



# Westdrone Inc.

Aerospace Research and Development

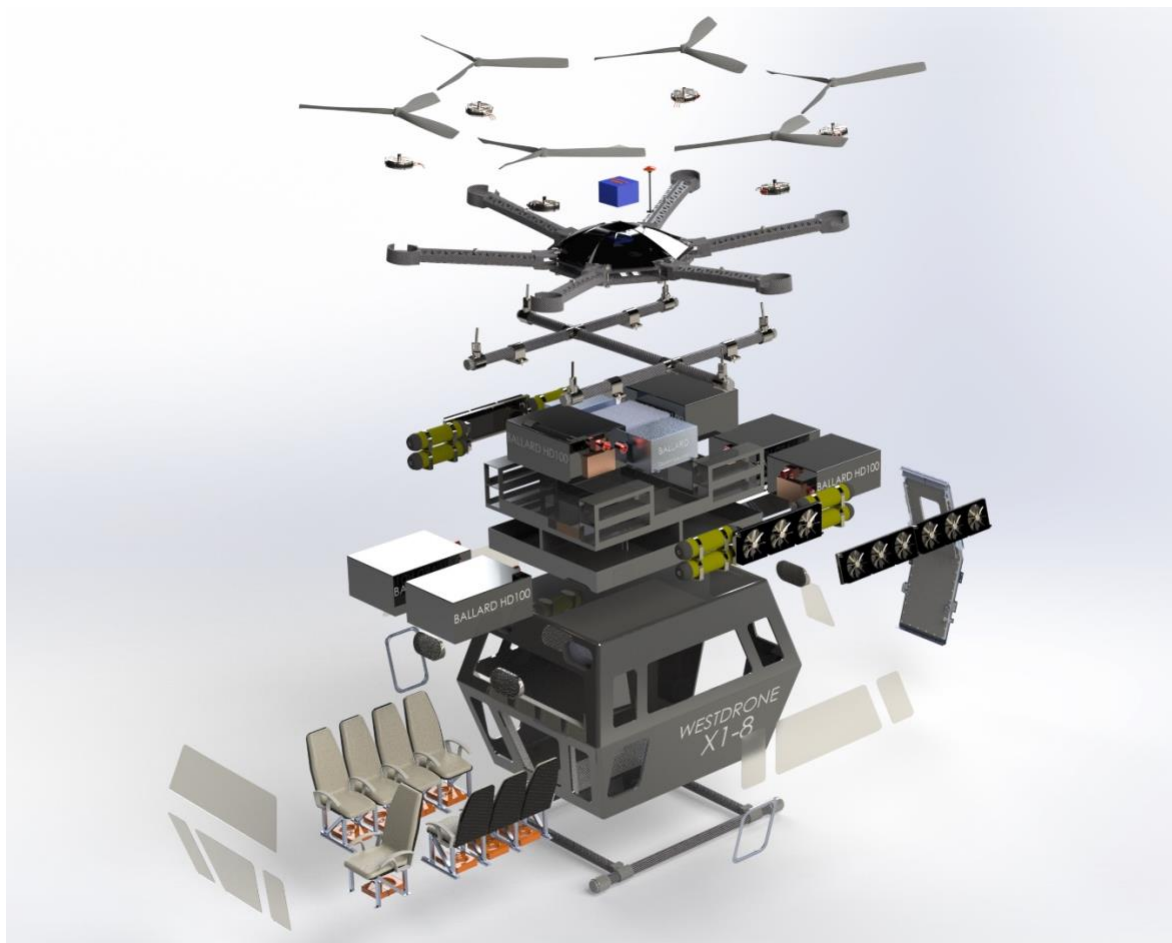
## 45X Capstone

**Date: September 1st, 2020.**

**Title: Design Airframe and Propulsion System for Passenger Drone**

### Introduction

Westdrone Inc. is dedicated to changing the way people and goods travel - with electric large-scale drones. Fly within minutes to a remote mountain lake from downtown on a Friday night to flying medical equipment and personnel from a ship into a remote area. The scope of possibilities is unlimited. The environmental footprint is minimal. Low operating costs mean low air fares and freight charges. The X1-8 is essentially an eight-passenger or 2,000lb payload flying van. The X1-8 is currently at research and development stage with a 1:6 scale working model built and tested.





