NASA Human Exploration ROVER CHALLENGE

Tavares Butler
Phillip Dimacali
Jessica Meeker
Lazaro Rodriguez
Jerald Yee

Team Introductions

Tavares Butler
Project Engineer

Jessica Meeker
Mechanical Engineer

Phillip Dimacali
Design Engineer

Jerald Yee
Quality Engineer

Lazaro Rodriguez
Manufacturing Engineer

Sponsors

Shayne McConomy, Ph.D.

Chiang Shih, Ph.D.

A statewide network of colleges and universities supporting the expansion and diversification of Florida's space industry through grants, scholarships, and fellowships to students and educators in Florida.

Jessica M.

Objective

To produce a functional rover capable of completing challenge course obstacles and tasks while being able to traverse on various terrains and adhere to the rules set forth by the 2020 guidebook.

Jessica M.

Project Background

Competition Dates:

April 17-18, 2020

Location:

Huntsville, Al

- 14 Obstacles
- 5 Tasks
- 2 excursion attempts
- 8:00 minute time limit per excursion attempted
- 114 Total Points Possible

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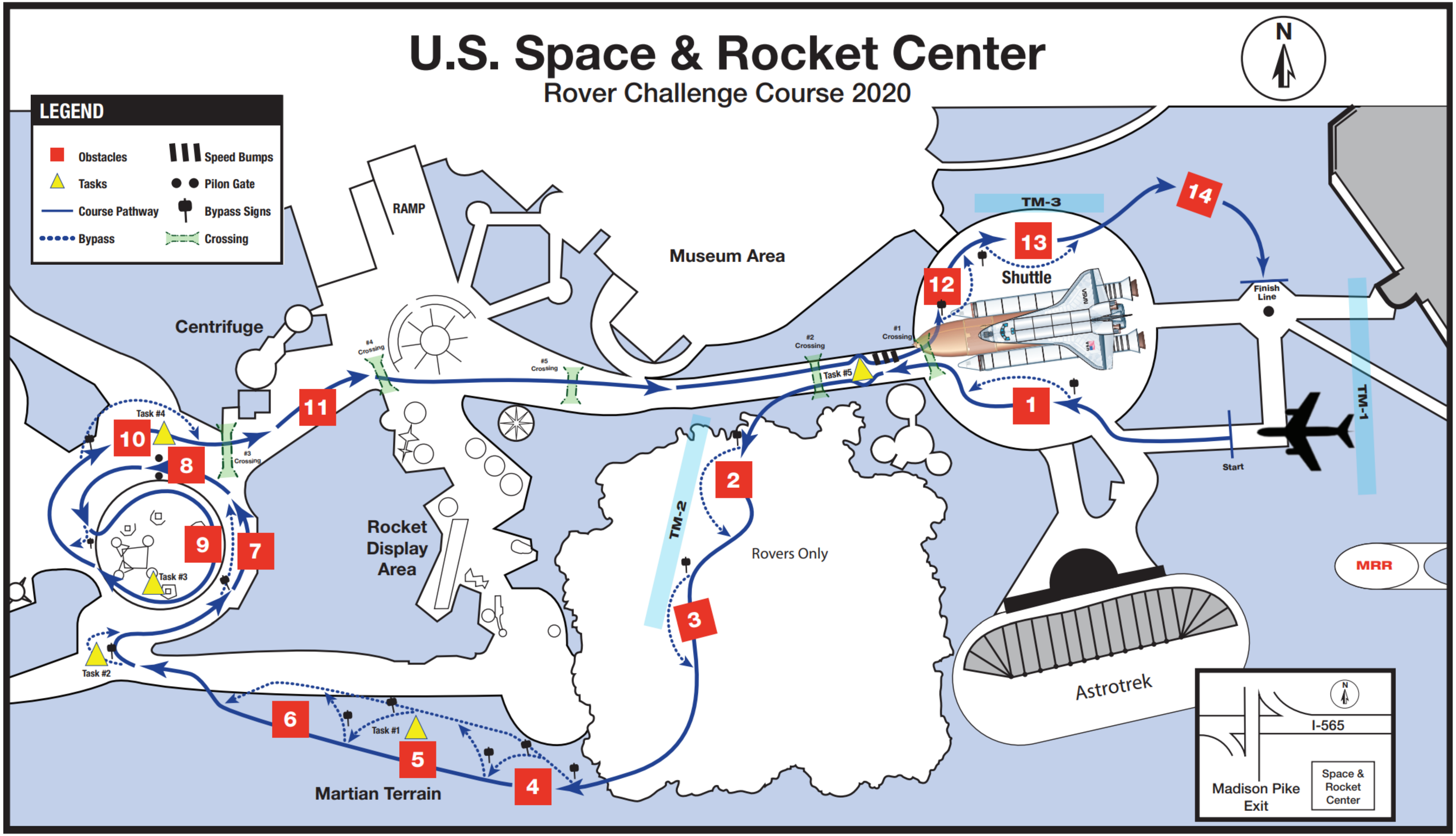

U.S. Space & Rocket Center
Rover Challenge Course 2020
N
LEGEND
Obstacles
Tasks
Course Pathway
Bypass
Speed Bumps
Pilon Gate
Bypass Signs
Crossing
RAMP
Museum Area
Centrifuge
Shuttle
TM-3
TM-2
TM-1
Finish Line
Start
Rovers Only
Rocket Display Area
Martian Terrain
Astrotrek
MRR
Task #1
Task #2
Task #3
Task #4
Task #5
#1 Crossing
#2 Crossing
#3 Crossing
#4 Crossing
#5 Crossing
1
2
3
4
5
6
7
8
9
10
11
12
13
14
I-565
Madison Pike Exit
Space & Rocket Center

Jessica M.

