

Clean Snowmobile Challenge Team

Rear Drive

Main Sponsors:



IDAHO
CSC



Powder Train Team Members:



Aaron Patterson



Zoltan Kiss



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College of Engineering

University of Idaho



Project Goal:

To develop a rear axle drive system for snowmobiles that can be installed on a stock chassis without modification to the chassis. The primary purpose of this rear drive system is to improve efficiency in the snowmobile drive train and improve fuel economy.

Client Requirements:

- Meet competition rules
- No chassis modification
- Testable using a chassis dyno
- No significant weight increase
- As many OEM parts used as possible



Past Projects and Research

RND Innovators



- Only Marketed Rear Drive System
- Shorter Stopping Distance
- Increased Efficiency
- Improved Handling
- Extensive Chassis Modification
- Exclusive Parts

Udaho Team RearMotion(2012)

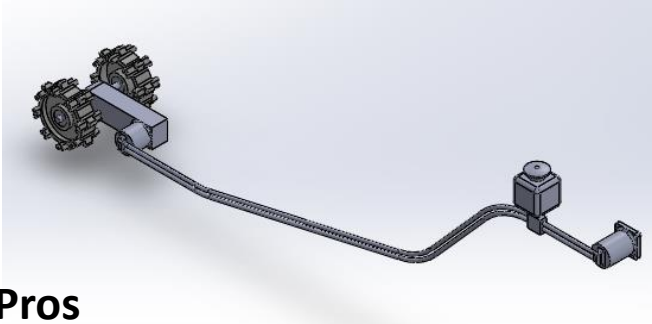


- Proof of Concept
- Increased Efficiency
- Improved Handling
- Heavier than stock (98lbs vs 59lbs)
- Suspension Issues
- Reliability Issues



Design Selection

Option 1: Hydrostatic Drive



Pros

- No limit to gear ratios available
- Constant maximum torque available
- Can use stock suspension
- Unique

Cons

- Expensive
- Very heavy
- No real hydrostatic knowledge

Option 2: Drive Shaft



Pros

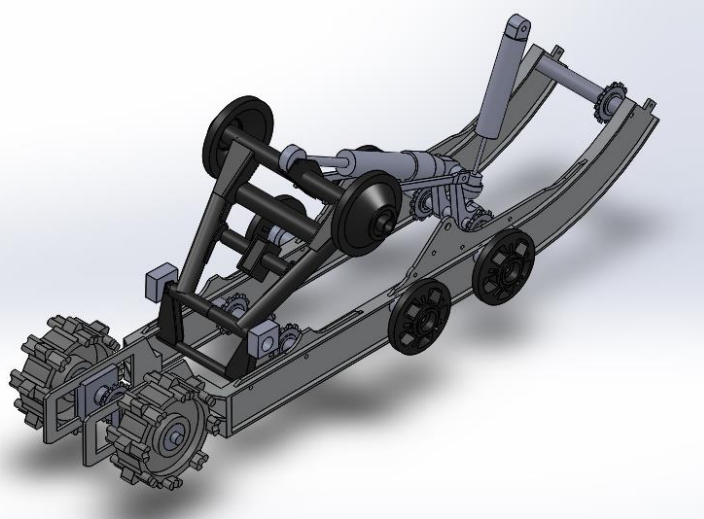
- Bolt in design
- Very strong
- Center of mass in ideal location
- Simple manufacture

Cons

- U-joint angle problems
- Heavier than stock
- Suspension modification required
- Not many off-the-shelf parts



Option 3: Chain Drive



Pros

- Minimum weight gain
- Stock Suspension
- Cost effective/off-the-shelf parts
- Wide range of gearing

