

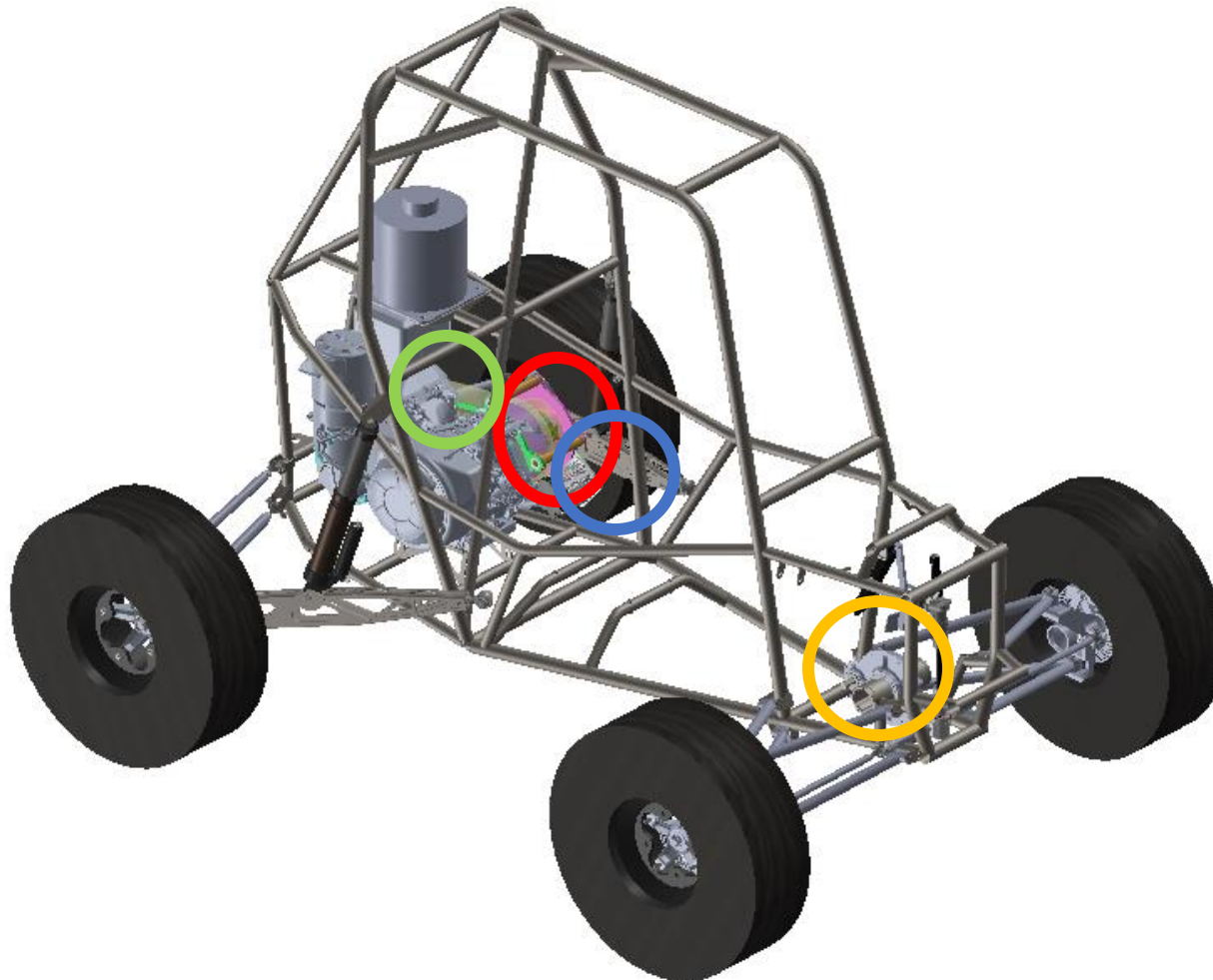
# **SAE Baja '24**

# **Drivetrain**

**33% Hardware Check**

Henry Van Zuyle, Ryan Fitzpatrick, Jarett Berger, Donovan Parker

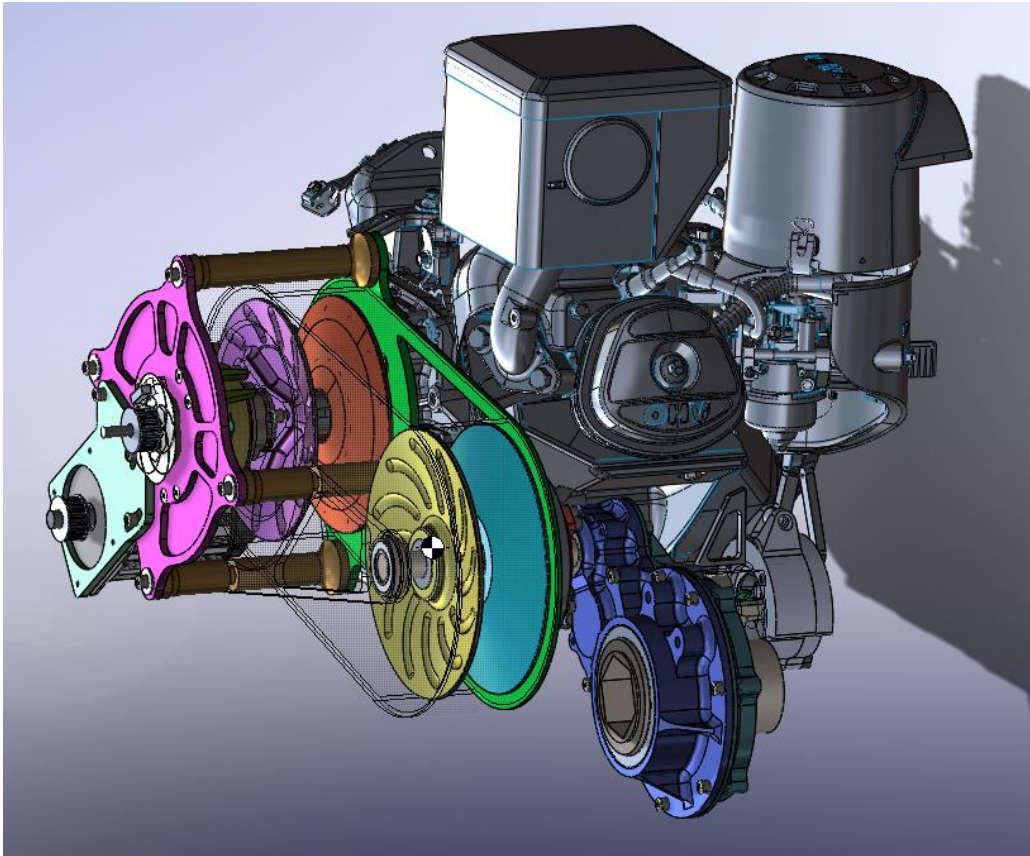
# Design Efforts – Drivetrain CAD



## Drivetrain “Zones”

1. ECVT