Competition Point Breakdown

Teams Evaluated Regarding:

- Vehicle Weight
- Vehicle Volume
- Assembly Time
- Excursion Time
- Tasks and obstacles are attempted/completed
- Vehicle Performance
- Several other parameters

Obstacles

Obstacle/Task Number	Description	Bypass	Possible Points	Point Breakdown
1	Undulating Terrain	Y	2	2 points for successful completion 1 point for attempt 0 points for bypass
2	Crater with Ejecta	Y	2	2 points for successful completion 1 point for attempt 0 points for failure to attempt

Tasks

Task 3 (Obstacle 9 must be attempted to attempt Task 3.)	Core Sample Retrieval	Y	9	Core Sample Retrieval 1 point for having all tools necessary to attempt the task **(ERR)** 4 points for successful core sample extraction **(TS)** 4 points for successful return of core sample that meets designated criteria **(PER)**

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Project Scope:
Key Goals

- Rover Successfully traverses competition course
- Wheel & Drivetrain are originally designed and manufactured
- Rover instruments are structurally sound and functional
- Misalignments and vibrations are minimized
- Rover Drivers are kept safe during excursions

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Markets

- Primary Markets

Organizations performing space exploration and those who require a vehicle to traverse regolith terrain

- Secondary Markets

Hobbyists, outdoorsmen, and smaller organizations that require a capable off-road vehicle such as ski resorts and remote nature parks.

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Assumptions

- Vehicle will be designed, specified, and verified using earth's physical specifications
- Rover drivetrain will be entirely human-powered
- Rover drivers will control steering, propulsion, and braking

Jessica M.

Stakeholders

Stakeholder	Financial	Decision Maker
Shayne McConomy	✓	✓
Chiang Shih	✓	✓
Keith Larson		✓
FAMU-FSU College of Engineering	✓	✓
NASA		✓

Jessica M.

Customer Needs

Customer Statement	Interpreted Need
A rover with riders in position ready to ride must have no less than 12 inches (30.48 cm) ground clearance.	All components in contact with the rider are at least 12 inches from the ground to its lowest point (seats, pedals, handles, etc.).
Failure to provide robust, practical seat restraints prohibits course participation.	The vehicle drivers are secure and safe during operation.
We encourage you to avoid using bike chains, which have proven to be inadequate in past races.	The vehicle utilizes an innovative and effective drivetrain system.
A tasks and obstacles of similar events are completed for full points.	Vehicle is capable of completing tasks.

