



ANIMAL DRAWN CARTS

3-16 April 2005
Rustenburg
North-West Province
Republic of South Africa

GROUP DYNAMICS

The Animal Drawn Carts group included:

- Industrial Design: professionals, educators and students
- A Mechanical Engineer
- An Architect
- And 5 donkey cart builders from Kuruman



RURAL TRANSPORT



Despite a wide spectrum of transport technologies, in rural areas much transport involves either walking or carrying. Rural people need intermediate means of transport that increase capacity & reduce human drudgery at an affordable cost.

SSATP World Bank Group

DESIGN PROCESS

Week One:

Research –

- Unpacked gathered data,
- Listened experts experience and advise,
- Interviewed villagers and Kuruman carters

Dissemination of information

Intellectual Conceptual work

Village feedback session

Setting Design Briefs

DESIGN PROCESS

Week Two:

Concept generation and discussions

(the Kuruman carters were used to assist in the understanding of concepts, technical feedback and direct input when trying out new concepts)

Village feedback session

Experts feedback sessions (ongoing in the second week)

Refinement of Concepts

Solution Generation

PROBLEM IDENTIFICATION

- Carts in use have not considered women and children
- There are few carts that are safe
- Very few carts have brakes
- The carts do not comply to any legislation
- Heavy carts and badly made harnesses are harsh on the animals
- The economics of introducing manufactured carts into this market have not been thoroughly considered

GROUP WORK

Three focus areas

- Harnesses and Hitching
- Low-capacity Carts
- High-capacity Carts

Each focus area was tasked to deal with the development of a specific design brief, the development of concepts and solutions, and testing of the solutions against users

The focus areas were also asked to consider the economic aspects related to how these systems could be implemented

BRIDLES, HARNESSING & HITCHING



Humane husbandry, handling, harnessing & use of working animals is the basis from which their power emanates and can be effectively used in a sustainable manner to the benefit of the owners, the animals & the community at large.

Morgane James , SPCA

HARNESSING AND HITCHING

PROBLEM STATEMENT

- Commercially available harness and hitching systems are currently too expensive
- Yoke Braking strains the animals neck
- Environment is tough on traditional harness materials
- Harness systems are often made by owner with minimum technology (cutting, sewing by hand, weaving wire)
- Good materials for home made harnesses are not readily available or are too expensive
- Social resistance to new harness systems (SPCA research experience)
- Loose and neglected harnesses cause problems
- Varying donkey sizes when attached to cart not accommodated by typical harness systems

HARNESSING AND HITCHING



DESIGN BRIEF

To offer improvements:

- Hitching system (from the donkey to the cart)
- Harnesses system (on the donkey)

Reasoning:

- Improve donkey welfare through good product design
- Optimise energy transfer between the donkey and cart
- To offer recommendations on best systems

HITCHING

Very difficult to develop hitching solutions:

- Social resistance to new harness systems
- Materials required to make decent systems are expensive
- Few craftsmen in village that can assist with such manufacture
- Good systems include a lot of components

Design solution

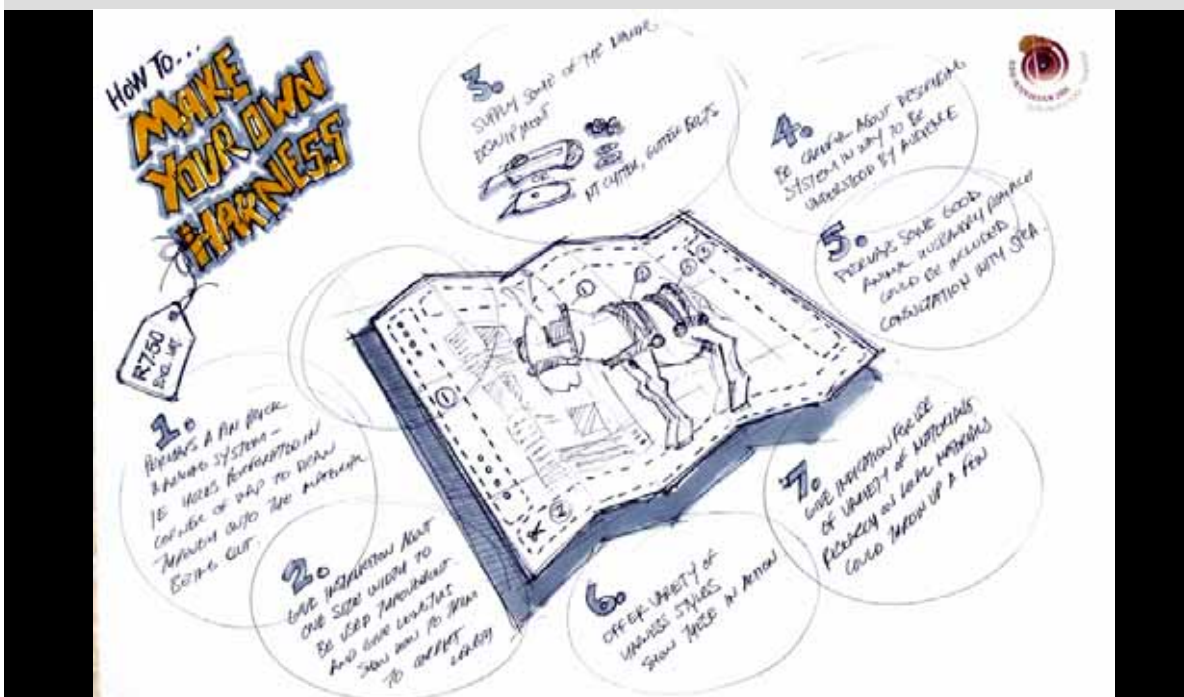
- Looked at best practice current system (Peta Jones)
- Looked at the yoke braking system
- Developed our own minimum component system that requires testing

HARNESS SOLUTION ONE: "MAKE YOUR OWN HARNESS SYSTEM"

Carters met during the Interdesign all repaired their own carts, and most made their own harness systems, therefore certain skills are already in place

System:

- Gives the cart owner an easy to follow pattern for making of a harnesses and bridles
- The guide would also have animal husbandry issues included and assist with animal care issue
- The system would be sensitive to regional material availability and try to work with materials from the carters' local area



HARNESS SOLUTION TWO:

“PRE-PUNCHED HARNESS SYSTEM”

Components:

- Bands manufactured from conveyer belt material
- Reflective paint on the bands (visibility at night for safety)
- Bits and rings manufactured from 8mm diameter mild steel rod

Booklet:

- DIY pictogram assembly instructions for harnessing donkeys
- Clear descriptions of best hitching and harnessing systems
- Information on animal husbandry and harness maintenance

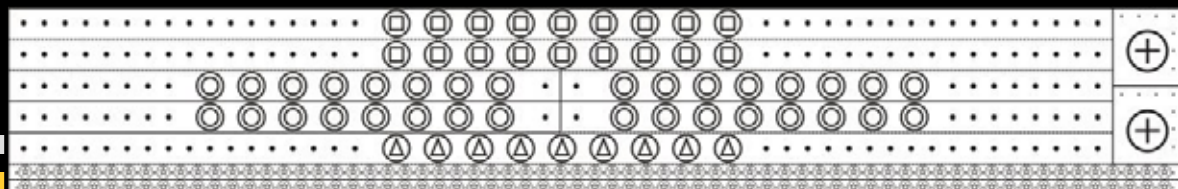
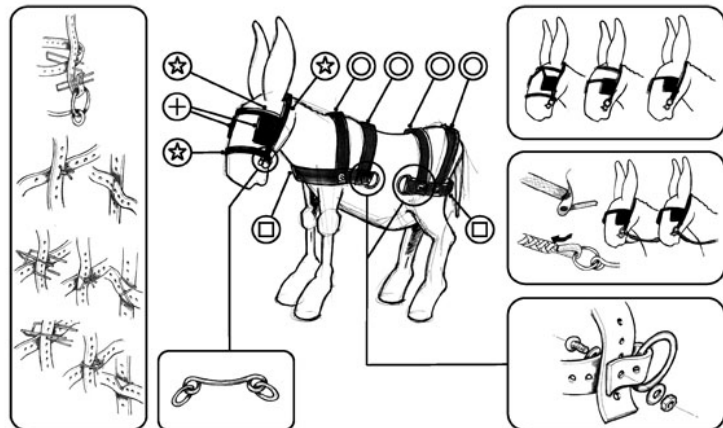
Assembly:

- Only equipment required for assembly: pliers and screw driver

Pre-punched Package (single donkey harness)

- 1 X conveyer mat
- 1 X booklet
- 12 X gutter bolts
- 12 X lock nuts
- 24 X washers
- 1 X bit
- 4 X rings (for traces)
- 7.5 m nylon rope
- 3 m wire

Bridle and Harness Assembly



SUSTAINABILITY MODEL

“Make Your Own Harness System”

- Sponsored by companies sympathetic to the SPCA
- Distributed by the SPCA

“Pre-punched Harness and Bridle System”

- Costs offset through advertising space on bands
- Nominal cost of approximately R 35 per set (single donkey)
- First prototype field tested in Hammanskraal – results pending

LOW-CAPACITY CARTS



Donkeys and small carts have come to be very important for reducing the drudgery in rural communities – particularly for hauling water, firewood, groceries, people, and for the transportation of live giving harvests.

“Empowering Farmers with Animal Traction” Kaumbutho et al.

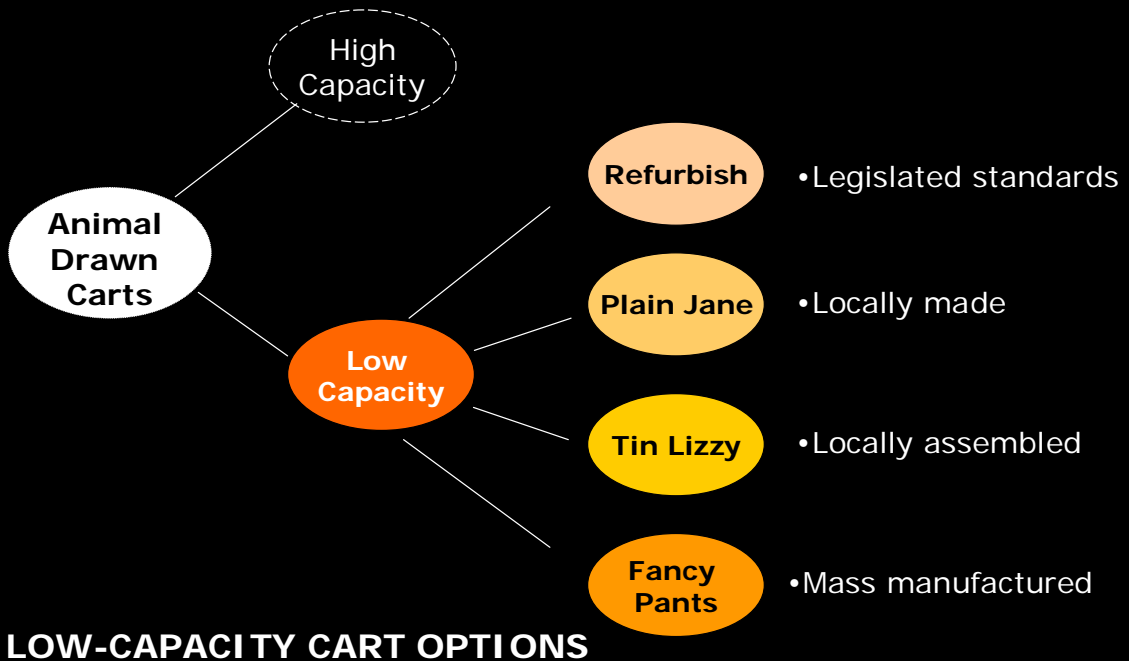
LOW-CAPACITY CARTS

PROBLEM STATEMENT



Access to efficient and adequate transport in and around the village can contribute to increased economic opportunity, lowered domestic workloads, and the ability to access to essential services.

LOW-CAPACITY CARTS



LOW-CAPACITY CART OPTIONS

LOW-CAPACITY CARTS

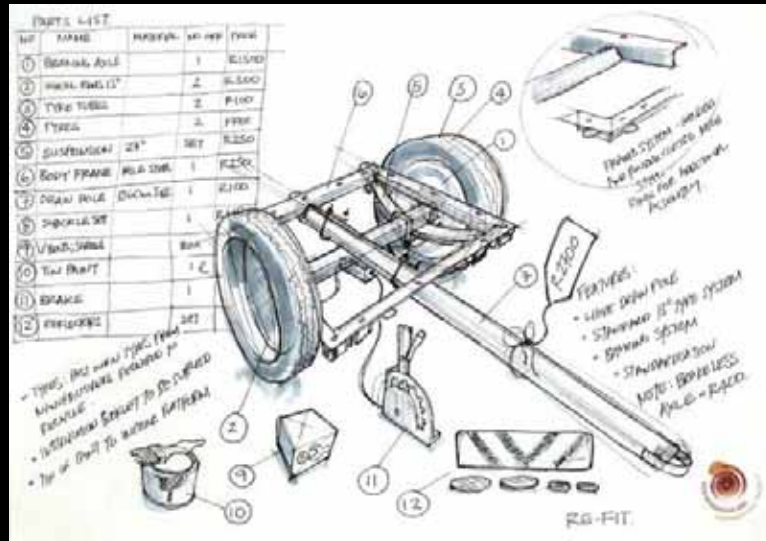
REFURBISH

Pre-assembled kit for refitting existing carts

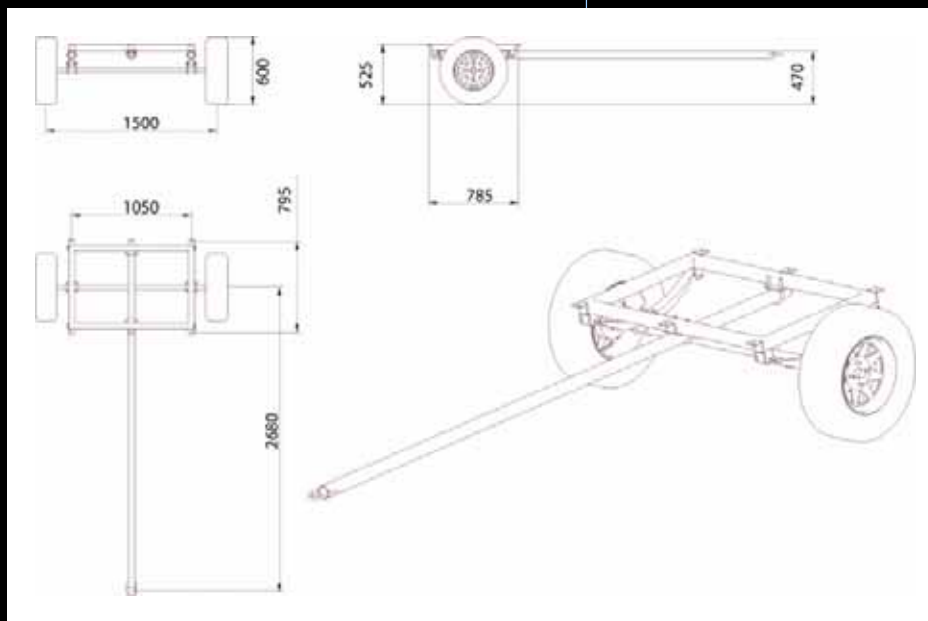
Designed to meet legislated standards

Improved safety

Includes brake, chevrons, assembly kit, finishing kit



LOW-CAPACITY CARTS

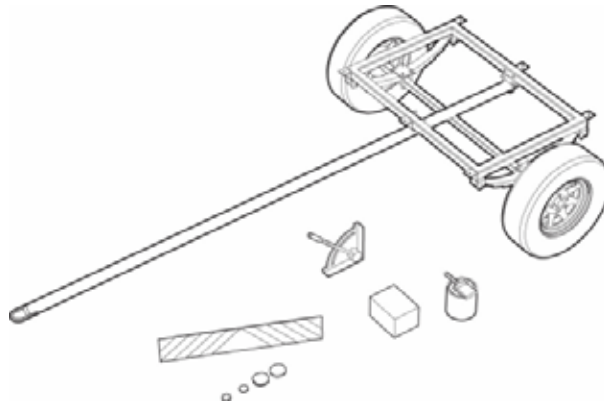


LOW-CAPACITY CARTS

Kit contains:

- Pre-assembled chassis with removable draw pole
- Brake system
- Fasteners
- Paint
- Chevrons and reflectors

Total cost: R2700



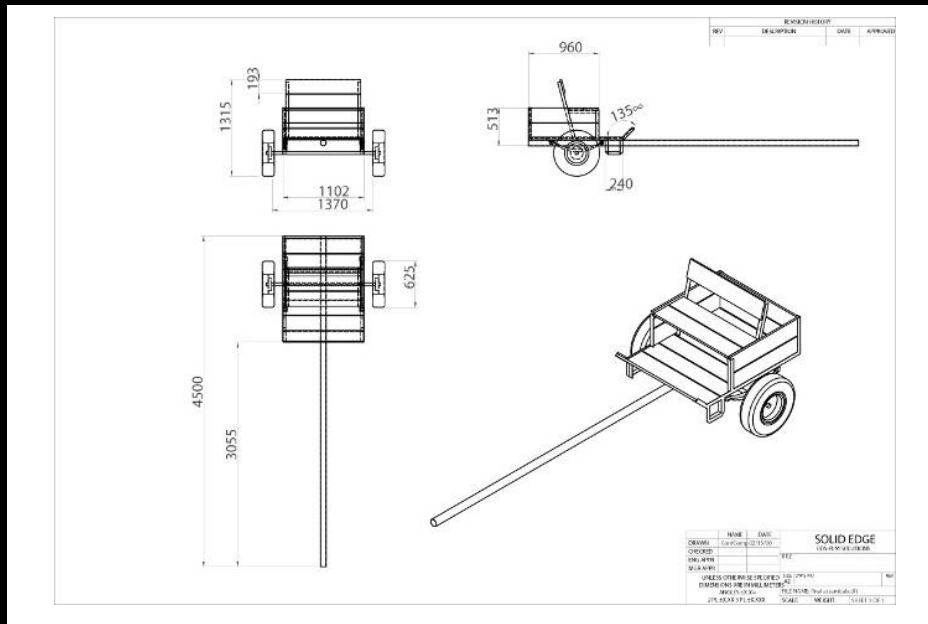
LOW-CAPACITY CARTS

PLAIN JANE



Locally manufactured
Use of local materials
Relatively inexpensive
Easy to maintain
Durable

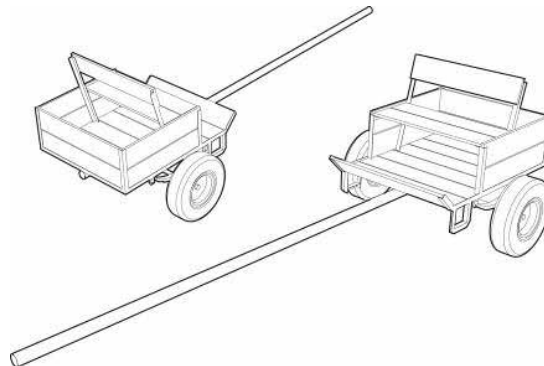
LOW-CAPACITY CARTS



LOW-CAPACITY CARTS

- Angle iron frame
- Wood plank body
- Removable tailgate
- Plank bench seat
- Flat loading bed

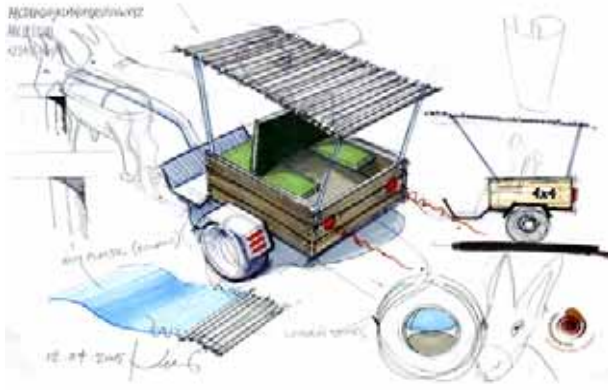
TOTAL COST: R3396



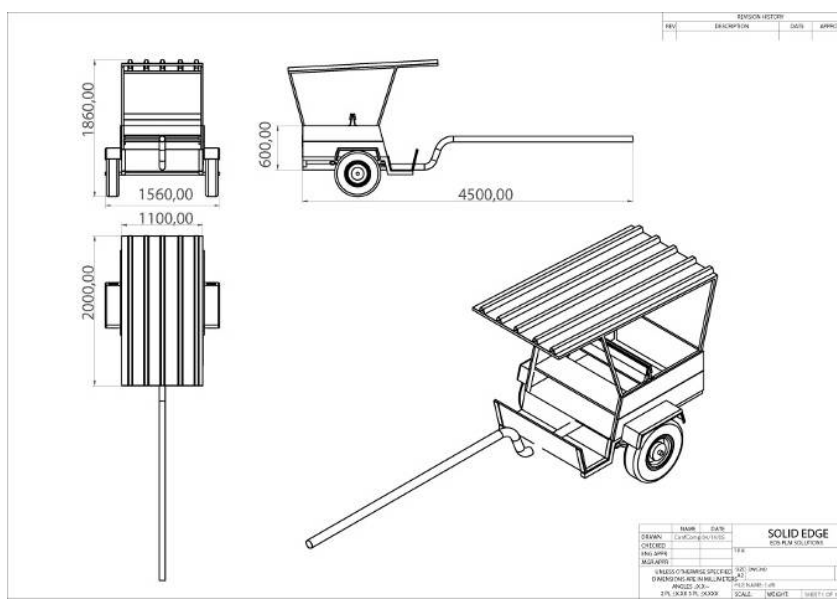
LOW-CAPACITY CARTS

TIN LIZZIE

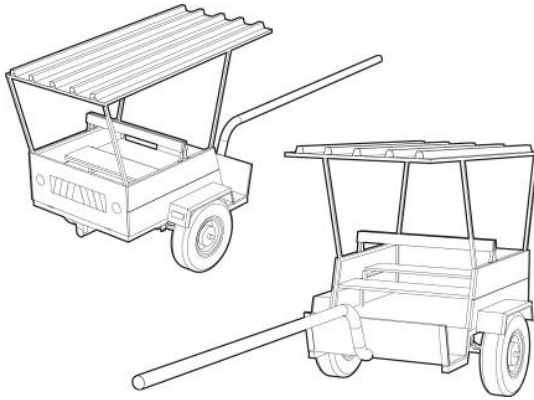
- Industry manufactured
- Locally assembled
- Designed to be maintained locally
- Higher comfort standards
- Family-oriented



LOW-CAPACITY CARTS



LOW-CAPACITY CARTS



- Square tube frame
- Corrugated metal roof
- Hinged tailgate
- Foldable back seat
- Mudguards
- Step-down chassis
- Chevrons and reflectors