2. Rear Gearbox
3. 4WD System
4. Front Gearbox

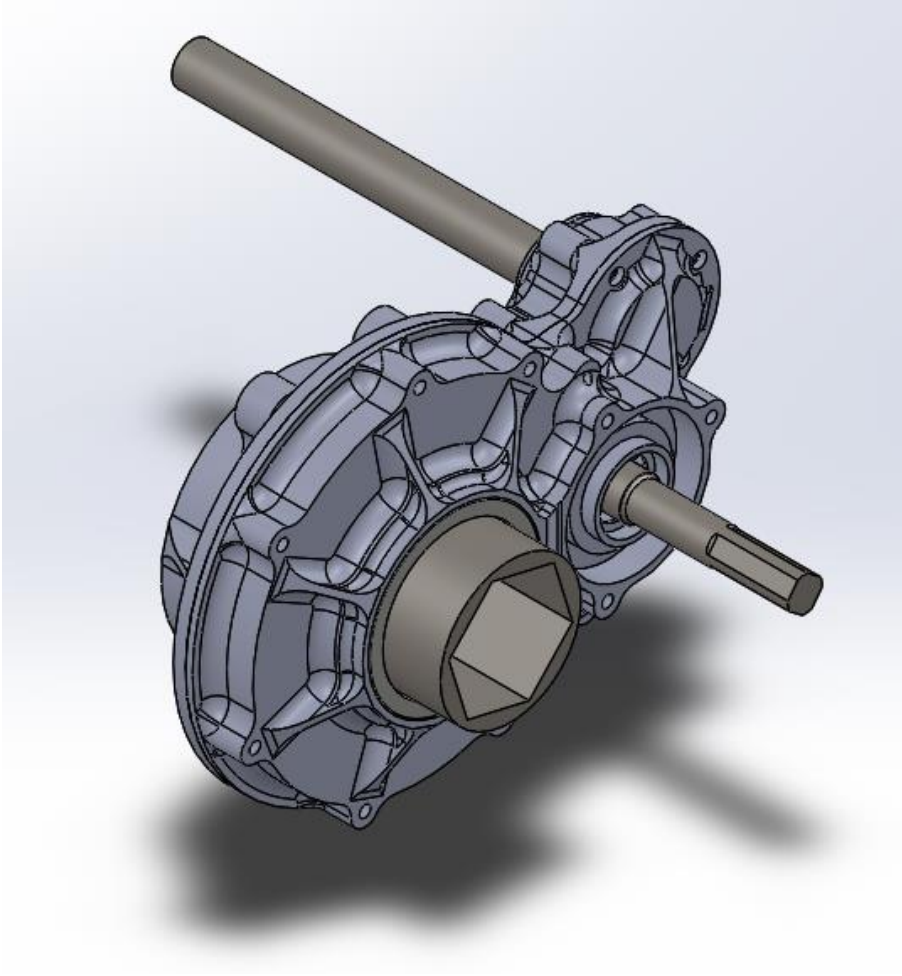
# Design Efforts – Drivetrain CAD



## CVT Changes:

- Changed the secondary response spring from a simple compression spring to a compression and torsion spring.

