Crew Resource Management

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Crew Resource Management

Crew Communication

Drone Crews

Pre-Flight Briefings

Visual Observer Training

ICAO

- Communication/Interpersonal Skills
- Situational Awareness
- Problem-solving/Decision-making/Judgement
- Leadership/Followship
- Stress Management
- Critique

Effective Communication

Effective communication encompasses the entire scope of the sender's verbal, non-verbal, and symbolic message

Effective communication is a recognition that a variety of assumptions and other filters potentially could distort the message that is sent or received

Effective communication involves active listening for clear comprehension

Effective communication completes the circuit of sending, receiving and feedback with all parties sharing a common understanding of the message

Essential Verbal Communication Skills

Inquiry – The quality of information has significant impact on the decision making. Clarification of an action or intended action is a right among the crew.

Advocacy – The clear stating of one's position and a necessary component to accept or rationalize different points of view.

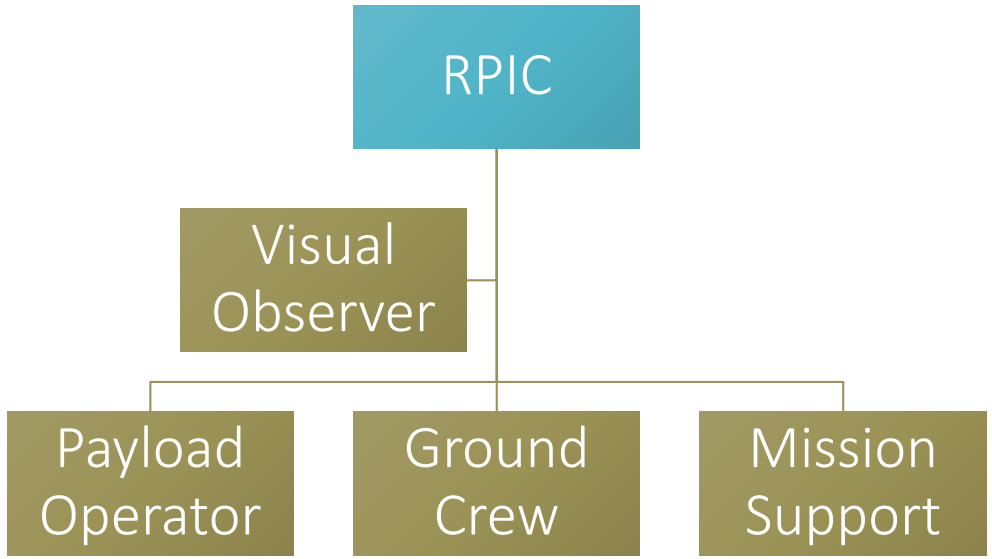
Listening – Active listening is an action, not a passive function. Actively inquire and respond – confirm that the message has been received and understood.

Conflict Resolution – With competing views, conflict is inevitable but should be dealt with rationally. Some issues should be deferred until another time while the crews deals with the task at hand.

Critique – Proper critique is a necessary component to analyze performance for future improvements.

In what situations do you see these skills being necessary in UAS operations?

UAS Flight Crew



A UAS Flight Crew may include a Visual Observer and other Support Personnel such as a payload operator, auxiliary visual observers, other ground support crews or mission support crew

