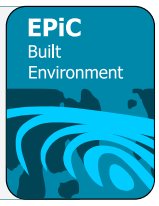
EPiC Series in Built Environment

Volume 1, 2020, Pages 223–231

Associated Schools of Construction Proceedings of the 56th Annual International Conference



iDUC: Solution to Address Common Challenges of State Agency Drone Deployment

Marchell Magxaka, Jason Lucas, PhD and Joseph Burgett, PhD
Clemson University
Clemson, South Carolina

The use of Unmanned Aircraft Systems (UASs), or drones, have been widely documented with benefits for many agencies and industries that deal with construction, planning, emergency management, and public safety. Many agencies that are currently using drones have limited resources and face challenges in their deployment. This research is examining the extent of those challenges among state agencies of South Carolina and how they may better be addressed through joint initiatives, enhanced communication, networking, and research. This paper documents an initial survey used to gauge drone use of different agencies throughout the state, common challenges that were identified, and strategies that are planned to address these challenges through future collaborative efforts.

Keywords: Drones, Unmanned Aircraft Systems (UASs), Best Practices, Agencies

Introduction

The use of Unmanned Aircraft Systems (UAS) also known as drones for geomatics applications is not a new concept. As early as the 70s, military surveillance and reconnaissance applications were being explored (Przybilla and Western-Ebbinghaus, 1979). UAS's in the construction industry include real-time reconnaissance of jobsites and providing high-definition (HD) video and still images for publicity and documentation of progress (Tatum & Liu, 2017). Drones provide easy access to large or hard-to-reach facilities when mapping information used for, land surveying, building inspections, providing visual materials to customers and employees or when monitoring the progress of work on the construction site and security control (Zaychenko et al., 2018).

Other areas where UAS's may have an impact is in combination with other technologies. Building Information Modeling (BIM) is anticipated as an important element in the improvement of the construction industry's productivity. Linking drone data to a BIM can provide a powerful workflow for documenting construction progress and as-built conditions. Currently there are limited solutions that allow the integration of as-built information, potentially produced by drones, into BIM (Dupont et

al., 2017). Additionally the use of a UAS for improving safety performance in observing and identifying potential safety issues during construction (Gheisari and Esmaeili, 2016) and for monitoring excavation slope stability (Xiao et al., 2018).

The FAA defines a UAS as the unmanned aircraft and all other associated support equipment such as communication and navigation system, unmanned aircraft, payload, data link, ground control station, and human operator(s). The communication and navigation system comprises of a combination of sensors mounted on the drone that allows for monitoring the aircraft's position, altitude, velocity, and attitude at all times (Gillian's et al., 2018). The use of drones for commercial and public applications have been refined and regulated over time. The issuance of title 14 Part 107 in the Code of Federal Regulations lifted many restrictions originally placed on commercial drone use and better defined how they can be safely used (FAA, 2016). One of the requirements listed in part 107 is that drone operators hold a FAA remote pilot certificate. Included in the exam are areas such as sectional charts, airport operations, Part 107 rules, and weather to name a few (FAA, 2016). The pilot certification exam does not have a practical component to where competency of flying an aircraft would be demonstrated.

Drones are commonly used for search and rescue missions, law enforcement reconnaissance and pursuit, as well as emergency management of earthquake prone areas, volcanic eruptions, fires and other natural disasters (West & Bowman, 2016). UAS use is also expanding for use in agriculture and environmental management (Smith, 2015). Drones are also used by agencies for mapping and surveying (Plotnikov et al., 2018). The growth of UAS as a functional tool has lead to many agencies hiring full time drone pilots and creating drone use policies. According to this report, drone use is purported to save time, money, and results in safer, faster and better data collection when compared to traditional transportation uses (AASHTO, 2018).

Collaborative User Groups

Collaborative groups of users from different organizations with similar goals is not a new idea in part, however it is new to the State agencies of South Carolina. Some other groups have been created and can serve a model of sharing resources. These include:

- The ANSI Unmanned Aircraft Systems Standardization Collaborative (UASSC) draws participation from industry, government agencies, standards developing organizations (SDOs), and other interested stakeholders. According to their website, participation is open to UAS stakeholders that have operations in the United States. Membership in ANSI is not a prerequisite and there is no fee to participate at this time (ANSI, 2019).
- DRONERESPONDERS Public Safety Alliance, a 501(c)3 non-profit program of AIRT, Inc. is an advocacy and resource group for the public safety sector, collaborating with the Commercial Drone Alliance to help get public safety departments the resources they need (McNabb, 2019).
- The North Carolina Framework is the North Carolina Statewide Drone Collaboration, led by NCDOT for drone program management, funding and support. The North Carolina Framework white paper noted that some of the main functions of the statewide collaboration includes; the shared access to layered drone deployment, public education and outreach under a structured and supported UAS management program (DJI, 2019).