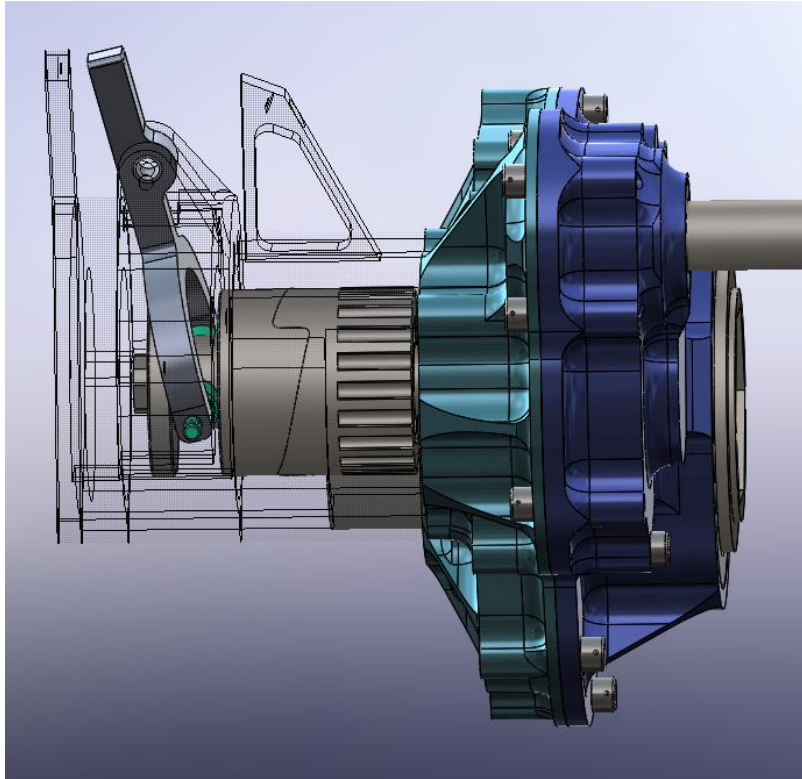
# Design Efforts – Drivetrain CAD



## Rear Gearbox Changes:

- Added in expansion bladder per Rule B.9.4.
- Split output gear with integrated CV cups into a separate gear and shaft.