TOTAL COST: R 5660

LOW-CAPACITY CARTS

FANCY PANTS



Mass manufactured

Primarily for people transport

ht frame

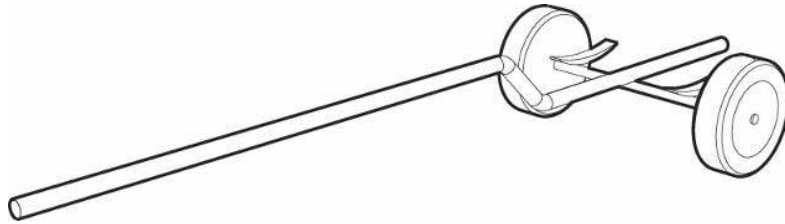
age oriented

st comfortable model

ghest price point

LOW-CAPACITY CARTS

Wheels, axle & draw pole : R 2710

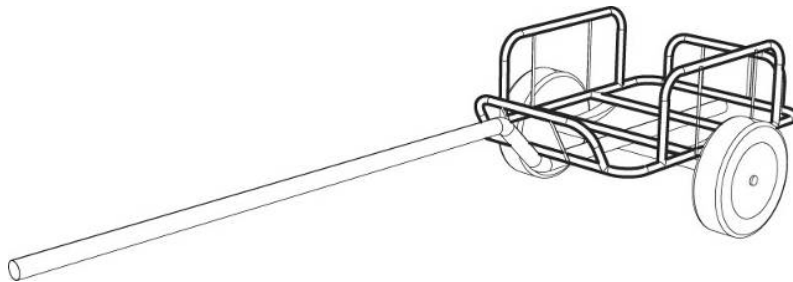


LOW-CAPACITY CARTS

Wheels, axle & draw pole : R 2710

Frame & powder-coating : R 1750

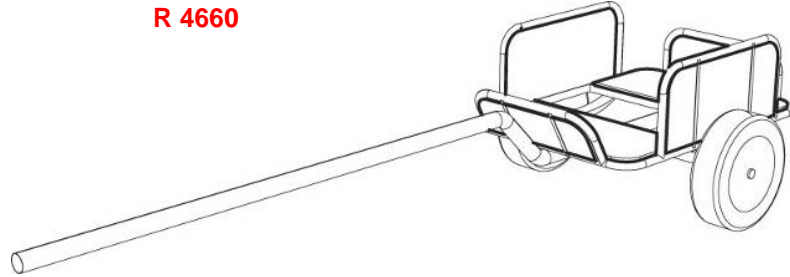
TOTAL **R 4460**



LOW-CAPACITY CARTS

Wheels, axle & draw pole : R 2710
Frame & powder-coating : R 1750
Wood planks : R 200

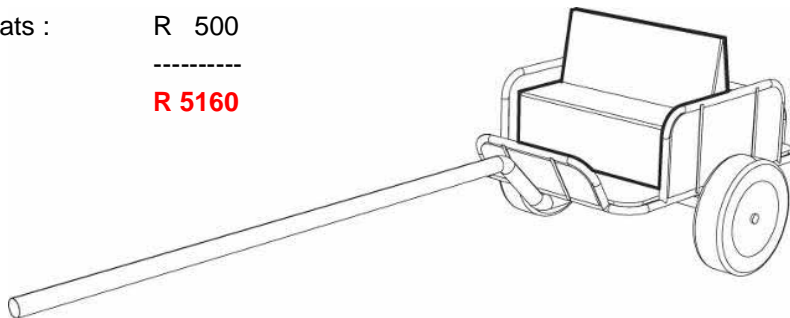
TOTAL R 4660



LOW-CAPACITY CARTS

Wheels, axle & draw pole : R 2710
Frame & powder-coating : R 1750
Wood planks : R 200
Storage box & seats : R 500

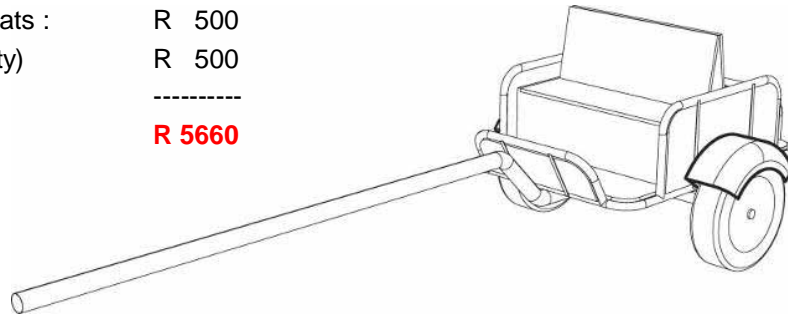
TOTAL R 5160



LOW-CAPACITY CARTS

Wheels, axle & draw pole :	R 2710
Frame & powder-coating :	R 1750
Wood planks :	R 200
Storage box & seats :	R 500
Mudguards (safety)	R 500

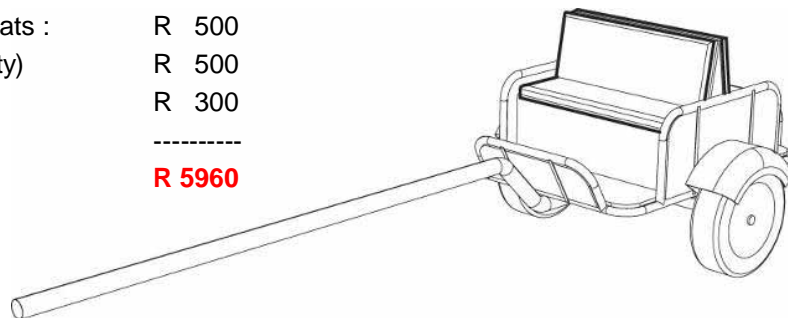
TOTAL **R 5660**



LOW-CAPACITY CARTS

Wheels, axle & draw pole :	R 2710
Frame & powder-coating :	R 1750
Wood planks :	R 200
Storage box & seats :	R 500
Mudguards (safety)	R 500
Cushions :	R 300

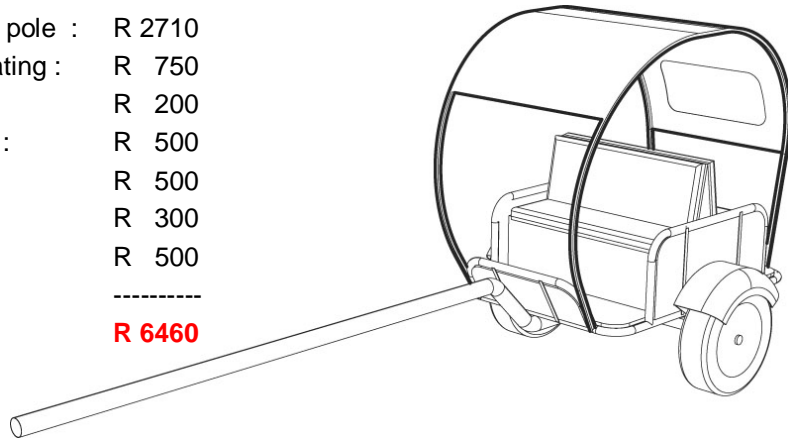
TOTAL **R 5960**



LOW-CAPACITY CARTS

Wheels, axle & draw pole :	R 2710
Frame & powder-coating :	R 750
Wood planks :	R 200
Storage box & seats :	R 500
Mudguards (safety)	R 500
Cushions :	R 300
Canopy & tubes :	R 500

TOTAL **R 6460**



LOW-CAPACITY CARTS

WOMEN AND TRANSPORT



It is about women gaining control over the means to make a living. It is about women lifting themselves out of poverty & vulnerability. It is about women achieving economic & political empowerment within their homes, their villages, their countries.

