IMAGINE IF.

PMI Conference

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HYPERLOOP


Parkway North
Penn Ave
W Carson St
River Ave
Fifth Ave
Forbes Ave
PITTSBURGH
n-Lincoln Pkwy W
Ewing Rd
Greentree Rd
W Liberty Ave
Hays Woods
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Allegheny National Forest
Poughkeepsie
1h 15min
Wilkes-Barre
PENNSYLVANIA
NEW YORK
PITTSBURGH
Altoona
Allentown
Harrisburg
6h 10min
Lancaster
Philadelphia
Wilmington
Pinelands National Reserve
Hagerstown
Atlantic City
Baltimore
Dover
Washington
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Allegheny National Forest
Poughkeepsie
1h 15min
Wilkes-Barre
PENNSYLVANIA
29 min $19
NEW YORK
PITTSBURGH
Allentown
Altoona
Harrisburg
6h 10min
Lancaster
Philadelphia
Wilmington
Pinelands National Reserve
Hagerstown
Atlantic City
Baltimore
Dover
Washington
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ELON MUSK

SPACEX

TESLA MOTORS

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SPACEX
HYPERLOOP POD COMPETITION
"To help accelerate the development of a functional Hyperloop Prototype"
SpaceX.com/Hyperloop
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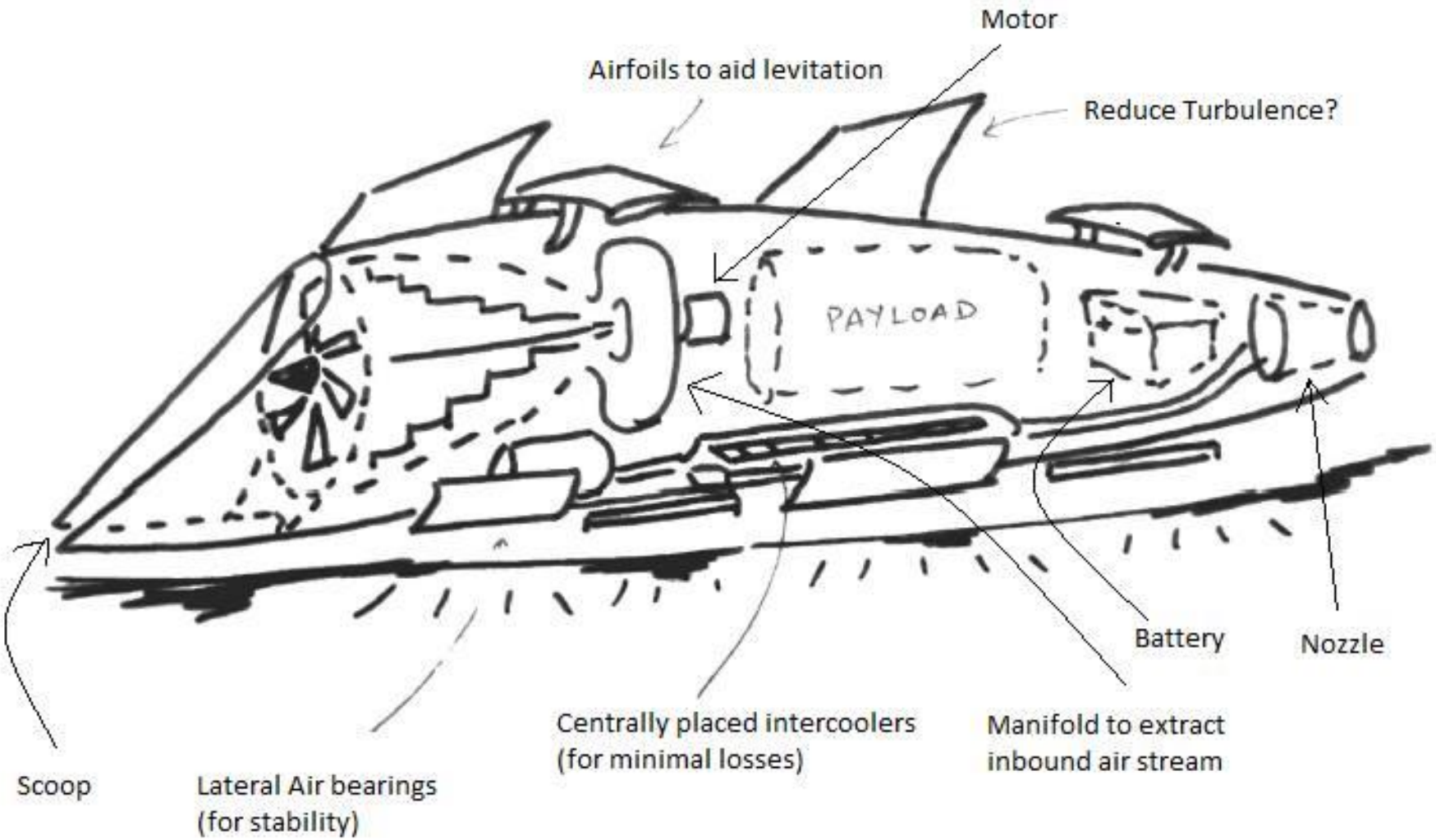
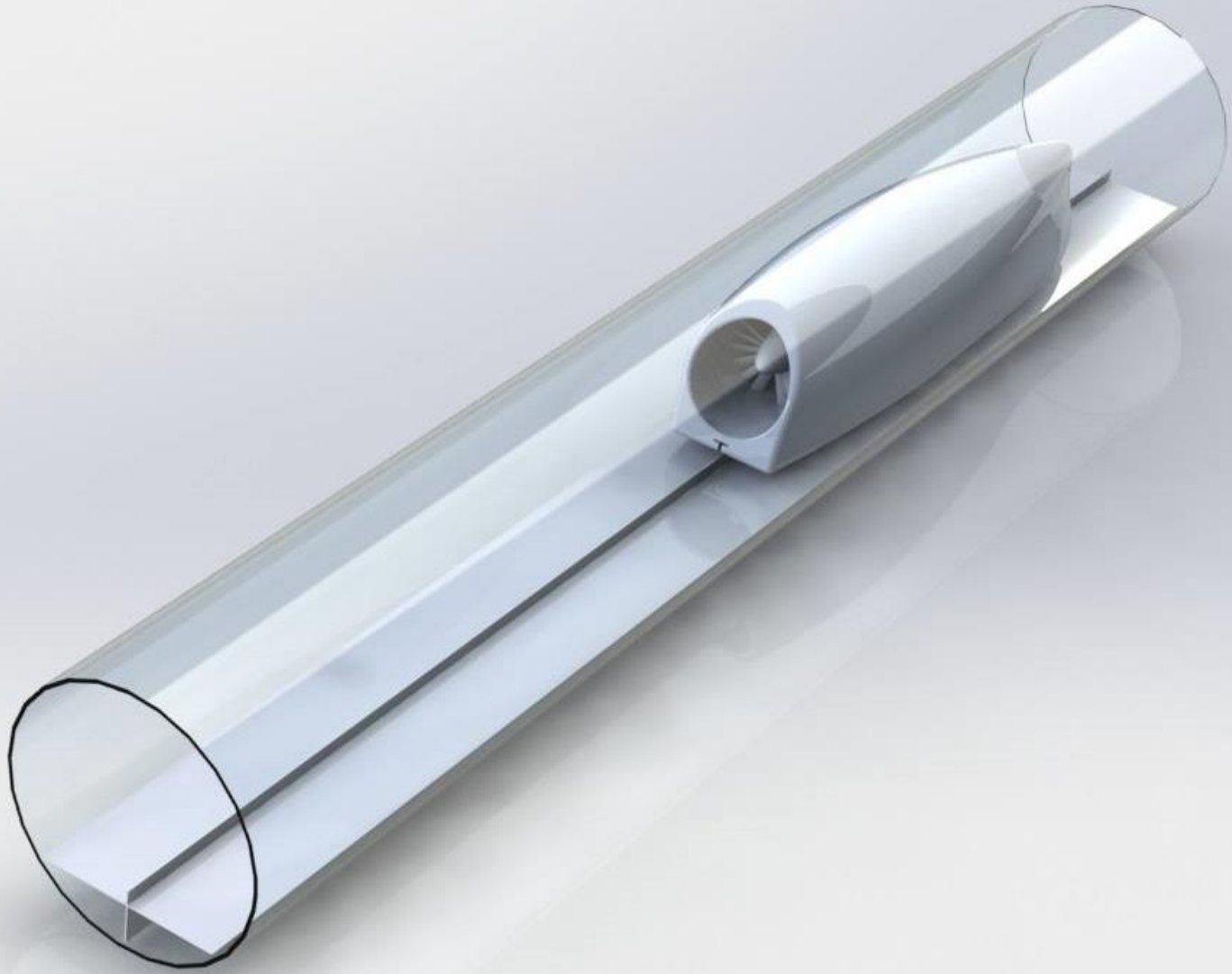

