

MICROGRAVITY MACHINE

Virtual Design Review 1



TEAM 511



Samuel Duval

Propulsion Engineer



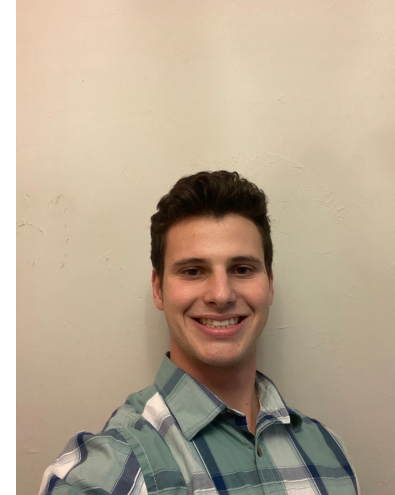
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Controls Engineer



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Test & Systems Engineer



Collin Gainer

*Design Engineer
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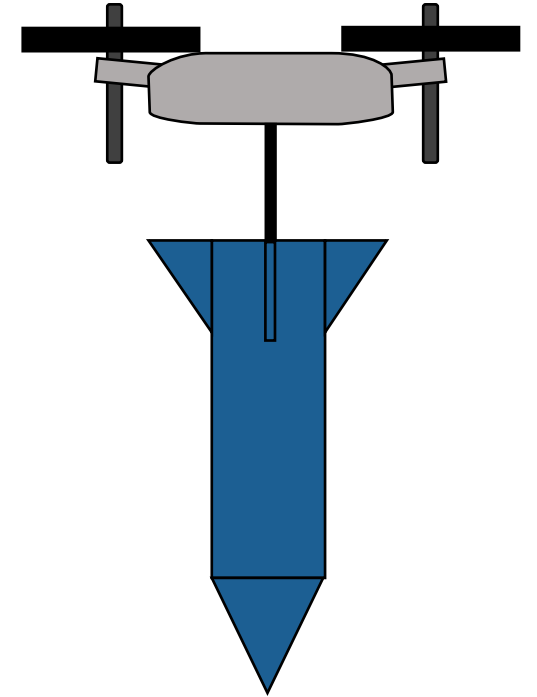
Mike Conroy

**Florida Space
Group
Consortium**

Samuel Duval

Project Objective

The objective of the project is to design a reproduceable system that can be dropped, achieve microgravity during its descent, and be safely recovered for reuse.

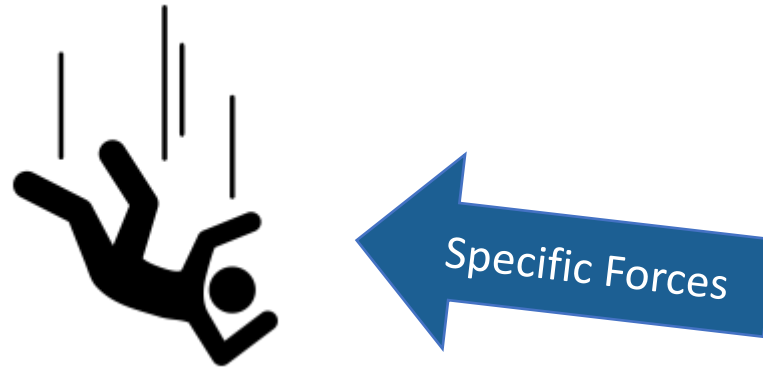


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What is Microgravity?

$$\vec{F}_{Specific} = \frac{\sum \vec{F}_{nongravitational}}{m} \approx 0 \frac{m}{s^2}$$

What does an
accelerometer measure?



Where Does Freefall Occur?



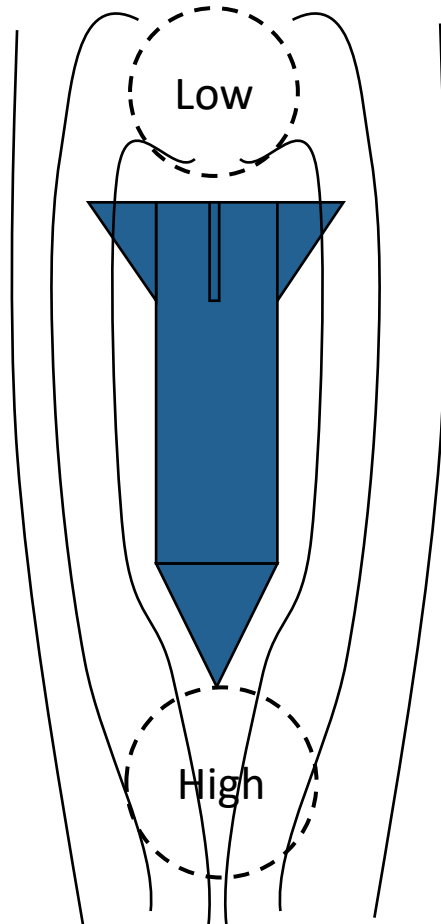
Falling



Orbit

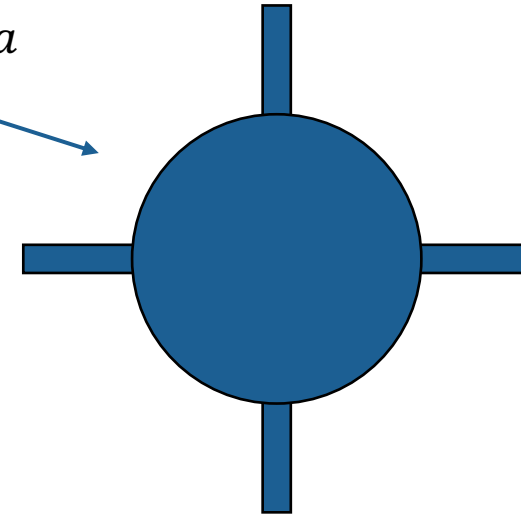
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What is Aerodynamic Drag?



