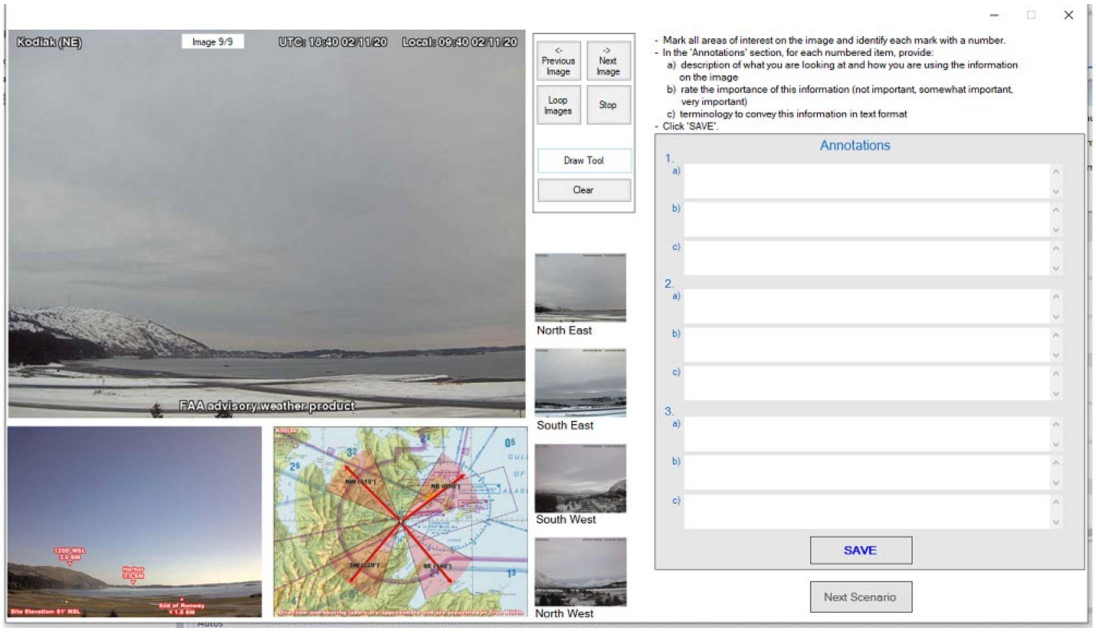


Figure 2. Alaskan weather-camera data collection page

2.2.4 Remote operational challenges

2.2.4.1 System lag

During internal testing, we found some amount of lag while sharing the screen to manipulate and enter data. Within our research group, we determined that the amount of lag was within a tolerable range although this remained somewhat of a concern given the potential variables in participant network speeds. While running participants, we did find some lag was greater than others, but it did not prevent us from collecting data from any participants.

2.2.4.2 Verifying system capabilities

We were unsure how familiar our participants would be with using GoToMeeting and wanted to ensure that each participants' system, network, and communication systems worked smoothly during data collection. Therefore, we scheduled a brief system check meeting with each participant to ensure they were able to use GoToMeeting and to identify any issues before their data collection time slot. We only had one participant that experienced issues substantial enough that we had to make other accommodations. This participant arranged to participate from an alternate location with better internet service.

2.2.4.3 Data collection disruption

We implemented an autosave function in the program so that if we were disconnected at any point, we would not lose any data. We also wanted to give the participant the flexibility to navigate to other images without losing track of data entries (there were multiple images per camera). Even if the participant switched to a different image, all annotations and drawings would automatically save in the results folder along with the corresponding image. Any drawings along with the annotations were repopulated when the participant returned to that image.

We did have an issue with the first participant where we encountered a software exception error. We had encountered the same error during shakedown and thought we had made adequate modifications to address the error. To address the issue, we had to restart the program (saved under a new file name so as not to overwrite the initial data file), skip through the already completed portion of the study, and resume data collection. The autosave feature performed as needed; we did not lose any data. We addressed the error and did not encounter it again.