Cons

- Use of custom rails
- Multiple chains increase complexity

Decision Matrix

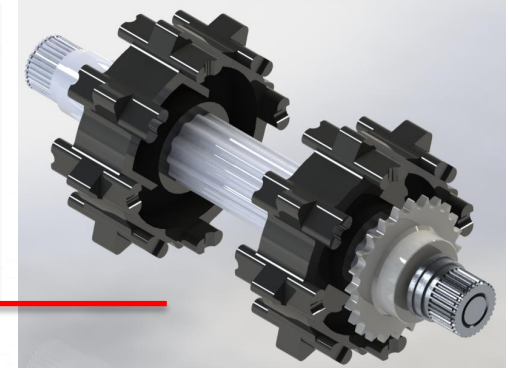
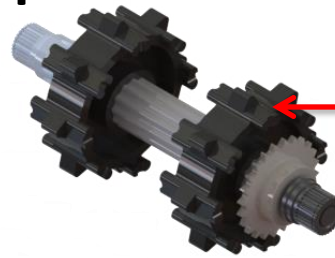
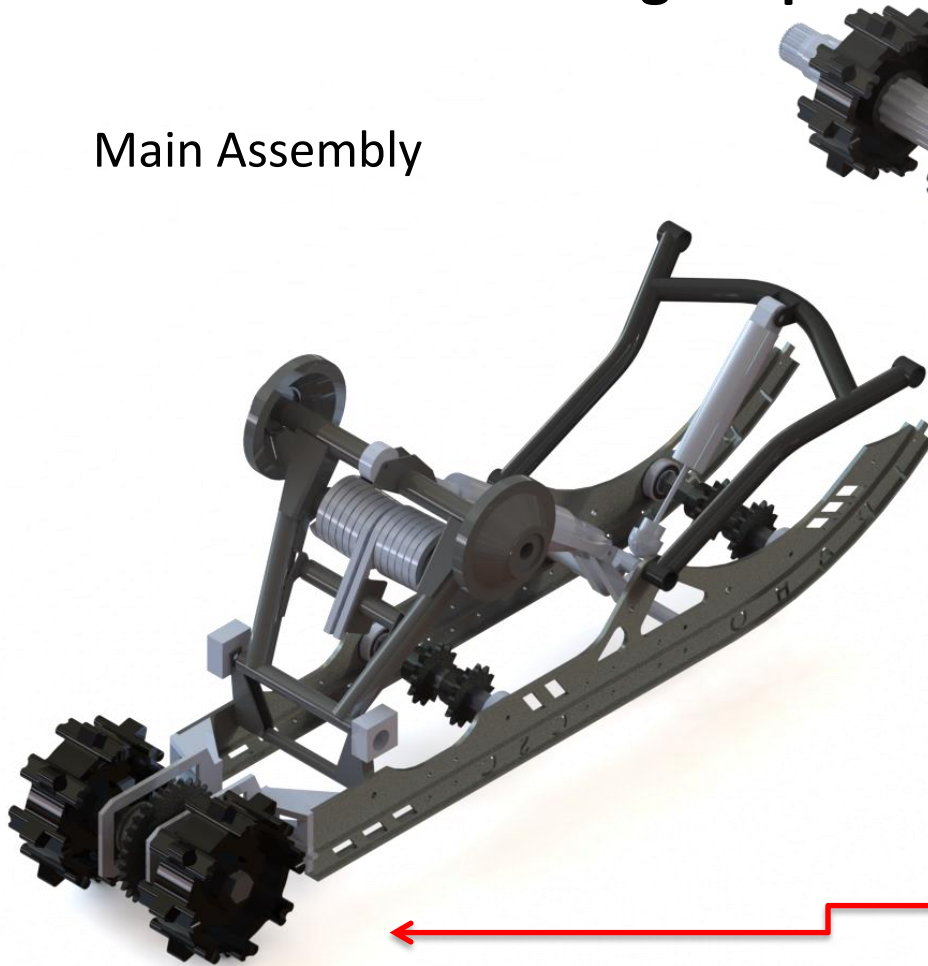
	Weight						
	3	3	5	3	2	3	
	Use Stock Suspension	Weight	Snow Pack	Drive Efficiency	Simplicity	Cost	Total
Hydro-Static Drive	2	1	2	1	1	1	27
Drive Line	0	1	1	1	0	0	11
Belt	1	2	0	1	2	1	19
Chain	1	1	1	1	2	2	24

Note: Feasibility Chart used to determine final design decisions. Design headings were determined using the design requirements outlined in the problem statement.

