Deliverable 8-C: Transportation Agency Field Demonstration Report

Michigan Technological University

Characterization of Unpaved Road Condition Through the Use of Remote Sensing Project

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Section I: Introduction

This report describes the field demonstration activities by the project team during Phase II of the "Characterization of Unpaved Road Condition Through the Use of Remote Sensing Project". These demonstrations served as both an outreach component and to assist in commercialization efforts.

During this phase of the project, the project team performed two field demonstrations. The first was in Salina, Kansas on June 10, 2015 and the second demonstration was held in Rapid City, South Dakota on October 20, 2015 as part of the North Dakota LTAP 2015 Regional Local Roads Conference. Both of these demonstrations followed the same format developed for the Sioux Falls, South Dakota event on June 26, 2014 held near the end of the first phase of the project. This format begins with an opening presentation by the projects Primary Investigator (PI) which introduces the audience to the project, the development of the Aerial Unpaved Road Assessment (AURA) system, and its condition assessment capabilities. This is followed by taking the participants to a representative section of unpaved road for a live demonstration of the system. During the live demonstration the participants were able to see the collection of condition assessment data for an unpaved road as well as learn how the Unmanned Aerial System (UAS) is set up and flown. After the field demonstration the participants are brought back to the meeting location to have a round table discussion with the project team.

The round table discussion has become an important component of the AURA system demonstrations. Since the audience has an opportunity to openly ask questions about the system and its potential uses, it engages the audience in discussion on how they could use the system for assessment of unpaved roads in their local transportation agency, tribe, company, or other end user group.

Section II: Selina, Kansas Demonstrations

The demonstration in Salina, Kansas was held on the campus of Kansas State University – Salina (KSU). There were 55 participants in attendance from various sectors of the transportation industry ranging from local roads managers to survey inspectors to state DOT staff. These included 23 city or County representatives, 15 academic representatives, nine from the private sector, and eight from Kansas state DOTs. The research team also asked Kurt Carraway, UAS Executive Director at KSU to join with the project team for the demonstrations and round table discussions. Since KSU has a strong aviation and UAS background it was important to include them as a partner in the demonstration. Figure 2-1 shows the project PI Colin Brooks giving the introductory presentation.

Figure 2-1: Colin Brooks presenting to the well-attended technical demonstration session at KSU-Salina

After the introductory presentation the attendees were taken to a representative unpaved road. Figure 2-2 shows the attendees learning about how the AURA platform is flown and collects data. The field demonstration allowed the attendees to get more familiar with operating UAVs and how they can be used for unpaved roads assessment in practice. All of the attendees are shown in Figure 2-3 at the field demonstration site.

Figure 2-2: Demonstration attendees observing the Bergen hexacopter collecting unpaved road data with project member answering questions.

Figure 2-3: Attendees at the field demonstration site

Round Table Discussion

The panel for the round table discussions included project PI Colin Brooks, Kurt Carraway of KSU – Salina, and Road and Bridge Director Dale Phillips for Barton County, Kansas. This part was geared towards the audience participations where they were lead into discussions on the uses of UAVs and the how they could use the AURA system (Figure 2-4). Along with the audience being able to ask questions of the panel, the audience was also asked questions which are important for the commercialization of the AURA system. These included whether they would like to own the system or contract out as a service, what other uses would they consider for the system, and whether they would consider this technology useful.

Figure 2-4: Colin Brooks (Michigan Tech – project PI & Senior Research Scientist), Dale Phillips (Barton County, KS Road and Bridge Director), and Kurt Carraway (Kansas State – Salina UAS Flight Operations Manager) answer questions during the afternoon discussion panel, with Valerie Lefler (IGD) recording the session.

Section III: Rapid City, South Dakota Demonstrations

The demonstration in Rapid City, South Dakota was held at the Best Western Ramkota Hotel. There were 55 participants in attendance from various sectors of the transportation industry and businesses who attended as a pre-conference workshop of the 30th Regional Local Roads Conference. Of those in attendance, there were 17 individuals who represented the private sector. There were more attendees who were from the private sector for this demonstration than the previous two. This is most likely a result of making the demonstration as part of the conference in which was attended by representatives by several companies.

Figure 3-1: Colin Brooks presenting an overview of the USDOT Project and AURA system.

As with the previous demonstration the attendees were taken to a representative unpaved road after the introductory presentation. Figure 3-2 shows the attendees being shown another UAS platform demonstration. This was important to show that other less expensive platforms can be used for a quick visual assessment of unpaved roads. The project PI flew a DJI Phantom Vision 2 which the camera is controlled by and sends video to the users' cellphone.

