Conceptual Design for Converting a Vintage Tractor to a Safe, Functional Electric Tractor

THE STUDENT FARM
AGRICULTURAL SUSTAINABILITY
INSTITUE AT UCDAVIS

UC Davis SHCS

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Tractors are too loud to teach students!

Where: UC Davis Student Experimental Farm

POC: Jim Muck, Field Operations Coordinator

For converting 1950's Allis Chalmers model G **gasoline** tractor on the Student Experimental Farm to **electric** *(15-20 hp, 4 hours per charge)* we did:

- Conceptual Design
- Grant Writing

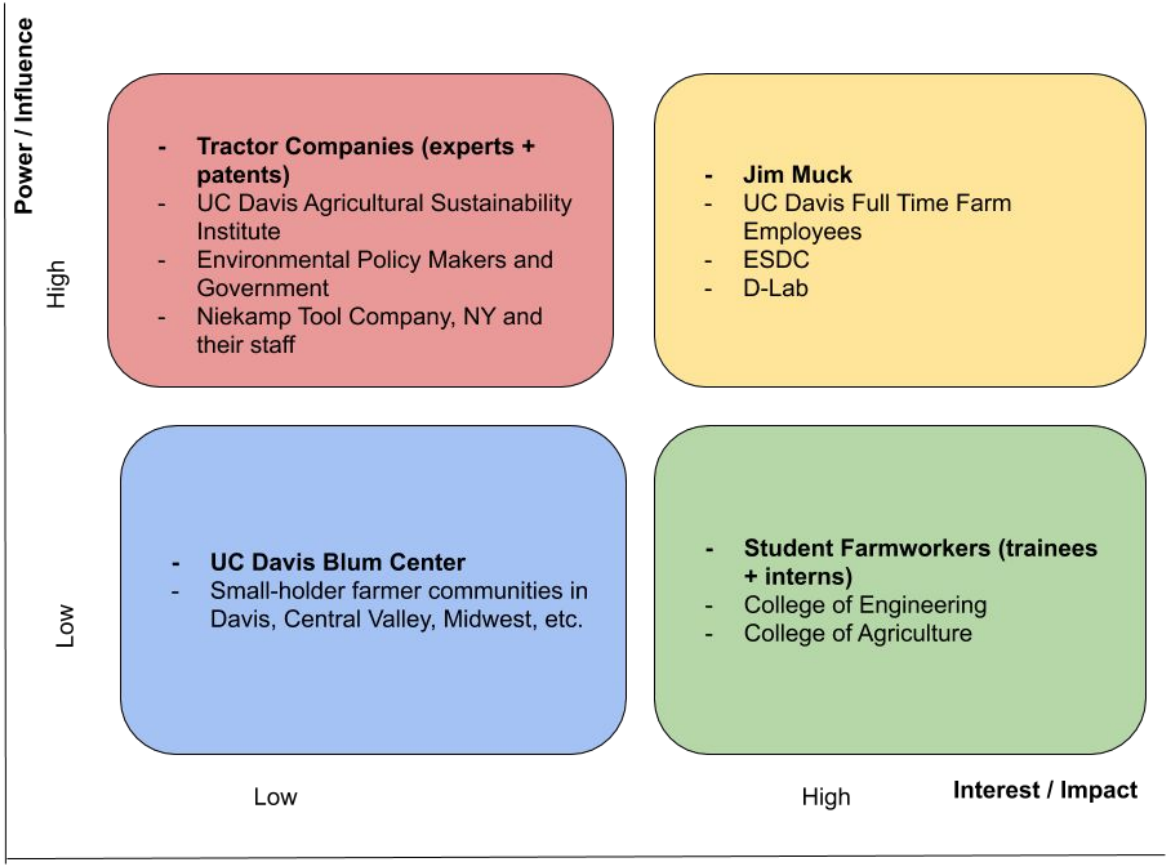
D-lab team goes tractor training!

