



University  
of Idaho



## CSC REAR DRIVE

TEAM SKIDADDLE :

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-AREF HAKAMI

-THOMAS ENTWIT

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## PURPOSE/VALUE PROPOSITION



Modern Snowmobiles have a track which is turned/driven with cog-drivers in the front. This pushes the track, which being a flexible element, bunches up. This leads to both drivetrain and handling inefficiency. A solution is to pull the track, by having the drivers in the rear. Currently, there are no rear driven snowmobiles on the market as an OEM or Aftermarket platform.

At the SAE Clean Snowmobile Challenge (CSC) which the U of I CSC Team competes in every year, technical innovation is highly valued.

To meet both these challenges, the goal is to develop a rear driven snowmobile system that will be able to directly generate data to compare rear-driven and traditional drive technologies. Our team is proposing a swappable front to rear drive system for this year's CSC team and snowmobile. Our design seeks to have similar suspension design and performance, while being easy to swap with the stock configuration.

In Short:

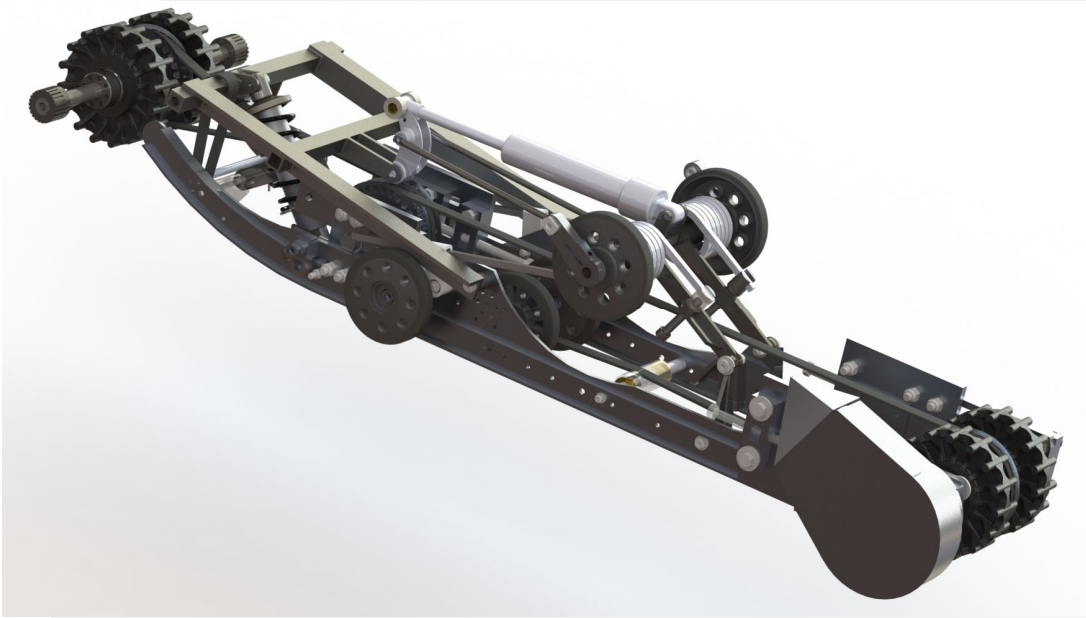
- The value to industry will be data showing the validity of rear drive vs. forward drive
- The value to the UICSC team will be an innovative project to bring to the 2020 CSC



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# FULL ASSEMBLY

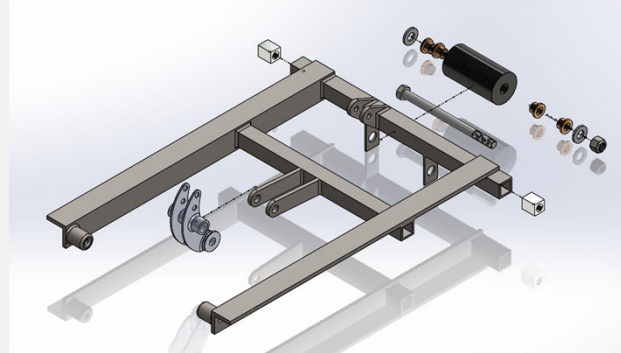
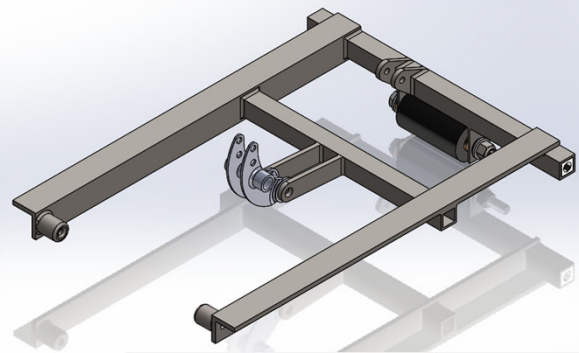