UN Dev Fund For Women

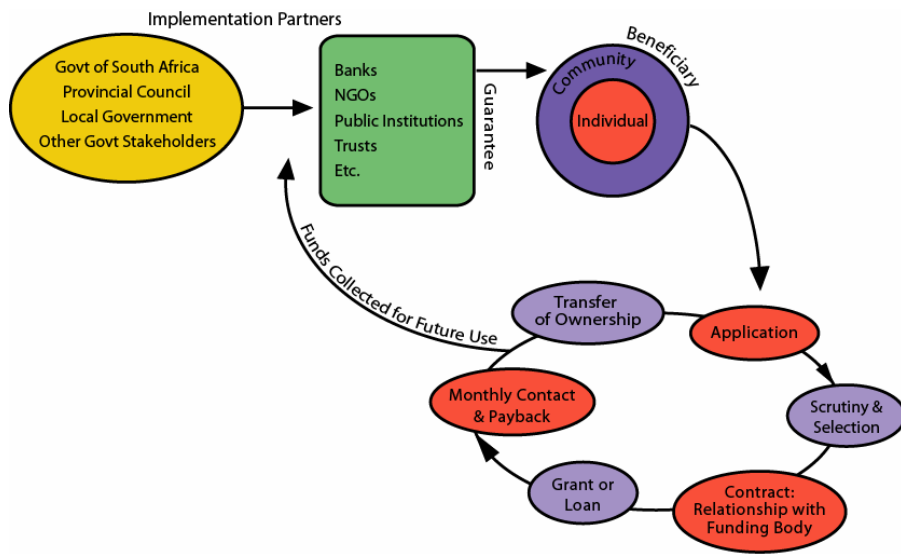
SUSTAINABILITY MODEL: MICRO-CREDIT PROGRAMME



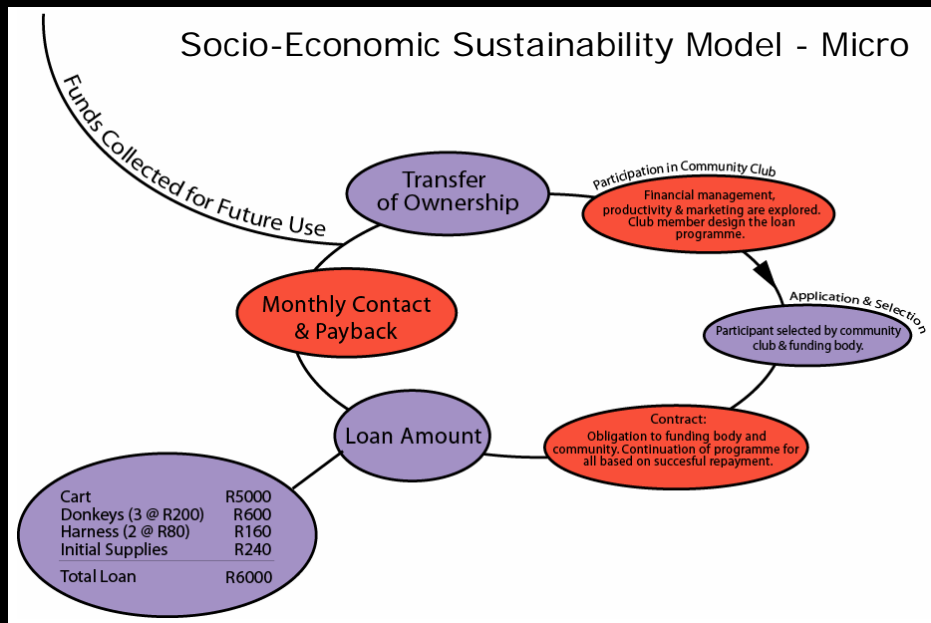
Benefits

- Accepted method of poverty alleviation
- For women who would not normally have access to credit
- Increased access to community services
- Potential changes in communities perceptions of women's roles
- Improvement in women's role in household

Socio-Economic Sustainability Model - Macro



LOW-CAPACITY CARTS



HIGH-CAPACITY CARTS



Four-wheeled vehicles (wagons) are desirable for transporting heavy loads because they eliminate the problem of large vertical forces acting on the backs – or necks of the animals.

Dr. Peta Jones, Donkey Power Consultancy

HIGH-CAPACITY CARTS

EXISTING HIGH-CAPACITY CARTS



HIGH-CAPACITY CARTS

PROBLEM ANALYSIS

PROBLEMS	PRINCIPLES	INITIAL DESIGN	FEEDBACK	SOLUTIONS
Acceptability	•Cultural sensitivity	practicality	"Cool" factor	Upgrade the existing products/prototypes
Accessibility	•Design-for-all	ingress/egress	Elderly/Disabled	Lower deck height/steps
Aesthetics	•Attractiveness	branding	Popular brands	Provide spaces for promotional graphics
Affordability	•Low-cost	appropriateness	Simplicity	Government subsidies needed
Comfort	•User-friendliness •Ergonomics	shelter/seats	Canopies/Cushions?	Provide canopies

HIGH-CAPACITY CARTS

PROBLEM ANALYSIS (continued)

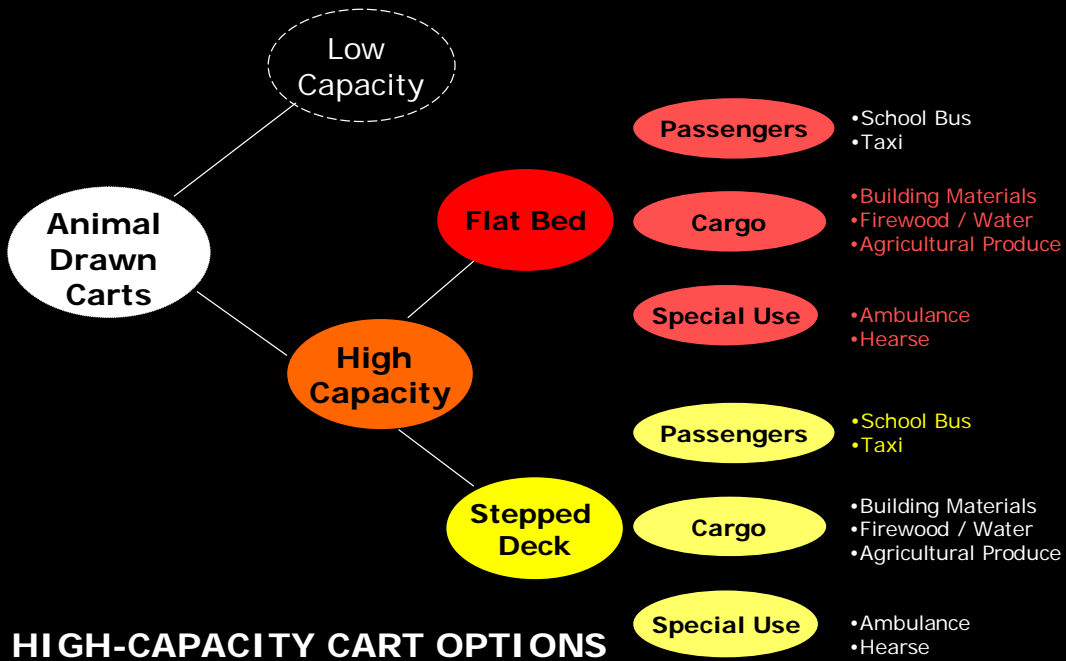
PROBLEMS	PRINCIPLES	INITIAL DESIGN	FEEDBACK	SOLUTIONS
Durability	•Ruggedness	structural integrity	Metal & some wood	Durable finishes & robust fittings
Flexibility	•Modularity •Design for disassembly	multi-functional	Cargo & People	Removable & adjustable features
Maneuverability	•Stability	weight	Low centre-of-gravity	Optimized chassis
Safety	•Accident prevention	visibility	Passenger safety	Omit sharp edges
Sustainability	•Technology transfer	use of local resources/skills	Export potential	Appropriate production methods
Welfare of Draft Animal	•Humane treatment •Good husbandry	Weight limitation/distribution	Avoid overloading	Provide food storage & weight indicator