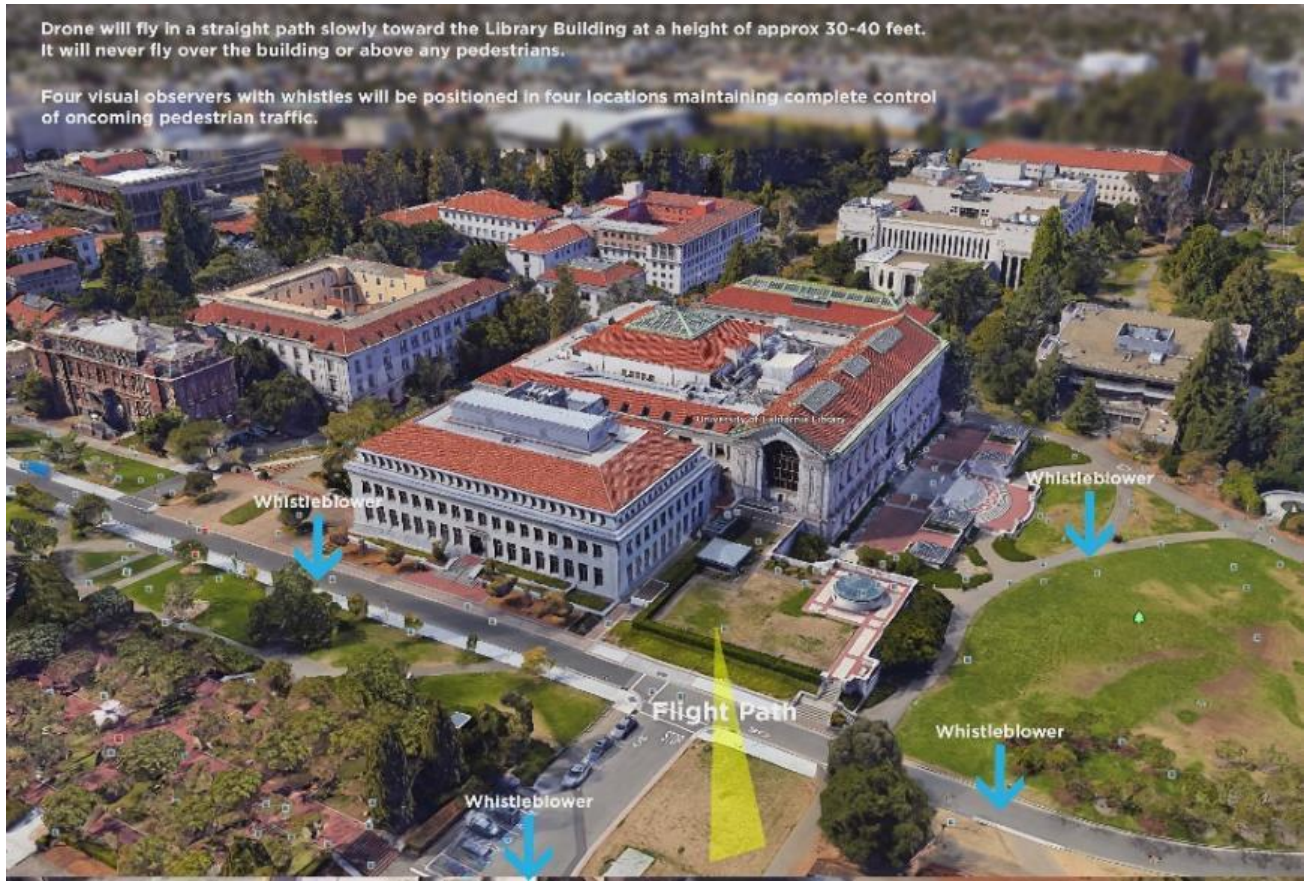
Everyone should have a defined role and responsibility

Example Crew Setup

Example flight at UC Berkeley

One RPIC, 4 VO/pedestrian ground support

Whistles used to communicate only one thing - halt UAS operation and move to a safe zone



Crew Briefings

A good crew briefing will let the entire crew know

- What their role & responsibility is
- Any pertinent information for their role
- What abnormal conditions to look for
- Emergency procedures

Crew Briefings

General
- Type of flight: e.g., training, maintenance, normal. Note appropriate restrictions
- UAS Status – condition, recent maintenance, other items of note
- Crew – roles & responsibilities
- Site Description
  - *Hazards and Risks*
  - *Boundaries*
  - *Areas of Concern*
  - *Non-participating persons*
  - *Nearby airports or areas of air traffic*

Mission
- Primary mission goals, any secondary goals
- Flight Path Detail – estimated duration, flight altitude, flight pattern,
- Crew coordination (who does what during the mission)
- Recovery Procedures

Weather
- Current observation
- Weather forecast covering the event
- Impact of weather on operations

Communication
- Within Team
- Other Participants
- Other communications means between participants

Emergencies
- Mission abort criteria
- Loss of power on takeoff
- Loss of power at altitude
- Lost comms- autopilot
- Lost comms – manual
- Landing emergencies
- Contaminated site (personnel, vehicles)

Practice Crew Briefing

Take a couple of minutes to write up a crew briefing – then share with your group, assigning roles & responsibilities.