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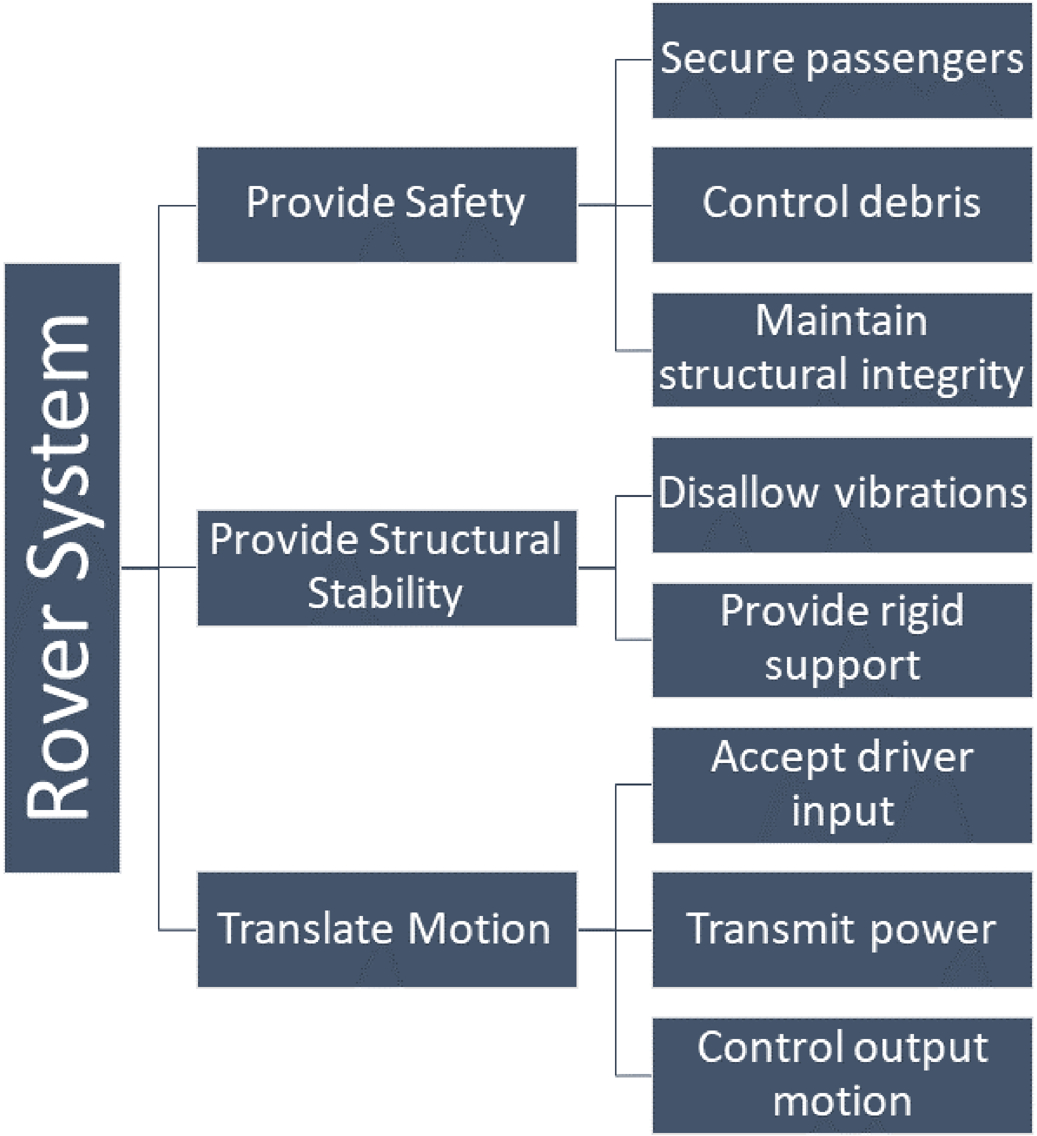
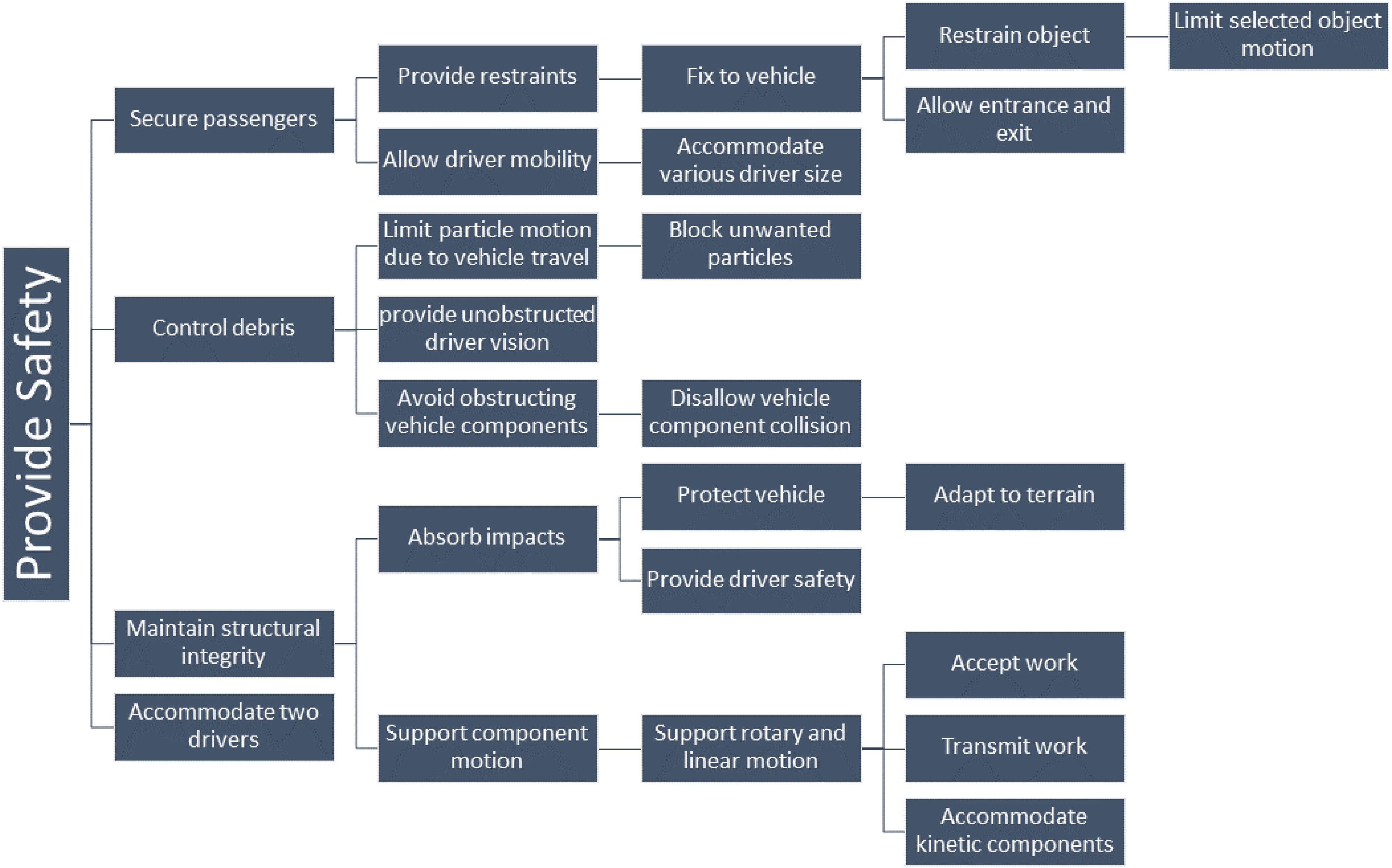
Functional Decomposition

Flow Charts


Rover System
Provide Safety
Secure passengers
Control debris
Maintain structural integrity
Provide Structural Stability
Disallow vibrations
Provide rigid support
Translate Motion
Accept driver input
Transmit power
Control output motion

Jerald Y.