Methodology

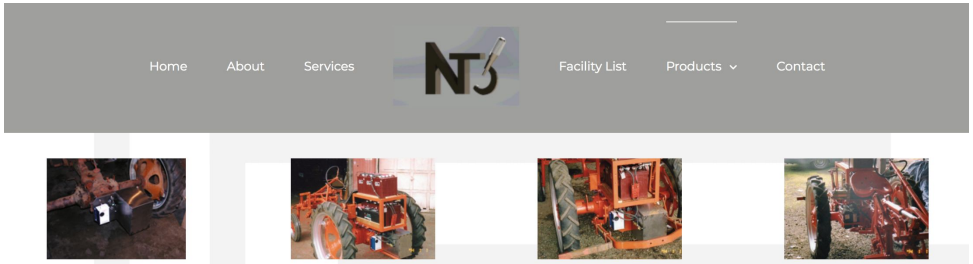
Conceptual Design

- **Tractor Conversion Kit**
- **Battery**
- **Occupational Health**

Stakeholder Analysis



Niekamp Contact



Niekamp Tool Company in Kingston, New York, is excited to share with you the unique and innovative Electric G Tractor.

Electric G Conversion Kit

Parts List / Packing Slip

Item #	Part Name	Description	Part # for Vendor	Quantity
1	Bell Housing Plate	Adapter Plate to mount Motor and pulley assembly	BHP 0501	1
2*	Motor Plate	Plate to mount Motor and allow adjustment of belt.	MMP 0502	1
3	Motor Bolts	Special Undercut Head 3/8-16 x 3/4" Socket Head Cap Screws	91274A300	4
4	Motor Cover	Cover to protect Motor from weather and debris as well as backing into things.	BATT CVR	1
5*	Motor Cover Mount	Provides for Attachment of Motor Cover to Motor Plate	MCM 0503	2
6	Motor Pulley	16 Tooth 1.5 wide Pulley with 1008 taper lock bore	P16H150-1008	1
7	Motor Pulley Bushing	1008 taper lock bushing with 7/8 bore	TLB 1008 .875	1
8*	Ball Bearing	6007 Double Sealed Radial Ball Type	NAC 6007-2NSE	2
9*	Needle Bearing	Provides Support for Pilot Shaft	TOR JH-1112	1
10	Belt	240 Tooth H series Belt 1.50 Inch Wide	240H150	1
11*	Output Pulley	32 Tooth Pulley Custom Machined inside to fit Clutch Drive and Bearing Unit	P32H200-2517	1

The belts seem to last nearly forever...I've heard of one replaced. There are kits as old as 14
Most I've seen that remarked of any problem related to battery life and usage. Running batte
batteries. The farmers I heard most from even charged a bit at lunch time.
Hope this is useful.
HN

Battery

	Lithium Ion	Lead Acid Battery
Cost	$5,000 - $15,000	**$500 - $3,000**
Capacity	**High energy density (discharge more energy)**	Low energy density
Depth of Discharge	**80%**	50%
Efficiency	**~95% efficient (charge faster/more solar power can be stored)**	~80-85%
Lifespan	**Several lifespans**	One lifespan
Maintenance	**Little to no maintenance**	Requires maintenance
weight	~400 lbs.	**~1,000 lbs.**
Charge Rate	**Fast**	Not so fast
LCA	75-80% of material recyclable Incineration of waste generates electricity and produces a lot of emissions	80% material is recycled for other batteries Easy to recycle Very toxic

Considerations/ Options	Noise (Wt - 3)	Emissions (Wt - 3)	Training Experience (Wt - 3)	Transferrable Skils (Wt - 2)	Ease of Maintenace (Wt - 2)	Waste Disposal (Wt - 2)	Start -Up Cost (Wt - 1)	Total
Solar and Rechargeability	3+	3+	0	0	1-	2-	1-	2+
Gasoline Tractor	3-	3-	3-	2+	2+	2-	0	7-
Hybrid Tractor: Gasoline and Electric	3+	0	3+	2+	3-	2-	2-	1+
Biofuel	3-	3-	3-	2+	2+	2-	1-	8-

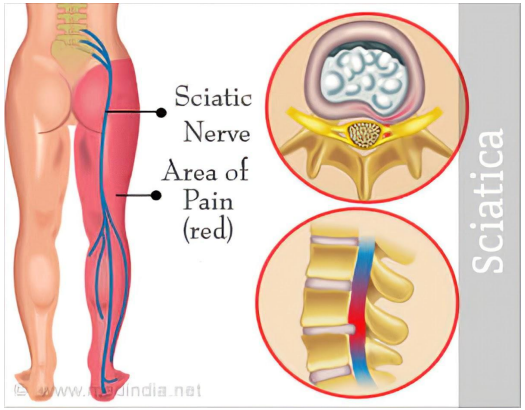
Q:

Solar Rechargeability vs. Hybrid Electric Tractor?

