An Electric Two-Wheel Tractor for empowering small-scale farmers in developing regions and economies
Global Trends and the Future of Agriculture

- **Increasing Agricultural Demand**: population growth; rising affluence; conversion of food crops to biofuels.
- **Increasing Production Challenges**: extreme soil erosion; increasing water shortages; rising global temperatures; extreme weather events.
- Production yields in the developed world have started to plateau; in some countries have even started to decline.

Background

Master’s Thesis Project

To improve the future of agriculture for small scale farmers in developing regions and economies.

Context

Predictions for the world in 2050 show us facing the critical issue of “the Forthcoming Global Crisis in Agriculture”.

Global Trends and the Future of Agriculture

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Focus and Research

Small Scale Agriculture

- Globally, over 500 million smallholder farmers, fishers, and agro-foresters supply food, fuel, and fibre to almost 2 billion of the poorest and most vulnerable people.¹
- Initial research showed Brazil having great potential for improvements in small scale agriculture.

Research Field Trip to Brazil

- 1 week long research trip with field visits and first hand observations with small scale farmers in rural São Paulo state.
- Planned through Bonsucro; organized in collaboration with WWF USA.

“...In most preindustrial economies, the food supply imperative causes almost the entire economy to be devoted to agriculture. Any improvement to farm productivity will have a huge impact on the wealth of the population...”²

¹ Smallholders must be part of the solution to the food crisis | Oxfam GB | Policy & Practice (2012).
² What if the tractor had never been invented? Pethokoukis, J. (2012).
Identifying a Product Design Opportunity

Failing, Learning, Correcting

- Visiting primarily sugarcane farms, and not real small scale farms meant not identifying a strong design problem.
- Sponsor feedback helped re-evaluate the project focus.
- Re-examining problems and observations so far quickly revealed a product design opportunity to focus on.

A Better Two-Wheel Tractor for Small-Scale Agriculture

- A prevalent tool with room for improvement; two-wheel tractors are a prime means of bettering productivity and quality of life for small scale farmers.
- No time or budget left for another field trip at this point.
- Analysis, understanding, and evaluation done through tutoring, research, 2nd hand experiences, group brainstorming, scenario mapping, user testing.
Connecting the Dots

Safety Concerns
- Traffic accidents associated with: braking; steering; nighttime visibility; driver experience level.
- Exposed moving components: flywheels, pulleys, safety shields being removed.

Ergonomic Issues
- RSI from vibrations of single cylinder engines.
- Noise exposure.
- Physical strength required to lift/tilt and operate the tractor.

Going Electric in Commercial Agriculture
- Developments in electric powered implements highlight their benefits.
- Hybrid and electric tractors are being developed and tested.

Countries Shifting to Electric
- Developing regions like South Asia show a strong drive to convert to electrical transportation.

Electricity and Development
- Increased implementation of micro-power generation in decentralized, remote locations in developing regions.
- Increased energy storage capacity could be a boon for residents.
Ideation
Further Sketch Explorations

Group Brainstorming
Sourced future Atlas Copco interns directing them in concept generation exercise.
Rough Mock-Up Testing & User Feedback
Final Design

Greater Flexibility/Adaptability
- Farmers adapt the tractor to their needs; rather than adjust to it's limitations.

Safer & More Inclusive
- Height adjustability for different needs.
- Easier and safer wheel changing.
- Reduced physical demands for operation, making it more inclusive for both genders.

Electric Power
- Electric motors reduce noise and vibrations.
- Hub motors place weight where it is needed and allow for skid-steer operation.
- Combined with micro-energy production (solar/wind), allows fuel independence and extra energy storage.
Wheel Changing & Bogies

- Many tractor wheels feature bolt-on split rims; allowing variability.
- Snap-on connectors are commonly used for tractor duals.
- Simple pump action hydraulic jacks are reliable for lifting heavy objects.

- Height adjustable bogies make wheel changing quicker and safer by lowering the tractor to the ground.
- Wheel hub motors detach quickly from rims.
- Changing to paddle wheels, or other options becomes easier.
Versatility and Adaptability

- Tractor frame with bolt-on points forms a platform for hacking.
- Adds functionality, flexibility, and adaptability.
Full Scale Model and Construction

Made possible with the skilful and talented help of 2 fellow students.