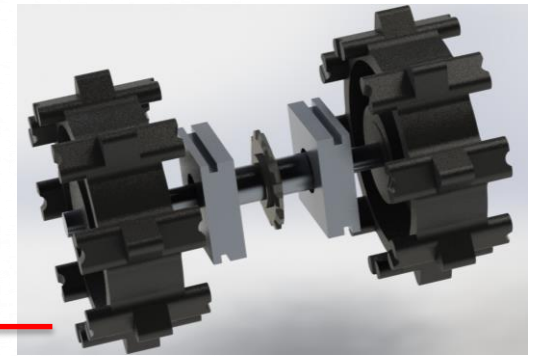


Chosen Design: Option 3 Chain Drive System

Main Assembly



Front Driveshaft



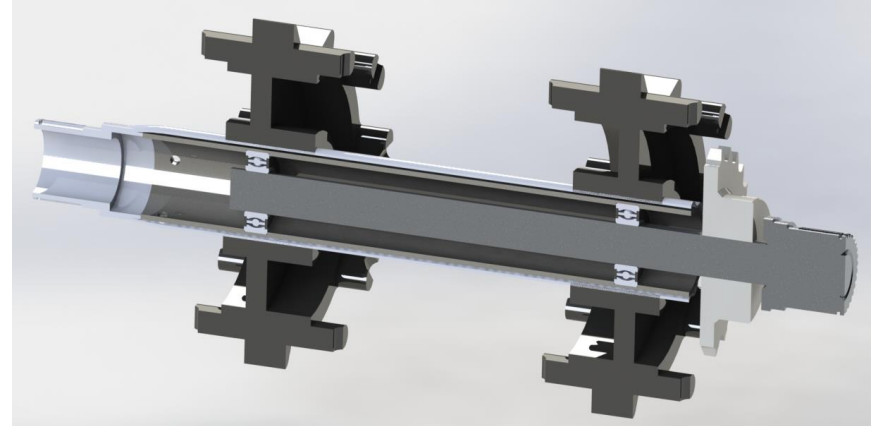
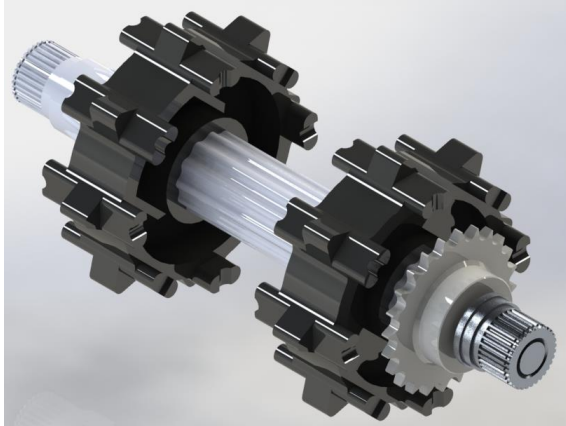
Rear Drivers

- Feasible and simple design with the most off-the-shelf parts and potential



Chain Drive Main Components

Front Axle



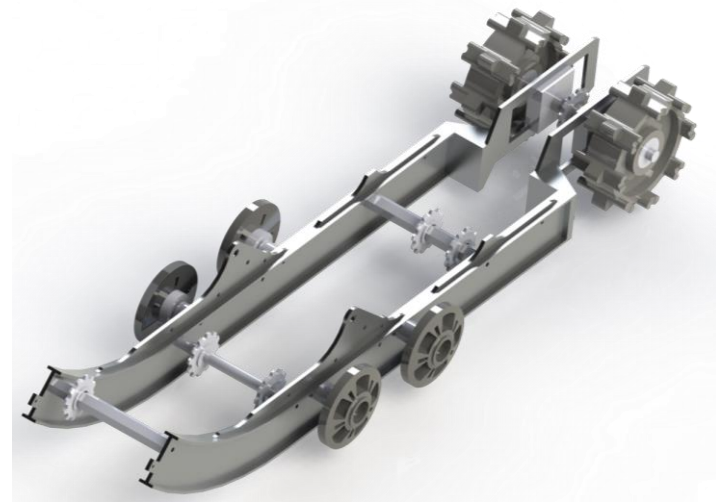
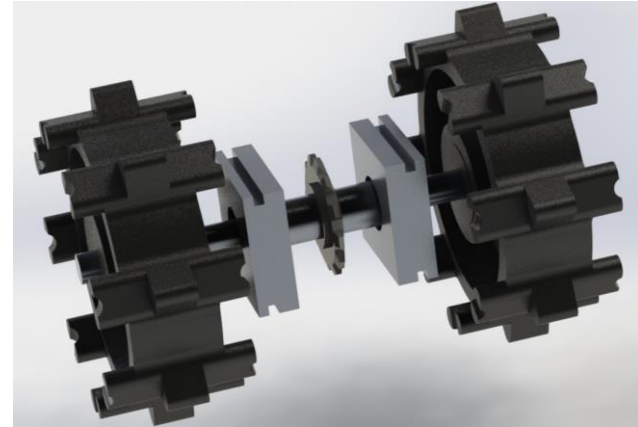
- 2 shafts spin independently:
 - Inner shaft transmits power via chain from the engine to the rear drivers.
 - Outer shaft connects with track via the stock drivers allowing the use of the stock brake.
- Gear ratio throughout allows 1-to-1 gearing but can be changed based on sprocket sizes.