Provide Safety
Secure passengers
Control debris
Maintain structural integrity
Accommodate two drivers
Provide restraints
Allow driver mobility
Limit particle motion due to vehicle travel
provide unobstructed driver vision
Avoid obstructing vehicle components
Absorb impacts
Support component motion
Fix to vehicle
Accommodate various driver size
Block unwanted particles
Disallow vehicle component collision
Protect vehicle
Provide driver safety
Support rotary and linear motion
Restrain object
Allow entrance and exit
Adapt to terrain
Accept work
Transmit work
Accommodate kinetic components
Limit selected object motion

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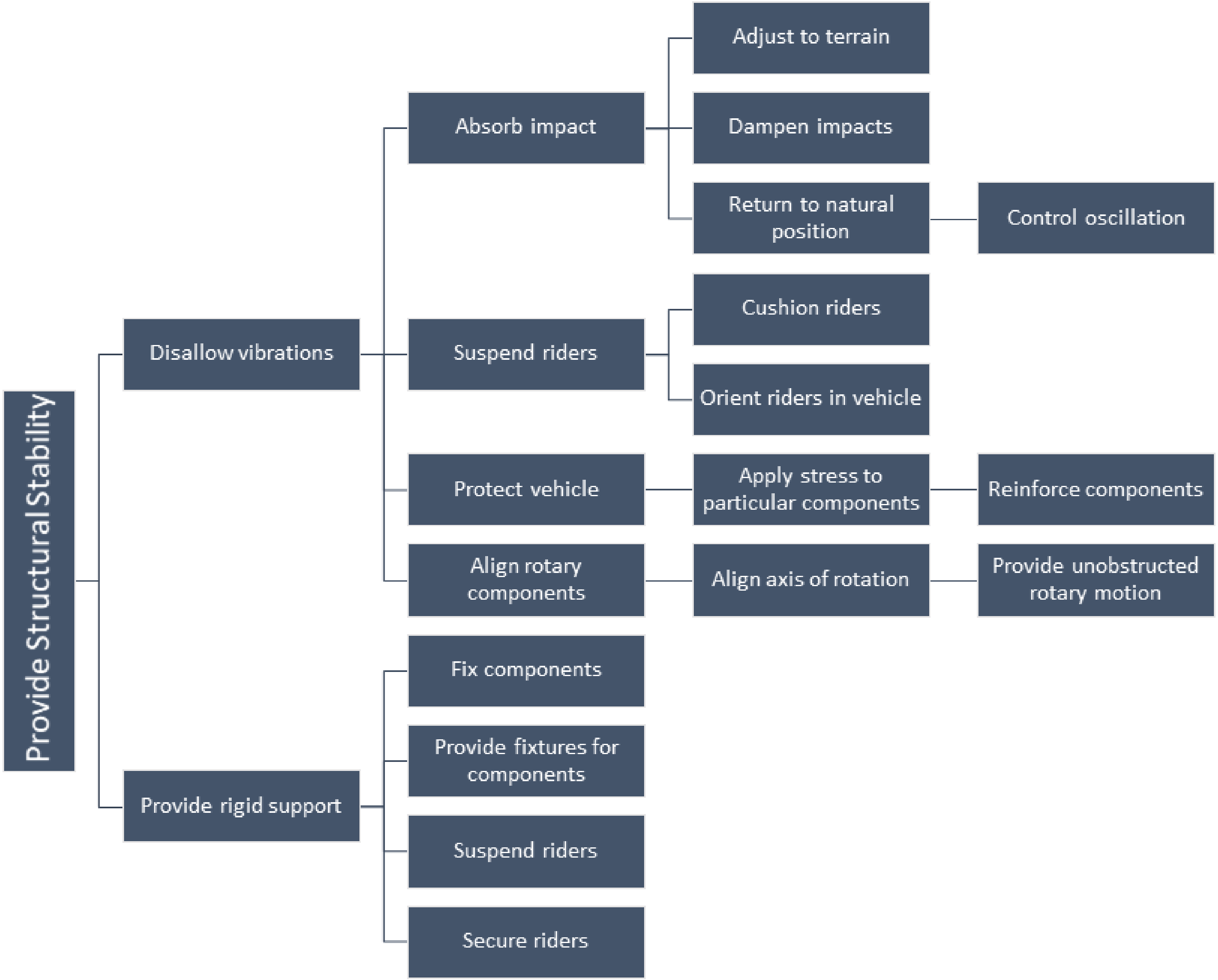
Provide Structural Stability
Disallow vibrations
Provide rigid support
Absorb impact
Suspend riders
Protect vehicle
Align rotary components
Fix components
Provide fixtures for components
Suspend riders
Secure riders
Adjust to terrain
Dampen impacts
Return to natural position
Control oscillation
Cushion riders
Orient riders in vehicle
Apply stress to particular components
Reinforce components
Align axis of rotation
Provide unobstructed rotary motion