Within South Carolina numerous agencies are utilizing drones for similar activities that include large scale mapping, monitoring, and surveying. In discussions between agencies it was determined that

similar issues were being addressed by each agency but there was a lack of communication in sharing solutions and resources. This lead to the question of how widespread and common are these issues and how might they best be addressed. Additionally, an interagency collaborative group for the agencies within the state was considered as a method for addressing common concerns. This paper focuses on identifying common challenges among drone users, the extent of those challenges, and how a collaborative user group made of members from various agencies with similar needs may be a solution to provide better communication and share in resources.

Methodology

The main goal of this study was to identify common challenges and barriers to UAS adoption faced by various agencies and then secondly, determine a mechanism for addressing these challenges moving forward. The three steps taken include an interest survey, a workshop, and then a post-workshop survey. The objective of the interest survey was to gauge interest and need as well as common challenges among the agencies of South Carolina. The findings of the survey were used to then construct an agenda for the workshop. It is worth noting that the workshop would not have taken place if respondents indicated there was not a need for this type of group. Based on the affirmative response from the interest survey the workshop was scheduled and a room large enough to accommodate those who expressed interest was secured. The workshop included introduction of attendees, overall goals and vision of what this type of organization would be if created, documentation of common challenges, and action items to move forward. To ensure that everyone had a voice in moving the organization forward and to more accurate gauge interest of those who wish to be involved a post-meeting survey was also distributed.

Interest Survey

An interest survey was developed to identify agencies who were using UASs, the extent of use of UASs at the agency, and to capture challenges that are being addressed. The initial request of interest was sent out to 35 contacts from various South Carolina agencies that were identified as using UASs through networking connection and from publicly available information on the agencies' webpages. The 35 contacts resulted in an interest of over 80 individuals who wanted to attend the workshop. The workshop was capped at 80 due to the room capacity.

The initial interest survey was used to document information on active drone users (those who were flying missions versus those who were at other stages of UAS deployment), number of licensed pilots, type of equipment used, use case types, and common challenges. The survey was sent to the 80 people who were confirmed to participate in the workshop. 56 responses were received from 17 different agencies. Of the respondents 17 were licensed pilots of which 9 have been recertified, meaning they were licensed for more than 2 years.

Figure 1 shows the percentage of respondents who were flying under different programs. Part 107 licenses are under the Title 14 Part 107 are licensed remote pilot operators under the FAA regulations. Organizations that are conducting higher education or research do not need to have a license under Part 107 to fly a drone but must follow the regulations for drone use. A Certificate of Authorization (COA) is provided to an organization who has a specific mission and are authorized directly by the FAA to utilize the UAS for that mission. COAs usually have specific limitations and provisions of how the UAS can be utilized that may not completely align with the Part 107 regulations.

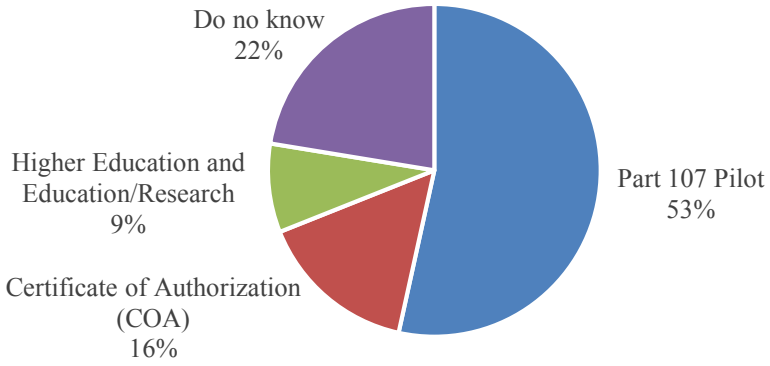


Figure 1. Participants Organizations Flying Under

The respondents were asked which type of aircraft their organizations were using when flying missions. The results are included in Table 1.

Table 1

Aircraft Type Used

Equipment Type	Number of Respondents
DJI consumer grade aircraft	28 (50%)
DJI enterprise aircraft	9 (16%)
SenseFly	3 (5%)
3DR	2 (3%)
Yuneec	2 (3%)
Parrot	1 (2%)

The software that the respondents indicated as using to plan and fly missions are shown in Figure 2.

