# FY25 RWDC National Uncrewed Aircraft System Challenge: Wildfire Support Logistics

## Background

Uncrewed Aircraft Systems (UAS) have near-term potential for numerous civil and commercial applications. The FY25 RWDC National challenge will continue the focus on Uncrewed Aircraft Systems and implementation of a UAS. This year’s mission is to develop an uncrewed aircraft support wildfire support logistics. The teams will use concepts from Engineering Technology (i.e., application of science and engineering to support product improvement, industrial processes, and operational functions) to identify, compare, analyze, demonstrate, and defend the most appropriate component combinations, system/subsystem design, operational methods, and a business case that includes a communications plan to support the challenge scenario. Through use of an inquiry-based learning approach with mentoring and coaching, the students will have an opportunity to learn (and apply) the skills and general principles associated with the challenge in a highly interactive and experiential setting. For example, students will need to consider and understand the various Uncrewed Aircraft System elemental (subsystem) interactions, dependencies, and limitations (e.g., power available, duration, range of communications, functional achievement) as they relate to the operation, maintenance, and development to justify their proposed business case.

To support the inquiry-based learning approach, each team will perform and document the following in an engineering design notebook:

1. ***Task Analysis*** - analyze the mission/task to be performed
2. ***Strategy and Design*** - determine engineering design process, roles, theory of operation, design requirements, system design, integration testing, and design updates
3. ***Costs*** - calculate costs and anticipated capabilities associated with design and operation, including modification of the design to further support a competitive and viable business case

As you progress through the challenge, your team will incrementally be presented with background relating to the composition and operation of Uncrewed Aircraft System designs, engineering design principles, business management, and development tools. You will need to work together as a team with coaches and mentors to identify what you need to learn while pursuing the completion of this challenge. By connecting your own experience and interest, you will have an opportunity to gain further insight into the application of design concepts, better understand application of Uncrewed Aircraft System technology, and work collaboratively towards completion of a common goal.

## Challenge

This year’s challenge is to design Uncrewed Aircraft Systems (UAS), create a theory of operation, and develop a business and communication plan for the system based on the following scenario.

***Scenario:*** *Based on the results of your initial proposal, your Company has been invited to submit a new proposal for the final round. Due to the rugged conditions at potential drop-off locations, a “no landing” requirement has been added for delivering supplies. Additional details about the equipment at the supply depot and aircraft size have also been provided.*

*In the United States, wildfires burn over a million acres of forests and grasslands each year with over a billion dollars being spent fighting these wildfires. Many state agencies, federal agencies, and companies are working together to develop strategies and technologies to tackle the complex problem of wildfires. Uncrewed aircraft have the potential to make a large impact on fighting wildfires by transporting critical supplies to remote areas in a timelier manner. Your company has been asked to develop a small uncrewed aircraft that can transport a given group of supplies within a specific amount of time. A set of design criteria has been developed that designs and analyses must follow. Companies can consider the environmental conditions common to the western United States (forests and grasslands) as the baseline region of focus; however, considerations based on other regions (within and outside the United States) are also encouraged. Successful proposals may be invited to the next round.*

*Your company is to design a single aircraft platform that is capable of transporting the required supplies within the specified time. Multiple aircraft might be deployed during a wildfire to increase the number of supplies that are transported; however, each aircraft must meet the minimum requirements outlined below.*

***Overall Design Criteria:***

* *Operating range of at least 30 km. Supply trip of 15 km from supply depot to the drop-off location plus the 15 km trip back.*
* *Communication range of at least 15 km.*
* *Supplies that must be transported within 6 hours*
  + *70 L of potable water.*
  + *25 L of gasoline.*
  + *Four hard plastic cases with dimensions of 0.6 m X 0.35 m X 0.35 m. These cases can contain a variety of supplies such as food, tools, and other equipment. The total weight of each case is 15 kg.*

***Supply Depot:***

* *All supplies that must be transported (outlined earlier) will be provided at this location.*
* *Consider the supply depot as the operating location of the uncrewed aircraft. Adequate space will be provided for the necessary equipment to operate the aircraft, but all equipment must be provided by the company. The location of the supply depot is temporary, so all equipment must be portable. If desired, a trailer, or other portable structure, may be used by the company, but it must be provided by the company.*
* *Takeoff and landing locations will be available. Aircraft may use a 6 m X 6 m location for vertical takeoff and landing, or aircraft may use a 200 m X 6 m rough runway (grass/dirt) for conventional takeoff and landing. Aircraft must fully fit within the takeoff and landing locations, e.g., the wingspan must be less than 6 m when using the runway.*
* *Aircraft must reach an altitude of at least 60 m within 100 m of liftoff.*

***Remote Drop-off Location:***

* *Located 15 km from the supply depot.*
* *Rugged area with no facilities for the aircraft. Location is a rest and resupply location for active wildfire crews such as Hotshot crews.*
* *Aircraft cannot land to deliver the supplies. Aircraft must be able to lower supplies from a height between 5 and 10 m above the ground. Supplies cannot be dropped. Empty containers for the return flight must be loaded using same lowering system.*
* *It can be assumed that a person familiar with the aircraft will be at the site to help unload/load the aircraft.*
* *For the return flight, the aircraft must be able to transport an empty container of the same type delivered. If delivering water, then an empty water container will be on the return flight. If delivering gasoline, then an empty gasoline container will be on the return flight. If delivering the hard plastic case, then an empty case will be on the return flight (assume an empty weight of 5 kg for the hard plastic case).*