# CHOSEN DESIGN: MAJOR SUBASSEMBLIES





# FORWARD SUSPENSION

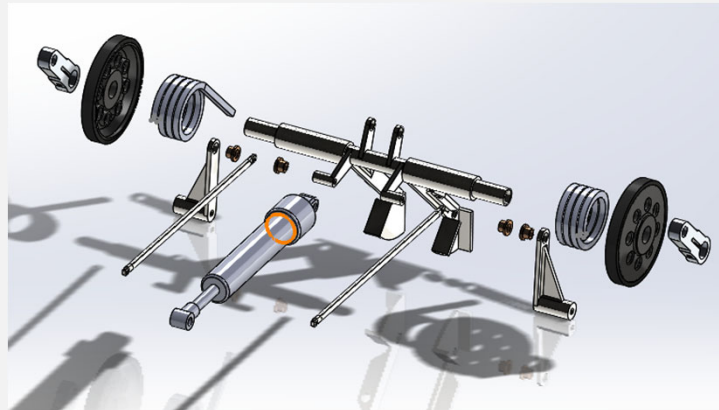
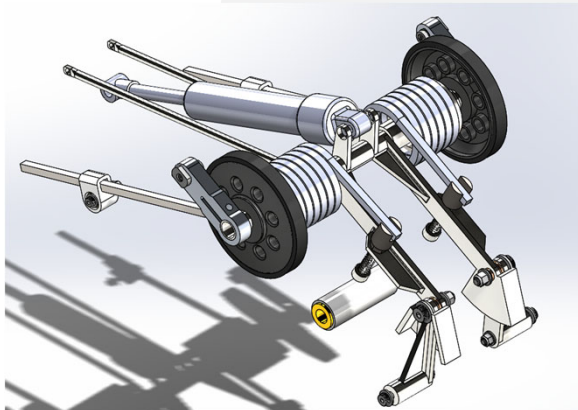


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# REAR SUSPENSION



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# POWERTRAIN/BELTS

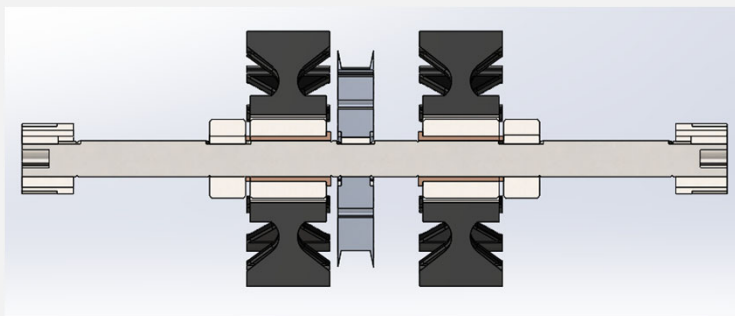
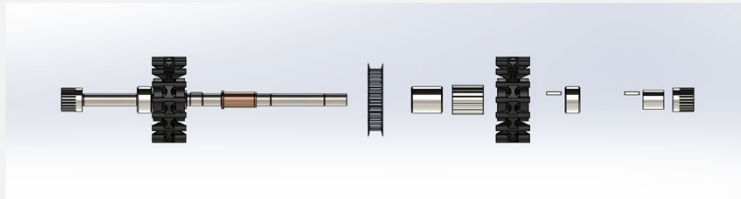
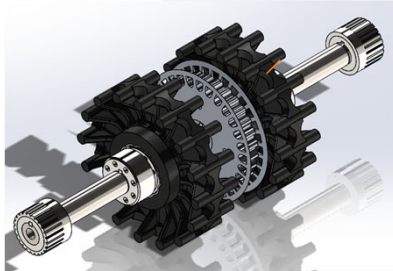


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# FORWARD AXLE

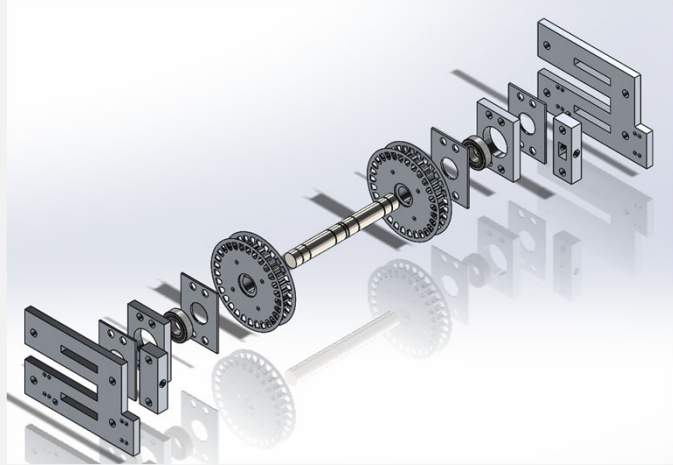
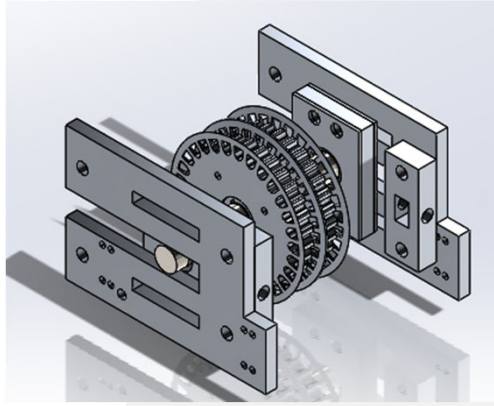


