

Introduction

This document is to explain the need for provisions to enable pilots onboard some lenticular *Luffships* with a size able to carry people (crew), such as the LS-L20 Mk1 SkyRover (as shown above), also designed to be flown as a drone (a UAV) either autonomously or from a remote station by radio control (R/C). It should be noted that crew and passengers (as people) are treated differently, where passengers normally are a part of the payload carried and crew are necessary people for aircraft operation.

Discourse

Naturally, weight and cost are issues that must be borne by any aircraft development with crew onboard who fly it; where either the aircraft could be smaller (so cheaper) or it could carry a greater payload and/or fuel weight (so more cost effective) if flown as a pure drone. However, there are a number of good reasons for pilots/crew to be onboard and fly/operate the aircraft, as follows:

1. Flight Test

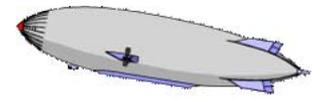
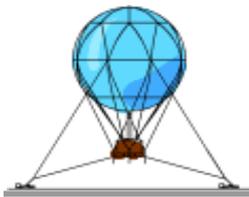
For any new aircraft, its maiden flight and the subsequent flight test programme, necessary to verify that it's airworthy, is an uncertain time when things may not work as expected or simply fail to meet expectations, needing change. Although the aircraft would be instrumented to monitor/record behaviour when something goes wrong, its own system wouldn't necessarily be able to adapt (since it won't have innate or any guaranteed intelligence to decide how to continue safely) and the failure or undesirable aspect may not be obvious to a ground pilot. If the failure was in the control system itself, then it could lead to an emergency situation and potential crash.

Assuming the aircraft could be recovered intact and (if not) that investors wouldn't respond in a knee-jerk manner (withdrawing funds) the question then would be, "what went wrong?" It may be that, due to following complicating circumstances (wrecked from crashing) the root cause would be impossible to determine, leaving a conundrum for how to proceed.

Now, with crew onboard in control and able to react, while the root cause of the upset may not be obvious at the time, they should be able to take alternative action to:

- continue safely, noting undesirable aspects
- communicate with the ground team to explain matters and get advice
- undertake ad-hoc tests to determine the root cause of any failure
- perhaps apply a temporary fix
- make a safe landing in whatever way possible, saving the aircraft and
- make a full post flight report enabling the issue to be understood and then solved

It should be borne-in-mind here that the prototype will be an expensive asset that the new company probably wouldn't recover from if it were inadvertently lost.



2. Certification

Commercial aircraft designed as pure drones are only allowed under air law regulations to operate under strict limitations set for such aircraft, although some aspects may be negotiable – depending on circumstances. A recent article¹ said that in the USA under new FAA rules for drones weighing less than 55 lb {25 kg} “operators must keep their drones within their visual line of sight, must only fly in daylight (unless the aircraft has anti-collision lights), and can’t fly faster than 100 mph {161 km/h} or above 400 ft {122 m} (with a few exceptions)”. While restrictive it does enable things.

The situation for larger drones (like SkyRovers) isn’t clear, where the authorities will be concerned that they pose a danger to other aircraft unless there’s a pilot onboard in control who can take action when necessary to avoid danger. Similar restrictions thus otherwise would be enforced until the authorities feel able to lift them.

For new aircraft developments operated by crew the certification process is less restrictive and, in the end, enables airworthiness authority pilots to fly and decide for themselves whether:

- The aircraft is airworthy
- Flight restrictions under a Permit to fly may be lifted
- It’s reliable and safe enough to fly as a drone in international airspace with other aircraft

Crew onboard thus enable the authorities to assess the situation over a period of time, as they have done with other aircraft that may takeoff, fly and land under automated control (necessary in thick fog when the pilots cannot see ahead properly) and gain confidence for rules relaxation.

3. Ferry Flight

There are occasions, such as when delivering the aircraft or transiting to another region for operation that ferry flights are desirable, but that may cross international borders and regions of controlled airspace that a drone wouldn’t be given permission to fly across. However, with a pilot onboard and in control, the situation changes – enabling permission to be granted.

4. Customer Requirements

The SkyRover originally was designed to satisfy US RFP requirements for an aircraft that could be operated at different stages and, depending on circumstances, by crew onboard and/or by a remote pilot with R/C and/or by an autopilot at the flick of a switch. Such versatility thus was a customer requirement intended to overcome a variety of circumstances depending on the needs of the aircrew (who may not be onboard or able to give attention to the aircraft) to execute their mission without worrying whether it would be available and ready for immediate continued use, which it had to be.