As you listen to other crew briefings, reflect on whether you have enough information to do your job?

If you don’t have enough information, communicate with the lead RPIC to resolve

Visual Observer Training

Being a VO is a different than being an RPIC

Visual Observer Responsibilities

§ 107.33 Visual observer.

If a visual observer is used during the aircraft operation, all of the following requirements must be met:

a) The remote pilot in command, the person manipulating the flight controls of the small unmanned aircraft system, and the visual observer must maintain effective communication with each other at all times.

b) The remote pilot in command must ensure that the visual observer is able to see the unmanned aircraft in the manner specified in § 107.31.

c) The remote pilot in command, the person manipulating the flight controls of the small unmanned aircraft system, and the visual observer must coordinate to do the following:

1. *Scan the airspace where the small unmanned aircraft is operating for any potential collision hazard; and*
2. *Maintain awareness of the position of the small unmanned aircraft through direct visual observation.*

What does this mean? What is the value? What can a VO actually do?

Top VO Skills

What do you think are the top 6 Visual Observer Traits or Skills?

(Not responsibilities)

Visual Observer Traits

Be an effective communicator – Your words must be concise and clear

Always think ahead – anticipate what will happen next and what needs to be done to get there

Get your hands dirty – Take action to handle issues, don't wait to be micro-managed

Be a buffer – Stave off disturbances and on-lookers

Be focused at the task at hand – Don't drop your concentration when monitoring for air traffic or pedestrian intrusions

Help the RPIC look good – Have equipment ready ahead of time

See the big picture – What needs to be done to complete the overall mission goal.

Checking the Lists with the Crew

Two are better than One – Make checklists teamwork

- Challenge and Response

Make sure that Crew are on the pre-flight checklist

Crew must be engaged in the pre-flight just as much as they need to be engaged in the flight activity

VO Call	Pilot Response
Wind and Weather	Within Limits
Batteries	Charged at xx%
Transmitter	On and Charged at xx%
Ground Station	(App name) On
Cameras	On / Not Required
Take Off Sequence	Auto/Manual Launch
Area and Air Traffic	Clear
Cleared for Take Off	Ready to Launch

Standard Phrase-ology

Standard Phrases help keep things simple
- Drone/Bird/Aircraft -> UAS Name

Call-Outs – RPIC to Crew
- Only on Crew Relevant Information (phase transitions)
  - *Reaching Altitude*
  - *Starting *mission*, *approach*, etc*
  - *Rotating to ****
  - *Heading Home*
  - *Switching to Manual Mode*
- Things not to call out
  - *Battery at 50%*
  - *Halfway through approach*

Some Possible Phrases
- Pause Flight
- Proceed
- All Clear
- Possible Aircraft Heard
- Visual Contact with Aircraft
- Threat inbound from *direction*
- Aircraft Non-Threat
- Flight Area Compromised