Motor
Airfoils to aid levitation
Reduce Turbulence?
PAYLOAD
Battery
Nozzle
Centrally placed intercoolers
(for minimal losses)
Manifold to extract
inbound air stream
Scoop
Lateral Air bearings
(for stability)



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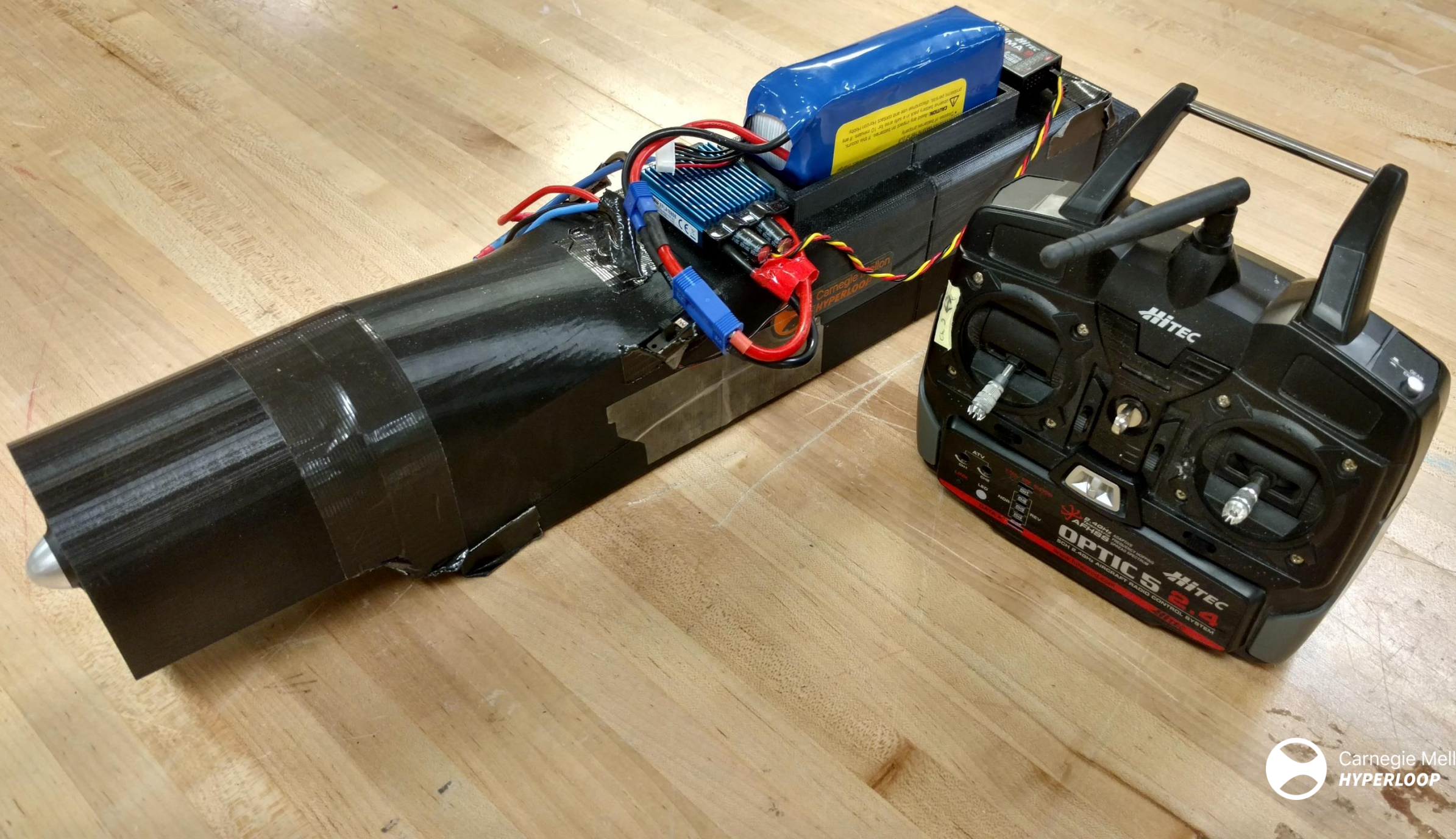
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AIRFLOAT
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TEAM

