Human Factors and ADM

Session Time: Four, 50-minute sessions

DESIRED RESULTS

ESSENTIAL UNDERSTANDINGS

In the absence of a medical certification requirement, it is important that remote PICs be familiar enough with physiology that they can self-assess their own mental and physical fitness to fly, as well as the fitness of their crew. (EU1)
A strong safety culture, focusing on elements that include crew resource management (CRM) and aeronautical decision making (ADM), should be established in all commercial UAS operations. (EU2)

ESSENTIAL QUESTIONS

1. How can a remote PIC tell if they or anyone in their crew are exhibiting symptoms of a physiological issue or a hazardous attitude, and what are the antidotes for common physical or mental conditions?
2. How can safety be encouraged in a formal, systematic way in UAS operations? How can risks be assessed and mitigated by remote PICs?

LEARNING GOALS

Students Will Know

- Physiological issues that remote crews might face during operations, including hypoxia, dehydration, hypothermia, stress, and fatigue.
- Important elements of aeronautical decision making (ADM), as well as the hazardous attitudes that can undermine them.
- How to identify and assess hazards in UAS operations.

Students Will Be Able To

- *Compare* different physiological conditions that might be exhibited by UAS aircrew members. [DOK-L3]
- *Make observations* about aeronautical decision making (ADM) in a variety of scenarios, and identify hazardous attitudes. [DOK-L2]
- *Assess* the severity and likelihood of risks in a UAS operation using a risk matrix, and offer ways to mitigate risks once identified. [DOK-L4]

ASSESSMENT EVIDENCE

Warm-up
The warm-up introduces students to ADM, where they discuss what aeronautical decision making entails.

Formative Assessment
The formative assessment is a group knowledge assessment of physiological factors that could affect a UAS crew member's ability to take part in an operation.

Summative Assessment

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This consists of an individual knowledge assessment of the decision-making and risk mitigation/identification techniques available to UAS operators and how UAS operators can use these techniques.

LESSON PREPARATION

MATERIALS/RESOURCES

- Human Factors and ADM Presentation
- Human Factors and ADM Student Activity 1
- Human Factors and ADM Student Activity 2
- Human Factors and ADM Student Activity 3
- Human Factors and ADM Teacher Notes 1
- Human Factors and ADM Teacher Notes 2
- Human Factors and ADM Teacher Notes 3

LESSON SUMMARY

Lesson 1: Preflight and Maintenance
Lesson 2: UAS Crew Resource Management and Communication
Lesson 3: Handling Emergencies
Lesson 4: Human Factors and ADM

The lesson will begin by introducing the PAVE checklist, explaining medical conditions, environmental influences, and human factors and how they contribute to hypoxia.

Next, the lesson will discuss heat and cold injuries, hyperventilation, fatigue, and illusions and how to mitigate the risks they carry.

Finally, the lesson will introduce hazardous attitudes and safety management systems. It will also present a version of the PAVE checklist and the risk matrix chart that are tailored to UAS operations.

BACKGROUND

Risk management is a major factor in daily life—when driving, walking across the street, or flying. During routine activities, we often carry out risk management subconsciously, but it is critical to be actively engaged in risk management when conditions could pose a threat to persons or property. This is the case with UAS operations, when pilots are responsible for safe and lawful flight in shared airspace. Reckless decisions can put others in danger, damage property, or result in forfeiture of a pilot certificate. Understanding human factors and aeronautical decision making enables PICs to identify risks before they become safety issues and is important to being a responsible PIC.

MISCONCEPTIONS

This lesson will focus on human factors: physical and mental issues that may affect pilots during an operation. Some of these factors, such as aeromedical factors and hazardous attitudes, have roots in the world of manned flight. However, this does not make them less important to consider in UAS operations.

Students might not initially see the value in learning some of the aeromedical factors or hazardous attitudes that can affect pilots. They may feel that they are unlikely to be affected by machismo or resignation. It is important for them to consider that all pilots will experience a hazardous attitude to some degree over the course of their career. Also, a remote PIC must be able to identify not only hazardous attitudes or aeromedical conditions that they are experiencing, but also those that other members of their crew are experiencing. This is because the PIC has the ultimate responsibility for any operation.