Occupational/ Environmental Health & Safety

- ➔ Student Training Experience
- ➔ Occupational Health
- ➔ Policy ID

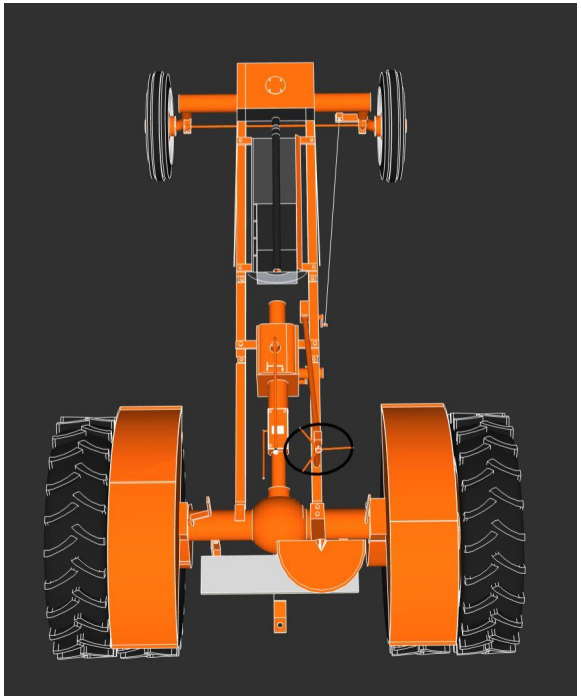
Rollover Protection System (ROPS)
Source:
https://blogs.cdc.gov/niosh-science-blog/2013/04/30/crops/

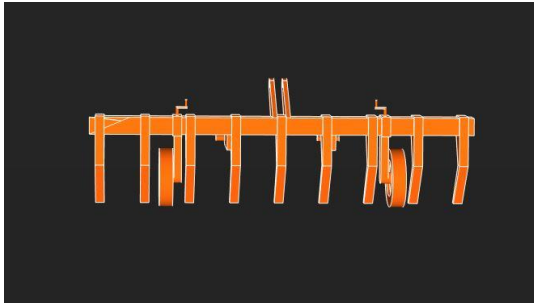


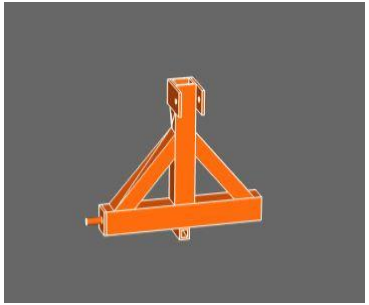
Sciatica (compression of spinal nerves in lower back)
Source: *https://www.medindia.net/patients/patientinfo/sciatica.htm*

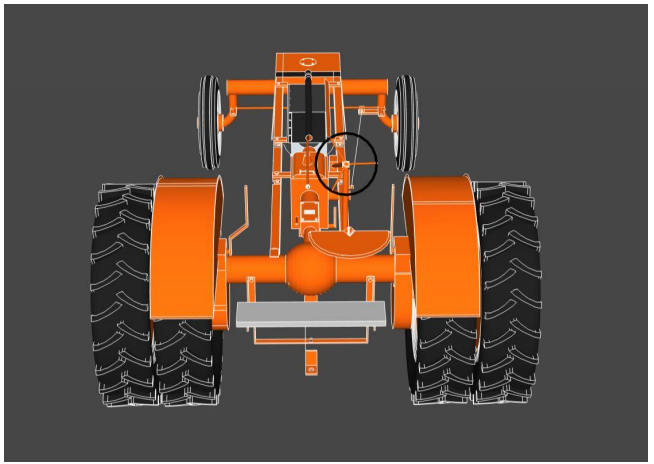
(Seifi et al., 2016)