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COMPETITION TIMELINE

JUN, 2015
Competition Announced

NOV, 2015
Preliminary Design Evaluation

JAN, 2016
Detail Design Evaluation

TODAY!

NOV, 2016
Pod Testing Weekend

JAN, 2017
FINAL COMPETITION

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Sustainability

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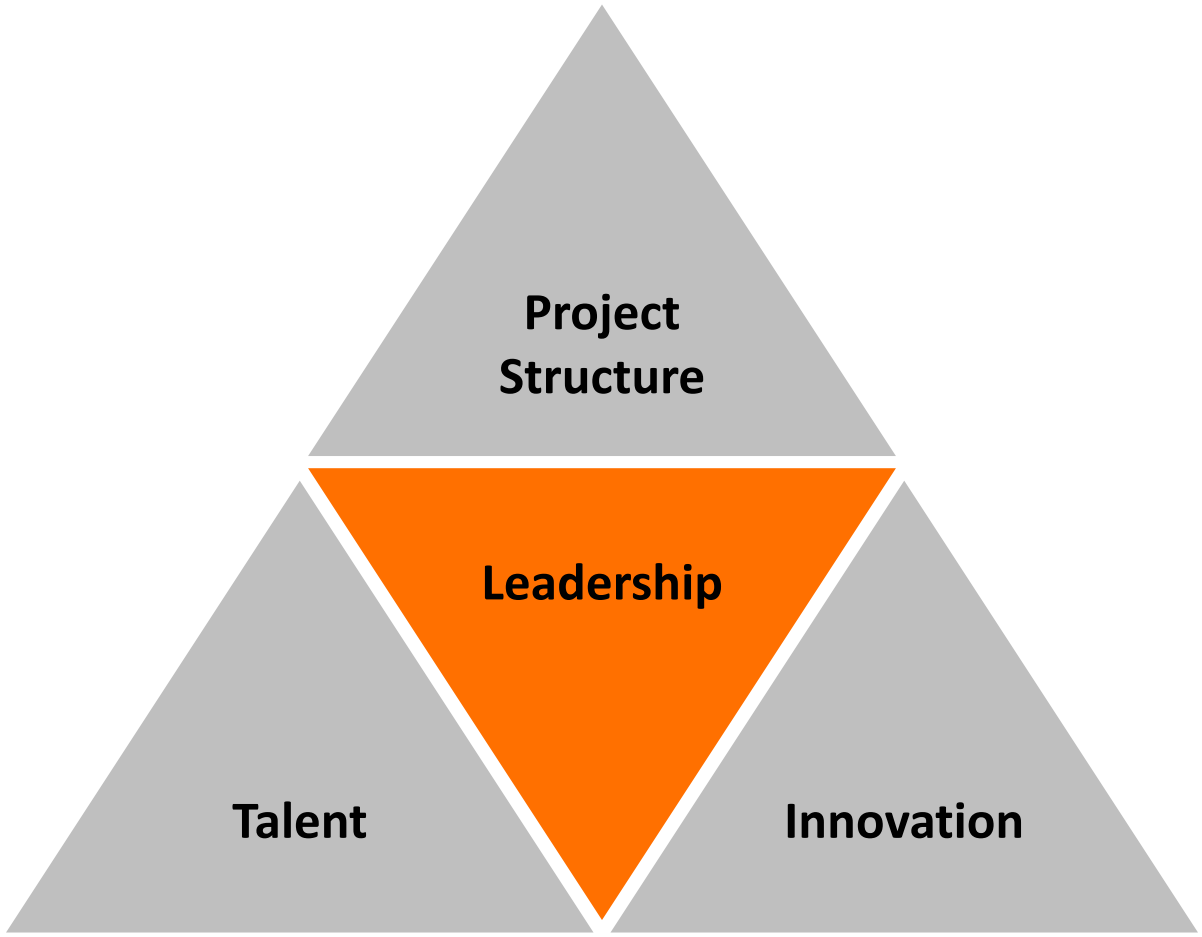
State of the team: September 2016