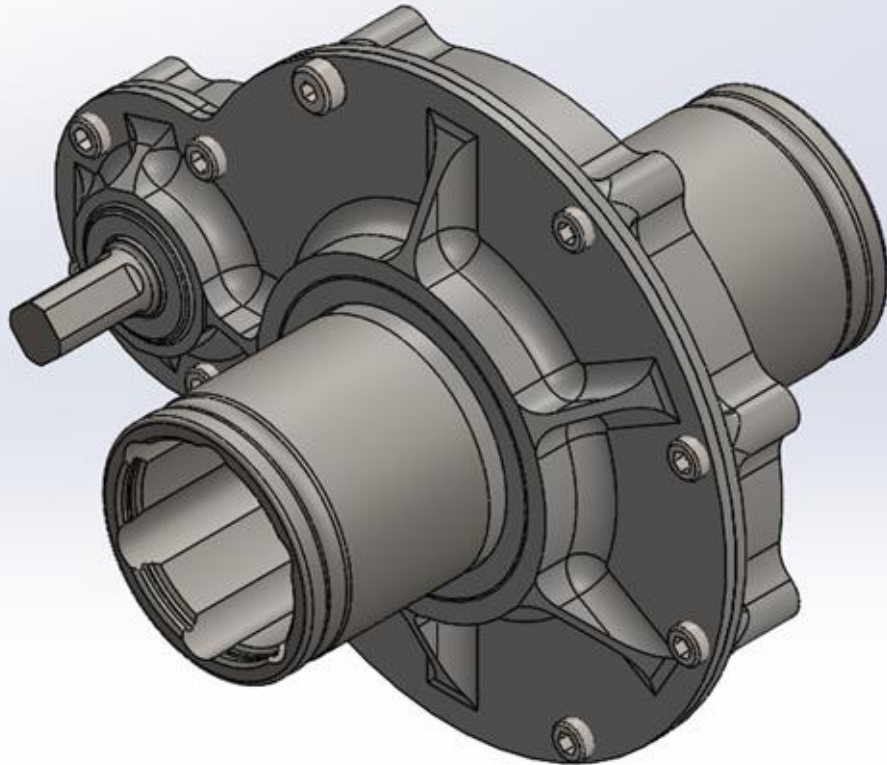
# Design Efforts – Drivetrain CAD



## 4WD Changes:

- **Tooth Pitch Changes**

# Design Efforts – Drivetrain CAD



## Front Gearbox Changes:

- Updated CV Cup Geometry

# Purchasing Plan - ECVT

Classification	Purchased	On Hand	Part Name	Quantity	Cost	Total Cost	Material	Purchase/Made	Vender	Vender Part Number
CVT			CVT control belt	1	6	6	Rubber	Purchase	Beidlers Belts	160xI037
CVT			CVT power belt	1	50	50	Rubber	Purchase	Xcaliber Motorsports	21g3353
CVT			Cam followers	8	4	32	Steel	Purchase	Amazon	CF4 cam follower
CVT			Oil-Embedded Bronze Sleeve Bearing	3	6.56	19.68	Bronze	Purchase	McMaster-Carr	6391K768
CVT			One-Piece Thrust Ball Bearing	1	48.72	48.72	Steel	Purchase	McMaster-Carr	60715K111
CVT			Ultra-Thin Ball Bearing	1	63.69	63.69	Steel	Purchase	McMaster-Carr	6656K236
CVT			Ball Bearing	1	7.72	7.72	Steel	Purchase	McMaster-Carr	60355K336
CVT			Ball Bearing	1	12.62	12.62	Steel	Purchase	McMaster-Carr	60355K983
CVT			Cast Iron Acme Round Nut	1	39.91	39.91	Cast Iron	Purchase	McMaster-Carr	97014A595
CVT			316 Stainless Steel Acme Lead Screw	1	33.52	33.52	Steel	Purchase	McMaster-Carr	95080A103
CVT			Limit switch	1	5	5	N/A	Purchase	N/A	N/A
CVT			Hall effect	1	13	13	N/A	Purchase	N/A	N/A
CVT			Magnet	2	0.25	0.5	N/A	Purchase	N/A	N/A
CVT			Hudson 343x	1	500	500	N/A	Purchase	N/A	N/A
CVT			Odrive pro	1	300	300	N/A	Purchase	N/A	N/A
CVT			Arduino portena h7 lite	1	80	80	N/A	Purchase	N/A	N/A
CVT			Primary mobile sheave	1	0	0	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Primary fixed sheave	1	0	0	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Secondary mobile sheave	1	0	0	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Secondary fixed sheave	1	0	0	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			CVT standoffs	2	15	30	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			CVT outside partial standoff	2	7	14	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			CVT inside partial standoff	2	7	14	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Control motor pulley	2	20	40	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Primary shaft	1	20	20	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Secondary shaft	1	20	20	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Secondary cam	1	40	40	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Secondary cam mount plate	1	10	10	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Backplate	1	50	50	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Frontplate	1	25	25	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Motor mount plate	1	10	10	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Square bush	1	15	15	Bronze	Purchase	McMaster-Carr	N/A
CVT			Gearbox shaft support	1	10	10	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Anti-rotation forks	3	2	6	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Lead screw nut flange	1	45	45	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Motor	1	900	900	N/A	Purchase	Kholer	N/A

