Evaluating The Merit Of Implementing A Safety Management System Into An Unmanned Aerial Systems Company

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Introduction

Safety Management Systems, or SMS, have seen wide implementation in manned aviation. Currently, while not required to do so, unmanned aerial systems (UAS) companies are beginning to explore the SMS usefulness to their organizations as well. Companies are offering solutions to aid unmanned aviation organizations with implementation, with the possibility of additional regulation on the horizon.

Problem

The use of drones in the general public, such as for delivery of goods, faces an uphill battle when it comes to public perception. This could quickly spiral out of control with a mishap involving a drone crashing into a home or person. With the possibility of ruining the reputation of a drone delivery company in mind, the implementation of an SMS should be considered. Currently, very little has been studied regarding the effects of an SMS implementation on a UAS company or program.

Purpose

The purpose of this study was to review the state of Safety Management Systems in manned aviation and then consider its usefulness to unmanned aviation companies. The authors wanted to reach out to companies that sold software to aid SMS implementation to gain their insight into the advantages these systems produced for unmanned aviation companies.

Research Questions

Will implementing SMS provide significant benefits to a small UAS organization? How do rapid technology changes and higher aircraft numbers affect UAS organizations?

Literature Review

SMS in aviation: The Federal Aviation Administration first published its regulations for air carriers to implement SMS programs at the beginning of 2015. However, these regulations required that these airlines implement SMS three years after the regulation was established. This means that even for many airlines in the United States, their SMS programs are only about two years old (Stolzer, Halford, & Goglia, 2011).

The move for the FAA to implement SMS came after both the European Aviation Safety Administrations (EASA) and the International Civil Aviation Organization (IACO) both introduced regulations concerning SMS (Stolzer, Halford, & Goglia, 2011). While the ICAO introduced their first Safety Management Manual (SMM) regulating how SMS should be implemented in air carriers, it was updated in 2015 with the Manual on Remotely Piloted Aircraft Systems (RPAS) in 2015, introducing UAS organizations to the same SMS as the air carriers (International Civil Aviation Organization, 2015).

Public Perception of UAS

As SMS processes have now been established in United States air carriers for several years, they are beginning to determine the return on investment from their implementation. A Safety Management System (SMS) process requires a significant amount of work to introduce, build, and run. This means hiring additional employees. In an airline it is very easy to justify the cost, one saved hull loss would pay for the entire cost of SMS implementation. However, small Unmanned Aerial System (sUAS) companies do not have this same type of justification. A loss of one drone while costly to the company would not in itself offset the cost of SMS implementation. What is critical to an sUAS company, however, is public perception. Should a drone crash or cause damage the company may not survive the already tenuous public opinion of sUAS. The Federal Aviation Administration (FAA) anticipates the number of drones to increase by a little less than 20% between 2017 and 2021 (Federal Aviation Administration, 2019). However, a study done by Aydin (2019) found that the public knowledge of drones and their use is limited. Most of the participants in this study felt that drones were primarily used for killing, invasions of privacy, or as toys (Aydin, 2019).

With this as the starting perception of drones, the safe operation of sUAS is critical. Any negative publicity on a drone company from an accident or injury could cause the company to lose a significant amount of business.

One of the largest challenges facing drone companies is that the general public knows very little about what drones are used for. One study found that when giving the public information on forty different use-cases for UAS, the public was not educated on most of them or future applications that they might be used for (Aydin, 2019). This study also showed that only 60% of people had heard that UAS did not have cameras (Aydin, 2019). According to a study done in Australia, there was a lack of public knowledge concerning the perceived safety of drones. However, most of the participants in this study were more concerned with the potential uses of drones and the lack of privacy they could create (Clothier, Greer, Greer, & Mehta, 2015)

While there has been significant research into implementing SMS into airlines, there is very little information about how this would look in a drone company. However, the same principals likely apply for implementing SMS in a drone company as they do in airlines. For this, implementing SMS in airlines, there are entire books about best practices and how to train employees in its use.

Implementing SMS, while increasing safety, is also a financial decision. For one major operator, implementing SMS in their ground handling process reduced the time lost for injuries by 13 percent and reduced ground damage costs by 41 percent. This resulted in a cost savings of almost $10 million (Stolzer, Halford, & Goglia, Implementing Safety Management Systems in Aviation, 2011). While drone companies work on a much smaller scale typically, this saving can still be

significant. However, this same text also points out that implementing SMS can result in significant changes throughout the company. SMS is the change from a reactive safety culture to a proactive safety culture. This results in significant challenges and expenses in retraining employees and hiring new employees to help develop and run a new SMS process (Stolzer, Halford, & Goglia, Implementing Safety Management Systems in Aviation, 2011).