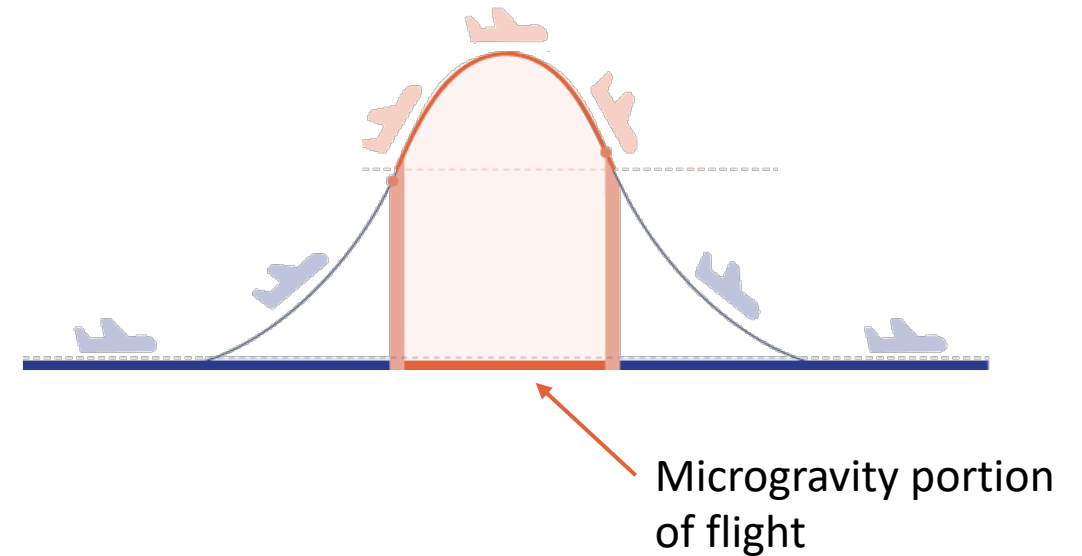
$$\text{Drag} = C_d \frac{\rho V^2}{2} A$$