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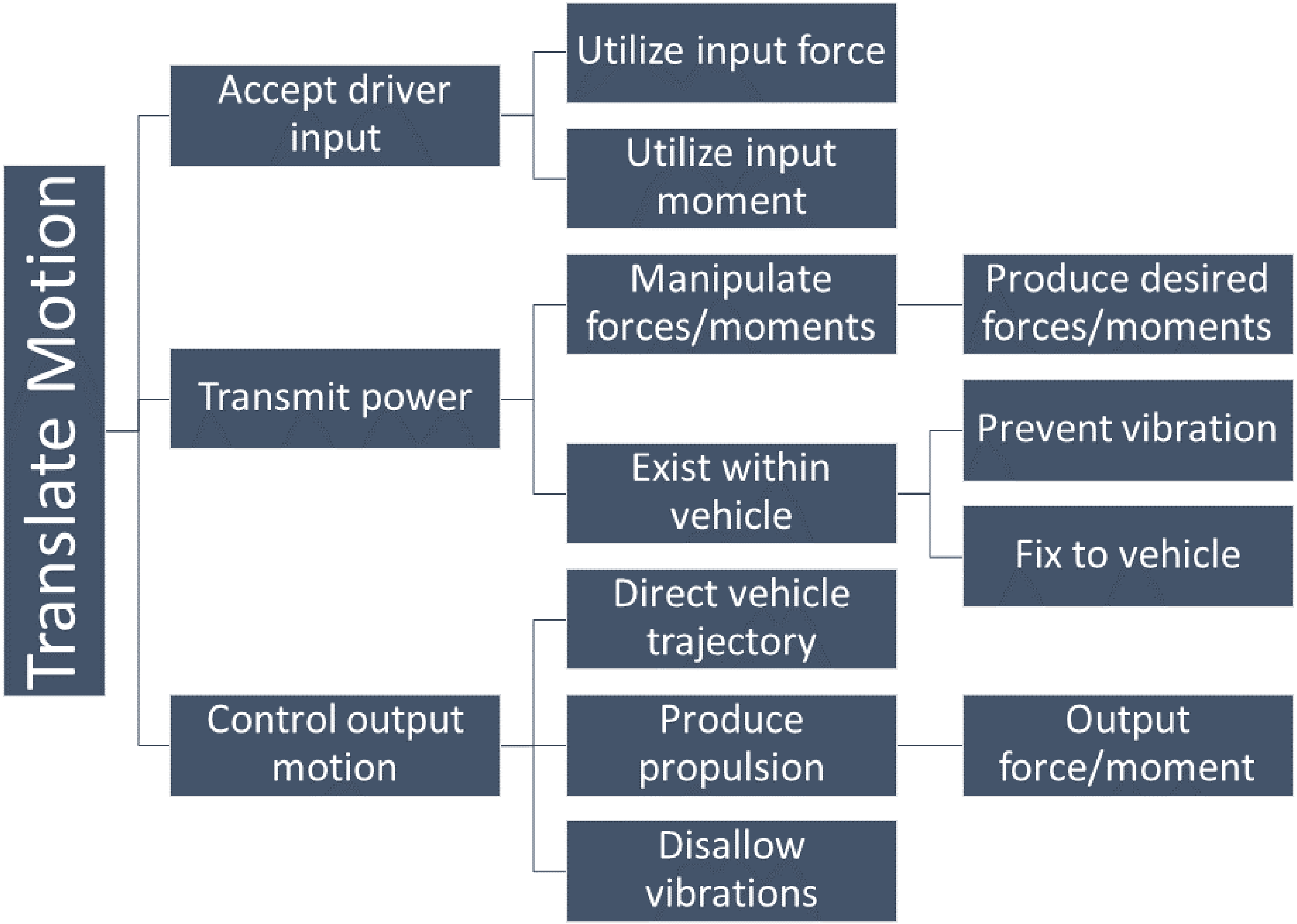
Translate Motion
Accept driver input
Utilize input force
Utilize input moment
Transmit power
Manipulate forces/moments
Produce desired forces/moments
Exist within vehicle
Prevent vibration
Fix to vehicle
Control output motion
Direct vehicle trajectory
Produce propulsion
Output force/moment
Disallow vibrations