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## Project Description

### **Project One – Chassis Design**

Design and test the X1-8 airframe. There are four frame sections plus a rail frame. The first section: six airframe arms carry the motors and rotors. The arms are detachable from the center section. The center section holds the electronics, navigation, and ballistic parachute. Below the center section, the third section holds the propulsion system including hydrogen fuel tanks and is detachable from the fuselage. A rail frame holds the center frame to the propulsion frame and acts as an attachment point for the arms. The fourth section is the fuselage that holds the pilot, passengers, and freight. Carbon fiber is used throughout.

## Expected Outcomes

### **Project One – Chassis Design**

Virtual design (simulation) is the feasible first step during the pandemic. Use numerical modeling to validate airframe, materials and structure for strength and performance. The challenge is to design in maximum strength with minimum weight. A BRS Aerospace ballistic parachute must also be incorporated into the airframe and the structural integrity to protect the passengers on impact from an emergency landing.

## Major Deliverables

### **Project One – Chassis Design**

Fabrication ready design of the four sections of the air frame. The base deliverable is designing material and structure. The next level of deliverable would add structural testing. The optimum deliverable would add flight performance and fuel usage.

## Special Considerations

A list of specifications and components as well as the layout and weight distribution will help narrow the scope and focus of the project. A list of components will be submitted as recommended. All components need to be evaluated.

**Additional funding beyond Capstone \$650, available for two projects combined on preapproval and justification basis.**

Required:

Capstone Undergraduate Project NDA Agreement

Capstone Undergraduate Project IP Agreement

# Specifications



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## Components and Structure

### Fuel cell

Ballard HD 100

Proton-Exchange Membrane (PEM) fuel cell

Maximum output 100kW (134DIN hp)

Weight 280 kg (564lb)

Size approx. 1200X869X487mm high (47"X34"X19" high)

### Coolant subsystem

Weight approx. 44 kg (97lb)

Size approx. 737X529X379mm high (29"X21"X15" high)

### Air subsystem

Weight approx. 61 kg (134lb)

Size approx. 676X418X352mm high (27"X17"X14" high)

### Air Frame

Diameter (propeller tip to tip) 7m (23 ft)

Top main center frame - carbon fiber 2.6mX1.9m (8.5ftX6.25ft)

Frame arms - carbon fiber 1.6764m (5.5ft)

### Yasa P400 RHC Series Electric Aerospace Motor – six required

(Yasa has a collaboration with Oxford University)

Power continuous 100 kW (134HP)

Propeller RPM 2,850 @ 100kW (134HP)

Torque continuous 200Nm @ 100kW (134HP)

Voltage 300-400V

Weight 24kg(57lb)

### Yasa Si400 Motor controller – six required

Dielectric oil cooling

Voltage 50-400V

Weight 5.75kg

### Propellers – six required

Propeller diameter – 2.1336m (84")

Carbon fiber

Pitch – 10"

Propeller Type – APC W

CF – 1.09

Number of blades – 3

Maximum RPM 2,850

Air temperature – 68F

Air density – 1.2045 Kg/m<sup>3</sup>

Static thrust 1,682.84 lbs.



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Perimeter speed (speed at blade tip) 318.22ms (320ms is maximum = the speed of sound)

Required engine power 87.881kW (119.489HP)

\*as temperature falls – static thrust increases and air density increases

## **Hydrogen Fuel Tanks**

Hydrogen tanks – 8 required

Dimensions 254mmX 870mm (10”X34”)

Pressure 70 MPa (10,000psi level 4)

Volume 40 L

Hydrogen storage 1.3 kg

Weight 32 kg (70lb)

Carbon fiber is used to build high pressure hydrogen fuel tanks making them light and strong. Toyota and Quantum are two major manufacturers but there are others. Manufacturer to be determined.

## **Ballistic Parachute**

BRS Aerospace

Weight (approx.) – 38.5kg (85lbs)

Due to 8,000lb weight of X1-8, BRS would need to custom design parachute

## **Power Management Unit (PMU)**

Power Management Unit regulates voltage for the 5-8V system required by the Main Controller, the GPS/compass, and the Inertial Measurement Units (IMU) 3-axis accelerometer, 3-axis gyroscope, and barometer. Second system is 12V for navigation, electronics, heating, ventilation, defrost, and windshield wipers.