After the live demonstration, the attendees and presenters returned to the Ramkota Hotel, where Associate PI Dr. Tim Colling of the Michigan Tech Transportation Institute and Center for Technology and Training, gave a review of integrating AURA system data into the RoadSoft GIS decision support system. Participants were able to learn about how high-resolution unpaved road condition data could be effectively integrated into unpaved road asset management. Co-PI also shared examples of processed data collection results, including 3D data of roadways and samples of the University of Vermont's road data collected via fixed wing UAS. Figure 3-2 shows audience members learning about these capabilities.

Figure 3-2: Project PI Colin Brooks shows field demonstration attendees how to control the camera of a Phantom Vision 2.

Figure 3-3: Audience members at the Rapid City, SD demonstration learning about AURA system capabilities.

Round Table Discussion

The round table discussion was led by PI Colin Brooks and project outreach professional Valerie Lefler of Integrated Global Dimensions, Inc. The round table discussion followed the same format as before, where the audience was encouraged to engage with the project team members, asking questions as well as

Mr. Brooks and Ms. Lefler asking the audience questions which are important to commercialization of the system. Unlike previous discussions, more of the attendees are interested in purchasing the system and perform in-house data analysis. This is mostly a result of the increased number of services firms represented in the audience who would offer AURA as a service to transportations agencies.

Vendor Booth Results

The Rapid City demonstration was done in conjunction with the North Dakota LTAP 2015 Regional local roads conference. Along with the usual field demonstration format the project team also gave a presentation on the unpaved roads project and staffed a vendor's booth at the conference (Figure 3-4). This gave attendees at the conference, including those who did not attend the field demonstration, more of an opportunity to learn about the unpaved roads project and the capabilities of AURA. This also led to commercialization discussions with aerial services companies in the area.

Figure 3-4: Vendor booth setup at the 30th Regional Local Road Conference, with Mr. Brooks engaging with an attendee.

Section IV: Outcomes from Demonstrations

So what did we learn from conducting these two demonstrations? Technical demonstrations in and of themselves are not a new groundbreaking forum, while not overly common, they typically resemble more of a dog and pony show at the circus than a consultant sales pitch. So in our demonstrations, we aimed to strike a balance. Seeking to show and tell, but also qualify our buyers.

New Assessment Methods

Traditionally the only survey technology demonstration participants complete is a one-page overview about the topic the speaker and the quality of the snacks. For our commercialization assessment, we really wanted to get into the weeds in understanding what about the AURA system was attractive to local road managers and others who were in attendance. It goes without saying that commercialization of technology at one point or another ends up in a purchase. Thus we needed to identify the specific value proposition and pain points that were associated with the problem and AURA solution.

With each demonstration, we were able to improve our methods. When surveying workshop participants there was a dramatic difference in the instruments between Kansas and Rapid City, South Dakota. This difference predominately was reflected in the detail of information we were able to determine.