Let’s come up with some other phrases and let’s discuss

Flying a Drone is like Playing in a Road

Only stay in the sky long enough to complete your mission

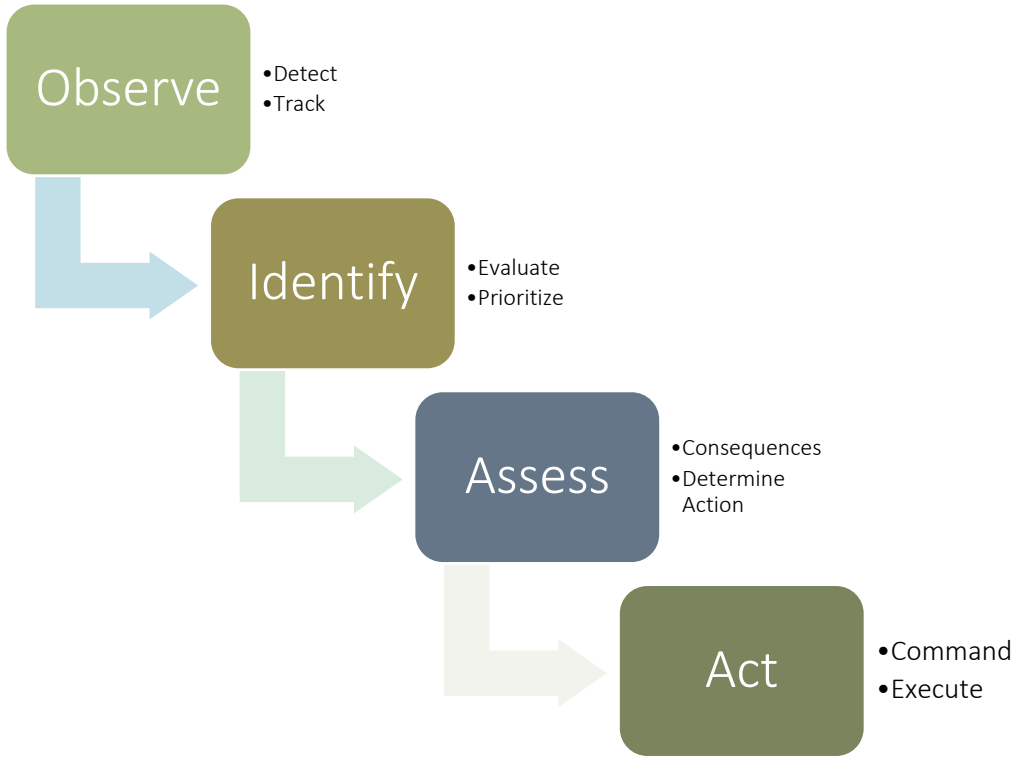
You need to be vigilant on the lookout

You're vulnerable to high speed collisions

You and your Visual Observer need to practice good 'See & Avoid' Techniques

See & Avoid in four easy steps

- Observe
  - Detect
  - Track
- Identify
  - Evaluate
  - Prioritize
- Assess
  - Compare Consequences
  - Determine action
- Act
  - Command
  - Execute
- All of these steps take critical time!

