UNMANNED
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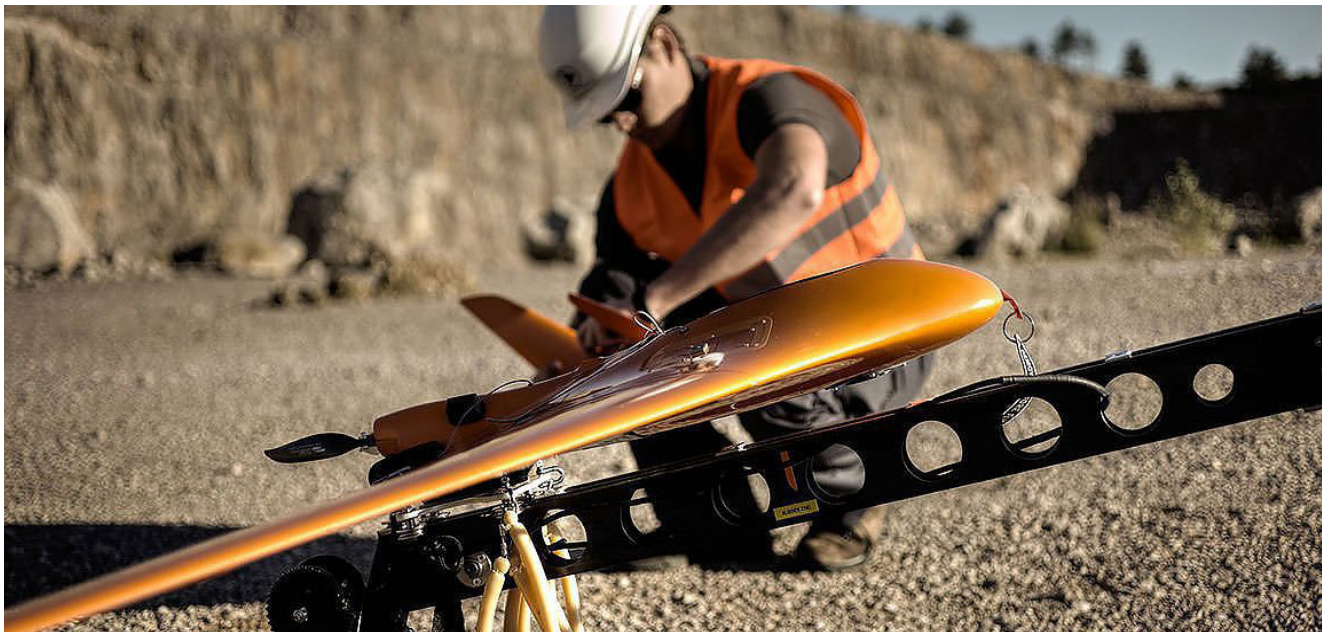
DEVELOPING AN ECOSYSTEM FOR UAS SAFETY

2017 WHITEPAPER SERIES



UAS OPERATIONS AS AN ECOSYSTEM

In its most basic form, an "ecosystem" is how living things interact with each other in their nonliving environment. The term is most commonly used to describe humans, plants, animals, and other organisms interacting with each other, and their environment, such as Earth and its atmosphere. Science gives us information about the planet and how to adapt to and protect our ecosystem. As living organisms our survival may depend on how successful we are.

Consider the same concept for the UAS ecosystem, which includes people, such as UAS program managers, pilots, maintenance technicians, etc., and the environment in which they will operate. The environment includes the UAS technology itself, the organization's program, regulatory agencies, etc. Unlike the planet's ecology, there is very little information about the UAS ecosystem. There is no long-term historic data about the industry, because it only began to emerge a little over a decade ago. There is, however, a wealth of knowledge and data in traditional manned aviation as to what is needed to assure safe and efficient operations, and transferring these concepts to unmanned aviation is a logical approach to replicate a safety record that has been established over the course of a century.

This whitepaper will discuss how an organization looking to use UAS technology can develop a network of support that is SAFE, adaptable to new markets and technology, and scalable to meet current and future demands.

UTILIZE A REPUTABLE SOURCE

The first step in the process is to gain knowledge about the technology, its applications, and regulatory requirements. Many entrants lack this knowledge and are thus unprepared to make even basic decisions about their UAS program. This can be accomplished through formal training programs, research, or hiring a subject matter expert (SME). SMEs can bring expertise not available internally and can provide great assistance to the program development process. However, this is a new industry and there are many self-identified "experts." A thorough background check of the qualifications of SMEs is well advised.

DEFINE THE MISSION

After gaining this knowledge, the next step is to define the mission to be performed by UAS. This is fundamental to building a program and may seem to be a simple process, but is not. The identified mission (or specific application of the UAS) will, quite literally, impact every facet of the UAS ecosystem, including the type of UAS required, the experience and qualifications of the pilot and crew, compliance with aviation regulations, etc. For example, a Realtor who decides to use UAS to take pictures of houses for sale will only need a small quadcopter, minimal pilot training, and experience and there are established regulations for this type of operation. On the other hand, a government agency that wants to use UAS to monitor large wildland fires will need a very complex aircraft, highly trained crews, and operate in airspace that does not yet have the technology or regulations to adapt to unmanned aircraft operations.