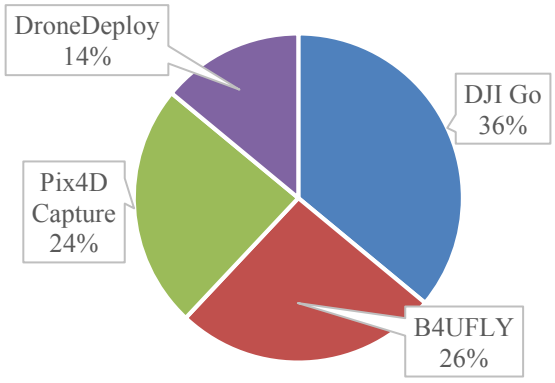


Figure 2. Software Used

Of the sensors used during flight missions, 31 were using cameras, 7 were using multispectral, 2 were using hyperspectral, 10 were using infrared, and 4 were using LIDAR. Use cases of data collection are identified in Table 2 with a list of post-flight processing software that was used in Table 3.

Table 2.

Uses-cases for data collection

Use/Purpose	Respondents
Video	28
2D Documentation	27
3D Imagery	20
Orthophotography	17
Volume/Area Calculations	16
Incident Response	10
Live Streaming	7
Selfies	5

Table 3.

Post-flight data processing software

Software	Users
ESRI Drone 2Map	12
Pix4D	9
DroneDeploy	4
Agisoft Metashape/PhotoScan	2
Bentley Context Capture	1

Another point of interest was the development of a UAS use policy and operational procedure guide. Of those department who were currently utilizing UAS systems, 4 identified that they had a use policy or operational procedure that they consider “Well Defined”, 11 stated they did not currently have a defined policy, 9 indicated having a “basic policy that needed significant improvement” while 7 others indicated “have a policy but looking to improve it”.

When asked what was needed to continue the development and support of a UAS system at their agency, one of the largest barriers is funding. This cannot be easily addressed by a collaborative user group however, there were many other topics that can. Common problems included training, getting management buy-in, support for program development, and technical support. Additionally, there was an expressed need for best practices to align with regulations, identification of what the state regulations actually are, education to better understand FAA regulations, and standardization of operating procedures between agencies so they can learn from each other.

Workshop

In total, 88 individuals from 36 agencies expressed an interest in attending but the workshop was limited to 80 attendees due to the size of the room available. An original space with an occupancy of 40 was reserved, however due to the initial interest and filling the space a larger room was identified. The 80 attendees to the workshop represented 33 agencies. Representatives from the agencies

included pilots, insurance agents, project managers, lower level supervisors, upper management, and policy makers from individual agencies. Three main goals were suggested for the workshop: 1) networking, 2) identify common challenges, and 3) determine the best next step in addressing the problems. During the meeting the agenda included a time for introductions to acknowledge which agencies were being represented, what stage of the process they were at, and what they wanted to achieve from the day's activities. This was helpful to identify attendees with similar UAS use goals or contacts that may be able to help. There was also some time allowed at the end of the meeting for further networking based on the introductions.

The rest of the meeting after the introductions was split into two segments. The first segment was to cover some common challenges as identified through the pre-meeting survey and validate/clarify those challenges. Some high level discussion of how different agencies were addressing these challenges was also included. The second segment was to then identify interest of the creation of a formal group of interagency UAS users and what the higher level goals and objectives of that group would be. The working name of that group was identified as the Interagency Drone Users Consortium (iDUC).

The challenges that were discussed that an inter-agency group could potentially address include sharing resources in development of drone policies that work, training for pilots to evaluate pilot skill, and disseminating information on new developments, challenges, and best practices as they arose. Additionally, the group could serve as a point for networking of drone users to stay up to date and discuss new challenges.

Post-Survey

In order to minimize the effects of groupthink during the meeting, the topics discussed were also incorporated into a post-meeting survey to gauge attendee interest and agreement to challenges and how a collaborative group may be able to help overcome the challenges. The survey was sent out to all attendees of the meeting. A total of 44 participants completed the post-meeting survey.

Related to a challenge of offering adequate training and education for pilots who were flying for the different organizations, the respondents were asked if training was required beyond becoming licensed. Even though 35 participants confirmed that their departments had drones and were actively flying missions, 13 participants stated that their departments did not require pilots to demonstrate their flight proficiency or require training beyond becoming licensed under Part 107.