# Purchasing Plan – Front & Rear Gearboxes

Classification	Purchased	On Hand	Part Name	Quantity	Cost	Total Cost	Material	Purchase/Made	Vender	Vender Part Number
Gearboxes			60355K178 Ball Bearing -R10	4	7.55	30.2	Steel	Purchase	McMaster-Carr	60355K178
Gearboxes			6656K151 Ultra-Thin Ball Bearing -61813-2RS	3	14.77	44.31	Steel	Purchase	123Bearing	61813-2RS
Gearboxes			GMN FK6205-2RS Sprag	2	0	0	Steel	Own	NAU SAE Baja	N/A
Gearboxes			Circlip CV Cup	2	0	0	Aluminum	Own	NAU SAE Baja	N/A
Gearboxes			Front Input Gear	1	50	50	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Front Output Gear	1	100	100	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Front Input Shaft	1	75	75	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Front Output Shaft	1	75	75	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			CV Cup	2	50	100	4140 Steel	Made	OnlineMetals	N/A
Gearboxes			Front Drive Side Housing	1	50	50	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
Gearboxes			Front Passenger Side Housing	1	50	50	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
Gearboxes			SKF 65X80X8 CRW1 R Seal	3	19.30	57.90	Nitrile Rubber	Purchase	Motion Industries	85311027328
Gearboxes			SKF 80X100X10 CRW1 R Seal	1	19.94	19.94	Nitrile Rubber	Purchase	Motion Industries	85311030847
Gearboxes			SKF 7438 Seal	3	11.36	34.08	Nitrile Rubber	Purchase	Motion Industries	85311005562
Gearboxes			Socket Head Cap Screw	8	0	0	Aluminum	Own	NAU SAE Baja	N/A
Gearboxes			Socket Head Shoulder Screw	2	0	0	Aluminum	Own	NAU SAE Baja	N/A
Gearboxes			60355K185 Ball Bearing - R12	3	8.99	26.97	Steel	Purchase	McMaster-Carr	60355K185
Gearboxes			6656K245 Ball Bearing -61816-2RS	1	21.89	21.89	Steel	Purchase	123Bearing	61816-2RS
Gearboxes			Rear Gearbox Input Shaft	1	35	35	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Rear Gearbox Intermediate Shaft	1	40	40	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Rear Gear 2	1	15	15	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Rear Gear 3	1	15	15	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Rear Gear 4	1	50	50	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Rear Gear 5	1	400	400	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Rear Gearbox Driverside Case	1	125	125	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
Gearboxes			Rear Gearbox Passengerside Case	1	125	125	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
Gearboxes			Rear Gearbox Expansion Chamber	1	36.30	36.30	Plastic	Purchase	Summit Racing	TGI-140207-1-KIT
Gearboxes			Rear Brake Rotor	1	0.00	0.00	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
Gearboxes			Bolts 3/8"-16 (Brake Caliper Mounting)	2		0.00				
Gearboxes			Bolts #8-32 (Brake Rotor Mounting)	6		0.00				
Gearboxes			Bolts 1/4-20 (Gearbox Assembly)			0.00				



# Purchasing Plan – 4WD System

Classification	Purchased	On Hand	Part Name	Quantity	Cost	Total Cost	Material	Purchase/Made	Vender	Vender Part Number
4WD			Driving Side Clutch	1	59	59.00	4140 Steel	Made	OnlineMetals	N/A
4WD			Driven Side Clutch + Pulley	1	59	59.00	4140 Steel	Made	OnlineMetals	N/A
4WD			Front End Pulley	1	10.92	10.92	4140 Steel	Made	OnlineMetals	N/A
4WD			Shifter Lever	1	25.24	25.24	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
4WD			Shifter Lever Housing	1	75	75.00	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
4WD			Shifter Fork	1	21.49	21.49	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
4WD			Swivel Joint	1	8.21	8.21	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
4WD			Gear Box Pulley Shield	1	19.67	19.67	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
4WD			Shift Fork Mount Guard	1	19.67	19.67	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
4WD			Dog Clutch Cap	1	19.67	19.67	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
4WD			Engagement Cable Mount	1	5.35	5.35	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
4WD			Idler Pulleys	11	0	0.00	Delrin	Made	McMaster-Carr	8576K27
4WD			Ball Bearings R10-2RS	2	1.68	3.36	Aluminum	Purchase	Amazon (Maple Ace)	R10-2RS
4WD			Idler Pulley Bearings	11	0.78	8.58	Aluminum	Purchase	Amazon (Maple Ace)	R8-2RS
4WD			Rollers	11	97.75	97.75	Delrin	Made	McMaster-Carr	8576K27
4WD			Linkage Cable	1	78.74	78.74	Steel, etc.	Purchase	N/A	N/A
4WD			1460T Threaded Black-Oxide Steel Track Roller	2	34	68.00	Steel	Purchase	McMaster-Carr	N/A
4WD			Circlips	2	2	4.00	Copper	Purchase	N/A	N/A
4WD			1/4-20 Screw	3	0		Aluminum	Purchase		
4WD			#10-24 Screw	2	0		Aluminum	Purchase		
4WD			4WD belt	1	76	76	Rubber	Purchase	Bolton	3280-8M-20 Optibelt OMEGA HTD Tim