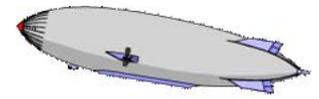
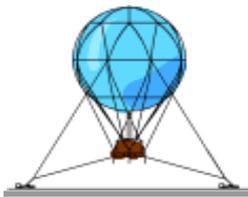
Other general customers also may very well like to have the options and versatility that such technology provides, where the SkyRover’s payload unit was designed as a simple unit without essential aircraft systems that may be easily and quickly exchanged with a differently configured unit to enable other purposes without affecting basic aircraft flight capability.

5. Operations

There are numerous occasions where the human onboard with his own eyes and ability to assess the situation plus decide action to take are an invaluable aspect for various operations, which may not be realised by remote operators without peripheral sight or a sense for what’s happening through their distant seat and with distractions at their location, which could be in another moving vehicle. Consider the implications for capture following an early test flight (when the crew have little operating experience) of a quite big prototype (necessary to carry the payload and compared with an HTA drone) poised over its mooring site with ground crew below in variable weather conditions. Would the remote pilot be able to control it well enough for safe capture without incident?

Naturally, it’s not an easy question to answer and the test flight shouldn’t have gone ahead without assessing the weather. However, Murphy is always lurking and the weather isn’t always predictable.

1 Website: <https://www.wired.com/2016/07/feds-just-put-us-back-global-drone-race>



6. Training, Safety and Emergency Situations

The versatility enabled by such technology offers many new possibilities for customers and operators to exploit, where:

- Pilots may be trained without an instructor onboard, but where control may be passed back to the instructor – or where the remote instructor may assume control (take over) in a similar way to car driving instructors with dual pedals.
- Safety in regular airspace improves with a pilot onboard to take action under situations arising (avoiding incidents) and enables situations arising (such as thick fog) to be overcome by passing control to a remote or auto pilot.
- Emergency situations, such as a pilot who becomes incapacitated, also may be overcome by a remote pilot assuming control to bring the aircraft back safely to a base. Such capability wasn't available to ground controllers of Germanwings Flight 9525, deliberately crashed 24 Mar 2015.

No doubt such capability has implications that must be carefully assessed. Nonetheless, there's potential for exploitation to improve matters; where the SkyRover is an opportunity to investigate the possibilities for onboard and off-board pilot control to help decide the best way.

7. Sales and Marketing

It's often been shameful that new airship proposals have been promoted as 'all singing and dancing' types offering a variety of operating roles when they were only suitable (as designed) for particular roles in an efficient and cost effective way. Nonetheless, customers appear to like the capability to operate in different ways, providing them with options for revenue earning services; where diversity is an attractive aspect for businesses to exploit and carry on with in an alternative way when particular services have low demand.

What is known is that, as pure drones, SkyRovers will face fairly restrictive limitations for legal operations in general airspace that may not be acceptable for business purposes, but that are eased when there's a pilot onboard. A way forward for the business thus is to promote the versatility of a 'drone or piloted aircraft', which was a deliberate SkyRover design aspect, to see how customers respond and find out whether it's wanted.

Naturally, this needs market research, not undertaken so far.

Conclusions

It should be clear from the Discourse that there are numerous benefits for a drone with sufficient capability to carry at least a pilot, who then generally would be in control. Versatility to switch roles between pure drone (with both R/C and autopilot control) and onboard pilot control also is an option that may be attractive/desirable for customers who acquire the aircraft or for the business offering services with them to have for various reasons.

What is not known and cannot be fully assessed until the aircraft enters service is how customers will take up and use it. This, most likely and as has occurred for other new products, could lead to modifications that are customer driven in the future. However, until that time it perhaps would be best to keep the option for a UAV or manned aircraft open.

In addition, it should be appreciated that this facilitates longer term plans for bigger aircraft, such as an aerial crane, that need crew onboard to operate. The Mk 1 SkyRover, already established as a market entry type for aerial services with 300 kg disposable loads (e.g. payload, crew, fuel & ballast) operating either manned or as a UAV, thus is but a stepping point to leverage future plans.

Contact as below.