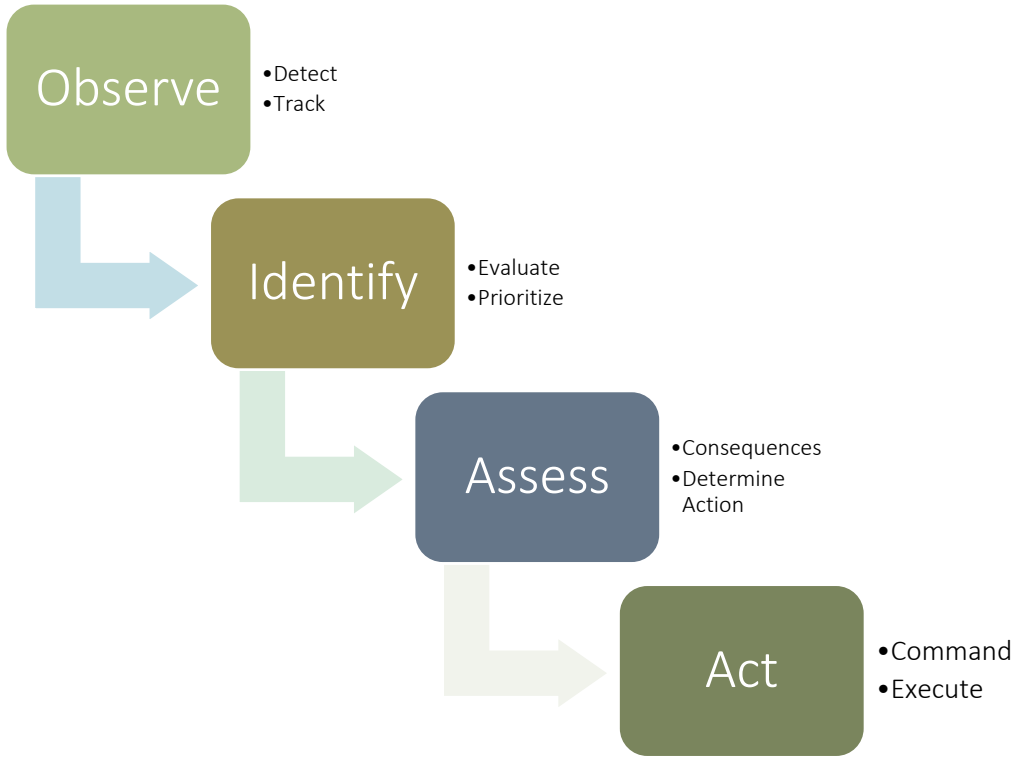


See & Avoid in four easy steps

Improve See & Avoid by minimizing the time you spend in each of the steps

How to minimize the time to **observe** a threat?

- Bring Visual Observers
- Focus on the horizon where the threats are likely to be
- Maintain a ‘sterile cockpit’ – avoid extraneous conversations
- Listen!

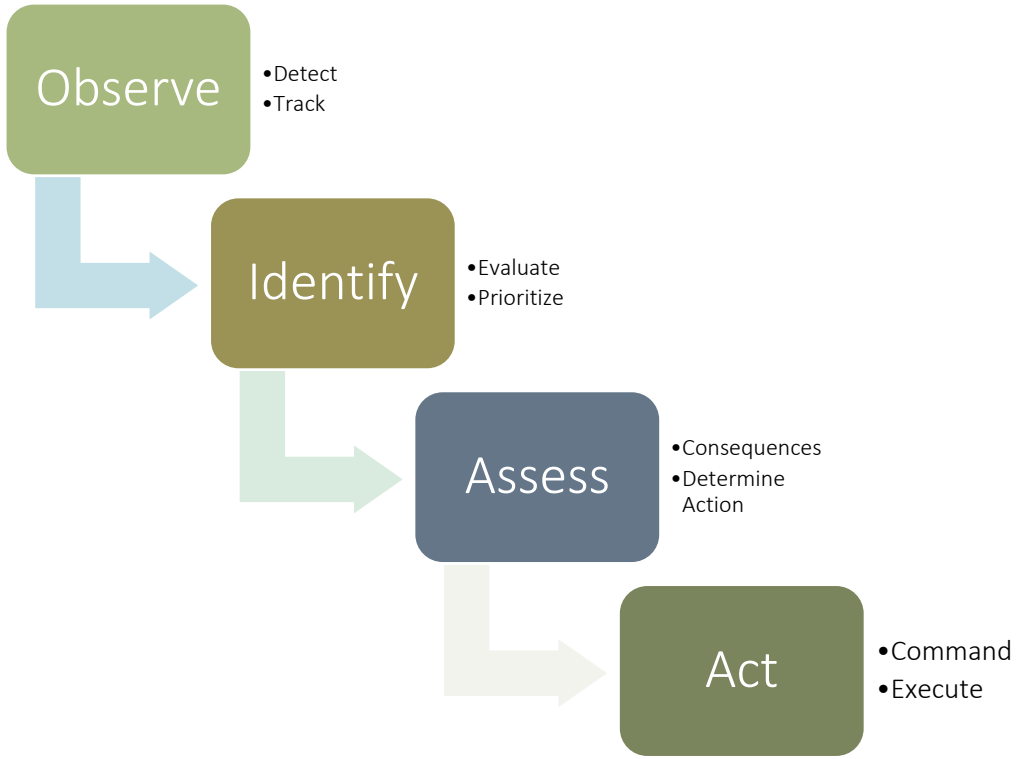


See & Avoid in four easy steps

Improve See & Avoid by minimizing the time you spend in each of the steps

How to minimize the time to **Identify** a threat?