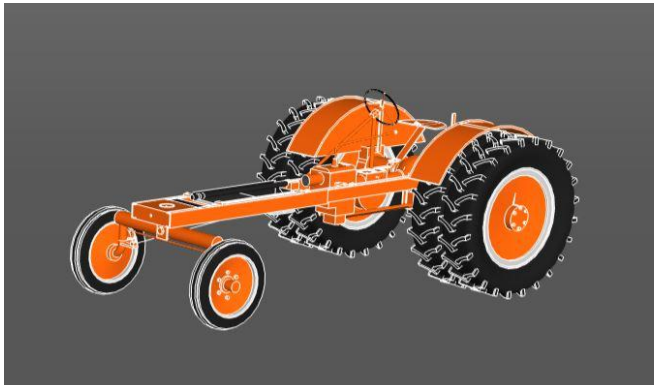
Components



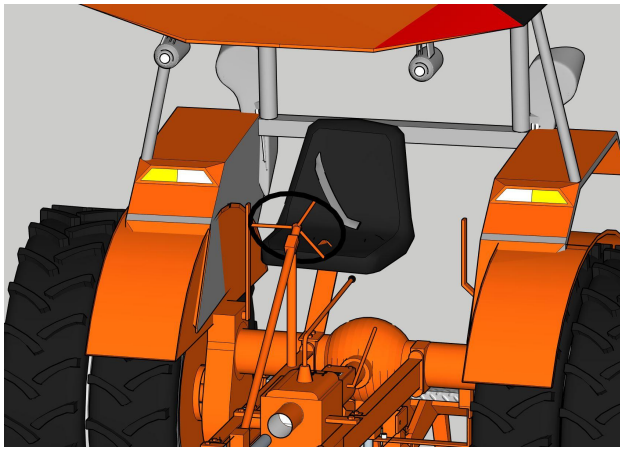








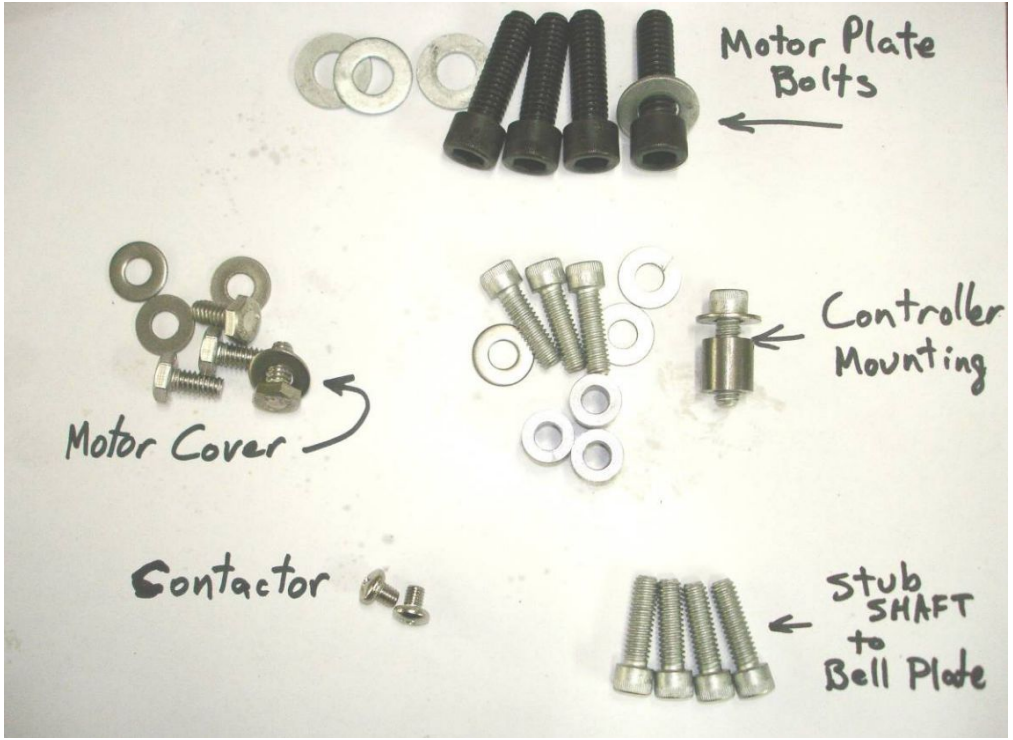
Tractor Model



SWOT Analysis

	Electric Tractor	Gasoline Tractor
Strengths	❖ Has already been converted! ❖ Access to D-lab	Students have worked/train on it
Weakness	Students limited to our electric tractor once trained; need to be well versed in shifting gears	❖ Can impair hearing - long term + during training ❖ Inhaling particulate matter

D-Lab I Deliverables



Recommendations for D-lab 2

Refurbish Tractor

-Strip components we don't need and build **blueprint**

Component Check

-Engine in the front while retaining hydraulics

-ROPS, seatbelts, **safety** mechanisms

Wiring solar panels + Selection of batteries

-Location and installation of **charging** station

Get the design!

-Icon of **sustainability** on campus

-Design **competition**

Winters' Tractor Parade 2020!

Bibliography

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SketchUp Components:----------

QUESTIONS?