When planning future online data collection, one improvement could be the capability to select specific scenarios as starting points instead of stepping through a predetermined progression. This would have enabled us to perform restarts picking up where the participant left off, rather than fast forwarding through the entire sequence to get to the correct scenario. This would be more complicated if we were randomizing scenarios. Depending on the project, it may be advantageous to have the software randomize the order in which we present scenarios, however, with online collaboration this would make it even more difficult in the event of a restart.

2.2.4.4 Scheduling and contingency coordination planning

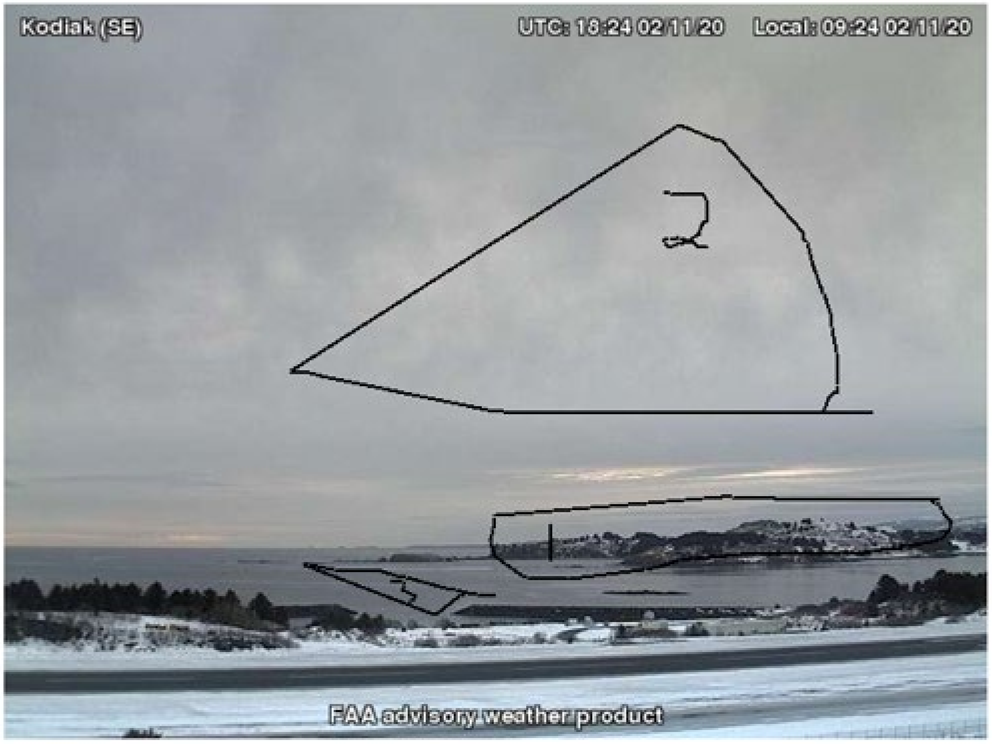
We developed protocols to protect the participant personal information and to keep the participant data separate from the research data. The Institutional Review Board reviewed and approved of the protocols. Engineering and Information Technologies Inc. (EIT) conducted all direct coordination with the participants. There was more coordination needed than for a normal study. First, we needed the scheduling coordination, then consent coordination, then the system check session, and finally the data collection session. EIT kept a spreadsheet containing all GoToMeeting invite information, including the links to ensure we sent the right invite to the right participant. If we lost connection with the participant during data collection, or needed to send an alternate meeting invitation, we would need to contact the EIT lead, who would contact the participant. Fortunately, data collection went well, and we did not need extra coordination due to interruption.

2.2.5 Data collection

During the evaluation, pilots reviewed and evaluated weather camera images from looped images from five Alaska weather camera locations. These locations were McGrath, Palmer, Kodiak, Valdez, and Cordova. These sites each have four cameras oriented towards different compass directions.