DIFFERENTIATION

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To support verbal reasoning in the ENGAGE and EXPLORE sections of the lesson plan, organize the class into groups for Think-Pair-Share instead of a whole group discussion. This allows learners to think about the questions, and discuss their thoughts with a partner before sharing with the larger group. Sharing encourages all students to participate and practice skills, including metacognition.

For learners with low working memory, creating graphic organizers for information in the EXPLAIN section of the lesson plan. Ask students to record and review their notes in graphic organizers to be able to recall this information more easily.

LEARNING PLAN

ENGAGE

Teacher Material: Human Factors and ADM Presentation

Session 1

Slides 1–3: Introduce the topic and learning objectives of the lesson.

Slide 4: Conduct the **Warm-Up**.

Warm-Up

To start class, ask students the following:

- What do you think of when you hear the term “aeronautical decision making”?
- What elements could be included in this decision making?
- How can remote pilots be encouraged to make good decisions and create an environment where safety is valued?

It is not necessary to correct student thoughts at this point; the purpose of these questions is to stimulate thought and conversation.

EXPLORE

Teacher Material: Human Factors and ADM Presentation

Slide 5: The video on this slide shows a prototype of a drone that could deliver packages:

- “Drone Package Delivery Prototype” (Length 1:58)
  https://video.link/w/PeG0

For teachers unable to access Safe YouTube links, the video is also available here: https://youtu.be/20nmHbDRhEs

Ask the following questions and allow class discussion as time permits. Example answers are given, but students’ responses may vary.

Questions

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- What are some risks that might be present in the type of mission the video shows?
  UAS flying beyond line of sight, flying over people en route, potentially dropping packages
- How serious do you feel each of these risks to be?
  Answers are subjective; students should use their best judgment.
- What are some ways these risks could be countered?
  Employing technology to assist with navigation, planning routes over unpopulated areas, securing packages with failsafes.

Slide 6: This slide introduces students to the PAVE checklist. This checklist is commonly used in manned aviation to evaluate a potential flight, and it is also valuable in unmanned aviation. The letters that make up the **PAVE** acronym stand for **P**ilot, **A**ircraft, En**V**ironment, and **E**xternal pressures. By thinking through each of these elements, UAS operators can assess and mitigate risks that may be present during the flight.

Slides 7-8: Organize students into groups and ask them to create a list of risks associated with each element of the checklist. (For example, for "pilot," what requirements should the PIC meet in terms of certification, physical and mental condition, and training?)

Once students have had time to brainstorm risks, have them discuss their ideas as a class using the following questions.

Questions

- What risks did you identify using the checklist that you did not consider in the initial class discussion?
  Take this opportunity to discuss new ideas that came up during the group brainstorms.
- What might this indicate about the use of checklists and other systematic means for identifying risks prior to an operation?
  Checklists may not be all-inclusive, and it is important to add justifiable items when needed for safety. Collaborating for input on checklists can improve safety.

Teaching Tips

The following are examples of risks associated with PAVE items in UAS operations. Note that these are not all-inclusive.

- **P**ilot – *inexperienced, fatigued, hungry*
- **A**ircraft – *inexperience with specific model of UAS, aircraft not airworthy*
- En**V**ironment – *inclement weather, wind, poor visibility*
- **E**xternal pressures – *short deadline, low battery life remaining, shifting hazards in flight*

EXPLAIN

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Teacher Materials: Human Factors and ADM Presentation, Human Factors and ADM Teacher Notes 1, Human Factors and ADM Teacher Notes 2
Student Materials: Human Factors and ADM Student Activity 1, Human Factors and ADM Student Activity 2

Slide 9: In contrast to pilots of manned aircraft, UAS crewmembers and pilots are not required to hold a medical certificate. However, this does not imply that the medical fitness requirements are different. Per 14 CFR Part 107.17, it is each crew member's responsibility to self-assess their medical fitness prior to any operation, and, ultimately, it is the PIC' s responsibility to ensure that the crewmembers are fit to participate in the operation.

This fitness includes psychological factors that could affect safety. If the PIC deems that a crewmember has a medical or psychological condition that could threaten the safety of the operation, it is the PIC's duty to terminate the operation or participation of an individual, as required. This screening process relies on the PIC's awareness of key physiological and psychological factors to effectively detect quickly diagnose them, and to intervene as necessary.