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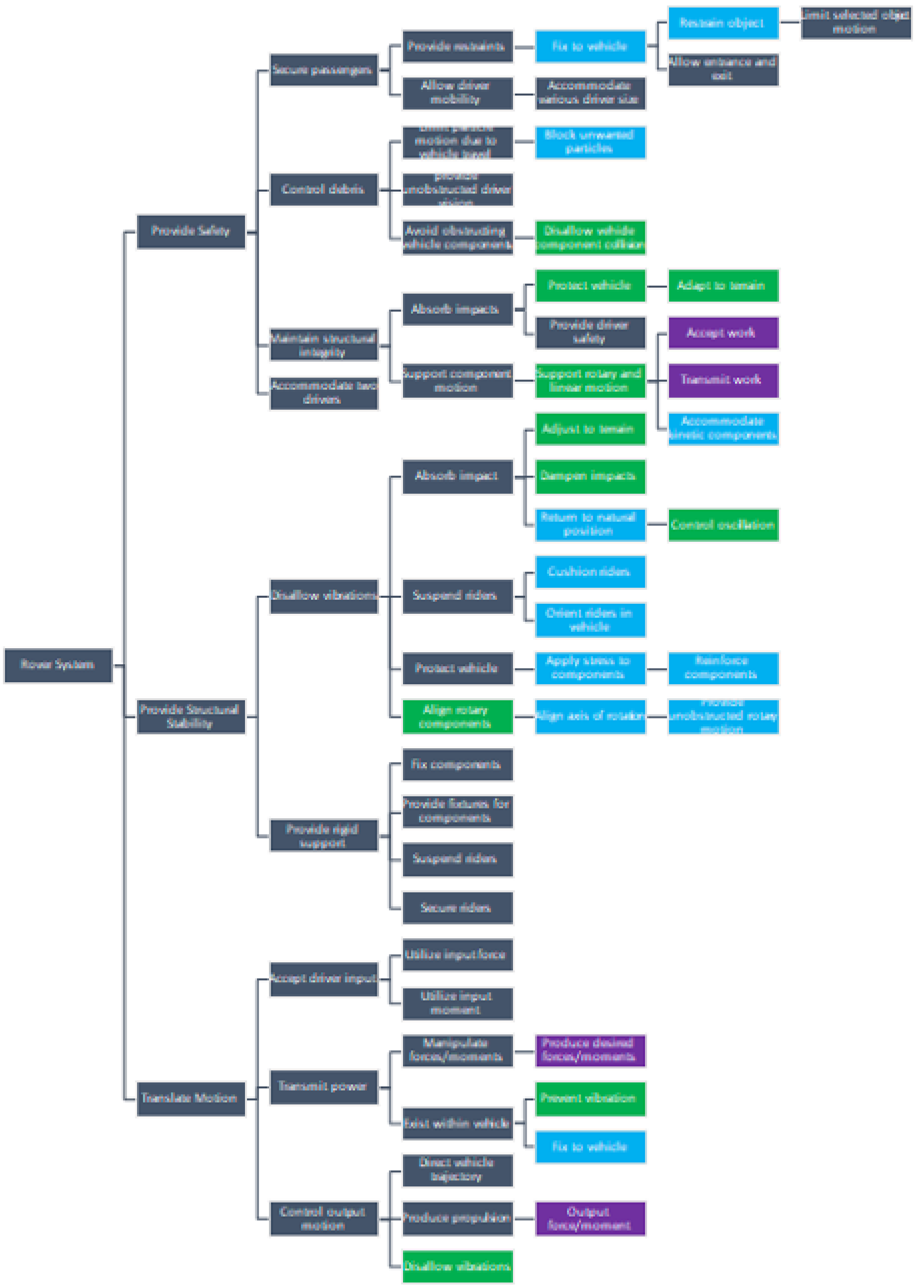
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Provide restraints
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Allow driver mobility
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Control debris
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Block unwanted particles
unobstructed driver
Avoid obstructing vehicle components
Disallow vehicle component collision
Maintain structural integrity
Absorb impacts
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Control oscillation
Suspend riders
Cushion riders
Orient riders in vehicle
Protect vehicle
Apply stress to components
Reinforce components
Align rotary components
Align axis of rotation
unobstructed rotary
Provide rigid support
Fix components
Provide fixtures for components
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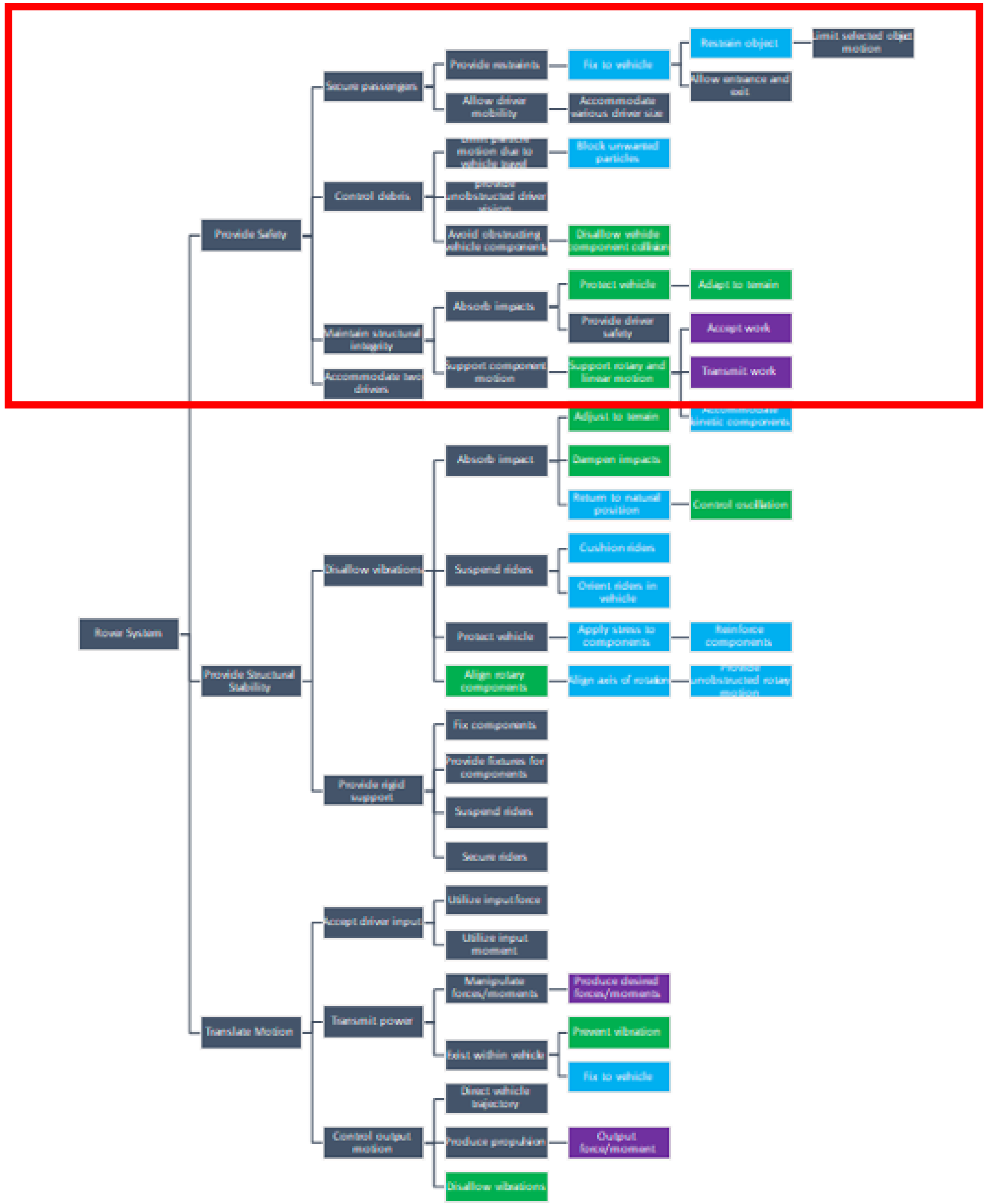