Key Facts

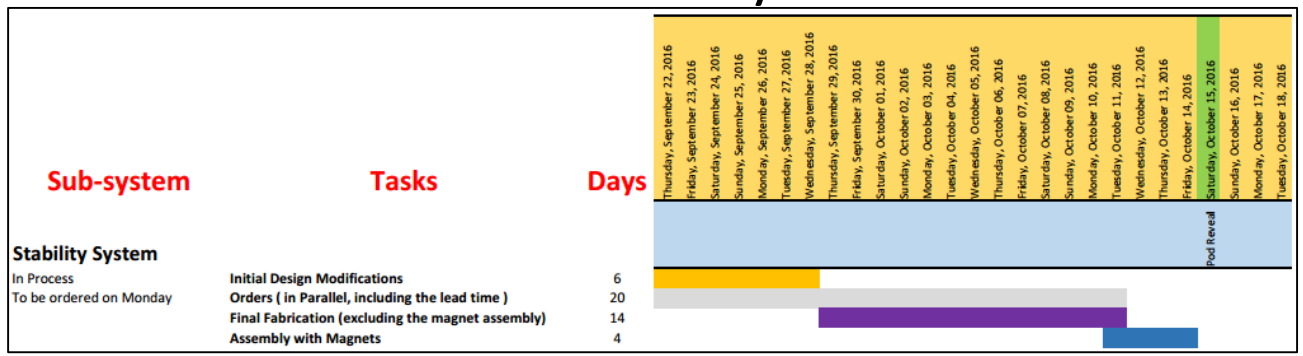
- Still did not have a viable product
- Lost team members to graduation or loss of interest
- Limited understanding of steps to completion
- New round of competition announced for Summer 2017
- Core members are graduating December 2016