HIGH-CAPACITY CARTS

PROBLEM ANALYSIS (continued)

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HIGH-CAPACITY CARTS



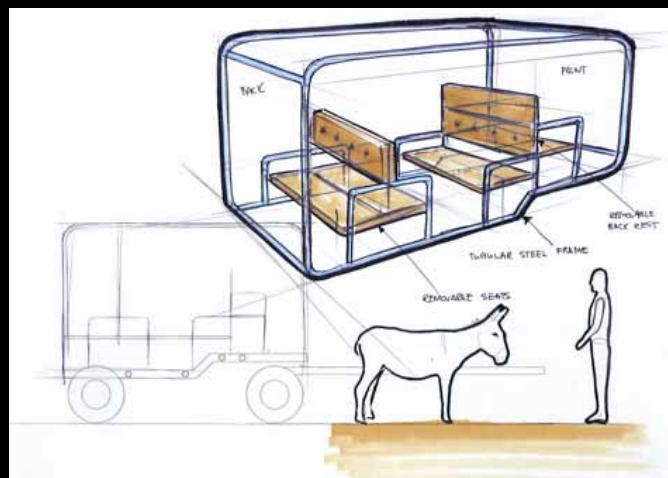
HIGH-CAPACITY CARTS

ERGONOMICS

- Overall Dimensions
- Accessibility
- Comfort
- Safe Edges
- Functional Accessories
- Textures

SAFETY FEATURES

- Reflectors
- Handbrake
- Indicators
- Mirrors
- Safety Strapping



HIGH-CAPACITY CARTS



PAYLOADS

- People
- Bricks, Wood, Sand & Stone
- Food
- Water
- Furniture
- Scrap metal

FUNCTIONALITY

- Loading Methods & Means
- Ingress & Egress
- Fastening Methods
- Stability
- Utility Holders

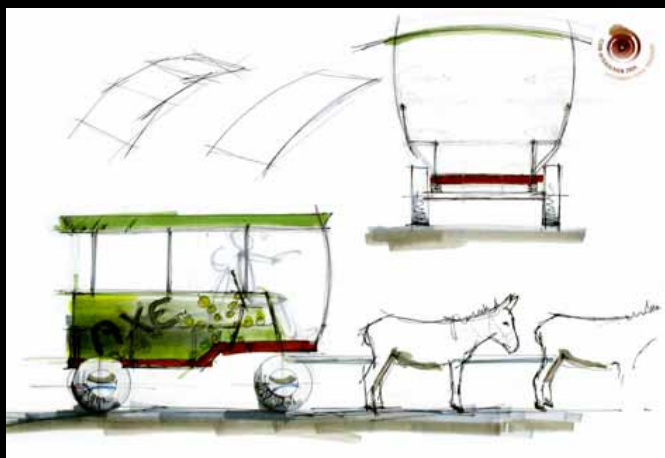
HIGH-CAPACITY CARTS

AESTHETICS

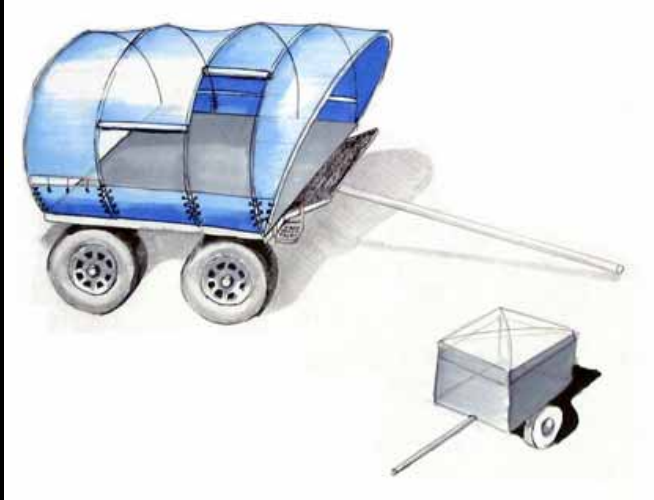
- Branding " The COOL Factor "
- Graphic Surfaces
- Colour choice & Surface finishes

CONTROLS/ DISPLAYS

- Radio
- Hooter
- Indicators
- Lighting



HIGH-CAPACITY CARTS



SHELTER

- Canopy (ease of use & flexibility)
- Side Walls
- Drainage
- Windscreen

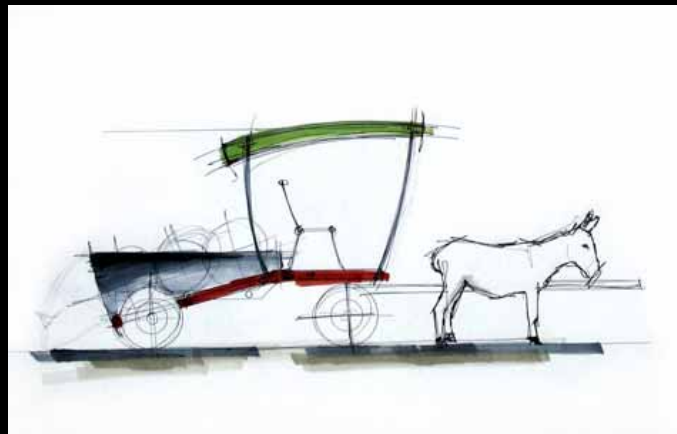
MATERIALS & PROCESSES

- Rubber Weaved floor mats
- Polyester Web Hammock Seating
- Woods, Metals & Plastics
- Welding & Standard Fasteners

HIGH-CAPACITY CARTS

STORAGE

- Multi-Purpose Utility Spaces
- Toolbox & First-Aid Kit
- Water Containers
- Fold Away Features (e.g. seats, canopy, etc)
- Animal Feed



ECONOMIC COMPARISONS

Modes of Transport	Purchase Price	Maintenance Cost/Year	School Fee Income	Additional Income
• Bicycle	R2400 (6 bicycles)	R600 (6 bicycles)	R0	R0
• Donkey Cart	R2880	R1000	R0	R4000-8000
• (upgraded)	R10000	R2000	R2400	R5000-10000
• Cheap Bakkie	R12000	R6000	R2400	R20000-40000

SOCIAL COMPARISONS

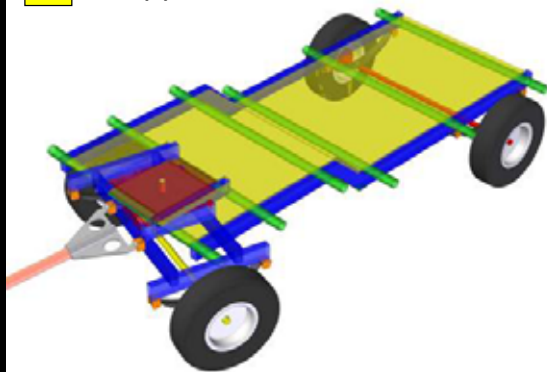
Modes of Transport	Maintenance Skill Level	Travel Conditions	User Energy Consumption	Cool Factor Perception
• Bicycle	Low	Poor	High	Medium
• Donkey Cart	Low	Poor	Low	Low
• (upgraded)	Medium	Good	Low	High
• Cheap Bakkie	High	Good	Low	High