Common physiological factors that could impact an operation include hypoxia, hyperventilation, dehydration, heatstroke, hypothermia, stress, and fatigue. The proceeding slides will cover these conditions in detail.

Teaching Tips

14 CFR Part 107.17 states: "No person may manipulate the flight controls of a small unmanned aircraft system or act as a remote pilot-in-command, visual observer, or direct participant in the operation of the small unmanned aircraft if he or she knows or has reason to know that he or she has a physical or mental condition that would interfere with the safe operation of the small unmanned aircraft system."

Slide 10: While many may believe hypoxia is a condition that only affects manned flight crews, it is actually a significant risk during UAS operations conducted at high altitudes and under certain environmental conditions, and it can also be an accessory risk to certain medical conditions. Different types of hypoxia can be related to medical conditions, carbon monoxide, substance use, and altitude.

Stagnant hypoxia and anemic hypoxia are types of hypoxia that might be related to carbon monoxide or other medical issues:

- Stagnant hypoxia can be caused by reduced blood flow, which affects oxygen delivery to the brain. This is usually attributed to cardiovascular problems.
- Anemic hypoxia can be caused by inadequate hemoglobin with which to carry oxygen. Even if the oxygen pressure is normal, it can result from an anemic condition or carbon monoxide poisoning.

Histotoxic hypoxia can be related to substance use:

- Histotoxic hypoxia can occur as a result of inhibited oxygen absorption caused by alcohol or narcotics. This risk underscores the importance of avoiding alcohol prior to an operation.

Hypoxic hypoxia is usually altitude related:

- The hypoxic type of hypoxia is typically caused by a lack of atmospheric oxygen or atmospheric pressure with which to "force" sufficient oxygen into the lungs. These conditions are found at high altitudes (e.g. mountain ranges).

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Slides 11-12: It is important for all UAS operators to know these conditions and how the symptoms might manifest themselves because affected crew members may not be able to communicate symptoms. Thus, it is invaluable during an emergency to have a working knowledge of these conditions and contributing factors. As students watch the following video, they should think about which type of hypoxia is presented and in what situations a remote pilot might experience this type of hypoxia.

- "Why You Should Put YOUR MASK On First" (Length 10:17)
  https://video.link/w/EQG0

For teachers unable to access Safe YouTube links, the video is also available here: https://youtu.be/kUfF2MTnqAw

Ask students the following questions at the conclusion of the video.

Questions

- Which type of hypoxia was presented in the video?
  hypoxic
- In what situations could a remote pilot experience this type of hypoxia?
  high-altitude operations (mountains)

Session 2

Slide 13: To begin the next session, ask students the following questions as a refresher.

Questions

- What are the four basic types of hypoxia?
  stagnant, histotoxic, anemic, and hypoxic
- What physical effect does alcohol have on the body's ability to process oxygen, and what type of hypoxia can this cause?
  Inhibited cell absorption of oxygen; histotoxic hypoxia
- Who is responsible for assessing the physiological fitness of crewmembers?
  the PIC

Slide 14: Hyperventilation is a lack of carbon dioxide (CO_2) in the body. This can be caused by outside stress, dehydration, fear, high anxiety, or other medical conditions in a stressful situation. Symptoms include onset of terror, chest pains, yawning, faster-than-normal heartbeat, and lightheadedness.

Treatment can include breathing into a paper bag, pursing one's lips while breathing to restrict airflow, breathing in a nose-in, mouth-out fashion, or closing the mouth and one nostril while using only the open nostril to breathe. This video explains the symptoms of and treatments for hyperventilation:

- "How to Treat Hyperventilation – First Aid Training" (Length 1:24)
  https://video.link/w/AbH0

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For teachers unable to access Safe YouTube links, the video is also available here: https://youtu.be/rXlttZOEpLo

Slide 15: Dehydration results from insufficient water in the body. Common causes include high heat, low water intake, extended exertion over a period of time, and digestive issues.

Symptoms of dehydration include overheating, hyperventilating, reddening of the skin (or flushing), weakness, headaches, and trouble standing.

The best way to treat dehydration is to remove the victim from heat and administer room temperature fluids. In extreme cases, a heat stress injury or severe dehydration could develop, requiring hospitalization and intravenous fluids.