$A = \text{frontal area}$



Current Solutions

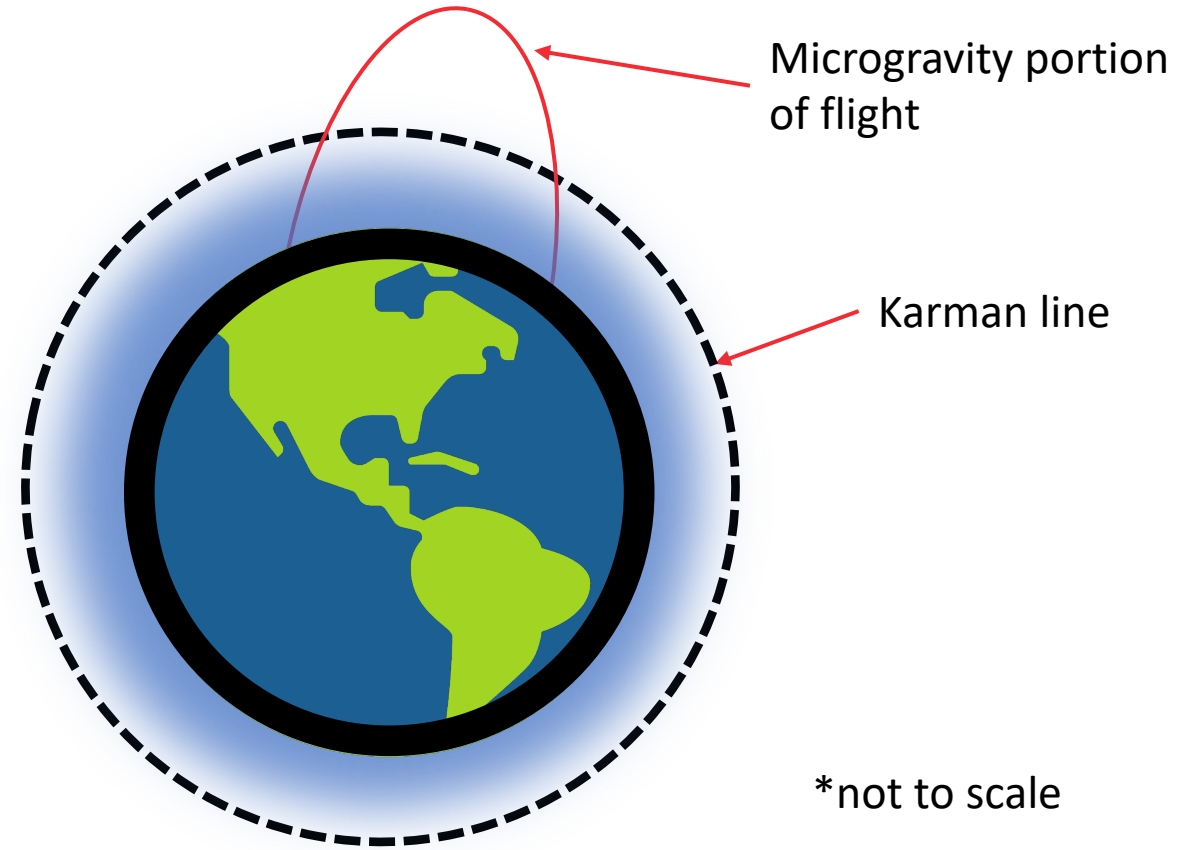
Parabolic Flight Path



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Current Solutions

Sounding Rocket



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Current Solutions

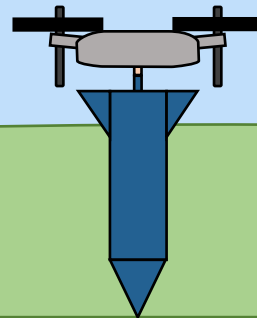
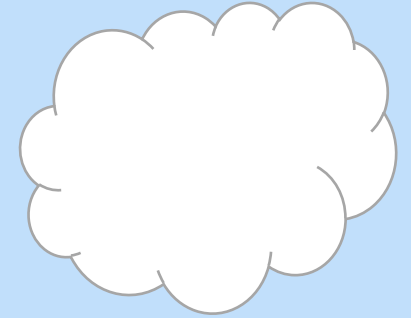
Drop Towers

Bremen, Germany



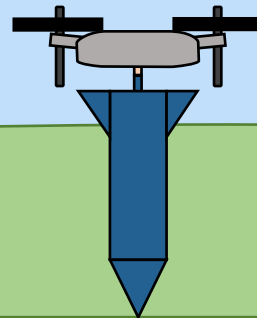
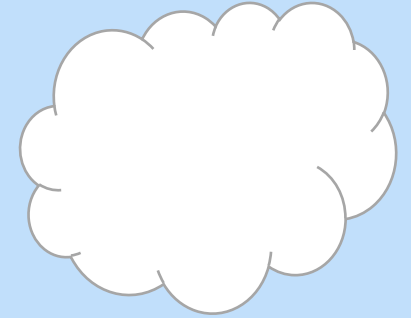
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Project Background



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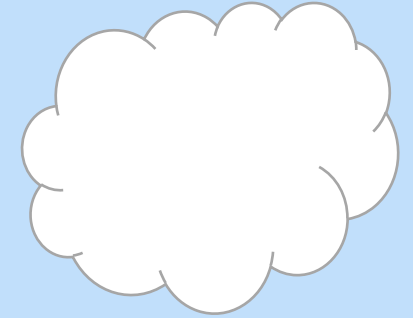
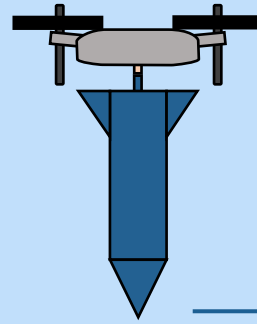
Project Background



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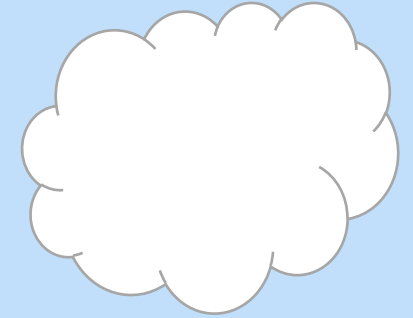
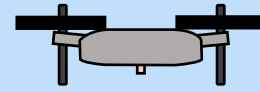
Project Background



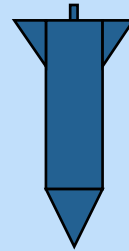
900 ft (275m)

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Project Background



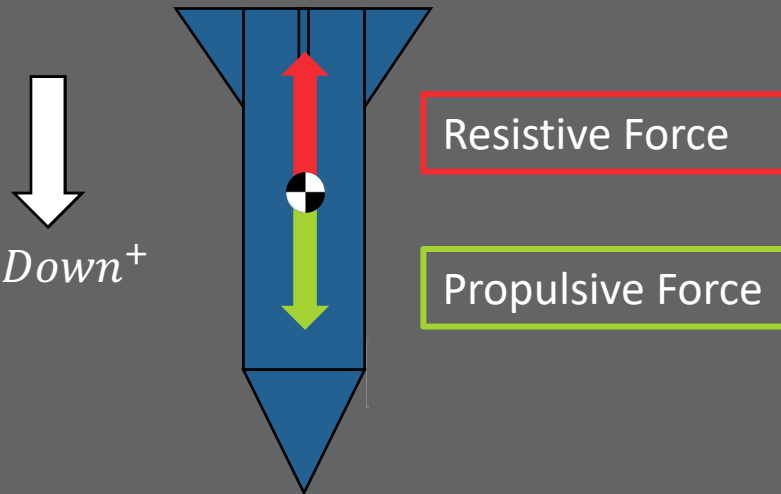
How do we stop the machine?