- Visual Observers from different vantage points can help identify if an incoming aircraft is a threat
- Learn to recognize the conditions of an actual threat
  - *Directly above ≠ threat*
  - *Flying parallel to site and behind you ≠ threat*
- Practice your VO communication

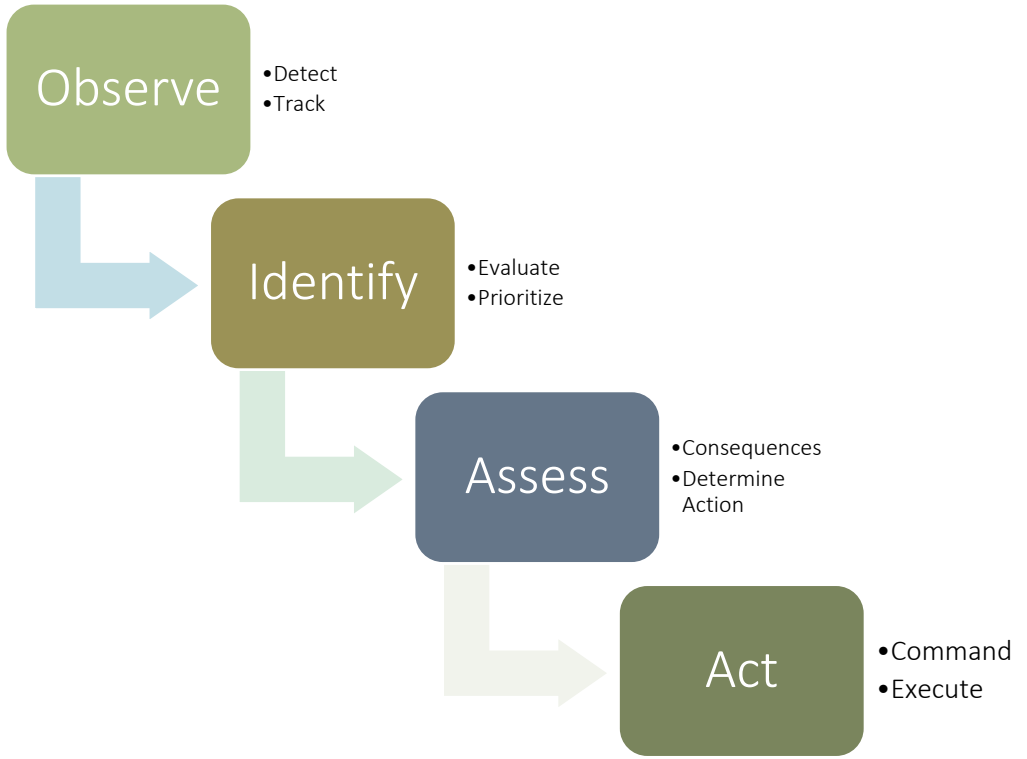


See & Avoid in four easy steps

Improve See & Avoid by minimizing the time you spend in each of the steps

How to minimize the time to **Assess** a threat?

- Always keep your aircraft as low and close to you as possible to make it easier to determine where a collision may occur
- Pre-identify escape routes or actions to take