CRAWL, WALK, RUN

Further, the UAS market is full of opportunities, with new applications for the technology being explored every day and entrepreneurs flooding the market to claim their share. Whether it is a company seeking to provide commercial UAS services, or an internal operation to support existing operations, initial UAS operations should be conservative and focused. Overpromising results, to either customers or investors, could be problematic. Also, being conservative allows UAS operators to gain essential knowledge and experience that will allow them to expand as technology and markets evolve.

"BEING CONSERVATIVE ALLOWS UAS OPERATORS TO GAIN ESSENTIAL KNOWLEDGE AND EXPERIENCE THAT WILL ALLOW THEM TO EXPAND AS TECHNOLOGY AND MARKETS EVOLVE."

Once the mission has been identified, the organization can properly establish a safe and effective UAS program. The steps necessary to do so include determining UAS requirements, acquisition, and maintenance; developing operations manuals; implementing a Safety Management System (SMS); and improving program personnel qualifications and training. Note that all the steps are critical to the development of a safe program and are not listed in order of importance.

SYSTEM SELECTION

To begin, with the mission defined, the system needed to accomplish that mission must be acquired. Some of the factors to be considered include the aircraft itself (VTOL, fixed wing, battery/liquid fuel powered, flight time endurance required, environmental factors, system redundancy for reliability, etc.). Next, payloads must be selected to meet the mission need, such as optical cameras or other environmental sensors. Third are software considerations, such as flight planning software, ability to interface with third-party post-processing software, etc. Finally, there

are manufacturer considerations. How long has the company been in business, how many aircraft/systems have they delivered, do they provide training, warranty and maintenance support. Getting the right unmanned aircraft system not only increases the chance of a successful mission, but also provides flight crews with the equipment they need to operate safely.

SYSTEM MAINTENANCE

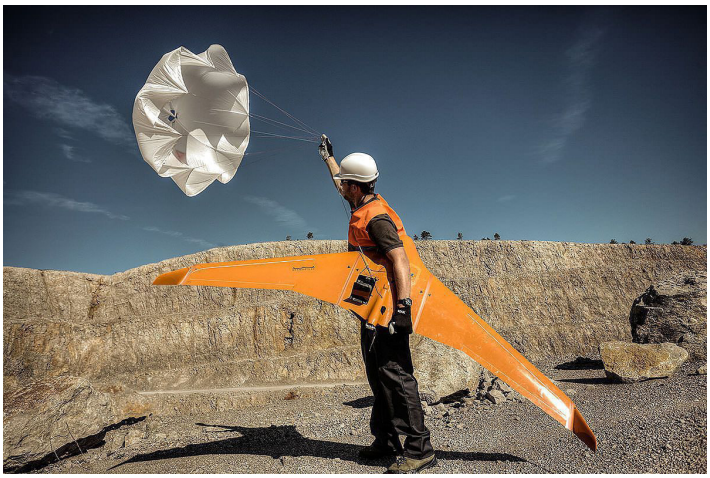
Maintenance of the system is essential to safe operations and begins with providing training to those who will be authorized to work on the system, including aircraft, ground control station, and other hardware and software. Maintenance tracking software can assist with this process, especially as the complexity of the program grows, perhaps with multiple types of UAS. The ability to track maintenance data will also help improve reliability of equipment over time.

DOCUMENTATION

The next factor is an operations manual. This manual contains procedures, instructions, and guidance for use by operational personnel. It should include such things as operations administration and supervision, regulatory compliance, safety, training; fatigue, flight time limitations, flight operations procedures, emergency response procedures, organizational Safety Management System (SMS) procedures, communications, and maintenance, to name a few. It will contain standardized checklists and other mission-specific forms, such as Flight Risk Assessment Tools (FRATs) and mission reporting forms. Properly crafted, an operations manual is easy and practical to use, is accurate and dependable, and creates the standard from which an organization operates its UAS. As with other factors discussed here, the operations manual is scalable to fit the size and scope of the program.

SAFETY MANAGEMENT SYSTEM (SMS)

All aviation operations, whether manned or unmanned, must have an SMS to manage risk. While it is beyond



the scope of this paper to provide a detailed discussion of SMS, the basic concepts will be highlighted.

ALL AVIATION OPERATIONS, WHETHER MANNED OR UNMANNED, MUST HAVE AN SMS TO MANAGE RISK.

To begin, there are four "pillars" of SMS: Safety Policy, Safety Risk Management, Safety Assurance, and Safety Promotion. Safety policy begins with a commitment by management that safety is an integral part of every operation. Risk management involves proactive identification of the hazards and risks of everyday operations, and responding proactively by improving the processes and conditions to mitigate that risk. No UAS mission should be undertaken unless the hazards can be mitigated to an acceptable level. Such things as FRATs are used prior to each flight to evaluate risk and document steps taken to mitigate that risk. Safety assurance is monitored by constant verification and upgrading. It is achieved through internal and external audits and ongoing monitoring of corrective actions. Finally, safety promotion includes employee training and communicating hazard information and lessons learned. These concepts are scalable to any size UAS operation, large or small, basic or complex.