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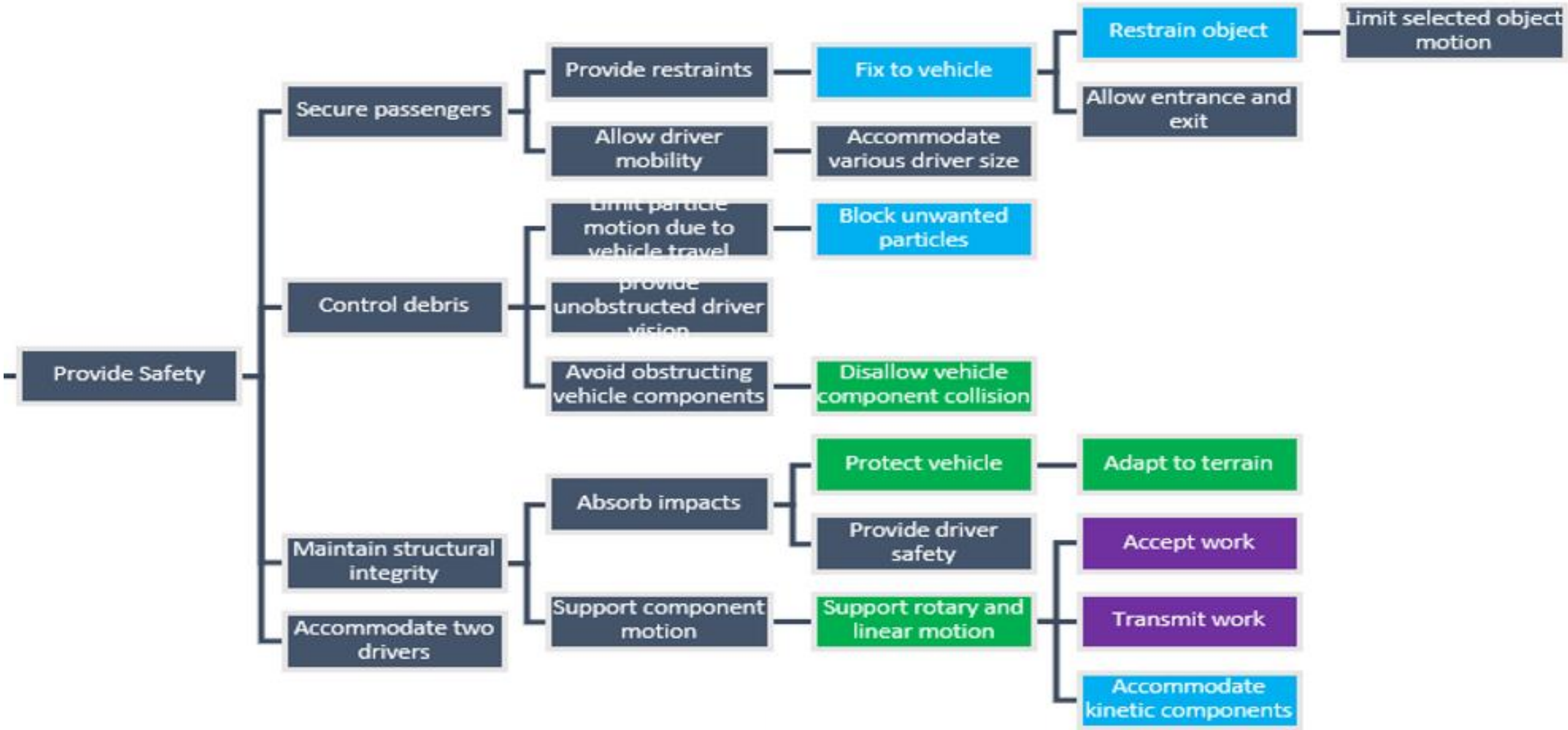
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Functional Cross Reference