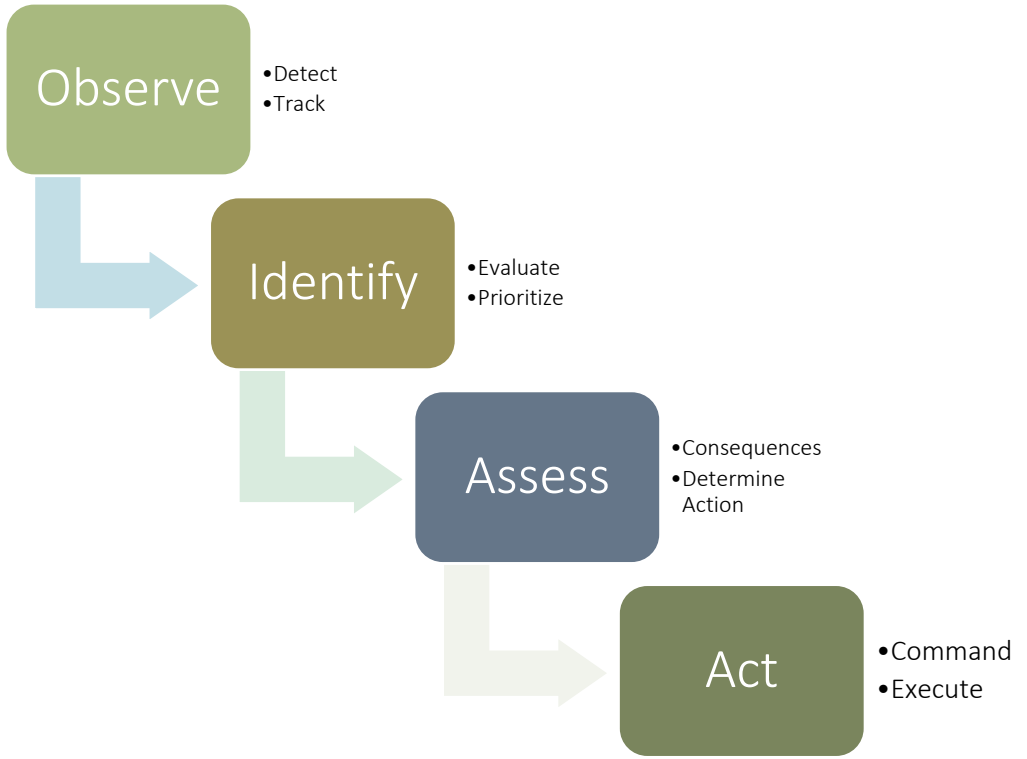


See & Avoid in four easy steps

Improve See & Avoid by minimizing the time you spend in each of the steps

How to minimize the time to **Act on** a threat?

- Keep your fingers in position to react
  - *On a P4, control the screen with your right hand, leaving your left fingers ready to switch out of autonomous mode*



Notes

You are likely to hear an aircraft before you see it

Always scan the horizon first – that's where the incoming aerial threats are coming from

If a manned aircraft or helicopter sees your UAS, they will not know your intentions and will have no means of communicating with you in a timely manner. They will react defensively even if you don't think there is a threat

Top 10 Tips for Safe UAS Flying

1. Practice. There is no substitute for experience. Gain experience by practicing flying your drone, conducting data collection missions, and flight planning. Get familiar with your equipment and processes.

2. Write Everything Down. Keeping records can help you maintain your equipment, monitor for unsafe practices and keep you on track. Things to track: battery usage, weather conditions, equipment use/damage, software versions.

3. Make Checklists and Use Them. Nothing derails a flight mission like forgetting an item or a step. Make a checklist for planning a mission, make a checklist for packing your equipment, make a checklist for preflight inspections and any other process you may have.

4. Always Keep an Eye on the Weather. Experienced field researchers know that weather reports are only a suggestion. Conditions in the field may change dramatically and can turn a good flying day to a disaster.

5. Bring a friend or two. Between juggling a flight controller, operating a payload, monitoring weather conditions and scanning for intruding air traffic, it can be taxing to try to do it all at an appropriate level. Bring some help to make sure everything goes smoothly.

6. Bring backups or replacement parts. Many operators will bring spare propellers or batteries to their flight missions, but don't forget about other supporting equipment such as cables, landing gear, radios or antennas. Make sure backup parts are on your pre-departure checklist.

7. Choose appropriate flight locations. When you choose a location to fly at, make sure you're aware of all the hazards. Look for indicators of hidden hazards like rolling hills or high tree lines that create turbulence, or low visibility hazards such as power-lines or towers that interfere with radio systems. Be aware that you as the pilot are responsible of ensuring the safety of all persons on the ground, whether you can see them or not.

8. Set boundaries for go/no-go situations and stick to them. Deciding when to fly and when not to fly should not be an ambiguous decision. Don't let external pressures push you to make unsafe decisions.

9. If something isn't right, stop immediately. Nothing fixes itself in the air. If something doesn't sound right on the ground during pre-flight checks, don't fly. If the weather changes to an unsafe condition, land as soon as it is safe.

10. Pause and consider all the risks before you fly. Damage to your aircraft is only one of many aspects to consider. Consider the payload, consider potential damage to other's property, consider secondary effects such as causing an auto accident when your aircraft crashes in the middle of a road.