

# Functional Decomposition

The functional decomposition allows the overall project system to be broken down into smaller functions and subsystems. The functional decomposition portrays the actions the project's systems must fulfill. Figure 1, below, is the functional decomposition for the lightweight UAV of this project. This functional decomposition was developed through discussions with the project sponsor, Northrop Grumman, and by referencing the work of the previous group.

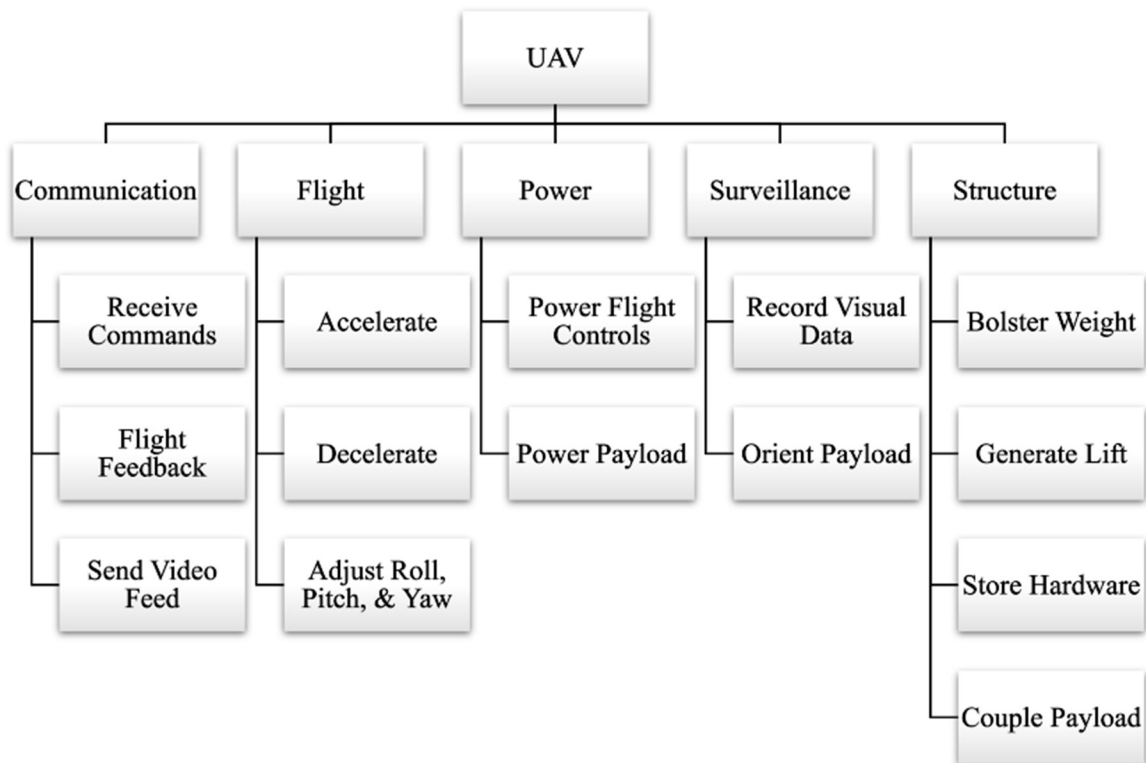


Figure 1: *Functional Decomposition of UAV*

The five main functions of the lightweight UAV are communication, flight, power, surveillance, and structure. As a team, we discussed what was necessary to make the UAV fly properly and perform proper surveillance. Each one of these major functions is broken down into

subfunctions. The subfunctions are what is needed for the major functions to perform properly. For the communication function to succeed, the UAV must receive commands from the user as well as send video feed back to the user. Another aspect of the communication function is that the UAV must provide feedback about its flight status to the user. For the flight function to succeed, the UAV must accelerate, decelerate, and adjust roll, pitch, and yaw. These are the dynamics that go into making a plane, or in this case a UAV, fly. The power function succeeds when there is power to the flight control and payload subsystems. Without power to the flight controls (motors, actuators, receivers) the plane won't move. Also, there must be power to the payload for the payload to function correctly. The surveillance function needs to record video as well as orient the payload in a direction to be successful and complete the project objective of providing surveillance. The structure function is needed to support the weight of the UAV, generate lift to get the UAV off the ground, store all the hardware involved in making the UAV work, and allow the payload to attach to the UAV. All these functions and sub-functions are what allows the lightweight UAV to perform and meet the project objective.

The table below us a cross reference table comparing the major functions against each other.

Table 2: *Major Functions Cross Reference Table*

	Communication	Flight	Power	Surveillance	Structure
Communication	x	x	x	x	x
Flight	x	x	x		x
Power	x	x	x	x	x
Surveillance	x		x	x	x

Structure	x	x	x	x	x
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The purpose of Table 2 is to compare the major functions against each other to gain a perspective of which function has the most importance. The comparison was done by examining the functions and asking if function ‘x’ effects function ‘y’. The functions of highest importance are the structure, power, and communication function.

Table 3 below is a cross reference table relating the major functions and the subfunctions. The subfunctions are part of a single major function, however they are also connected or related to other major functions. This helps the team when developing the systems of the prototype and allows subfunctions to be integrated into other systems. This table also helps determine the importance of functions and their dependency with each other. This can help with the overall goal of developing a lightweight drone. Systems that perform more than one function keep the overall weight down. For instance, the subfunctions of flight are also connected to the communication and power functions. The user must be able to communicate with the UAV when and how much to accelerate, decelerate, and adjust the roll, pitch, and yaw. Also, these subfunctions must be powered by the power system. Looking at the bolster weight and generate lift subfunctions of structure, they also are incorporated into the flight function. This is because the weight of the UAV must sustain itself to fly and the structure must generate lift to fly.

Table 3: *Major Functions and Subfunctions Cross Reference Table*

	Communication	Flight	Power	Surveillance	Structure
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Receive Commands	x	x	x	x	
Flight Feedback	x	x	x		
Send Video Feed	x			x	
Accelerate	x	x	x		x
Decelerate	x	x	x		x
Adjust Roll, Pitch, & Yaw	x	x	x		x
Power Flight Controls	x	x	x		x
Power Payload	x		x	x	x
Record Visual Data	x		x	x	
Orient Payload	x		x	x	x
Bolster Weight		x			x
Generate Lift		x			x
Store Hardware					x
Couple Payload		x		x	x

**Priorities of Main Functions:**

Structure- This function is placed in first because the craft must be able to support itself in flight as well as during takeoff and landing. If the UAV doesn't support its own weight, and the structural system fails, there will be no UAV to fly. Looking at table 2, all the other functions rely on the structure function.

Power- The power function is ranked second on our list of functions. Without adequate power the UAV is unable to move, and unable to achieve flight. Also, the power is necessary for the communication and surveillance functions to work. Power is critical because it supports the other main systems throughout the UAV.

Flight- Flight is necessary to get airborne. Due to the UAV's default flight setting, it is neither dependent on communication nor surveillance. If the drone is unable to fly, the Team's mission will fail, no matter how well the rest of the UAV is designed. So, that is why we have ranked it ahead here.

Communication- The communication function ranks fourth in our priorities list. The communication function relies on the power system because it needs power before it can work. The drone relies on the communication between the user and flight controller on the UAV in order to relay how the drone needs to maneuver during flight. Also, the drone will need to be flying before it can communicate the desired feedback data to the user.

Surveillance- Surveillance is the last function to receive priority because it is dependent on all the other functions being accomplished. The first objective of this project is to achieve an increased flight time using light-weighting techniques, then provide surveillance. The drone can still fly without the surveillance aspect working.