	Recurring Function Groups		
	Vibration Control	Structural	Power Transmission
Provide Safety	▪ Disallow vehicle component collision ▪ Protect Vehicle ▪ Adapt To Terrain ▪ Support rotary and linear motion	▪ Fix to vehicle ▪ Restrain object ▪ Block unwanted particles ▪ Accommodate kinetic components	▪ Accept Work ▪ Transmit work
Provide Structural Stability	▪ Adjust to terrain ▪ Dampen impacts ▪ Control oscillations ▪ Align rotary components	▪ Return to natural position ▪ Cushion riders ▪ Orient riders in vehicles ▪ Apply stress to components ▪ Align axis of rotation ▪ Reinforce components ▪ Provide unobstructed rotary motion	
Translate Motion	▪ Prevent Vibration ▪ Disallow Vibrations	▪ Fix to object	▪ Produce desired forces/moments ▪ Output force/moments

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Device Action and Outcome

Vibration Control	Structural	Power Transmission
• Dampen impacts • Control oscillations • Maintain axis alignment for rotary components	• Suspend riders to a required height • Withstand deformation • Secure and protect riders • Accommodate kinetic vehicle components	• Accept input forces/moments • Manipulate forces/moments • Output forces/moments

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Five Most Important Points from this Lecture

1. Rover is powered by two individuals and meets safety regulations.

2. Innovative designs for the wheels and drivetrain.

3. Three systems; Provide Safety, Provide Structure Stability, Translate Motion.

4. Functional Cross Reference.

5. Device Action and Outcome.

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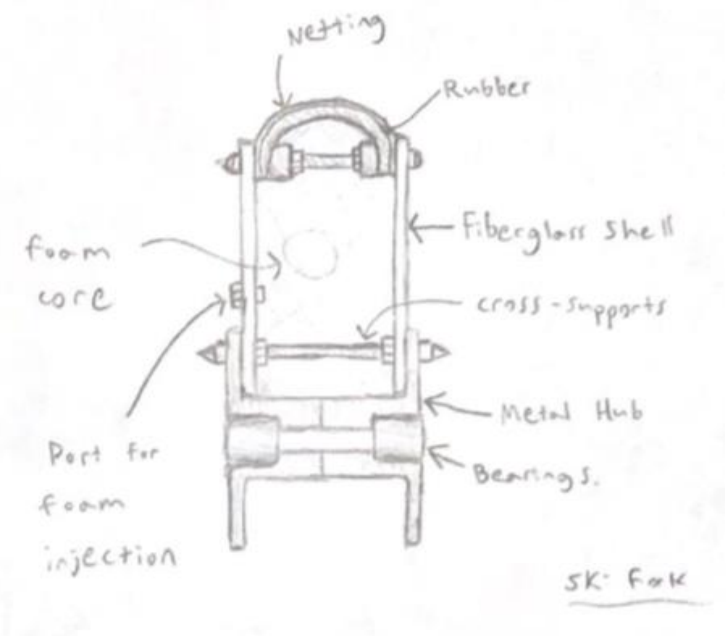
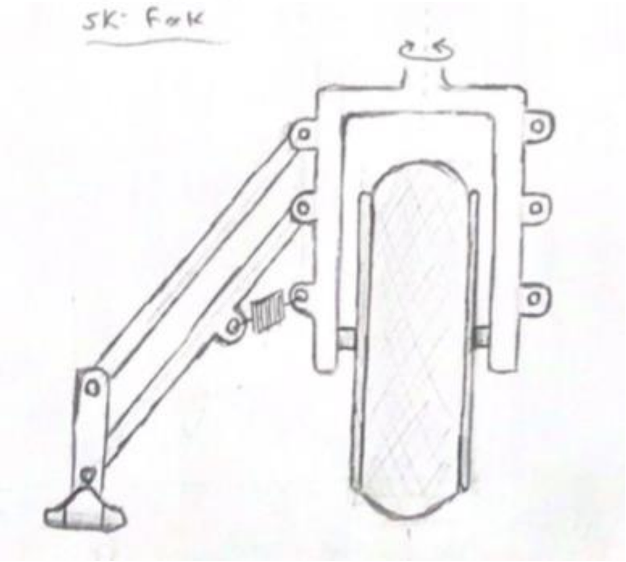
Future Work

- Selecting an optimized course for most points
- Targets and Metrics
- Concept generation and selection





Jerald Y.

References

National Aeronautics and Space Administration. (2020). Human Exploration Rover Challenge: 2020 Guidebook. *NASA Human Exploration Rover Challenge: 2020 Guidebook*. Alabama , United States of America.

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