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Project Background – Freefall

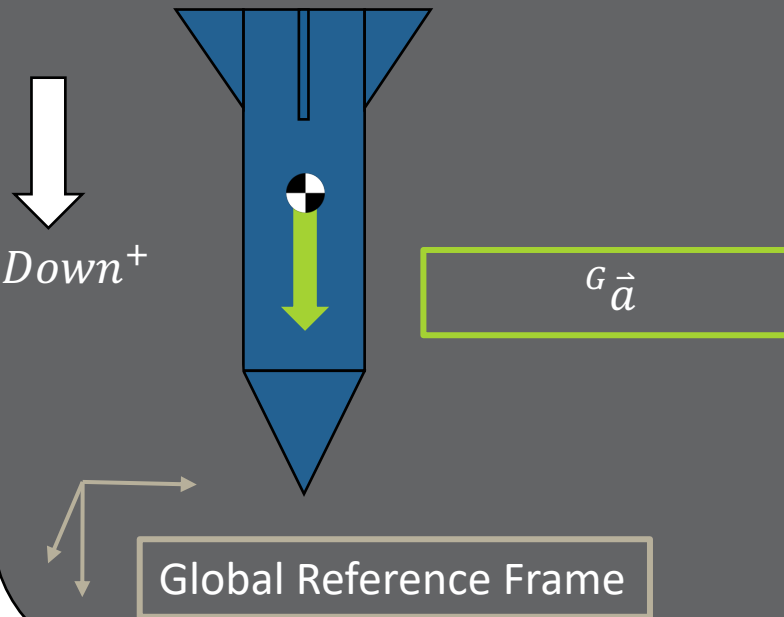
Accelerometer Reading



$$\vec{F}_{Specific} = \frac{\overrightarrow{Propulsive} - \overrightarrow{Resistive}}{m} \approx 0 \frac{m}{s^2}$$

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Project Background – Freefall



Time of flight $\cong 4$ seconds

$$G \vec{a} \approx 9.81 \frac{m}{s^2}$$

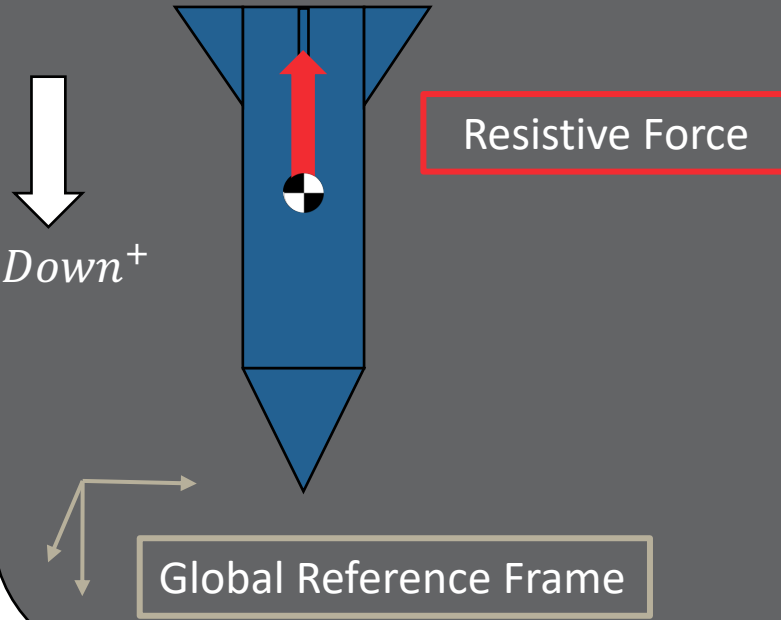
$$\Delta x \approx 78.48 \text{ m}$$

$$\vec{v}_f \approx 39.24 \frac{m}{s}$$

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Project Background – Slowing

Slowing portion of flight



Remaining altitude = 195m

$$\vec{v}_0 \approx 39.24 \frac{m}{s}$$

$${}^G \vec{a} = -7.86 \frac{m}{s^2} \quad (3)$$

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Assumptions

Vehicle will be lifted and released without malfunction of drone

Vehicle's path is clear of obstacles

Tested in standard earth atmosphere

Drag negligible for initial 0.5 seconds of free fall

Weather conditions aren't of concern

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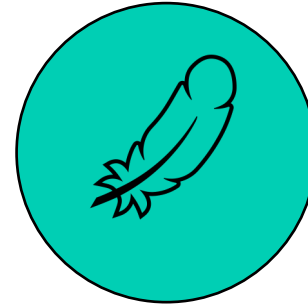
Key Goals



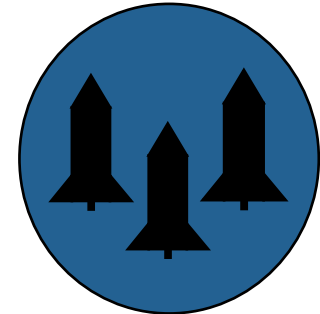
Microgravity



Recoverable



Meet weight requirements



Reproduceable

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Customer Needs



How long will we have to experience microgravity?



