Good Morning. I am glad we are starting the symposium with this discussion. The global community continues to struggle with the RPAS question and a significant problem has been that the manufacturing has outpaced the regulatory frameworks and this places a burden on both. For the regulators, there is tremendous pressure to develop regulations quickly, while for the manufacturing community they are forced to speculate as to what the future requirements might be to avoid manufacturing something that won’t be permitted to operate as designed. For remote tower operations, if we fail to act now, early in the process, we will quickly find ourselves in the same situation.

When we talk about the commonalities between the two, it depends on where we look. From an operational perspective, there are very few commonalities, because in fact, there are few operational commonalities between aircraft and air traffic control – there is interaction, but not comparison.
When we look at the integration question, there are significant differences. This is because they are fundamentally different types of innovation.

Remotely Piloted Aircraft are a disruptive technology. I would argue they are the first truly disruptive technology in decades of civil aviation.

Remotely Operated Towers are not, they a sustaining innovation, perhaps even a revolutionary one.

From an integration perspective, this is an important distinction. The disruptive technology has consequences for stakeholders across the existing market, it effects existing airspace users, air traffic control providers and systems, airports, regulators, engineering standards, lawyers, virtually everyone engaged in the aviation industry is in some way affected by the integration of remotely piloted aircraft. It has forced a reaction.

For remotely operated towers, that is not the case. It does not disrupt the industry, it is innovation, in the same way that radar was an innovation, but the effect on stakeholders, and on which stakeholders, is different than remote aircraft.

It is when we step back from the operation that the underlying commonalities become apparent.

**TYPES OF INNOVATION**

- **Disruptive** – an innovation that creates a new market, overtakes an existing market, or forces a reaction from an existing market, using a different set of values. Unexpected.

- **Sustaining** – an innovation that does not disturb existing markets
  - **Evolutionary** – improves a product in an existing market
  - **Revolutionary** – unexpected, discontinuous or radical development in an existing market
The need for technical standards for each is clear. What we are trying to achieve has one big common element. That is, how do we replace perception from the human eye with technology? And one of the challenges presented by both remote aircraft and remote towers is that there is no performance standard for the human eye. We have a medical vision standard, but that is not a performance standard for perception.

The question should not be: “are the systems used equal to or better than the human eye?” The question we need to ask in each case is:

“What information does the system need to provide to the pilot or controller so that the existing air traffic control standards, rules and procedures can be used?”

And, if the systems cannot provide that information:

“What standards, rules, and procedures must be developed in order for the remote systems to be used?”

When we ask those questions, the need for standards becomes even more clear.

In replacing a visual process with a surveillance tool, we have challenges that are new, and this is common for aircraft and towers. We need to have a standard for the communications link to ensure that the information is delivered to both pilot and controller in a sufficiently timely and reliable way, and that there is appropriate synchronization between the elements of the system that deliver the information. If you think about other surveillance systems, and the work that was necessary to transition from a single source radar data to multi lateration or a fused target, the
same questions apply to an image created by multiple cameras or sensors, whether it is on the aircraft or the airport.

Another commonality in replacing direct vision is that it needs to detect non-cooperative elements. Not just aircraft, but also vehicles, obstacles, and other hazards. This is something that other modern surveillance systems generally do not do. This is a difficult question that results in a higher standard requirement than other surveillance systems. This is because the job of those other systems is different.

Most aerodrome surveillance systems are designated for situational awareness, not separation. ACAS is a safety net, not a primary system. So we were able to design these systems in a way that recognized that they only detect participating targets and other elements of the system compensate for that. We don't have that luxury when we are removing the direct vision, because in many cases, direct vision was the primary system.

Another commonality is the need to transition our concept of aviation surveillance systems to include camera or video based representations. For most of our history, surveillance meant radar. As we added other technologies, like ADS-B, we had to update our definitions, but it was still a radar-like presentation. It just wasn't Radio Detection And Ranging. Some steps have been taken, but they don’t go far enough.

Finally, in both domains, there are already multiple manufactures, creating a need for a common set of minimum standards, just as we have for other surveillance technologies used in aviation.

WHAT IS SURVEILLANCE?

Dictionary –
continuous observation of a place, person, group, or ongoing activity in order to gather information

ICAO Doc 4444: PANS ATM
ATS Surveillance System - A generic term meaning variously, ADS-B, PSR, SSR or any comparable ground-based system that enables the identification of aircraft.

Surveillance- A function of the system which provides identification and accurate position information on aircraft, vehicles and obstacles within the designated area.
Generically, there is no question that a remote tower is a surveillance system:
- Continuous observation of a place, person, or ongoing activity in order to gather information.

For an ATS surveillance system, that information is used for the purposes of air traffic control and ICAO documents offer more specific definitions.

From PANS-ATM, an ATS Surveillance System includes a “ground based system that enables the identification of aircraft”

Further, when we are discussing Aerodromes, we find ICAO support defining surveillance not as a specific technology, but as the function –

“A function of the system which provides identification and accurate position information on aircraft, vehicles and obstacles…”

While PANS-OPS does not offer a definition of surveillance, vol 1, section 7 provides a chapter on Airborne Surveillance, currently devoted to ADS-B IN, specifying that it is an aid to the visual acquisition of surrounding traffic.