Participants viewed camera images presented as shown in Figure 2. Figure 2 shows that the images were presented as selectable thumbnails for each camera view, an enlarged view of the selected image, a clear day image for each camera view, and a sectional view. The clear day images include range and ridge elevation markers (when possible). The participants identified areas of interest on the image by placing a circle in the image and numbering each circle. They then filled out the corresponding numbered annotation portion of the form with a description of each identified area (line “a”). Participants could select single images to view individually or play looped images. Participants evaluated each image to identify obscurations, flight obstacles, isolated areas of low visibility, and any other image information that they considered to be of importance. Participants were asked to annotate the final image in the looped set and any additional images the participant chose. Because some of the looped images were very similar, the participants were told it was not necessary to comment on each image. The researcher also asked the pilot to rate the importance of each type of information. The importance ratings were: 1-not very important, 2-somewhat important, and 3-very important. Finally, if able, the participants provided any input on the conversion of the graphic.

The pilot-marked images and corresponding annotations were recorded for analysis. Figure 3 is an example of participant feedback. In this example, the pilot identified three separate areas in the image and provided a description of each circled area (entered into line “a” of the Annotation panel).



Note:

1- Visibility 5.5+[miles] along shore. Ceiling over 500'.
2- Clouds seem to be lower in this image as opposed to previous. Clouds on shore may be dropping, ceiling dropping. Conditions change quickly on shore low clouds 5.5+.
3- Water – low winds min ripples, calm water, wind min 5.5+.

Figure 3. Example of web camera image marking with notation responses

3 Summary

We were able to successfully complete our study objectives using online collaboration. During this web-camera image evaluation, pilots viewed and evaluated static web camera images and looped images from five Alaska weather camera locations and identified features that they felt would be beneficial to flight planning. Participants were able to remotely enter data and complete questionnaires. Though we encountered a few issues (which also occurs with in-person data collection), we were able to troubleshoot and resolve those issues without any loss of data.

Just as with in-person data collection, we recognized the importance of preplanning and tried to anticipate as many issues as we could. Since our platform was entirely online, we had to ensure the interface was functional, user-friendly, and efficient. We identified and resolved issues with the platform prior to data collection, such as screen resolution, button functionality, and save features. We developed and exercised our data collection process with team members and shakedown participants prior to the study.

4 Future planning

Our experience with online collaborative data collection during this project has led us to explore the possibility of using it for other projects. While we weigh the value of in person data collection against increasing delays, we explore ways to achieve other project objectives using similar methods used for the weather camera study.

4.1 Visual flight rules not recommend statement automation

Prior to COVID-19 restrictions, we planned to continue work developing an automated visual flight rules (VFR) not recommended (VNR) statement in 2020. Flight Service briefers issue a VNR statement to pilots when weather conditions are not recommended for VFR operations, but currently, this is only available when speaking to an actual briefer. We defined a procedural method for determining VNR conditions, potential standardization format for the VNR justification statements, and identified criteria for the obvious cases of VFR and VNR conditions for automation purposes. We created weather scenarios to step through VNR cases using a prototype graphical user interface (GUI) of a VNR information webpage (see Figure 4) to generate discussion regarding information requirements and user needs. While we are not developing a GUI, we are using it to focus on the identification of user needs, information requirements, and consistent ways to communicate information to the users.