Slide 16: Heatstroke occurs when the body overheats and cannot self-regulate temperature. Initially, the symptoms may be the same as those of dehydration, along with a core body temperature higher than 104 degrees Fahrenheit and possibly the onset of confusion.

To treat heatstroke, remove the victim from heat, wrap the victim in a sheet soaked with cool (not cold) water, and use a fan if possible without overchilling. Get the victim to a hospital immediately and/or call 911.

Slide 17: Hypothermia occurs when the body temperature drops to dangerous levels because the body loses more heat than it can generate for itself. Symptoms include fast breathing, confusion, weak pulse, shivering, clumsiness, trouble forming sentences, confusion, lethargy, discoloration of the skin, and potential unconsciousness.

To treat hypothermia, remove the person from the cold air and/or cold ground, remove wet clothing, call 911, and get the victim to a hospital immediately. In the meantime, provide them with a warm drink, apply compresses, and avoid intense sources of heat and hot fluids. Avoid warming the arms and legs because this tends to force cold blood back to the heart.

Slide 18: It is important to prepare for extreme climates or conditions by selecting appropriate clothing and sun protection. First aid and other supplemental equipment should be considered as well (for example, sunscreen, warm clothing, first aid kits, ice packs, cool drinks, emergency blankets, signal mirrors, and satellite phones).

Slide 19: Many factors, such as working with an inexperienced crew, operating in adverse weather or under poor flight conditions, or being unfamiliar with the regulatory environment, can cause stress. To avoid acute stress, it is important to pre-plan as much as possible for a given mission and to allow the PIC to dedicate their attention to the mission. Long-term or unmanaged stress can result in chronic stress. Physiological factors like anxiety, depression, and lack of sleep from insomnia can contribute to chronic stress, which should be addressed prior to conducting an operation.

Slide 20: Fatigue is a familiar condition that affects the physiological state of the entire body. This can manifest as loss of coordination, concentration, or attention, mistakes in operation, and an inability to communicate. Fatigue can be either acute (short-term) or chronic (long-term).

Acute fatigue, while considered normal, is usually caused by physical exertion, lack of sleep, excessive mental workload, or even hunger. The best treatment is to ensure proper nutrition intake and adequate rest.

If not addressed, acute fatigue can become chronic fatigue. Chronic fatigue might also be the result of a medical condition such as an immune system problem, infection, or hormonal imbalance. Those who experience chronic fatigue will usually feel excessive fatigue up to 24 hours following exercise, and rest will not alleviate it. Treatment usually requires a doctor-prescribed regimen.

Slide 21: Conduct the **Formative Assessment**.

Formative Assessment

Provide students with **Human Factors and ADM Student Activity 1**, which contains questions to assess knowledge of physiological factors that could affect a UAS crew member's ability to take part in an operation. Answers for these questions are given on **Human Factors and ADM Teacher Notes 1**.

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[DOK-L3; *compare*]

Slide 22: Visual illusions are a common hazard when conducting UAS operations due to the visual nature of these operations. Visual illusions are more common during night operations than those conducted during the day. Visual illusions take several forms, which will be discussed in the proceeding slides. It is not a question of if UAS pilots will encounter illusions; it is a question of when.

Visual illusions can disorient pilots when pilots are unable to regain their perception of the location of the aircraft in the air. When operating a UAS at a distance, it can become increasingly difficult to visually orient the aircraft and determine its attitude. In the case of a multicopter, if the pilot becomes disoriented, it is usually wise to stop lateral and vertical travel by hovering in place and referring to the ground control station (GCS) and any instruments to regain awareness.

Autokinesis occurs when looking at a light surrounded by a dark background or lack of visual reference. The light will appear to drift or move. Simply knowing about autokinesis can help pilots avoid it. If they experience it, they can look to the side of the light rather than directly at it.

Featureless terrain illusions occur when flying over water or in areas with few or no ground references, such as in low-visibility areas, dark areas, or over snow-covered terrain. This creates the perception that the aircraft is at a higher altitude than it actually is. Onboard instruments can help check for true altitude, and a vertical speed indicator can help pilots avoid being affected by this illusion.