Key Issues to Address



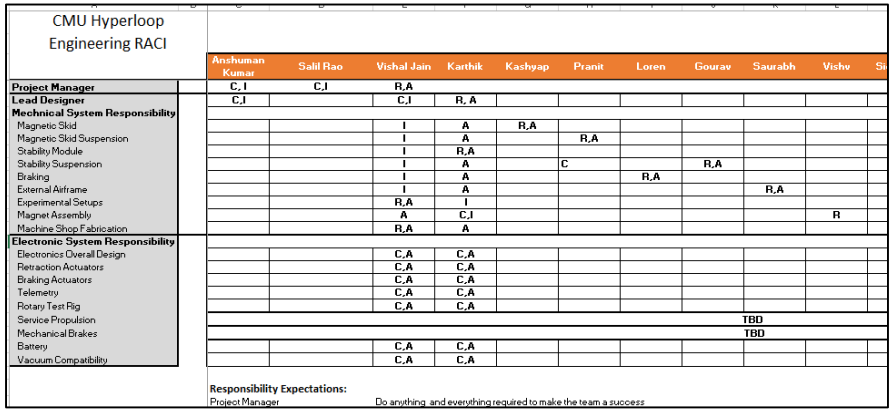
Project Structure

Gantt Charts to crystallize vision



Sub-system	Tasks	Days
Stability System		
In Process	**Initial Design Modifications**	6
To be ordered on Monday	**Orders (in Parallel, including the lead time)**	20
	Final Fabrication (excluding the magnet assembly)	14
	Assembly with Magnets	4

RACIs to define responsibilities



CMU Hyperloop Engineering RACI

	Anshuman Kumar	Salil Rao	Vishal Jain	Karthik	Kashyap	Pranit	Loren	Gourav	Saurabh	Vishv
Project Manager	C, I	C,I	R,A							
Lead Designer	C,I		C,I	R, A						
Mechnical System Responsibility										
Magnetic Skid			I	A	R,A					
Magnetic Skid Suspension			I	A		R,A				
Stability Module			I	R,A						
Stability Suspension			I	A		C		R,A		
Braking			I	A			R,A			
External Airframe			I	A					R,A	
Experimental Setups			R,A	I						
Magnet Assembly			A	C,I						R
Machine Shop Fabrication			R,A	A						
Electronic System Responsibility										
Electronics Overall Design			C,A	C,A						
Retraction Actuators			C,A	C,A						
Braking Actuators			C,A	C,A						
Telemetry			C,A	C,A						
Rotary Test Rig			C,A	C,A						
Service Propulsion									TBD	
Mechanical Brakes									TBD	
Battery			C,A	C,A						
Vacuum Compatibility			C,A	C,A						

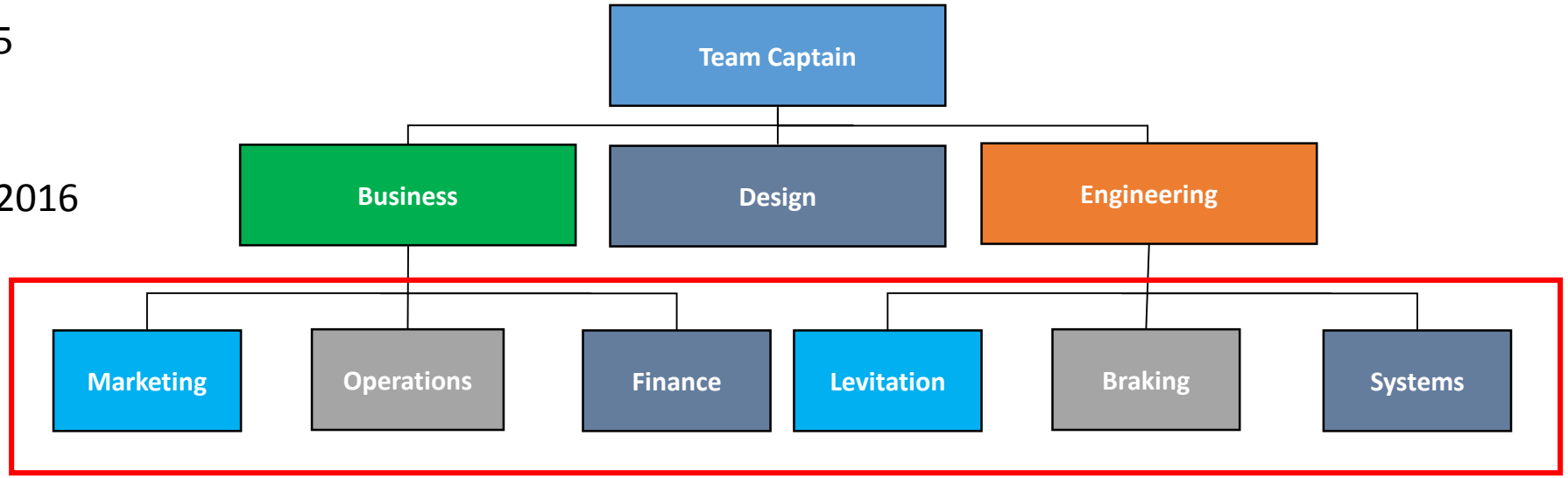
Responsibility Expectations:
Project Manager — Do anything and everything required to make the team a success