While there are no current regulations in the United States to require SMS to be implemented in drone companies, ICAO does require SMS to be implemented in aircraft operators and service providers which does apply to Remote Pilot Aircraft Systems (RPAS) operators as well (International Civil Aviation Organization, 2015). On top of this, there is a general lack of safety. The FAA reports that between April 2019 and June 2019, there were 714 drones spotted around airplanes, helicopters, and airports, with punishments ranging from fines to jail time (Federal Aviation Administration, 2019).

Reasons for Introducing SMS into UAS Organizations

SMS systems can cost tens of thousands of dollars and much more than that in salary and man-hours to train employees, ensuring "buy-in" and culture change over the years it takes to implement. Despite the great cost, it is believed by many that Safety Management Systems are extremely important to aviation organizations. Stolzer and Goglia point out that many aviation authorities and experts believe that the future of aviation safety belongs to SMS (2015). While

there are variations in study results searching for the most important of the four main SMS components (see Brady & Stolzer, 2016, and Karanikas, Roelen, Vardy, & Kaspers, 2019), some of the latest evaluation methods such as Data Envelope Analysis seem to indicate that SMS is an overall net-positive. Stolzer and Goglia write that SMS' "impact upon aviation safety seems unquestionable" (2015, p. 301). Over time, hard data in the form of trends should show a decrease in injuries and destruction of property since SMS was mandated for air carriers and airports.

SMS benefits will likely transfer to UAS organizations as well. At least one recent news story in the United States has highlighted a UAS service provider receiving a high grade from a safety audit that included its implementation of an SMS. The ICAO is also encouraging this type of organizations to implement an SMS ahead of regulation requiring it to access to segregated airspace (Grimaccia, Bonfante, Battipede, Maggiore, & Filippone, 2017). UAS organizations should not take a "wait and see" approach when it comes to SMS, however. If they do not embrace safety, the technology and services they provide will be fenced in and held back because of mishaps and the resulting public/policy-maker fear. "Safety will be the benchmark that determines how quickly and how successfully unmanned aircraft develop over the next decade" (Wolf, 2017). Considering how the public currently views drones, this quote may be spot on.

Consequences of Incidents for UAS Organizations

At least one study has shown extremely high levels of distrust by the public when it comes to unmanned aerial systems and their safety. Rochester found that a majority of those studied failed to have high trust in both large and small UAS and their levels of safety (2018). Rochester (as cited in Friedenzohn & Mirot, 2013) also listed public polling (Associated Press) showing a majority of those polled as having at least some privacy concerns when it came to drone usage by law enforcement. With these levels of distrust already existing in the general public toward UAS, UAS organizations will be fighting an uphill battle in the arena of public opinion.

Public relations would also be disastrous in the inevitable event that a UAS strikes and injures or kills a person. Studies have been conducted to measure the severity of UAS collisions with persons and property (Arterburn, Ewing, Prabhu, Zhu, & Francis, 2017). Arterburn et al. conclude that a UAS colliding with a person could cause blunt force trauma, penetration injuries, and lacerations based on a dummy used in UAS impact tests (2017, p. 70). These types of accidents must be avoided at all costs to prevent sensationalist headlines and a meltdown in a company's reputation.

Current Interest in SMS from Unmanned Aviation Organizations

While manned aviation organizations have implemented safety management systems, unmanned aviation organizations are just beginning to formally implement SMS' on a greater scale. To better gauge the interest and impetus for these UAS service providers in implementing SMS, we reached out to a provider of SMS that has been in the news for working with UAS companies. We spoke with C. S. Cunningham, Vice President of Sales & Marketing, ARGUS International, Inc. ARGUS focuses on safety across the board from auditing to SMS. It's a cornerstone of the company. Everything is focused on Safety, however, Cunningham made it clear that SMS is not just software. It's a company culture that requires continuous improvement (personal communication, November 8, 2019). There are two competing sides to safety with any UAS company. There's the tech culture that tries to innovate and deploy new technology quickly while the aviation side wants a proven safety record before commencing operations. UAS service providers have the unique challenge of attempting to blend these two environments, says Cunningham. He also points out that while manned aviation has the cost-prohibitive side of aircraft acquisition, the number of aircraft in an unmanned organization will likely proliferate because they lack this cost. The issues on the manned side will be greatly amplified by the unmanned side due to these vastly increased numbers. Cunningham argues that large UAS companies have a lot more to lose and thus, understand the importance of having an SMS. His

advice to them is to think of safety from the very beginning or government will do it for you with regulation. "[Safety is] not difficult to do it from the start. Rather, it's difficult to build something and then realize your culture is in misalignment with safety principles in your industry" (personal communication, November 8, 2019).