HIGH-CAPACITY CARTS

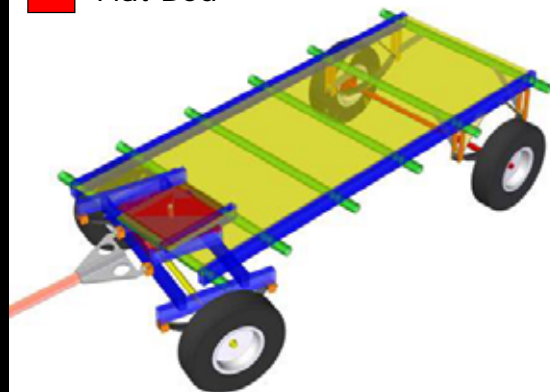
HIGH-CAPACITY CHASSIS OPTIONS



Stepped Deck



Flat Bed

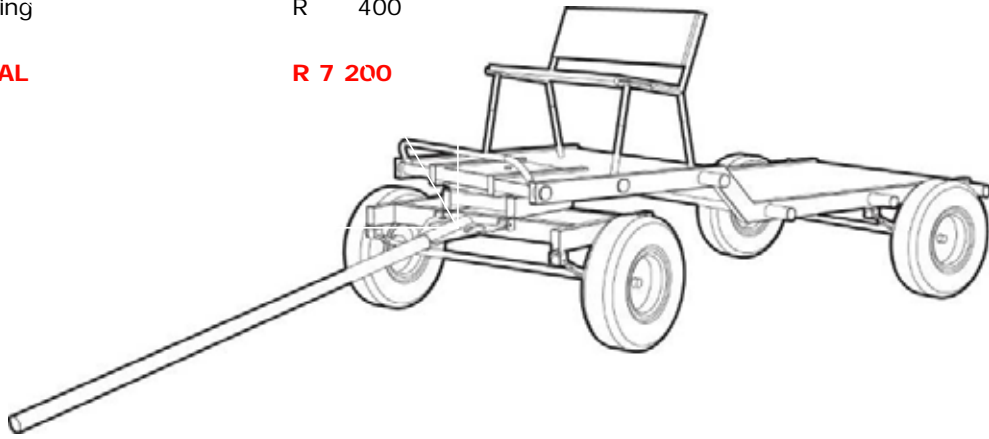


HIGH-CAPACITY CARTS

Stepped Deck Costing

Chassis Structure	R 4 000
Moving Gear	R 2 800
Seating	R 400

TOTAL R 7 200

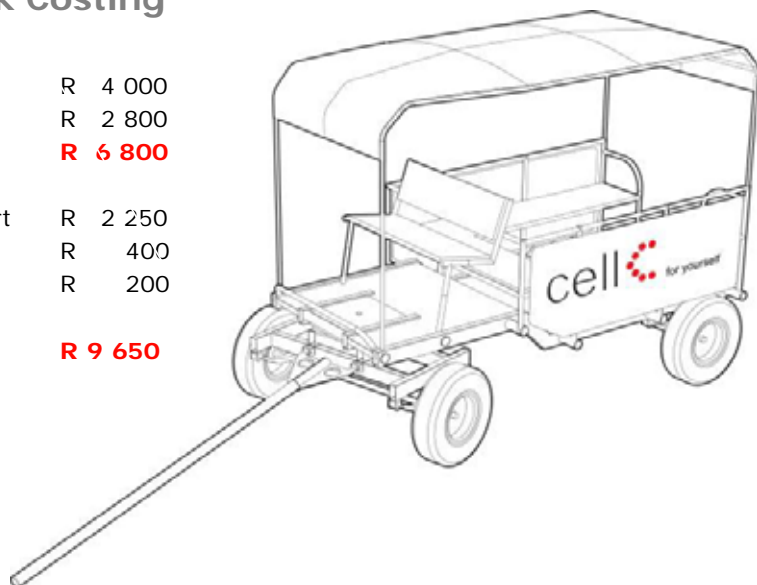


HIGH-CAPACITY CARTS

Stepped Deck Costing

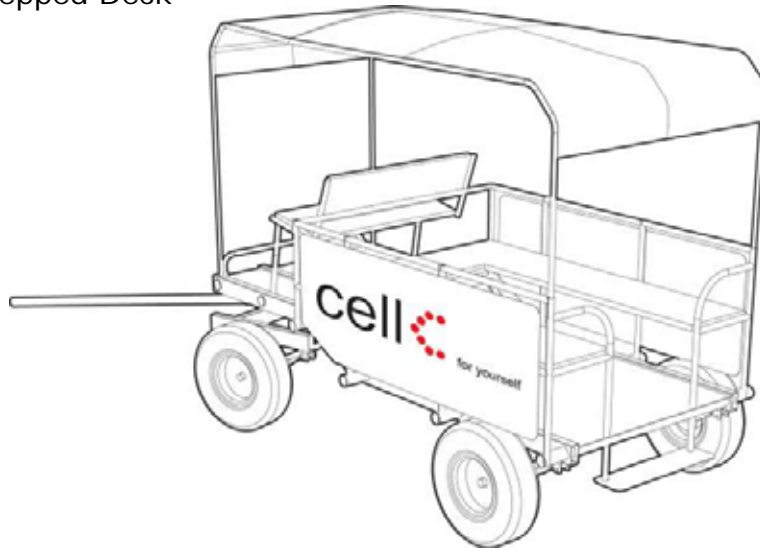
Chassis Structure	R 4 000
Moving Gear	R 2 800
Sub-Total	R 6 800
Side and Canopy Support	R 2 250
Seating	R 400
Roof Canvas	R 200

TOTAL R 9 650



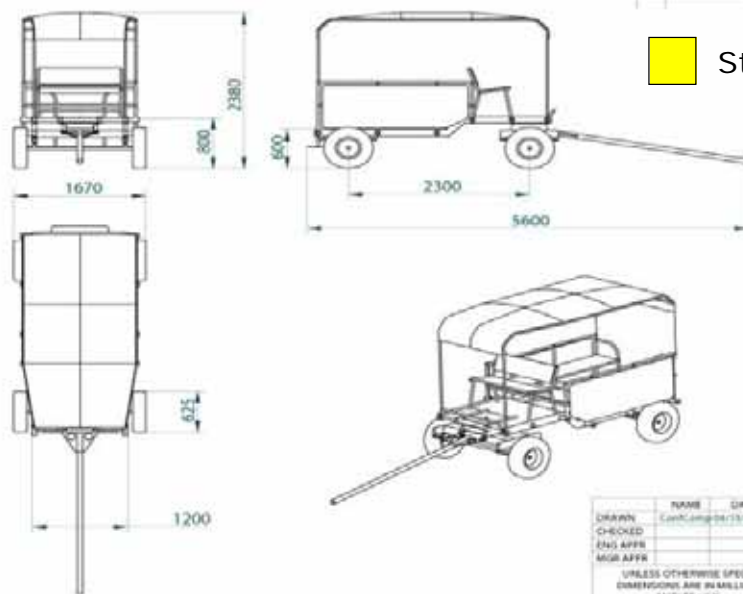
HIGH-CAPACITY CARTS

 Stepped Deck



HIGH-CAPACITY CARTS

 Stepped Deck



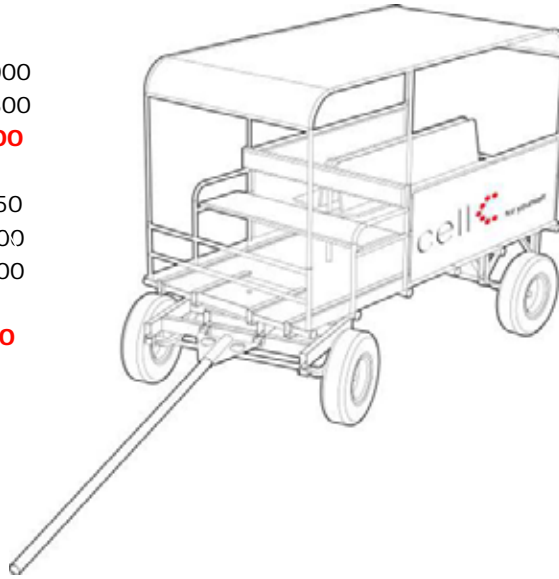
REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED

NAME	DATE	SOLID EDGE EDS-PLM SOLUTIONS	REV
DRAWN			
CHECKED			
ENGR APPR			
MGR APPR			
UNLESS OTHERWISE SPECIFIED: SEE DWG/REV			
DIMENSIONS ARE IN MILLIMETERS			

HIGH-CAPACITY CARTS

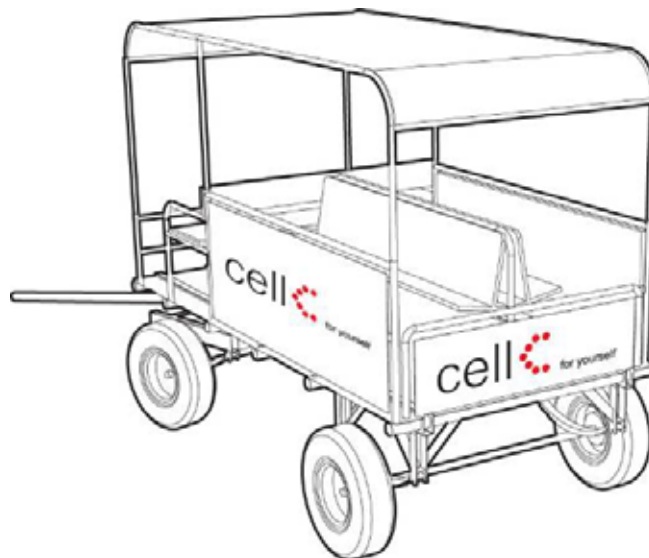
Flat Bed Costing

Chassis Structure	R 4 000
Moving Gear	R 2 800
Sub-Total	R 6 800
Side and Canopy Support	R 2 250
Seating	R 400
Roof Canvas	R 200
TOTAL	R 9 650

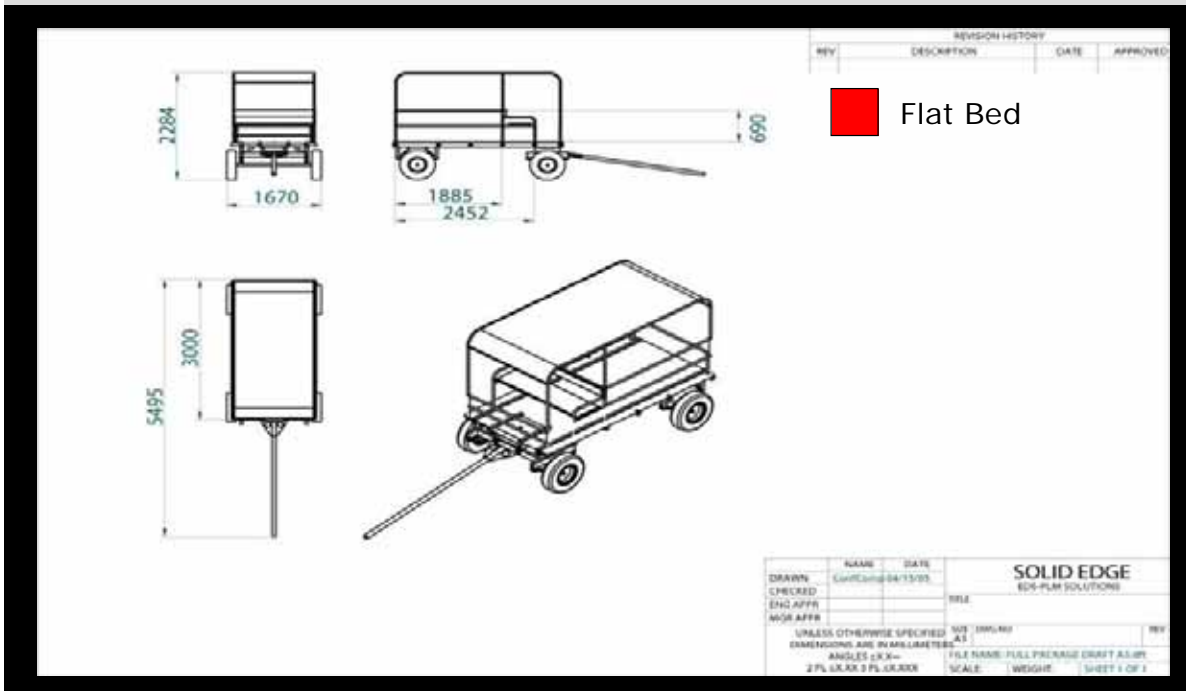


HIGH-CAPACITY CARTS

Flat Bed



HIGH-CAPACITY CARTS



HIGH-CAPACITY CARTS

LEARNERS AND TRANSPORT



Question posed to Chief of Pitsedisulejang:

If you could do one thing to improve transport in your village, what would it be?

Answer:

To get the children to school in all weather – and a donkey cart will do just fine.

HIGH-CAPACITY CARTS

SUSTAINABILITY MODEL

6am - 8am

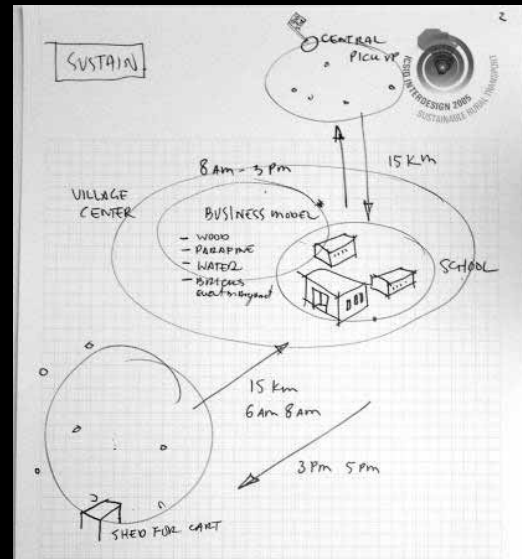
Transport of learners to school
(50c/child)

8am - 3pm

Transport of goods for operator
income

3pm - 5pm

Transport of children back home
(50c/child)



HIGH-CAPACITY CARTS

SUSTAINABILITY MODEL (continued)

Cart and donkeys would be school-owned and supported by outside funding

Operator responsible for:

- Care and maintenance of donkeys and carts
- Transport of learners to and from school

In exchange for:

- Learner transport fees (R 1.00 / child / day)
- Income derived from off-hour economic activity



3-16 April 2005
Rustenburg
North West Province
Republic of South Africa

ANIMAL DRAWN CARTS

CONCLUSION

WAY FORWARD

This is the start...

- SABS has made available capital on behalf of a rather slow moving Department of Transport to sponsor the manufacture of cart prototypes
- Development work has been completed by Industrial Design students at UJ
- UJ students to commission the manufacture prototypes
- Harnessing and bridle system has been made into a working prototype with a guide and has been field tested by the SPCA in Hammanskraal – results pending
- Extension of this system for horse and mule use to follow

THANKS

Thank you to the community leaders and villagers for giving us the opportunity to visit their villages and to share their knowledge

The experts: Morgane James, David Serepelo, Whitey Maphakela, Peta Jones and Linda Jele

The Animal Drawn Carts Design Group: Mike Nieuwoudt, Dakie Kaikai, Koos Kaekae, Benjamin Mabilu, Paul Kaelo, William Bodumele, Joost Alferink, David Christer, Niki Dun, Mugendi M'Rithaa, Mark Volger, Marius Botha, Adriaan Hugo, Goerge Gower, Berno Wellmann and Chris Bradnum