The machine must simulate microgravity for 3-4 seconds.

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Customer Needs



Are there any
additional
limitations?



The device can't
feature explosives.

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Customer Needs



Are there weight restrictions for the machine?



Machine must be less than 22 lb.

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Customer Needs



Why haven't previous teams' designs been successful?



Design needs to be recoverable.

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Customer Needs



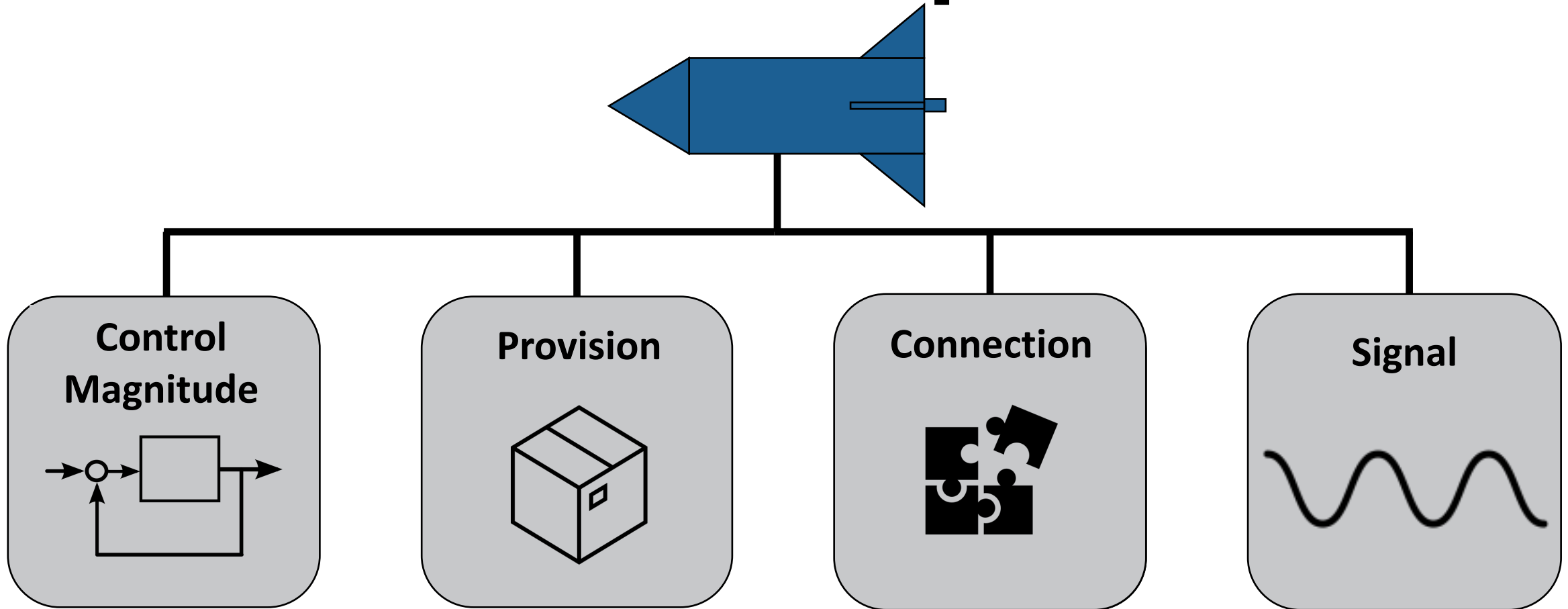
What are the dimensions for the payload to be contained?



Machine must house a 3U CubeSat sized payload of dimensions 100x100x300 mm.

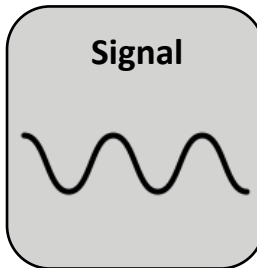
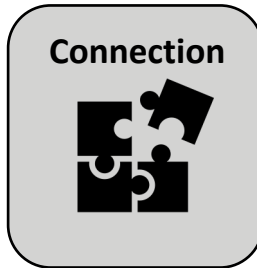
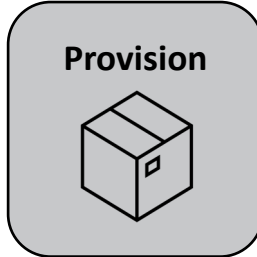
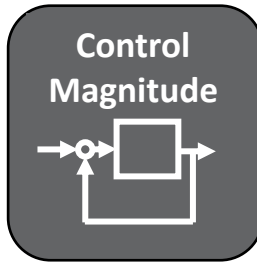
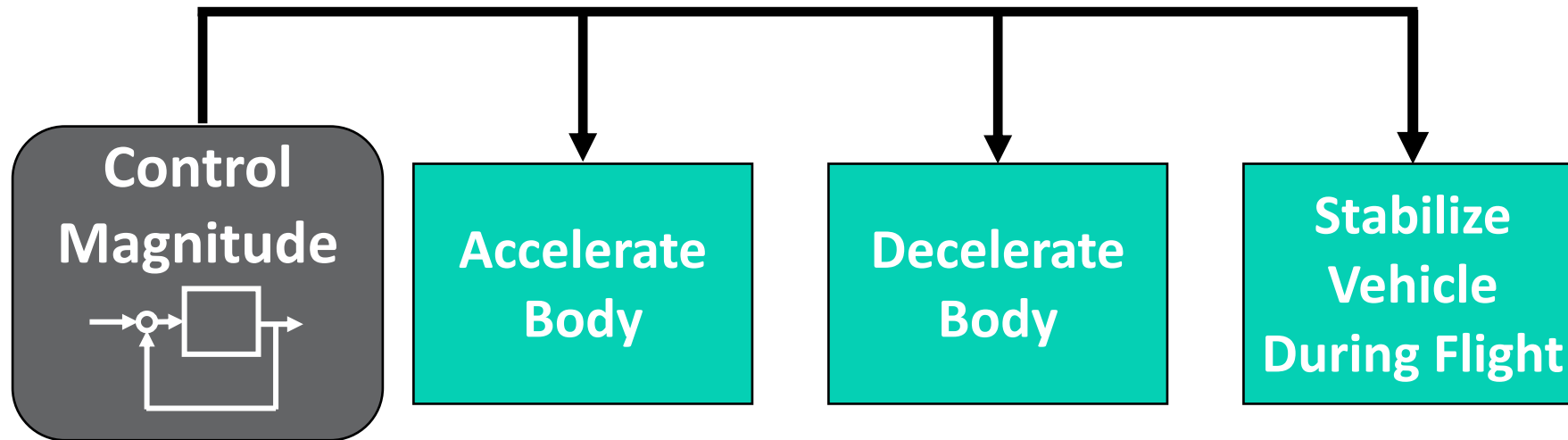
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Functional Decomposition