Atmospheric illusions can occur when the horizon is obstructed by fog, dust, haze, low clouds, or smoke. This can happen even if visibility minimums are within safe limits. Common conditions such as proximity to bodies of water, reflections from other lights, sunlight in the clouds, and other sources of illumination can amplify the illusion. Again, reliance on instruments is important for mitigating the effects of this illusion.

Slide 23: Aeronautical decision making (ADM) is a process by which pilots use situational awareness to take the best actions under a given set of circumstances. It is related to and used in tandem with crew resource management (CRM). Lesson 7B2, UAS Crew Resource Management and Communication, focused on the resources the PIC and crewmembers use to conduct safe and efficient UAS operations. In addition to a PIC with final authority, this crew could include a control manipulator and one or more visual observers.

Getting “behind” the aircraft (in other words, not keeping up with what it is doing) can lead to a loss of situational awareness.

Pilots must use safety culture, including implementation of situational awareness standards, ADM, and CRM, in commercial UAS operations. Remember that CRM comprises delegation of tasks, crew member management, communication standards, and openness to crew member input and concerns.

It is important for the PIC to be able to recognize when crew members experience hazardous conditions or illusions or demonstrate medical ailments or hazardous attitudes. The next session will discuss these hazardous attitudes and methods for identifying them.

Session 3

Slide 24: To begin this session, ask the following refresher questions to the class.

Questions

- What are some types of visual illusions?
  autokinesis, featureless terrain illusion, atmospheric illusions, disorientation
- How can pilots address visual illusions?
  Stop lateral and vertical travel by hovering in place and referring to the GCS and any

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instruments to regain awareness. Maintain an awareness of different visual illusions that might occur under specific operating conditions.

- What are some things the PIC should look for when checking crewmembers for fatigue, stress, or hypoxia?
  visible tiredness, lethargy, frustration, hazardous attitudes, shortness of breath, confusion

- What is the difference between acute and chronic fatigue?
  Acute is short-term and caused by excessive workload; chronic is long-term and caused by medical issues.

- What is CRM?
  Crew resource management: management of crew and resources to conduct safe operations

- What is ADM?
  Aeronautical decision making; pilots leverage situational awareness to handle circumstances in real time in addition to using CRM.

Slide 25: Hazardous attitudes come in several forms, and if they go unchecked, they can pose a serious danger to UAS operations. PICs must be aware of these attitudes and their potential consequences, which could include losing a UAV or endangering bystanders. The five hazardous attitudes that can affect operations and effective decision making are as follows: anti-authority, impulsivity, invulnerability, machismo, and resignation. AOPA describes each of these factors on its website.

Slide 26: AOPA describes anti-authority as follows: "To save a few seconds of time, pilots sometimes abbreviate the traffic pattern or use nonstandard entries, skip checklists, or fly closer to the clouds and in poorer weather conditions than legally allowed. . . . When we feel a strong need to get somewhere, we can feel justified in bending the rules. When our anti-authority attitude overwhelms our good judgment, we're squarely in the danger zone."

- Motto: "Don't tell me . . ."
- Indicators: Overconfidence, reckless operation, showing off.
- Antidote: Follow the rules; they're usually right.

Slide 27: AOPA describes impulsivity as follows: "The need to do something—anything—quickly. But there are times when reacting too quickly can get us into trouble. Rush through a checklist, and you might miss an item . . . In most situations, including many emergencies, it's better to take time to sort things out before committing to a course of action."

- Motto: "Do something quickly!"
- Indicators: Rushing, skipping steps.
- Antidote: Not so fast—Think first!

Slide 28: AOPA describes invulnerability as follows: "We tend to believe that accidents happen to other pilots, and that all the factors that affect safety are under our direct control. We know that as long as we make good decisions, we should never have an accident. . . . This feeling of invulnerability should always be tempered by an equally strong sense of caution. Otherwise, this important survival mechanism becomes a serious safety liability. "

- Motto: "It won't happen to me . . ."
- Indicators: Reckless operation, not paying attention.
- Antidote: "It could happen to me!"

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Slide 29: AOPA describes machismo as follows: "Pilots must have a high degree of confidence in their ability to operate an airplane. Aviation is full of challenges: flight planning, decision making, computing, and navigating . . . Sometimes our confidence outstrips our ability to safely fly the airplane. Especially when we have a strong desire to accomplish a goal, we can fool ourselves into believing that we can do something that is actually stretching the limits of our abilities."