# Purchasing Plan Percentages

Purchased

$$\frac{153 \text{ items}}{189 \text{ items}} = 82\%$$

On-Hand

$$\frac{123 \text{ items}}{189 \text{ items}} = 65\%$$

# Manufacturing Plan - ECVT

ECVT				
Primary mobile sheave	Henry	50%	1/23/24	2/16/24
Primary fixed sheave	Henry	100%	1/22/24	2/5/24
Secondary mobile sheave	Henry	95%	1/31/24	2/7/24
Secondary fixed sheave	Henry	100%	1/22/24	2/5/24
CVT standoffs	Henry	10%	2/5/24	2/22/24
CVT outside partial standoff	Henry	0%	2/6/24	2/20/24
CVT inside partial standoff	Henry	0%	2/6/24	2/21/24
Control motor pulley	Henry	90%	1/25/24	2/22/24
Primary shaft	Henry	10%	2/5/24	2/22/24
Secondary shaft	Henry	100%	1/22/24	2/5/24
Secondary cam	Henry	85%	1/28/24	2/8/24
Secondary cam mount plate	Henry	100%	1/22/24	2/5/24
Backplate	Henry	50%	1/30/24	2/12/24
Frontplate	Henry	50%	1/31/24	2/13/24
Motor mount plate	Henry	50%	1/29/24	2/14/24
Gearbox shaft support	Henry	100%	1/22/24	2/5/24
Anti-rotation forks	Henry	50%	1/30/24	2/12/24
Lead screw nut flange	Henry	100%	1/22/24	2/5/24

# Manufacturing Plan – Rear Gearbox

Rear Gearbox				
Casing (Passenger)	Henry	0%	1/30/24	2/14/24
Casing (Driver)	Ryan	100%	1/31/24	2/6/24
Gear 2	Donovan	5%	2/19/24	2/22/24
Gear 3	Donovan	25%	2/7/24	2/22/24
Gear 4	Donovan	5%	2/5/24	2/22/24
Gear 5	Donovan	25%	2/19/24	2/22/24
Input Shaft	Henry	0%	2/6/24	2/22/24
Intermediate Shaft	Henry	90%	1/23/24	2/22/24
Output Shaft	Henry	0%		

# Manufacturing Plan – Front Gearbox

Front Gearbox				
Casing (Passanger)	Henry	0%	2/12/24	2/22/24
Casing (Driver)	Henry	0%	2/12/24	2/22/24
Gear 2	Donovan	0%	2/12/24	2/22/24
Gear 3	Donovan	0%	2/12/24	2/22/24
Input Shaft	Henry	0%	2/12/24	2/22/24
Output Shaft	Henry	0%	2/12/24	2/22/24
CV Cups	Henry	0%	2/12/24	2/22/24

# Manufacturing Plan – 4WD System

4WD				
Clutch / Pulley	Donovan	0%	2/16/24	2/27/24
Driven Clutch	Donovan	0%	2/16/24	2/28/24
Front End Pulley	Donovan	0%	2/16/24	2/29/24
Clutch Casing	Henry	0%	2/16/24	3/1/24
Front End Casing	Henry	0%	2/16/24	3/1/24

# Project Demo (Cool Stuff)



Manufactured Drivetrain Components: Left (Right-Rear Gearbox Intermediate Shaft), Center (4340 Stock for Front and Rear Gears), Right Image (Rear Gearbox Passenger Casing and Bearings & Seals)

# Project Demo (Cool Stuff)



Manufactured CVT Components



# Project Demo (Cool Stuff)



Henry Operating the Lathe in the Machine Shop

# Gantt Chart Updates

SAE Baja

NAU Capstone Drivetrain

Project start: 1/22/24

Display week: 1