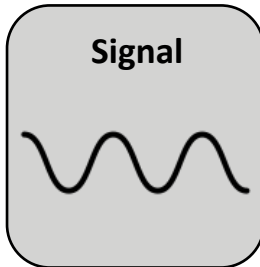
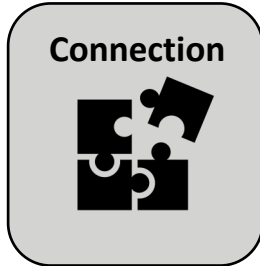
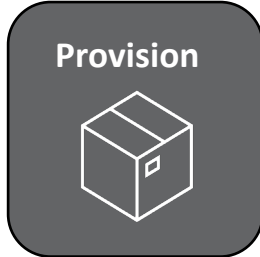
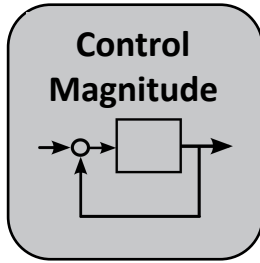
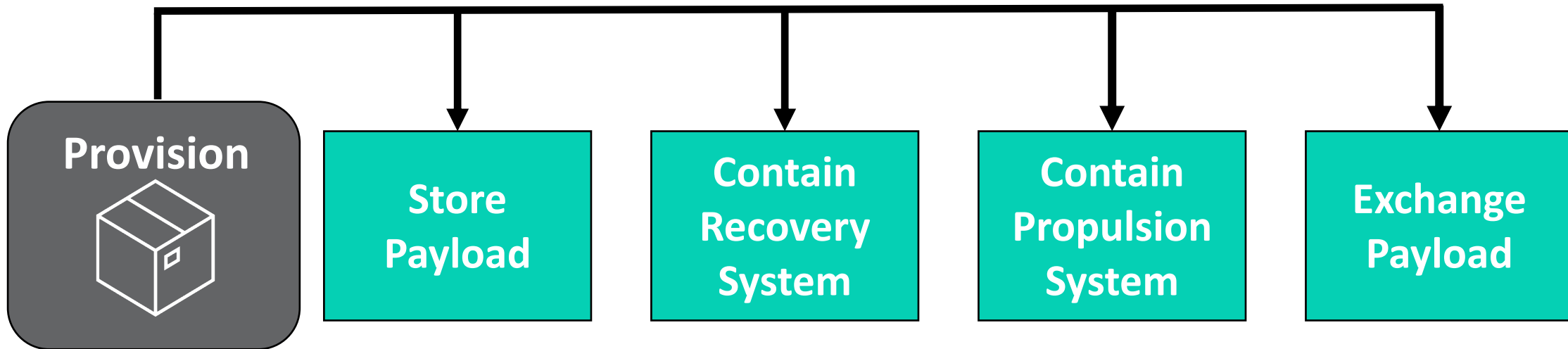
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Functional Decomposition