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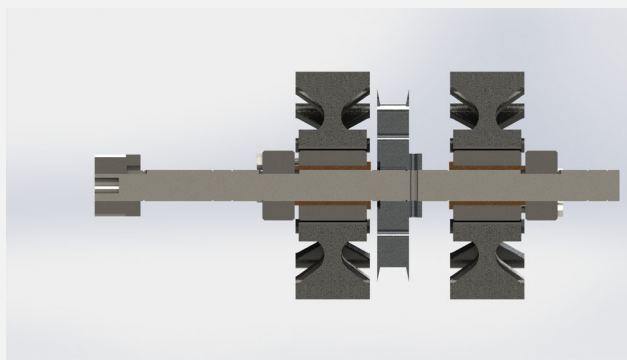
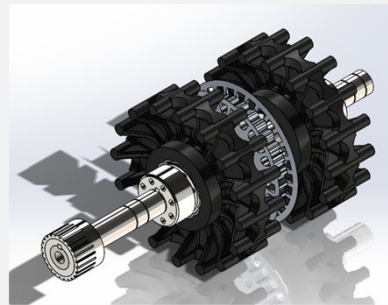
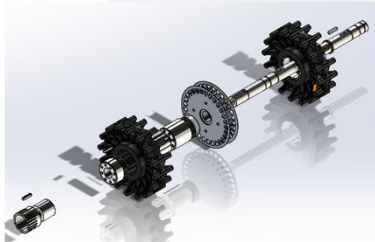
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# INTERMEDIATE AXLE



# REAR AXLE



# DYNAMIC BELT TENSIONER



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## MANUFACTURING - PLAN

**Material:** We purchased our material from a vast assortment of locations. Facilities was our main supplier for stock material. The University machine shop also has an inventory of material that is available for use by the clean snowmobile team.

**Machines:** CNC Mill, CNC Lathe, Manual Mill, Manual Lathe, MIG Welder, TIG Welder, Band Saw, Drill Press

**Specialty Tooling:** Broach Set

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**Water Jet:** A large majority of our flat plate welded components was cut using the SEL donated machinist time and equipment.

**Paint:** In the past the team has had parts powder coated by Custom Coat in Lewiston for free. However, if we are not able to get our parts powder coated for free we have the means to paint parts using the paint booth in the SMERF.

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**Welding:** A combination of MIG and TIG will be done by Brannon H. under the supervision and guidance of Bill. Certain parts will need a manufactured Jig for alignment and locating during welding.

**Machining:** A combination of Manual and CNC machining will be used. Depending on machine availability and complexity of the parts will determine whether there are made on a manual or CNC machine. We will require soft jaws, clamps and other fixturing to set up parts to run in the mills. Omar Ruiz will be the primary CNC programmer. All team members will participate in machining parts under the supervision of Bill.

**Assembly:** The assembly processes will be conducted in the HEV.

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# MANUFACTURING UPDATE



Part Name	Lead	Target Completion Date
Belt Cog Pully's	Brannon	3/6
Rear Susp. Arm (welded)	Thomas	2/19
Front Susp. Arm (welded)	Thomas	3/6
Front Belt Tensioner	Brannon	3/6
Forward Drive Axle	Brannon	3/6
Intermediate Axle	Brannon	3/6
Tensioner Circular Cases	Brannon	3/6
Spline Shaft Inserts	Brannon	3/6
Rear Axle Sprocket Hub	Brannon	3/6
Tensioner Blocks	Brannon	3/6
Front Susp. Tunnel Plug	Brannon	3/6
Front Susp. Runner Spacer	Brannon	3/6
Rear Brake Line	Thomas	3/6



