

“NorTrackTor”

Open Source Cold Climate Tractor

Project Report

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1. Vision and Objectives

To refine the design and prototype an open source cold climate tractor the *NorTrackTor*. This prototype tractor will be used to assess the potential for open source designs to provide cost effective solutions for northern agricultural needs and provide platform upon which future developments of northern farming technologies can be researched, innovated and commercialized.

2. Background

Open source hardware is a developing trend in product design and manufacture in which the entire design, prototyping, and fabrication process is collaboratively shared over the internet. Good documentation and open source licensing are the two stalwart aspects of an open source hardware project, but common themes include affordability, modularity, and universality of parts. Such projects have shown to reduce both up-front and maintenance costs, advantages that are potentially magnified in Northern and remote product use locations.

3. Project scope

Open Source Ecology is a US based not for profit that is bringing open source development to the agricultural industry. Their mission is to facilitate the design and development of open source, modular, DIY, low-cost, high-performance agricultural machines that can be made at a fraction of commercial costs. The designs of these machines are shared online for free to accelerate further design innovation, customization and refinement. The Open Source Ecology tractor design was the basis for the NorTrakTor. The design was analyzed and tweaked before fabrication for further appropriateness to potential uses in Yukon agricultural sectors.

4. Current market

Yukon Agriculture Association and Yukon Growers of Organic food have both identified the price of farm equipment as a barrier to market entry.

5. Future Benefits

Increase profitability:

Open source innovation has already been demonstrated effective at breaking down cost barriers across a variety of industries. Open Source Ecology's tractor design can be constructed for under \$10,000US compared to over \$40,000US for a John Deere 5075M utility tractor of comparable size and power. The price of the NorTracktor was higher in the Yukon due to the additional transportation costs of materials, but the lower cost of maintenance is expected to be reciprocally more beneficial due to similar factors.

Enhancing skills:

As of the end of this project the NorTracktor will be tested at the Tr'ondëk Hwëch'in and Yukon College teaching farm in Dawson before being donated to Yukonstruct where it will be available for use as a platform for further agricultural machine innovations. Yukonstruct will also use the tractor as a platform to run community workshops focused on developing manufacturing and repair skills.

6. Build Report

The Fabrication process for the tractor went fairly much as expected, with our two main points of obstacles proving to be parts supply and adjusting the design to our own innovations.

Ajax steel was a great resource and service was very prompt, and we were able to find an importer (Unique Prospect Ventures), which made the import of most of the American parts much easier. We went with American supplied parts listed on the Open Source Ecology website, partly for replication purposes, but the hassle of importing and the added cost of recent exchange rates makes the sourcing of Canadian-sold hydraulic motors and valves a big desirable for any future builds.

The design settled on was used Open Source Ecology's Lifetrac IV with our own modifications for increased operator comfort and durability. The following outlines these modifications.

A. Welded frame:

Open source Ecology drills and bolts its frame together for parts re-use and fabrication ease, but we felt that durability and square of the frame would be better with welding, so the entire frame welded.



Fig 1. Frame being squared and welded.

B. Bent loader arms frame forward:

The center of gravity is slightly too far forward in the Open Source Ecology design, so we bent the forward frame and the loader arms, achieving a lower center of gravity and better lines of sight. We also shortened the wheel base to move the loader arm axel towards the back. The result is a smoother driving experience and increased loader capacity.



Fig. 2 Bent arms, frame, and shortened wheel base.

C. Re-designed wheel hubs:

Open Source Ecology's wheel hub and motor mount design resulted in coupler shearing and maintenance problems, so we re-designed the attachment hubs with 2 inch steel axels and chain-couplers attaching the motors, in order to mitigate the torque that was shearing Open Source Ecology's couplers. This seems to have fixed the problem, which is also partly remedied by the welded frame.

D. Motor Controls:

The driving experience of the Open Source Ecology design was bumpy and uncomfortable due to the position of the control panel and the layout of the controls, so we modified the design to mimic a bobcat's and ease operator strain. A joystick loader control and lowered control position drastically improves smoothness of operation, but the wheel control should be moved to pedals for further versatility.

7. Financials

The parts costs were pretty much 1/3 more than expected due to the increased American/Canadian exchange that developed after the design and sourcing stage. Costs could be reduced by sourcing from Canada and salvaging, but the time to do so was unavailable. The total project parts cost was \$16,053.94

Power Cube Steel	Ajax	\$222.30
Power Cube Engine	Small engine Suppliers	\$1,452.46
Power Cube Steel	Ajax	\$194.15
Tractor Frame Steel	Ajax	\$1,505.56
Cutting Lube	Ajax	\$26.24
Swivels	Ajax	\$156.67
Tools	Ajax	\$419.87
Jig Steel	Ajax	\$39.85
Tractor Component fittings	Surplus Center	\$6,477.85
Bucket and Motor Mount Steel	Ajax	810.01

Oil Cooler	Amazon	259
Steel	Ajax	171.44
Tools	Ajax	12.15
Oil Cooler Fan	Amazon	74.25
Tank fittings	Ajax	31.9
Welding Gas	Ajax	94.75
Power Cube Mount Steel	Ajax	26.87
Pipe	Ajax	16.14
Weldon Flange	Yukon Pump	10.48
Mounting hardware	Ajax	62.94
MIG Wire	Ajax	45.78
ffittings	Ajax	36.67
½" plate steel	Ajax	7.27

Steel	Ajax	\$322.30
Hardware & Fittings	Ajax	72.26
Lovejoys	Quality Bearing	216.41
Hex Bits & Adaptors	Ajax	124.12
Hydraulic Fittings	Ajax	65.47
Hydraulic Fittings	Ajax	84.42
Hydraulic hose	Ajax	261.18
Hydraulic connectors	Ajax	115.46
Hydraulic lubricant	Ajax	96.09
Hydraulic o-rings	Ajax	21.29
Hydraulic threading	Ajax	118.07
Hydraulic Oil	Ajax	187.06

Tractor Arm Steel	Ajax	530.43
Tires and rims	Quality tires	\$600.00
tools	HH, territorial	\$70.72
ajax steel plow	ajax	325.01
nuts bolts	ajax	63.74
fittings	ajax	19.15
hydraulic hose	ajax	226.13
holes cut lumps	mobile maintenaince	262.01
welding gas	jacobs	118.02

TOTAL: \$16, 053.94

8. Conclusion

All in all the build went well, with minimal technical questions. We will have to suggest to Open Source Ecology that the currently suggested design components be consolidated, as the documentation is scattered between the ~7 Lifetrac versions. Other than that our main frustration was that of any building project in Yukon: parts supply. However, now that it is built, it is quite easy to work on, and parts should be easy. The true test of efficiency for the Open Source approach will come with the following season of consumer testing and maintenance at the Trondek/Yukon College Experimental Farm. Delivery and basic training is scheduled for early June.