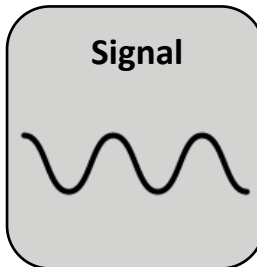
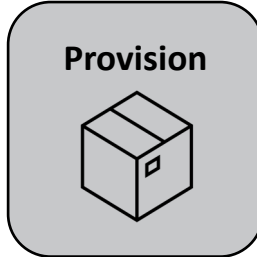
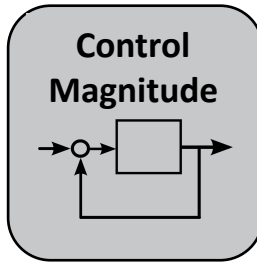
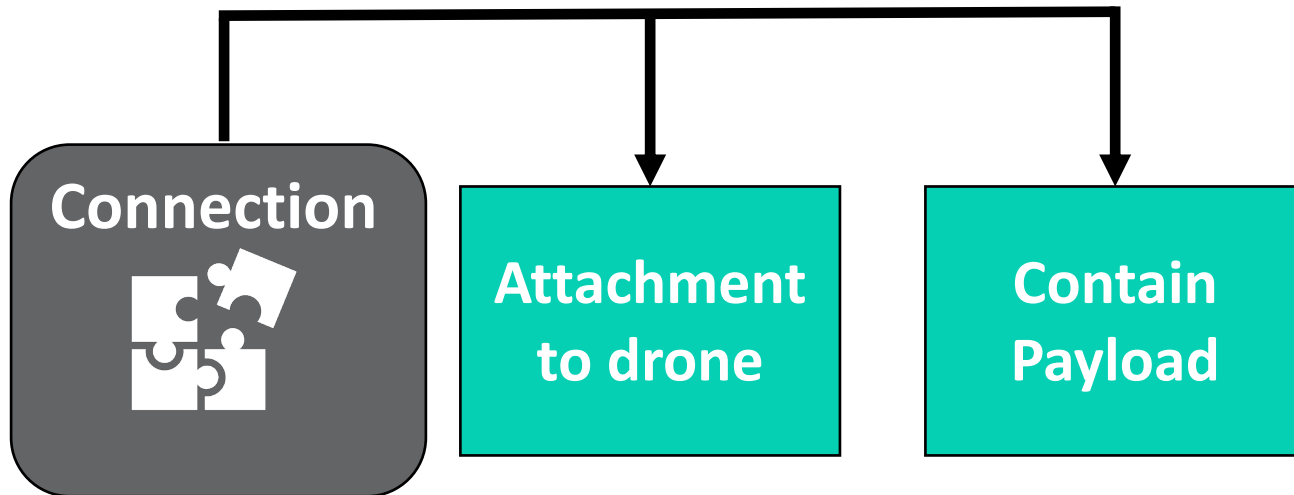
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Functional Decomposition



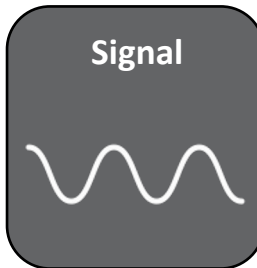
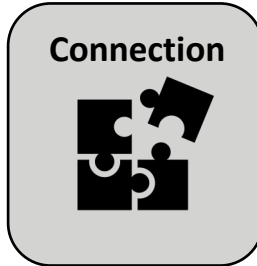
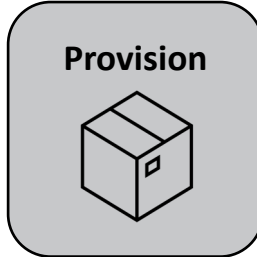
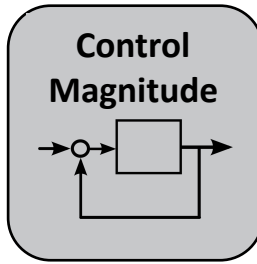
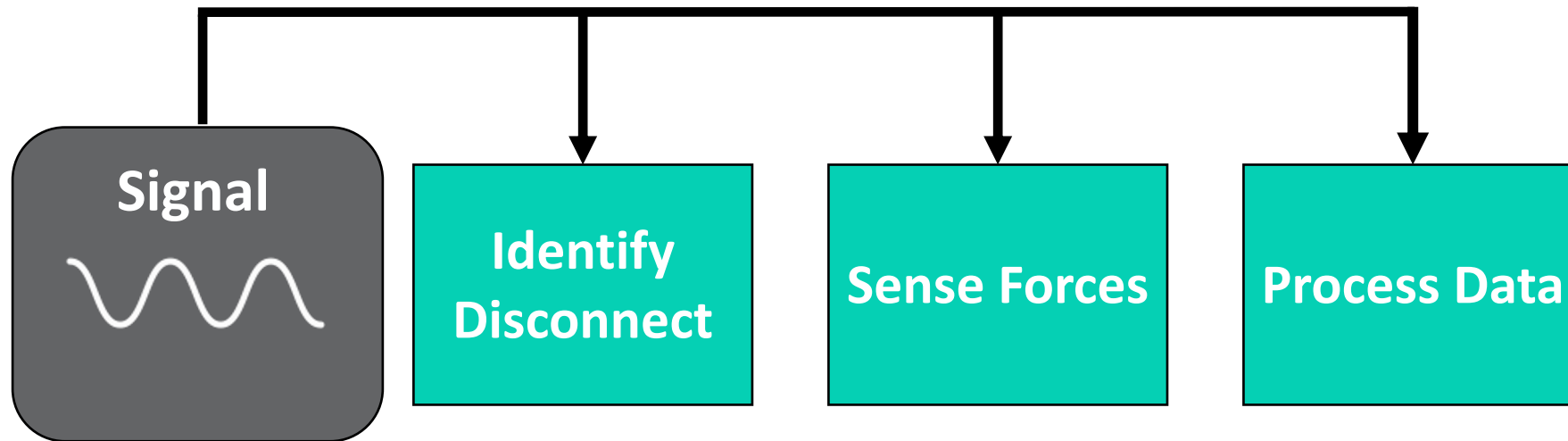
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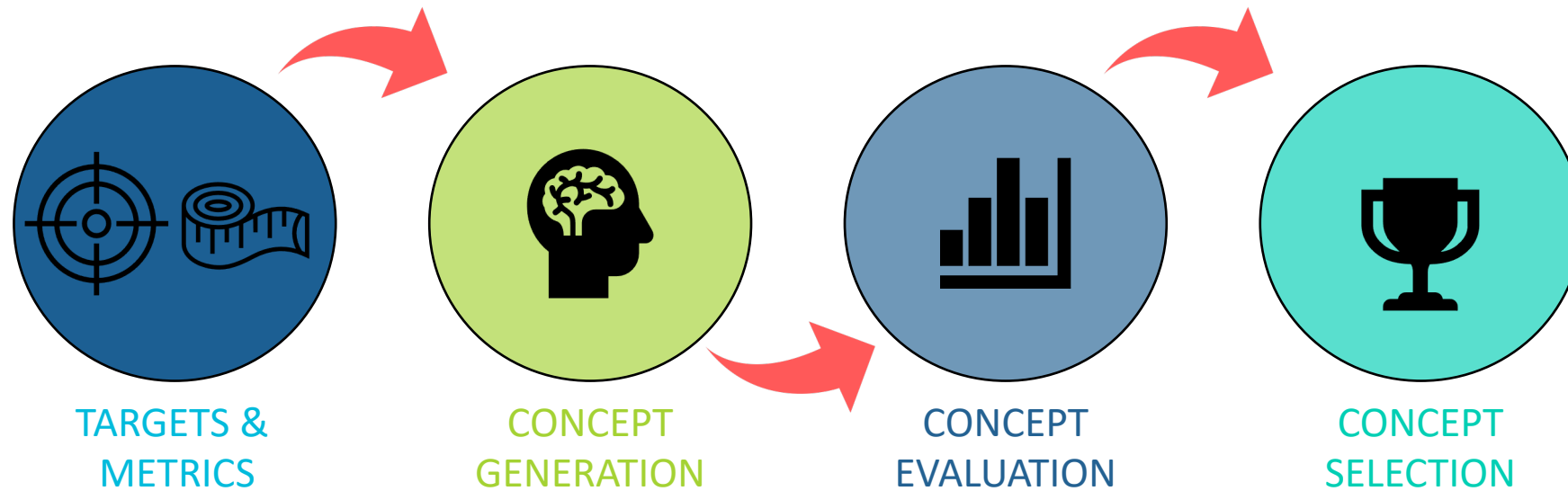
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Functional Decomposition