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# BUDGET UPDATE



Supplies/Parts	Supplier	Total Cost	Purchased/Needed
½" Sheet Aluminum	Facilities	\$ 696.99	Purchased
Angle Iron	Facilities	\$ 126.54	Purchased
Steel 4140	Facilities	\$ 23.98	Purchased
Belts (4)	Denniskirk	\$ 835.00	Purchased
Silent Drive Axles (2)	Valley Powersports	\$ 594.00	Purchased
Ski-doo Runners (2)	Valley Powersports	\$ 620.00	Purchased
Hardware Order	McMaster-Carr	\$ 281.39	Purchased
Hardware Order	Bolt Depot	\$ 192.53	Purchased
Brake Line Parts	Amazon	\$ 218.98	Needed
5" Round Stock W: 1ft	Metals Depot	\$ 171.56	Needed
Bronze Bushings	Moscow Building Supply	\$ 20.00	Needed
TOTAL COSTS (ESTIMATED AND FINALS)		<b>\$ 3,780.97</b>	Budget (\$ 3,750)



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# VALIDATION PLAN:

- TESTING PLAN
- DATA ANALYSIS
- SAFETY CONCERNS/PROCEDURES



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# TESTING PLAN (BRAKING)

- **Measurements:** *Distance and Time*
- **Tools:** *Measuring Tape, Marker Flags, Stopwatch*
- **Procedure:**
  - *Mark a 6' wide gate, with marker flags*
  - *Have the snowmobile configured in a drive mode*
  - *Have the snowmobile a distance away from the gate, accelerate to a constant speed of 30 mph, in the direction of the gate*
  - *When reached the gate, start recording time (from 0) and apply brake until vehicle stops.*
  - *End recording time at the moment the vehicle stops*
  - *Measure distance from gate to resting position of the end of the track*
  - *Record the values of distance and time for each run, along with notes of snow and weather conditions.*
  - *Repeat steps 3-7, 4 more times(5 total tests per drive mode)*
  - *Start at step 2, with the snowmobile in different drive mode, and repeat steps 3-7 until all drive modes have been tested*
- **What does this tell us about our Design? – Overall Machine Braking Performance**



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## TESTING PLAN (J2263 COAST DOWN)



- **Measurements:** *Distance and Time*
- **Tools:** *Measuring Tape, Marker Flags, Stopwatch*
- **Procedure:**
  - *Mark a 6' wide gate, with marker flags*
  - *Have the snowmobile configured in a drive mode*
  - *Have the snowmobile a distance away from the gate, accelerate to a constant speed of 30 mph, in the direction of the gate*
  - *When reached the gate, start recording time (from 0) and coast until vehicle stops.*
  - *End recording time at the moment the vehicle stops*
  - *Measure distance from gate to resting position of the end of the track*
  - *Record the values of distance and time for each run, along with notes of snow and weather conditions.*
  - *Repeat steps 3-7, 4 more times(5 total tests per drive mode)*
  - *Start at step 2, with the snowmobile in different drive mode, and repeat steps 3-7 until all drive modes have been tested*
- **What does this tell us about our Design? – Overall Drivetrain Efficiency**



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## TESTING PLAN (ACCELERATION)



- **Measurements:** *Time*
- **Tools:** *Measuring Tape, Marker Flags, Stopwatch*
- **Procedure:**
  - *Mark two gates, 6' wide and 500' apart.*
  - *Have the snowmobile configured in a drive mode*
  - *Have the snowmobile with the front of the skis at start of one gate, and in the direction of the other.*
  - *Start Accelerating at max throttle, and start recording time (from 0)*
  - *Stop recording time, and stop accelerating when the snowmobile reaches the second gate.*
  - *Record the value of time for each run, along with notes of snow and weather conditions.*
  - *Repeat steps 3-6, 4 more times(5 total tests per drive mode)*
  - *Start at step 2, with the snowmobile in different drive mode, and repeat steps 3-7 until all drive modes have been tested*
- **What does this tell us about our Design? – Overall acceleration performance from a complete stop.**



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## TESTING PLAN (FUEL ECONOMY)



- **Measurements:** *Distance and Fuel Consumption*
- **Tools:** *Gas Cans, Scale*
- **Procedure:**
  - *Weigh gas cans, record weight measurements*
  - *Fill gas cans, recording the filled weights and fluid volumes (from pump)*
  - *Fill snowmobile gas tank to a repeatable level (such as the top of the fill spout)*
  - *Ride snowmobile at 45 mph average for a distance (recorded by odometer) of 50 miles*
  - *At end of ride, stop snowmobile, turn off engine, and fill gas tank to the original level*
  - *Record weight of gasoline required to fill tank.*
  - *Repeat steps 4-6 as needed for data*
- **What does this tell us about our Design?** – *Overall machine fuel efficiency compared to stock snowmobile driver arrangement.*



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## RISK MANAGEMENT



- **Project Risks**
  - Manufacturing
    - Fabrication
    - Delay of Deliverable Risk
  - Testing
    - Rider Risk
    - Vehicle Damage Risk
- **Mitigation**
  - Risk Waivers
  - Training
  - Wearing proper P.P.E.



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