Grew org structure to instill individuality and focus

Summer 2015

Winter 2015/2016

Fall 2016



Talent

Challenges

- No full-time resources
- No financial compensation
- Competition on resources -> Schedule misalignment
- Retention – High turnover
- Constant ambiguity -> Resource underutilization & overutilization
- Temporary – Masters students available for 1.5-2 years max
- Intellectual capital retention

New human resource process

Hiring	On-Boarding	Retention	Knowledge Transfer
Recruitment Sessions	One month evaluation	Provide Ownership	Use of shared drives
Look for passion in interviews	Start with simple tasks	Work virtually	Pair off with new members for IC transfer
Use references and previous work	Continually engage	Align background and interests	
Added if skills meet needs			

Innovation

- Design Sprints as framework for product development

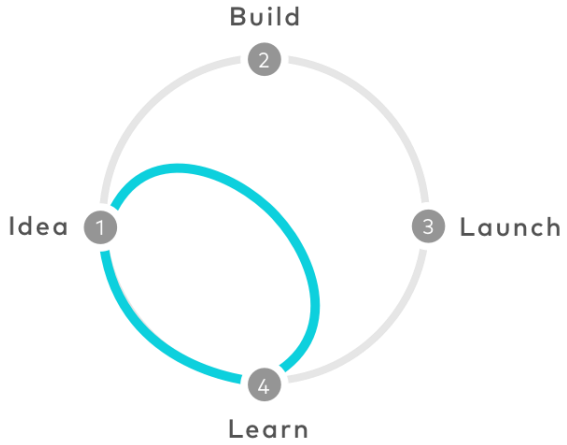


Image Source: www.gv.com/sprint

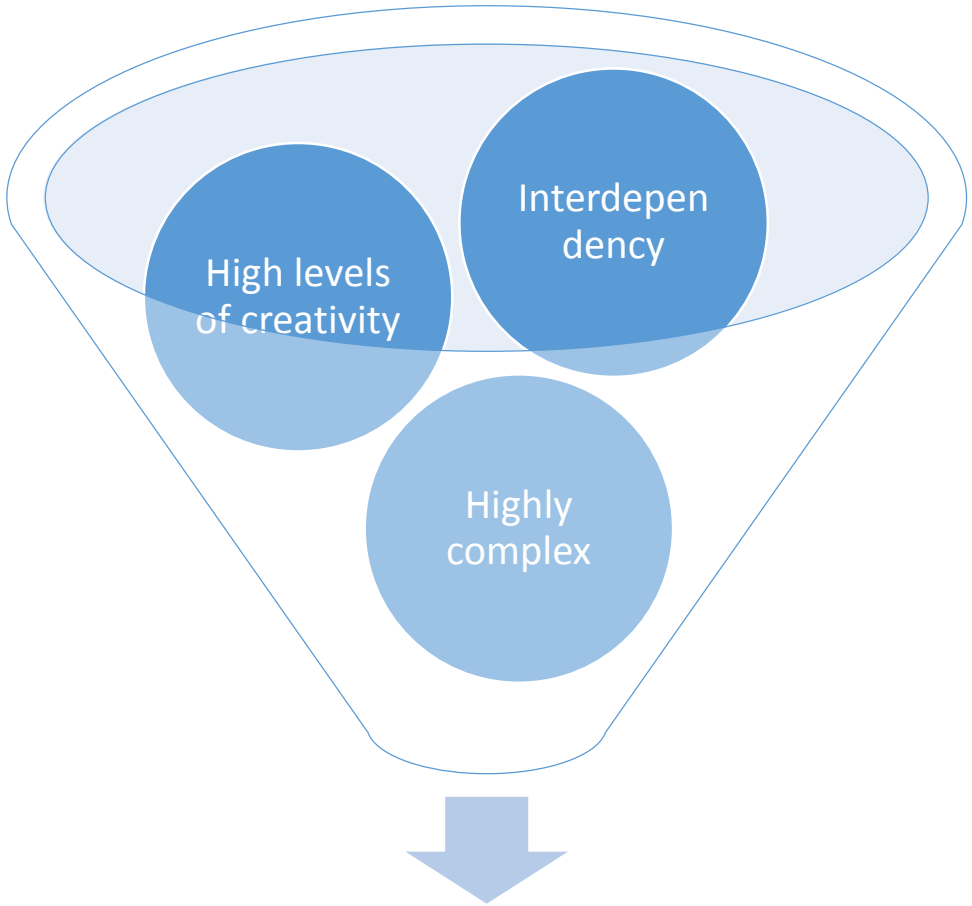
Five Key Phases

1. Understand
2. Sketch
3. Decide
4. Prototype
5. Validate

Why Sprint?

Avoid Decision Fatigue	Weighted Voting (Executive Decisions)
Leverage Parkinson's Law	How might we + Note & Vote
Reduce Response Bias	Weighted matrix
Balance Opposing Views	All-In-One vs. The Rumble
Spark Innovation	Sub solutions + unique combinations

Leadership



Different Form of Leadership

Shared Leadership

Leaders in the CMH organization are facilitators, decisions are made individually and locally

- Leverage expertise
- Provide ownership at every level of the organization
- Semi-autonomous
- Streamlined communication between relevant stakeholders
- Maximizes Output

Lessons learned

Project Structure

- Let your team structure serve you, do not serve your team structure