Additionally, when asked what benefits an interagency group may provide participating organizations the following were main themes of the responses:

- Communication between agencies: the group could serve as a network of users who had common goals and missions. The group could support a listserv or other website based forum to support answering common questions and connecting users with available resources.
- Shared resources: large amounts of data are collected by agencies for different operational purposes and especially mapping data can be used by different agencies. A list of operational flights and areas that have been mapped can help save time in performing duplicate flights or data processing if agencies had the ability to share raw data that could support the mission of multiple groups. Additionally, sharing templates for best practices and policy development within the agencies instead of each group starting from scratch could be of benefit.

- Training and education: beyond the basics of getting a license, training for proficient and effective use of drones and hands on training to help new pilots learn the skill of flying may be a benefit where novice users can learn from more advanced users within the group.
- Funding and research: most of the agencies involved list the need for funding to do more. Members of the group may be able to partner with University users from within the group to identify appropriate programs to get external funding and develop processes and advanced uses of the technology.

The respondents were asked what the priorities of the organization should be. Communication between agencies was the top followed by an entity to help with the dissemination of information, training, and policy development (Figure 3). Though research and funding were not listed as high of a priority by the majority of the participants, 34 stated they would be willing to write a letter of support for federal or state grants that would help support the mission of the organization.

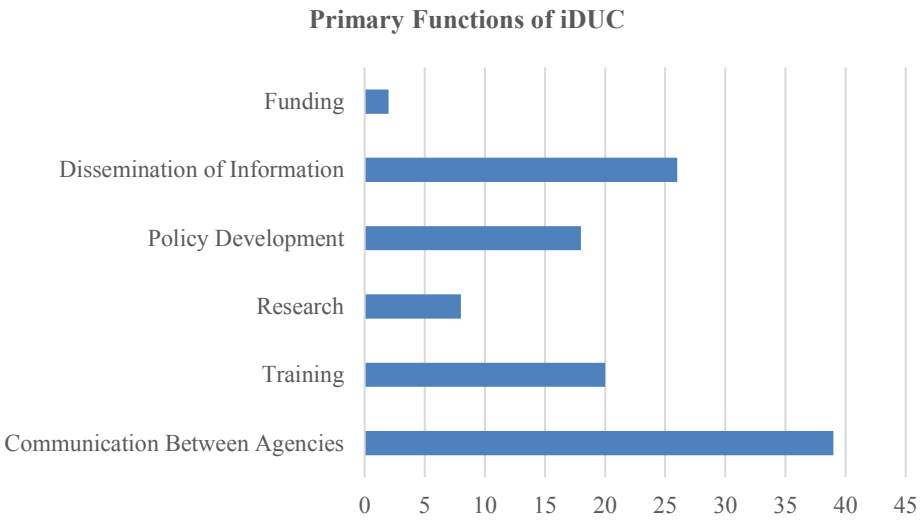


Figure 3. iDUC Priority

Furthermore, the interest of formally creating an interagency organization was gauged. The respondents were asked for the level of interest in serving in such an organization. Nine (9) were extremely interested and seven (7) were very interested while only 5 were not interested at all in service within such an organization. 48% of the respondents indicated that they thought such an organization was “extremely important” for the state and 42% felt it was “very important”. Overall, there was a continuation of the enthusiasm for moving forward with the creation of an interagency organization with the results of the post-meeting survey.

Discussion

This study examined the need and enthusiasm to support the creation of an interagency drone users consortium for state-wide public agencies. An interest survey to gauge interest and identify common issues agencies are facing was conducted. Based on the findings of this survey, an interest meeting and workshop was scheduled. Interest for the meeting was significant to the point the space had to be rescheduled for a larger room. In addition to filling the space a wait list for those who wanted to

attend was also created. Common barriers that an interagency group can support were identified that include communication and dissemination of information, education and training, and assistance in policy development.

Moving forward a second iDUC meeting is planned with the interested partners that will include an information session on insurance issues, available policies for drones and breakout sessions for long-term planning on how to address the challenges presented. A more formalized group will then be able to determine methods for communicating between agencies, disseminating resources, and sharing best practices.

Additionally, communication between agencies and dissemination of information are the biggest priorities listed by the respondents. Both of these deal to some extent with information exchange. Many agencies expressed they feel like they are starting from scratch and are concerns about not knowing all of the rules. This may be a reason why drone use adoption is slower in the public sector than that of the private sector. Management is hesitant and many individuals in the room were also part of the legal representation of agencies interested in developing a better defined program. These areas of addressing rules and helping identify appropriate uses and overcoming common obstacles in getting a drone program off the ground are where the iDUC can be of value.