SMS in an Unmanned Aviation Organizations

As SMS is not extensively being used yet in unmanned aviation organizations, we have developed a sample of what this might look like. Likely, SMS will take a few years to implement, it is a process, so even once the regulations are in place, the systems will have to work over to them. A company should plan to invest two to three years developing their SMS and implementing it. It also may take longer for SMS to become the "normal way of doing business," depending on how long the company has been using another system (Stolzer, Halford, & Goglia, 2011).

To implement SMS, all the four major components, as well as the 12 elements, must be addressed. The four main principals consist of safety policies and objectives, safety risk management, safety assurance, and safety promotion. These could be addressed in the following ways.

For safety policy and objectives, the UAS organization will need to comb through all its policies and procedures and ensure they are written to explicitly explain responsibility, accountability, and expectations. These policies and

procedures should help to instill the idea that safety is the core value of the organization.

The organization will also need safety risk management. This will need to be a formal system of hazard identification, assessment, and mitigation. A process for when a hazard is identified how it is assessed and how the root cause is found and then how its effects are minimized. This will differ slightly from the airline sector as there are much fewer groups in play. Whereas an airline risk might involve pilots, flight attendants, ground handling personnel, operations agents, and dispatchers. Most of the UAS risks will likely come from how the system performs or is operated. This will likely make the safety risk management a much simpler process to design and develop in the UAS industry. Should the UAS organization become significantly more complex, moving products or people, this will have to be revised and adjusted. (Stolzer, Halford, & Goglia, 2011).

To go along with this, the organization will also need safety assurance or a way to measure and identify key performance indicators. This will enable the UAS organization to know if any of its controls are slipping or not performing as intended. This is what will feed safety risk management. These will have to be regularly reviewed by management. This should also be slightly simpler than that of an airline as there are again fewer pieces in the UAS organization. This will also set the organization up for continuous improvement. Having these measures in place will allow for the organization to grow, which all UAS organizations are

likely to do, in a controlled manner without letting safety slip (Stolzer, Halford, & Goglia, 2011).

Lastly, the company will need safety promotion. This is again to ensure that everyone in the company knows that they are also responsible for safety. This should include safety training for all employees and regular communication about safety concerns and improvements. As UAS organizations are generally significantly smaller than airlines this is of even more importance. While if one person is not committed to safety in an airline it is likely it will be caught by someone else. In a small UAS organization, there might only be one or two people doing each job. Therefore, it is critical that everyone, from the UAS operators to the accountants, have a safety mindset and are willing and encouraged to speak up if they see something that is not safety motivated (Stolzer, Halford, & Goglia, 2011).

Adaptation of SMS for Unmanned Aviation Organizations

Safety policies and authority chains will have to be written to accommodate the smaller size and funding available of UAS service providers. Safety Risk Management (SRM) in UAS operations will require additional hardware safeguards to compensate for having no pilot on board. As an example, autonomous UAS delivery service provider Volans-i has added full redundancy in its motor, navigation, communication systems avoid system failure even when there are malfunctions and no pilot available to compensate for it (Frost & Sullivan, 2019).

Also, SRM will be challenging because of the need to constantly evaluate hazards and risks in an environment where capabilities constantly evolve. Safety assurance may entail platform, pilot, and service certification as well as fully automated data collection to enable safety analysis on a large scale. Finally, because of the pace of technological innovation, training schedules may have to be sped up, being offered quarterly rather than yearly as an example.

Conclusions

As SMS is still relatively new in the US aviation industry, it is slowly making its way to smaller organizations. There have been little reported measurable impacts from implementing SMS, so it is difficult for a small company to justify the expense of totally changing its safety system. However, new companies will likely look at SMS as they first start to develop safety programs. Since ICAO has made it necessary for small UAS organizations to implement SMS processes into their business, it is likely that if they see positive impacts from this the FAA will follow with similar regulations, just as they have with implementing SMS overall.

Recommendations

There are still significant steps before SMS will be widely implemented in small UAS organizations. If the benefits are made evident to small UAS companies, they may be willing to make the investments to introduce SMS to their organizations. It is likely to continue to trend toward SMS implementation, even without regulation, and will become the new standard for safety systems in these UAS organizations.

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