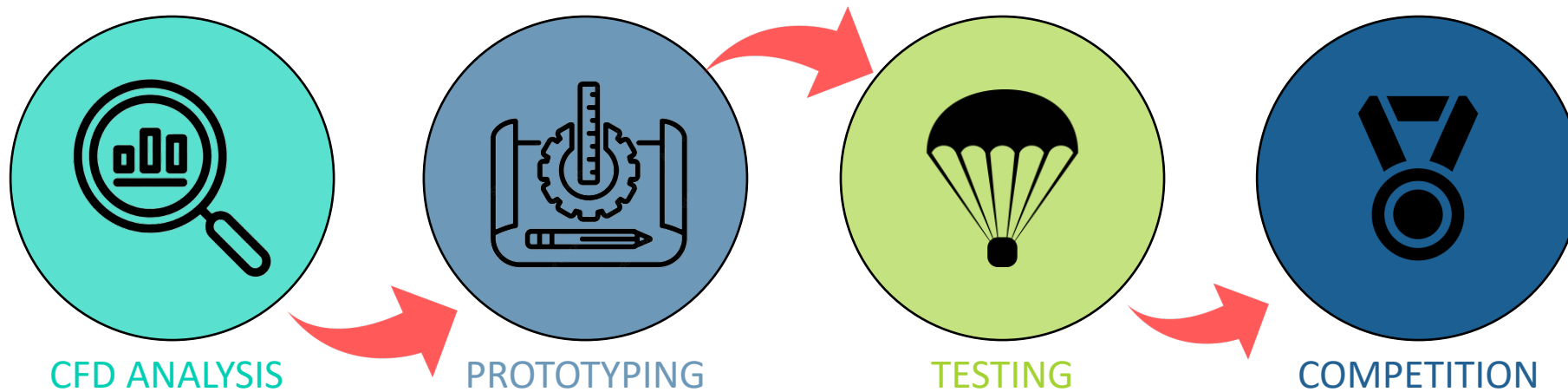
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Future Work



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Future Work



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References

Images:

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<https://www.hitec.uni-hannover.de/en/large-scale-equipment/einstein-elevator/>

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Further Readings:

<https://www.gozerog.com/>

https://www.nasa.gov/mission_pages/sounding-rockets/missions/index.html

<https://www.zarm.uni-bremen.de/en/drop-tower/general-information.html>

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https://www.youtube.com/watch?v=4aCMDQsx740&ab_channel=TomScott

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