- Motto: "I can do it."
- Indicators: Showing off, taking risks, thrill seeking.
- Antidote: Taking chances is foolish.

Slide 30: AOPA describes resignation as follows: "Everyone has a limit, and at some point, each of us will recognize that we have reached it and resign ourselves to the consequences . . . Our perception of our limits can change from year to year or even minute to minute as our environment changes and physiological, psychological, and physical factors come into play. This resignation becomes hazardous when a pilot gives up when faced with difficult situations."

- Motto: "What's the use?"
- Indicators: Complaining, visible frustration.
- Antidote: "I'm not helpless."

Slide 31: Provide each student with **Human Factors and ADM Student Activity 2**.

- The activity presents several scenarios. Guidelines and answers are presented on **Human Factors and ADM Teacher Notes 2**.
- Have students form groups of 2–3.
- Assign scenarios to the groups. In each scenario, at least one of the group members will display a hazardous attitude.
- As a group, students should identify the hazardous attitude in each scenario they are assigned.
- Next, each group will write a skit to accompany their assigned scenario(s).
- Students will then present their skits to the other groups.
- After each group presents, the class will discuss the scenarios, identifying the hazardous attitude being portrayed and deciding on an antidote that could be used in the situation.
- Students will write notes on the antidote(s) to the scenarios on the activity.

Slide 32: Pilots use the **DECIDE** model to make decisions in aviation operations. The acronym is broken down as follows:

- **D**etect the fact a change has occurred.
- **E**stimate the need to react to a change.
- **C**hoose a desirable outcome for your decision.
- **I**dentify actions to take to achieve the desirable outcome.
- **D**o (take necessary action).
- **E**valuate the effect of your action on the needed change.

Slide 33: Another memory aid, known as the **Three Ps**, was discussed in the first semester. The Three Ps are **P**erceive, **P**rocess, and **P**erform. Operators should *perceive* the need for changes, *process* the effects and what they mean for the operation, and then *perform* the appropriate actions as needed. The Three Ps represent a constant loop of action and reaction.

Slide 34: SMS is an acronym for safety management systems. It is a top-down approach to safety that encompasses mission and flight procedures, safety and operational policy, hierarchy of responsibility, and hazard recognition. Examples are the Three Ps, CRM, and PAVE.

As mentioned, the **PAVE** checklist is a type of safety management system. It stands for **P**ilot, **A**ircraft, en**V**ironment, and **E**xternal pressures. The next slides will discuss these in greater detail.

Slide 35: For the **Pilot** component of the checklist, the acronym **IMSAFE** can be used. Pilots should ask themselves the following:

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- **I**llness: Am I affected by illness?
- **M**edication: Am I taking medications that could affect my ability to safely conduct a flight?
- **S**tress: Am I stressed to the point of distraction?
- **A**lcohol: Have I had none in the last 8 hours, no impairment or hangover, and below 0.04 blood alcohol content (BAC)?
- **F**atigue: Am I well rested?
- **E**motion: Am I emotionally stable?
- Ask: Have I deemed that **IMSAFE**?

> **Teaching Tips**
>
> The "Ask" prompt is not a question to be answered in class; it is a question for pilots to self-assess in the field as a summary of the checklist item.

Slide 36: For the **Aircraft** component of the checklist, pilots should verify airworthiness, operating limitations, registration, instrument calibration, GPS signal, and anything else related to the aircraft itself.

- Ask: Is the aircraft airworthy for these conditions?

Slide 37: When it comes to the environment, density altitude, winds, rain, and harsh weather are factors. For the **Environment** component of the checklist, pilots should verify observed weather conditions seem to match those that were forecast.

- Ask: Is the aircraft rated for proper performance under the prevailing conditions?

Slide 38: Regarding the final component of the checklist, pilots should acknowledge and mitigate **External Pressures** when possible. These pressures include tight deadlines or clients observing the flight. Other crew members can also put pressure on the pilot if the pilot is nervous about being watched or if the crew pushes the pilot to rush or take chances.

- Ask: Is there anything pushing me to do something I would normally not do under these circumstances?