Finally, while management "owns" the SMS and is responsible for developing and implementing the formal process, everyone involved in the UAS operation is responsible for safety.

UAS CREW REQUIREMENTS

Next, minimum requirements for UAS personnel must be established. Safety-focused operations are dependent on having the right people in place. This applies to managers/supervisors, remote pilots, and nonpilot aircrew. The process begins with who will manage and supervise the program. Does this person have an aviation background, UAS experience, expertise in the mission to be performed, interest in new technology? Mere assignment to a position within the organization should not be a deciding factor. The

same concepts apply to aircrew, but there is a greater emphasis on the operational aspects of the position. Such things as an aviation background and previous UAS experience are important factors to consider. For newly created positions, a job description should be developed that lists all the requirements.

EDUCATION AND TRAINING

Education needs to involve ground-based education on operations, such as for site surveys, UAS flight planning, FAA requirements, and the keys to safe operations. These can include crew resource management and aeronautical decision making specific to UAS. Training needs to incorporate initial-qualification training on the specific UAS acquired, scenario-based training to perform the identified mission, system maintenance, safety system training, and operational policy and procedures training. Recurrent training is also necessary to maintain technical and procedural proficiency. For remote pilots, this assumes the pilot has also received the training necessary to meet certification requirements for a remote pilot certificate issued by the FAA, or other civil aviation authority. For nonpilot aircrew, there are no FAA certification requirements; thus, it is incumbent on the organization to determine training needs for those positions. Finally, all certifications, initial and recurrent training, and flight experience should be tracked by the organization to assure all personnel meet requirements in a timely manner.

THIRD-PARTY SAFETY AUDIT OF INTERNAL AND EXTERNAL SERVICE-PROVIDER OPERATIONS

During UAS program development, the organization should consider complying with evolving industry standards for UAS operations. ARGUS Unmanned, the Public Safety Aviation Accreditation Commission, and the National Fire Protection Association have or are developing UAS standards that organizations can use to assure the quality of their operation. Regardless, the UAS organization should regularly evaluate its operation and continually strive to improve performance. This is accomplished by conducting internal and external audits of operations. If the organization is contracting for UAS services from a commercial provider, this is particularly important. The employing organization must assure that the contractor meets all the minimum requirements for a safe operation.

When combined, these factors provide the organizational support needed by the remote pilot and aircrew as they strive to provide safe and effective UAS operations.

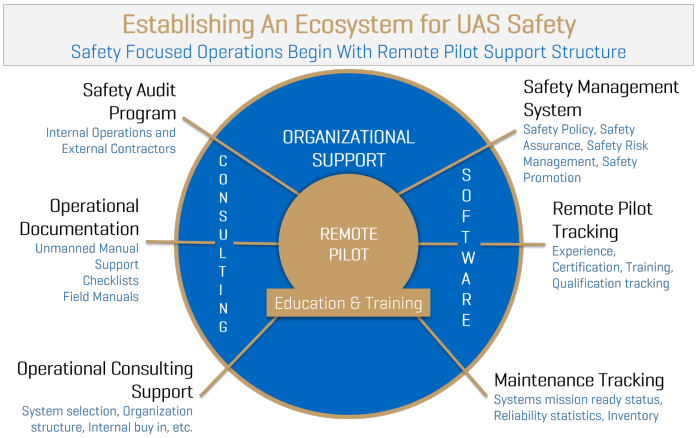
TURNKEY SOLUTION

Unmanned Safety Institute® (USI) is a subsidiary of ARGUS International, Inc., and has established robust, comprehensive education and training programs to meet the needs of any size organization and any level of UAS.

ABOUT UNMANNED SAFETY INSTITUTE®

Unmanned Safety Institute brings over 30 years of experience in UAS flight safety operations and, we have worked around the world delivering our award-winning UAS safety training and certification programs.

Unmanned Safety Institute employs SMEs from varied disciplines including human factors, aeronautics, autonomous technology, safety assurance, and much more.



USI was formed in 2014, and acquired by ARGUS International, Inc., in 2016. We are headquartered in Orlando, FL, with offices in Denver, Cincinnati, and Columbus.

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AUTHOR

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Donald L. Shinnamon, Sr., serves as an instructor and consultant for Unmanned Safety Institute. Mr. Shinnamon has over a decade of unmanned aircraft industry experience, including work with Boeing's unmanned aircraft company Insitu. Before venturing into the UAS industry, Mr. Shinnamon had a distinguished career in public safety. In 2008, he was selected to serve on the historic first FAA rule-making committee to draft regulatory language for integrating small unmanned aircraft systems into the national airspace system that eventually became Part 107 of the FARs. A frequent speaker on UAS topics, he has published numerous articles addressing UAS operations. Mr. Shinnamon holds a master's degree in business administration from the University of Baltimore and completed the aviation safety program at Embry-Riddle Aeronautical University. An experienced aviator, he is an active commercial pilot, rated in both helicopters, airplanes, and unmanned aircraft.