In our form in Kansas the research team asked the participants to list what they would use the AURA system for, however in South Dakota we gave them a list of the use cases that were identified in Kansas and asked them to check off which ones they would use the system for. This improved consistency in the answers as well. For example, you can see in Figure 4-1 almost 65% of those individuals who completed the survey indicated that they would use the AURA System for Unpaved Roads Condition Monitoring. In addition, we can see the range of how often they indicated they would use the system - ranging from 5+ to 12 times. However, you can see from the fact that some individuals did not read the question well, that they put "high" or "multiple times" in the frequency answer box, thus indicating that we could have been more specific in frequency of use in the future.
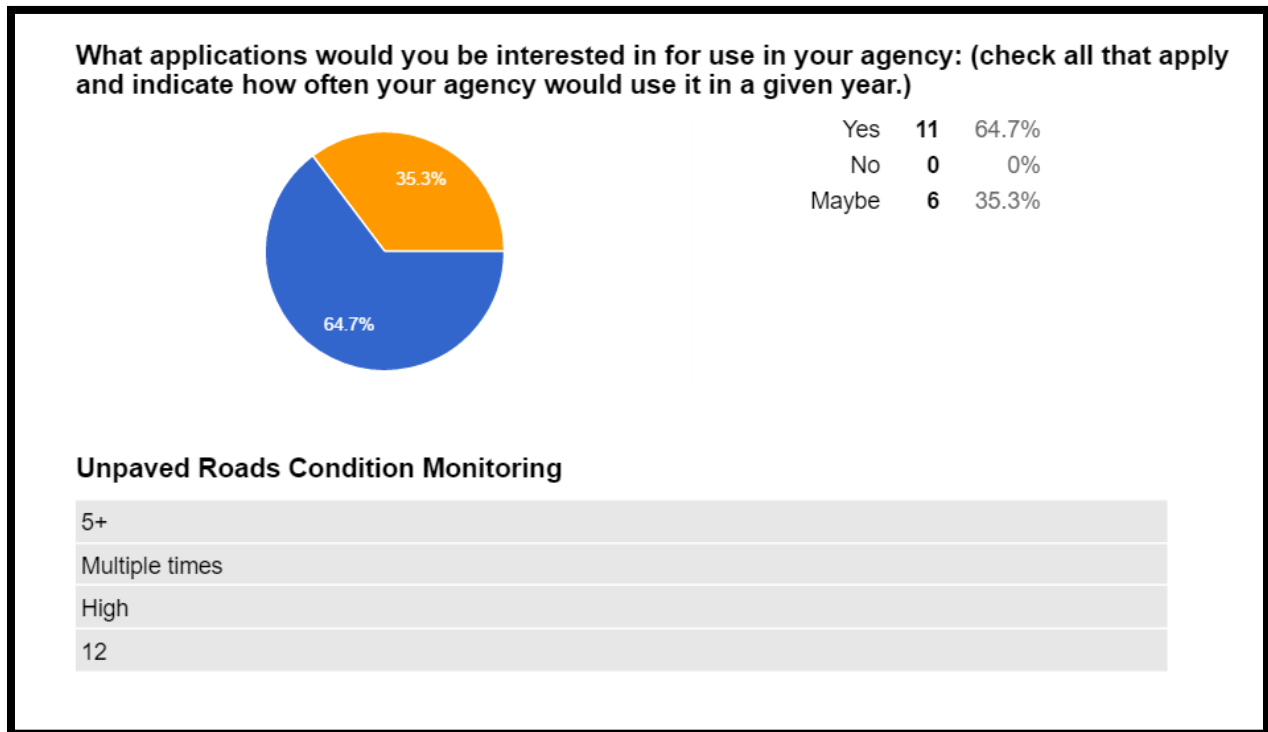
Figure 4-1: Response to Survey Question for South Dakota Demonstration

We were also able to understand more dimensions of the persona of the buyer. For example, in visiting with the local road managers in Kansas, we realized the physical burdens of getting on your hands and knees and measuring the crown of a gravel road properly. We also discovered that the average age of a local road manager was on average late 50's to early 60's – and very commonly struggling with back

issues due to the thousands of hours running snow plows and road graders before ergonomic equipment was designed. Thus we asked on the form in South Dakota specifically what "physical stress or pain at work" AURA would save, and we received answers about mangers not only avoiding the stress of measuring crown, but also "not climbing stock piles". The benefits in occupational welfare were not anywhere on our radar prior to the technical demonstrations.

Impact Comparison

In visiting with the demonstration participants it became clear that survey companies were on the leading edge – more willing to address or investigate the requirements to legally use a UAV on a roadway. Throughout the two events we received input and interest from a number of states, counties, agencies, and private sector firms that were added to our qualified list of stakeholders. We had drastically more success reaching more partners in our second demonstration because there were more opportunities to interact one-on-one, network in low pressure environments, and refocus. Compare the two experiences below:

Kansas Day 1: Welcome, Short Presentation, Demonstration, Extended Presentations, Q&A

South Dakota: Day 1: Welcome, Short Presentation, Demonstration, Extended Presentation, Q&A**, Day 2:** Mass Presentation to Conference Audience, & Vendor Booth Available

There are a significant number more of "impressions" on the audience in the two-day format. Having the "booth" available during the conference to allow state agencies, consultants, and other vendors check out the technology, touch the equipment, and visit with a member of the research team was very beneficial.

Figure 4-2: Colin and Tim visiting with prospects about AURA at the South Dakota Conference.

Commercialization Opportunities

While during the grant period we have not made direct sales there have been numerous agencies – public, private, and academic who have an increased awareness of UAVs in transportation by attending our

demonstrations. While they may not be using AURA for any number of reasons, they may be using UAVs to do other types of monitoring. Regardless, as their needs become more specific to AURA, they will come back to MTRI for a quote to provide service.   Figure 4-3 lists how "likely" the AURA system would be used as rated by demonstration participants, and the most common results were by a landslide a rating of 6 or 7.   This indicates that the MTRI team was able to demonstrate the purchase value of AURA. However, what are the barriers of adoption that they are facing in making the purchase? The private sector companies who were the most interested in purchasing were still either working through the UAS Certificate of Authorization process or they wanted features that were not available instantly on demand. It is noteworthy that since the Rapid City demonstration, three firms have discussed offering AURA services from their bases in Ohio, Nevada, and Arizona. With new Federal Aviation Administration rules ("Part 107") having been announced on June 21, 2016, it is now significantly easier for companies to offer UAS-enabled services.