Chain Drive Main Components

Main Assembly with Rear Driver/Rails

- 3 Intermediate shafts allow chain travel through the stock suspension to final rear shaft with the drivers
- Compact design with brake mounted in the front stock location allows a narrower stance and better center of gravity
- All off-the-shelf parts bolted into place
- No chassis modification needed
 - Stock system can be re-installed easily

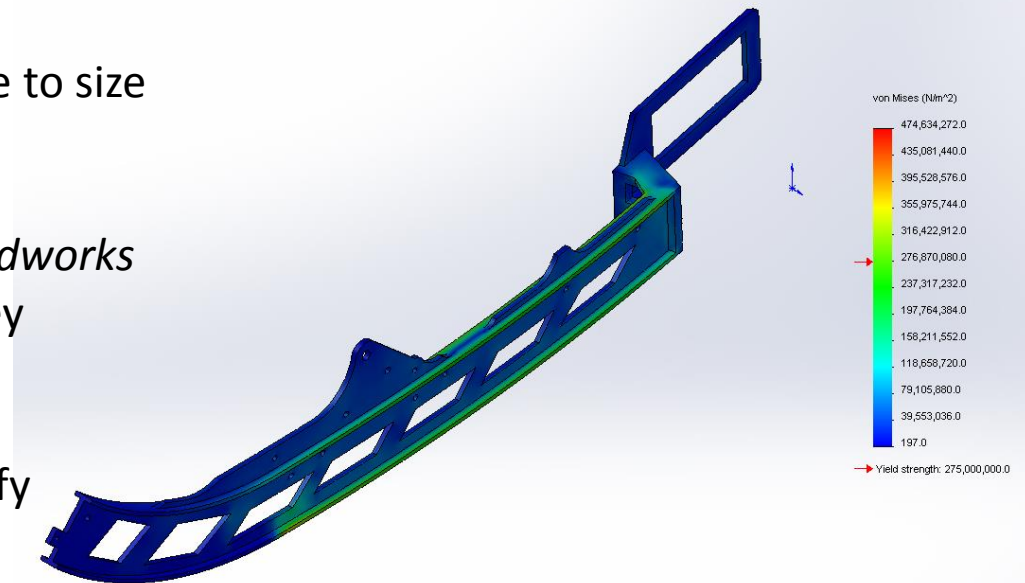


System Analysis

Name	Type	Min	Max
Stress	VON: von Mises Stress	197.037 N/m ² Node: 803	4.74634e+008 N/m ² Node: 15715

Josh Left Skid Modified CD ANALYSIS-SimulationXpress Study-Stress-Stress

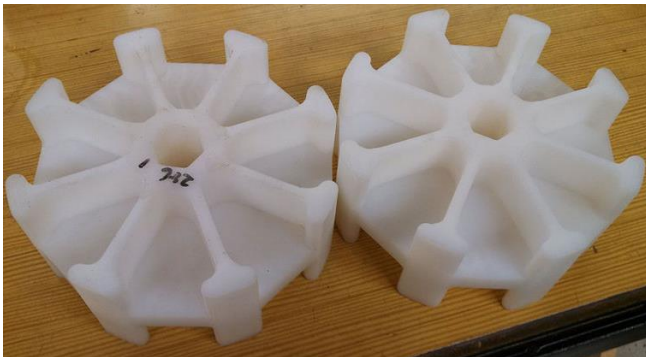
- Drive train torque analysis was done to size shafts/sprockets correctly
- FEA analysis completed through *Solidworks* to test strength of Rails and other key components
- DFMEA analysis completed to identify critical components before final design and manufacture.
- Proven stock components used as often as possible.



Manufacturing



- The rails had to be custom made to fit the sprockets: Donated by *Ice Age Performance*
 - Chain travels over and under the suspension mounts so needed taller rails



- The Driver wheels were donated by *Avid* and
 - Made to fit a Hex-shaped shaft (strength)

Special thanks to: ***Avid-Products***
College of Engineering



University of Idaho



Manufacturing



- Most hardware was purchased and easily assembled
- Almost all machine work was done on the mill and lathes found in the University of Idaho's machine shop
- Hex shaft was used for strength and machined to fit common sized bearings



Problems

- Outsourced rails have not arrived limiting ability to produce other parts
- Still waiting on some materials
- Splines take a long time to cut and special tools
 - Stock spline information took a long time to get from manufacturer



Future Work

- Modify rails and build adapters to fit intermediate shafts
- Cut splines and finish manufacture of all other parts and assemble rear drive
- Test the drive train efficiency vs the stock system on the dyno
- Test handling/efficiency/durability in a real world application



Electric Motor Mount Built for Dyno Testing



Questions?