EXTEND

Teacher Materials: Human Factors and ADM Presentation, Human Factors and ADM Teacher Notes 3
Student Material: Human Factors and ADM Student Activity 3

Session 4

Slides 39-40: A PIC must manage and delegate roles, responsibilities, and tasks for a UAS operation. A tool for assessing risk, among the others that were discussed, is the risk matrix (slide 40 shows an example). A risk matrix is a chart used to map out the likelihood and severity of a risk to determine if it falls within acceptable limits or needs mitigation. The following video shows how to use this matrix:

- "Risk and How to use a Risk Matrix" (Length 5:28) https://video.link/w/83P0

For teachers unable to access Safe YouTube links, the video is also available here: https://youtu.be/-E-jfcoR2W0

Slide 41:

- Using **Human Factors and ADM Teacher Notes 3**, pick two of the scenarios for class discussion.
- Do not issue students a copy of the activity at this time. Instead, walk through the two scenarios you have chosen as a class, identifying hazards, hazardous attitudes, and ways that each scenario can be made safer. After the class

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discussion, you will hand out **Human Factors and ADM Student Activity 3**, and students will individually respond to each of the scenarios in the **Summative Assessment**.
- Guidance and sample responses are provided in **Human Factors and ADM Teacher Notes 3**.

EVALUATE

Teacher Materials: Human Factors and ADM Presentation, Human Factors and ADM Teacher Notes 3
Student Material: Human Factors and ADM Student Activity 3

Slides 42–71: These slides will cover questions from the FAA Practical Knowledge Exam.

Slide 72: Conduct the **Summative Assessment.**

Summative Assessment

- Issue each student a copy of **Human Factors and ADM Student Activity 3**.
- Students will work individually in the role of PIC to detail resolutions for the scenarios.
- Students should list ways to mitigate risk in each scenario.
- Guidelines are given in **Human Factors and ADM Teacher Notes 3**.

[DOK-L4; *assess*] [DOK-L2; *make observations*]

Summative Assessment Scoring Rubric

- Follows assignment instructions
- Postings show evidence of one or more of the following:
  - Knowledge of risk management techniques
  - Provides details about the factors that affect risk
  - Provides explanation of tools and acronyms for safety and risk management
- Contributions show understanding of the concepts covered in the lesson
- Contributions show in-depth thinking including analysis or synthesis of lesson objectives

Points	Performance Levels
9–10	Correctly uses the risk matrix to assess and mitigate risk for each of the 5 scenarios; Demonstrates a solid understanding of the lesson objectives
7–8	Uses the risk matrix to assess and mitigate risk for each of the 5 scenarios showing some gaps in understanding; Demonstrates a sufficient understanding of the lesson objectives
5–6	Uses the risk matrix to assess and mitigate risk for each of the 5 scenarios showing many gaps in understanding; Demonstrates an insufficient understanding of the lesson objectives
0–4	Demonstrates a lack of understanding of how to use the risk matrix to assess and mitigate risk for the 5 scenarios; Demonstrates little or no understanding of the lesson objectives

STANDARDS ALIGNMENT

NGSS STANDARDS

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Three-Dimensional Learning

- **HS-ETS1-3** - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
    - Science and Engineering Practices
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - ETS1.B: Developing Possible Solutions
    - Crosscutting Concepts
        - None

COMMON CORE STATE STANDARDS

- **RST.11-12.2** - Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- **RST.11-12.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*.
- **WHST.11-12.6** - Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
- **WHST.11-12.8** - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
- **WHST.11-12.9** - Draw evidence from informational texts to support analysis, reflection, and research

REFERENCES

- AOPA Hazardous Attitudes www.aopa.org/news-and-media/all-news/1999/september/flight-training-magazine/hazardous-attitudes
- ASA 2019 Remote Pilot Test Prep (5-13 – 5-17)
- ASA The Complete Remote Pilot (8-1 – 8-8)
- Drone Package Delivery Prototype

YouTube link: https://youtu.be/20nmHbDRhEs

- Why You Should Put YOUR MASK On First (My Brain Without Oxygen) – Smarter Every Day 157

YouTube link: https://youtu.be/kUfF2MTnqAw

- How to Treat Hyperventilation – First Aid Training – St John Ambulance

YouTube link: https://youtu.be/rXlttZOEpLo

- Risk and How to use a Risk Matrix

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- IMSAFE checklist

https://www.thebalancecareers.com/the-i-m-safe-checklist-282948

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