Some of the bigger strategic issues that will be addressed are the need for well-defined and consistent policy and operating procedures. Less than 10% of the respondents indicated having a well-defined policy and 26% indicated they had no policy at all. Considering only 5% of the respondents stated their agencies did not have drones there is a sector of agencies flying without a defined policy. Granted some of these may be in the initial stages policy development, however, this is a gap that an interagency organization could help address.

From the University standpoint, there was an identified need for education/training, research, and funding. The University can partner with the various agencies and determine education/training needs. Through the interagency organization such as the iDUC, this training can then be offered at a reduced/shared cost through economies of scale. Additionally, funding and research go hand-in-hand. There are many federal agencies that have programs to provide funding for exploring the use of new technologies however the state agencies often do not have the resources or understanding to locate these opportunities and adequately pursue them. A partnership effort between academia and the agencies through the networking of an interagency group can be very valuable to procure technology for research and policy development that can then be applied for practical missions.

Conclusion

The results of the surveys and workshop indicated enthusium and support for the creation of an interagency consortium to provide support in communication and sharing of resources between state agencies to increase the use of UASs in serving the public interest of the state. This collaborative effort between the agencies and public universities can be very valuable in ensuring new technologies are understood and appropriately adopted. An entity, such as iDUC, would allow for a formalized relationship between these agencies and provide a platform for collaboration, networking, and sharing of resources is seen to have great value.

References

AASHTO (2018). Survey finds a growing number of State DOTS are deploying drones to improve safety and collect data faster and better-saving time and money. Transportation TV Special Report.

ANSI (2018). ANSI Unmanned Aircraft Systems Standardization Collaborative (UASSC). ANSI Standards Activities, Retrieved on 10/22/19 from URL: https://www.ansi.org/standards_activities/standards_boards_panels/uassc/overview

DJI (2019). Drones in Government Work: Build Your Drone Program with Lessons from North Carolina's Statewide Drone Collaboration. DJI White Pape.

Dupont, Q. F. M., Chua, D. K. H., Tashrif, A., & Abbott, E. L. S. (2017). Potential applications of UAV along the Construction's Value Chain. Science Direct, 182, 165-173.

Gheisari, M. and Esmaelili, B. (2016). Unmanned Aerial Systems (UAS) for Construction Safety Applications. Construction Research Congress 2016, 2642-2650.

Gillins, D. T., Parrish, C., Gillins, M. N., & Simpson, C. (2018). "Eyes in the sky: Bridge inspections with unmanned aerial vehicles".

FAA (2016). Operation and Certification of Small Unmanned Aircraft Systems. Federal Aviation Administration (FAA). Retrieved on 10/22/19 from URL: https://www.faa.gov/uas/media/RIN_2120-AJ60_Clean_Signed.pdf

Mcnabb, M. (2019). "The Partnership Between Commercial Drones and Public Safety Drone Stakeholders – and Why It's Important." Dronelife. Retrieved from URL: https://dronelife.com/2019/08/22/the-partnership-between-commercial-drones-and-public-safety-drone-stakeholders-and-why-its-important/

Plotnikov, M., Daiheng, N., and Collura, J. (2018). "The State of the Practice of Unmanned Aircraft Systems in State Departments of Transportation," Transportation Research Board 97th Annual Meeting, Washington DC.

Przybilla, H. J., Wester-Ebbinghaus, W. (1979). "Bildflug mit fernglenktem Kleinflugzeug. Bildmessung und Luftbildwesen. Zeitschrift fuer Photogrammetrie und Fernerkundung." Herbert Wichman Verlag, Karlsruhe, Germany.

Smith, K. (2015). The Use of Drones in Environmental Management. World Environmental and Water Resources Congress 2015, 1352-1361.

Tatum, M. C. & Liu, J. (2017). Unmanned Aircraft System Applications in Construction. Procedia Engineering. 196, 167-175.

West, J. P. & Bowman, J. S. (2016). Domestic Use of Drones: An Ethical Analysis of Surveillance Issues. Public Administration Review, 76(4), 649-659.

Xiao, Y., Kamat, V.R., and Lee, S.H. (2018). Monitoring Excavation Slope Stability Using Drones, Construction Research Congress 2018,

Zaychenko, I., Smirnova, A., & Borremans, A. (2018). Digital transformation: the case of the application of drones in construction. MATEC web of conferences, 193, 5066.