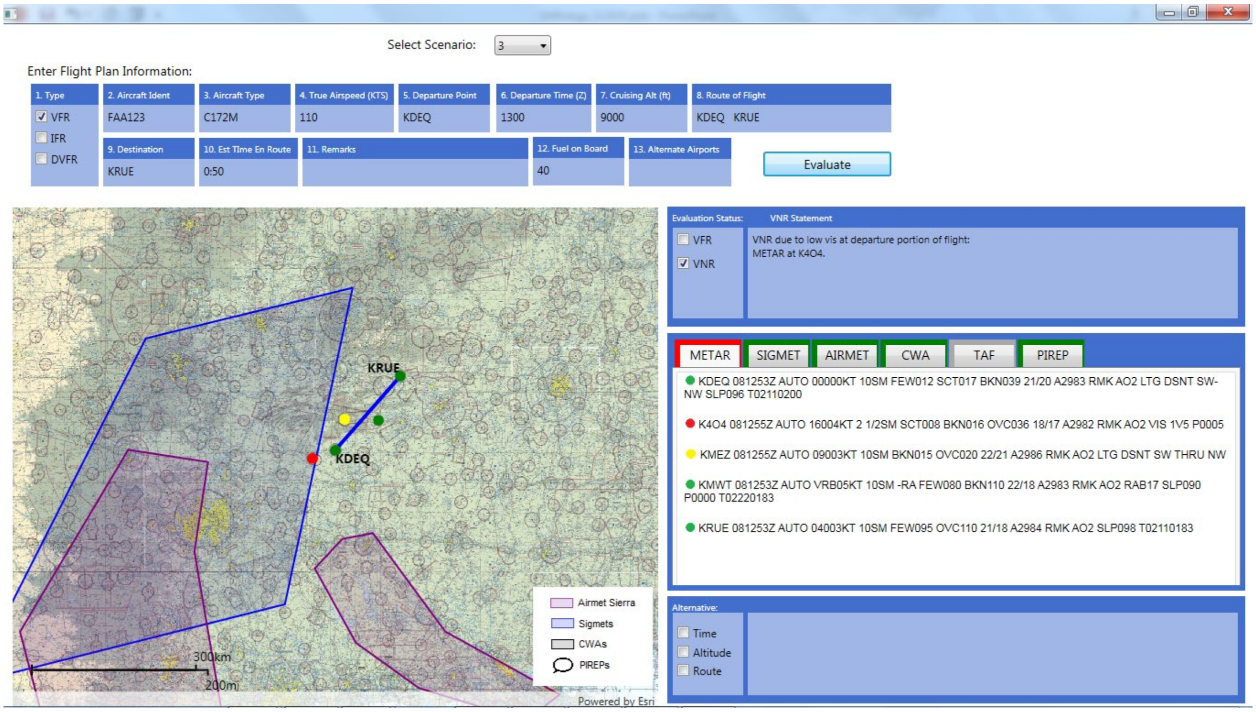


Figure 4. Mockup of VNR information webpage

Because we are in the early stages of this concept development, we prefer to interact with users in person to collect data. However, given that in-person restrictions are still a factor, and since this concept is ultimately meant for online purposes, we are evaluating online data collection methods such as those used in the weather camera study.

We are currently planning online collaborative data collection for this project, using the lessons learned from the weather camera study. Like the weather camera study, we will use screen sharing to allow participants to fill in forms and questionnaires. They will be able to view our weather scenarios and provide feedback using the interface.

Since we have been through this process with the weather camera study, we feel confident that we will be able to navigate any challenges that this new study will present.

4.2 Digital co-pilot

The Digital Co-Pilot (developed by Massachusetts Institute of Technology Research and Engineering) project involves using tablet-based software to provide flight assistance to general aviation pilots. The WTIC program office has an interest in conducting studies related to pilot decision-making using Digital Co-Pilot. The original intent was to use the general aviation simulators located at the Cockpit Simulation Facility (CSF) for a high-fidelity study. Prolonged restrictions may lead the research team to explore expanded online collaboration efforts beyond what can be achieve through software such as GoToMeeting. This project would require researchers to connect participants to a general aviation simulator at the CSF, with the pilot controlling the simulator by remote means, a capability which has not been tried before. The staff at the CSF are exploring different possibilities on how to achieve this capability.

One of the great advantages of using a simulator is the realistic, immersive environment. The cockpit simulators at the CSF are designed with out-the-window views similar to real aircraft. A serious consideration for conducting this study using online collaboration would be the impact of realism on the study objectives. The research team would need to determine what questions can be adequately addressed given additional study constraints, and how best to answer the research questions under the study constraints. Even with only an initial brainstorming session, however, we were able to come up with a few options to explore. It may be possible to leverage the proliferation of virtual reality technology to conduct this type of study. As the planning for this study proceeds, we will address any challenges and constraints with all the resources that we have available to us.

5 Conclusion

In our research, we commonly face constraints in time, resources, and funding. Part of our responsibilities is to work within the bounds of whatever those constraints are to meet our objectives and produce valid results. While COVID-19 restrictions have added considerable constraints to conducting research, this paper describes a study where we were able to adapt our research methodology and use alternative means to overcome the challenges posed by the pandemic. Additionally, we describe methods that we are currently exploring for conducting upcoming research projects should they face similar constraints.

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