***Business case:***

*This year business case will be structured like a group applying to a contract for some work. Teams will create an operating budget for delivering supplies to a team fighting fires using a UAS. A certain volume of supplies will be delivered to complete the contract. The business case should detail both the costs to operates, both fixed and variable costs, and should give some logistical details on what personnel needed to operate the system. Contracts are being evaluated based on how well the task is performed and how much it will cost. Teams should include the following details on their business plan:*

* ***Account for all costs****: Teams will need to account for all the costs of operating the aircraft*
  + ***Fixed costs****: Calculate the fixed costs are. These include the cost of all the equipment needed to fly such as the UAS, Command Communication equipment (command center, communication arrays, etc.), support equipment (any other things you might need to operate), etc.*
  + ***Variable costs****: Variable costs calculate the cost to fly. For this example, it will include the operating costs needed to fly one set of supplies to the firefighting team. How much is spent on fuel, charging batteries, and personnel. Teams need to determine how much these will cost to fly the supplies based on the personnel and fuel requirements for your UAS.*
* ***Basic logistical details****: In addition to a budget teams should explain the roles of all the personnel and how they will use them to accomplish their mission. Logistical detail the list of tasks that need to get done and what positions are being used to accomplish those tasks.*

***Public Affairs/Communications plan:*** *How are you able to make an argument to Government Agencies that using a UAS to support wildfire mitigation is a good idea. Government Agencies are unsure if UAS should be involved in wildfire mitigation. Teams will need to come up with a plan both to explain why it is important to utilize UAS in wildfire mitigation and how they plan to effectively communicate with the Agencies. The teams’ communication plan should have the following characteristics:*

* ***Audience and purpose:***
  + *Communications should be written for an appropriate audience, keeping in mind that some people in Government Agencies may not have technical background in the areas needed to understand the project.*
  + *There should be a compelling reason to use the proposed design.*
* ***Plan for communication:*** 
  + *In this section teams should come up with a plan to promote the use of UAS with Government Agencies, so they understand the value of what teams are doing.*
  + *What kind of information should be used in materials to make the case.*
  + *How are materials being distributed. Keep in mind that you may need to get broader support from the general population.*

## Objectives

Your designs will be judged on how well they satisfy the objectives while meeting the requirements above. It will be up to your team to decide on your design and provide sound engineering arguments to justify your design decisions.

* Minimize your costs
* Maximize aircraft performance

## Other Resources

* RWDC National Uncrewed Aircraft System Challenge: Detailed Background
* RWDC National Engineering Design Notebook Template
* RWDC National Challenge Scoring Rubric
* Student, Coaches, and Mentors Guide
* Challenge Statements and Detailed Backgrounds from previous RWDC competitions
* Winning Engineering Design Notebooks from previous years
* RWDC Content Webinars (schedule to be determined)
* The RWDC Support Site with FAQs, tutorials, material allowables, and other supporting materials: Getting Started section of the RWDC website (<http://www.realworlddesignchallenge.org>).
* Mentors from the aerospace and defense industry, government agencies, and higher education

## Tools

* PTC Creo Computer Aided Design (CAD) software for 3D geometry design (if you have other CAD tools, you may use them)

## Team Submissions

The Engineering Design Notebook submission including the business plan and appendices must be 80 pages or less. Detailed information regarding what must be documented can be found in the RWDC FY25 National Challenge Scoring Rubric. Teams must submit the following:

1. Engineering Design Notebook (refer to RWDC FY25 National Challenge Scoring Rubric)
2. CAD drawings in Engineering Design Notebook (refer to RWDC FY25 National Challenge Scoring Rubric)

## Scoring

* Teams’ submissions will be evaluated based on criteria outlined in the RWDC FY25 National Challenge Scoring Rubric and in reference to the example mission scenario.
* Technical scoring will be based on deliverables to be incorporated in the Engineering Design Notebook.
* Engineering Design Notebooks must follow the paragraph order of the RWDC FY25 National Challenge Scoring Rubric.
* Judges will be looking for the ability to express comprehension and linkage between the design solutions with what students have learned. Specific recognition will be given for design viability, manufacturability, innovation, business plan development, and additional application beyond the package delivery mission.
* Total team score at the National/International Challenge Championship is 70% from the Engineering Design Notebook and 30% from the presentation at the National/International event.

## Merit Awards

Special RWDC Merit Awards will be given at the National/International Challenge Championship. Merit awards will be granted at judges’ discretion to teams that do not place in the top three but are top performers overall. Only one merit award will be granted per team. Awards will be based on the team presentation and Engineering Design Notebooks.

* Innovation
* Design Viability
* Teamwork and Collaboration
* Effective Mentor Collaboration
* STEM Interest Impact
* Most Creative
* Against All Odds
* Best Business Case
* Best First Year Team
* Best Communication Plan
* Judges Award

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