The fundamental commonality between RPAS and Remote Towers is that we are attempting to transition from a human decision making process based on information derived from direct visual observation to one that is based on information presented on a screen, regardless of whether that image is presented from a video feed, computer generated imagery, or an otherwise enhanced visual picture.

So while from an operational perspective, there are fewer commonalities, from a regulatory perspective there is a great deal in common. Our regulatory frameworks did not evolve with this concept in mind and the documents are important. Because the legality of applying a separation standard that specifies direct visual observance in an environment where direct visual observance is not available, is questionable.

In order to establish that possibility, the technology must be validated against the separation standard and the regulatory documents must be amended to reflect that validation. The integration of ADS-B provides a model for this validation. It was not just assumed that ADS-B and radar were equal, ASD-B standards were developed to enable the use of a separation standard that was identical to Radar, and the ICAO documents were amended to reflect that ADS-B was an ATS Surveillance System. And work is ongoing to enable new separation procedures that capitalize on the technology, like the in-trail climb procedure.

There is an opportunity for the regulatory process for remotely operated towers to learn from the experiences in the RPAS activities and perhaps avoid some of the pitfalls the RPAS community has encountered. The first is recognition that it may be a broader multi-disciplinary question that originally envisioned.
This is not a comprehensive list of ICAO documents that require examination and possible amendment to accommodate remote operations, but it is an illustration of those that are common between remotely operated Towers and Aircraft and in some cases, there may be opportunity for the amendments to cover both domains.

In licensing, we have several common questions. The first is whether the current categories of licenses cover remote operation. Second, how do we categorize it? Is it a separate category of license or is it a rating? If it is a rating, what is the underlying license requirement?

In both Approach and Area Control, ICAO has a distinct surveillance rating; Aerodrome control does not yet offer this rating.

In answering the licensing question and developing the ICAO documentation to support licensing for remote operations, there is a common question to be answered, what is the pre-requisite? Does a remote pilot need a pilot’s license first in order to get the rating, and if so, which type of pilot’s license is adequate. For a controller, what type of controller license is required before a remote, or surveillance rating can be granted.

To put it more directly, can someone be licensed as a remote pilot, having never sat in a cockpit on board an aircraft and can someone be licensed to as a tower controller in a remote operation having never looked out a tower window?
When it comes to Rules of the Air, do we need to redefine what is meant by visual or “to see” to encompass detection through video presentation of information? Or do we need entirely new rules to allow similar operations when direct visual observance is not possible?

For Annex 10, the standards will be new, as they are for the introduction of any new technology that is used for the separation of aircraft or collision avoidance.

For Annex 11 – any procedure that requires either the pilot or controller to see something – to see traffic, to see obstacles, to see terrain, to see the runway…needs to be adapted to recognize that the pilot or controller may only “see” a video representation of those things and that video representation may be distorted to fit within the display area available. What rules and standards are necessary to allow for that distortion? How much is allowable? And what adjustments need to be made to accommodate that difference? But this isn’t unusual – we have different separation standards based on surveillance source, 3 miles and 5 miles for example, and this is all defined in PANS-ATM

PANS-ATM

But within PANS-ATM, specifically Chapter 8 – ATS Surveillance Services, we have 8.10 USE OF ATS SURVEILLANCE SYSTEMS IN THE AERODROME CONTROL SERVICE.

It details the functions that may be performed using an ATS Surveillance system and it does not yet allow for the full provision of aerodrome control. In fact, 8.10.1.4 expressly precludes it, it states:

**In prescribing conditions and procedures for the use of ATS surveillance systems in the provision of aerodrome control service, the appropriate ATS authority shall ensure that the availability and use of an ATS surveillance system will not be detrimental to visual observation of aerodrome traffic.**

In maintaining this language, ICAO precludes the use of remote towers for aerodrome control as the removal of the controller from the tower, or the elimination of the tower itself is detrimental to visual observation of aerodrome traffic.

Moving on to Annex 13, what are the requirements of recording and retaining the video information provided to pilot or controller through the remote system? Generally speaking, when we have information transmitted through electronic means, which is used in the pilot or controller decision-making process, that information is expected to be recorded and retained for accident investigation purposes.
And of course, safety management, which touches on all of these areas.

All of these issues are common when we take a regulatory approach. Hopefully the air traffic side can capitalize on some of the work that has already been done on the aircraft operations side.

But I would be remiss if I only talked about the challenges and the work ahead. We can also see common benefits in the development of remote operations.
With any new technology we should look for opportunities to improve existing systems – where can this technology be used that enhances the existing operations, for example, if we have remote tower technology that uses sensors to detect small animals that may pose a runway hazard, why would you restrict its use to a remote operation? We should consider where these technologies could improve safety in manned towers as well.

**COMMON BENEFITS**

- Technology developed for remote operations can be used to enhance traditional operations
  - Enhanced pilot synthetic vision systems
  - New aerodrome surveillance technologies
- Improved services in remote locations
- Emergency services in disaster situations

My time is running out, so let me close with this. There are significant differences in the implementation of these concepts. In many ways remote towers will have an easier path to full integration, because the regulator and ANSP have greater control over the situation, they can amend procedures to accommodate the operation with limited or no implications for other stakeholders. However, this should not be used as a reason to shortcut the regulatory processes. In fact the remote tower community should look to the comprehensive and multi-disciplinary work of the remotely piloted aircraft community as a model to ensure that important steps are not missed.
Thank you.