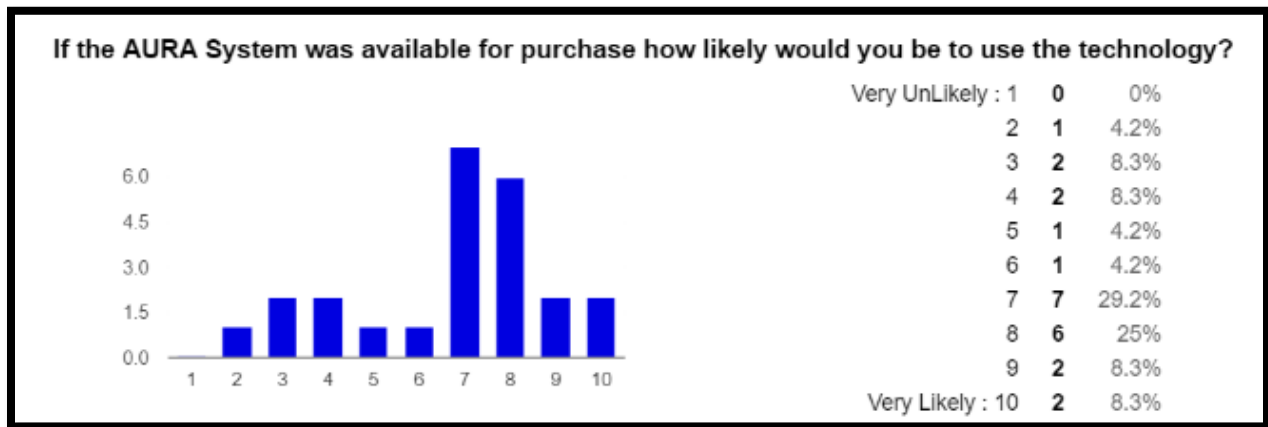| If the AURA System was available for purchase how likely would you be to use the technology?		
Very UnLikely : 1	0	0%
2	1	4.2%
3	2	8.3%
4	2	8.3%
5	1	4.2%
6	1	4.2%
7	7	29.2%
8	6	25%
9	2	8.3%
Very Likely : 10	2	8.3%

Figure 4-3 – Commercialization Potential South Dakota

The nature of the early adopters who typically attend technology demonstrations, they want to seek to understand not only the product in its intended form, but also look for new and innovative ways to use the technology.   In addition to using AURA on unpaved roads, the demonstration participants identified the following use cases:

- Highway Road Monitoring
- Site Surveying
- Stock Pile Quantities
- Airfield Pavement Condition Inspection
- Bridge Inspection
- Levee Inspection
- Landfill Monitoring
- Work Zone Analysis
- Weather Event (Tornado, etc.) Documentation
- Haul Road Monitoring
- Crash Investigation
- Inventory of Roadway Features
- Road Safety Audit
- Selection Road Weather Information System (RWIS) Site Locations

While these are not the primary functions of AURA, if these reasons give enough use cases for AURA, they can do gravel road monitoring AND… it improves the value proposition – especially for the private sector.

When it comes to price, the question came up at both demonstrations "what does it cost" and while the price of the equipment was available, the price to buy AURA and put it in the truck with the software CD that day was not available, because it depends on the needs of individual projects and different agencies. The call to action was missing from the demonstrations in order to push the sales. This was a take away for future demonstrations that involve commercialization that the price to buy and rent should be clear and there should be incentives for purchase such as hours of free tech support, or a session of free training that normally runs $2,500 (for example) to set up the system. The guarantee or return policy should also be available.

The benefit and purpose of the demonstrations however was predominately to identify what the elements of the product were highly desirable as well as what problems they solved for our target audiences. Thus, our objectives were achieved in gathering that information for future commercialization.

Section V: Conclusion

The two field demonstrations held in Phase II of the project provided opportunities for potential end users and third party service providers to learn about the capabilities of the AURA system and how it could be used in asset management system for unpaved road assessment. Local road managers, tribal representatives, engineering firms, state DOT employees, and others attended the two demonstrations and showed strong interest in the AURA system. Participating in a vendor booth, and gaining attendee opinions through enhanced questionnaires, both led to more engagement of potential end users and service providers. The materials produced for these demonstrations provided information that has since led to three companies wanting to provide AURA services, and a paying customer is being search for. Commercialization efforts will continue through the end of the project and beyond.

Example road flown for the Rapid City, SD field demonstration.