Talent

- Diversity improves team performance – Don’t be stuck in it
- Hire people based on needs and passion
- Bring on members based on needs but let them stay to follow their interests

Innovation

- Balance experimentation vs analysis when faced with ambiguity
- Leverage expertise and diversity of thought through Design Sprint like exercises

Leadership

- Small teams >> Big teams
- Empower people as fast as possible
- Semi-autonomy works well

Opportunities for improvement

Project Structure

- Find balance between formal project structure and flexibility
- Promote cross-pollination between engineering, design, and business to strengthen team bonds
- Further engage members and increase autonomy

Talent

- Need more long term members of the team to act as glue between different classes of graduates -> undergraduates
- Need a more formal intellectual capital documentation and transfer process
- Improve on-boarding process to ensure development & retention

Innovation

- How to organize team and plan around overlapping iterations of a product
- Continually innovate and be nimble
- Shorten feedback cycles
- Eliminate bias

Leadership

- Find right blend of shared & vertical leadership model
- Create reward or incentives system
- Identify and develop future leaders
- Reinforce vision & purpose

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Interested in supporting the team?

We need sponsors and supporters for the next round of competition for Summer 2017!

If interested,
Email our inbox: **cmuhyperloop@gmail.com**
or
Contact Salil Rao: Business Lead – **snrao@tepper.cmu.edu**

Connect with us!

@cmuhyperloop facebook.com/cmuhyperloop cmuhyperloop.com


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THANK YOU!