Design for Developing Countries

Whirlwind *Africa-1*

My Background

- **MIT**

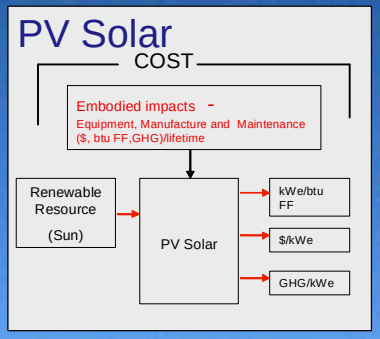
International Development Initiative

- **DEKA R & D**

Rural Electrification

- **UC Davis**

Renewable Energy, LCA, Vehicle Technologies



- **Whirlwind Wheelchair**

Low cost Wheelchairs

Motivation

- The need for wheelchairs in Africa
- UN goals
  - Poverty eradication
  - Access to education
  - Global partnership

Target Countries

- Kenya
- Tanzania
- Uganda
- Zambia
- Zimbabwe
- Mozambique
- Swaziland

Prior Art

The good

The bad

The Ugly

What is the current state-of-the-art?

African Success Stories

TOYOTA

Durable

Vs

LAND ROVER

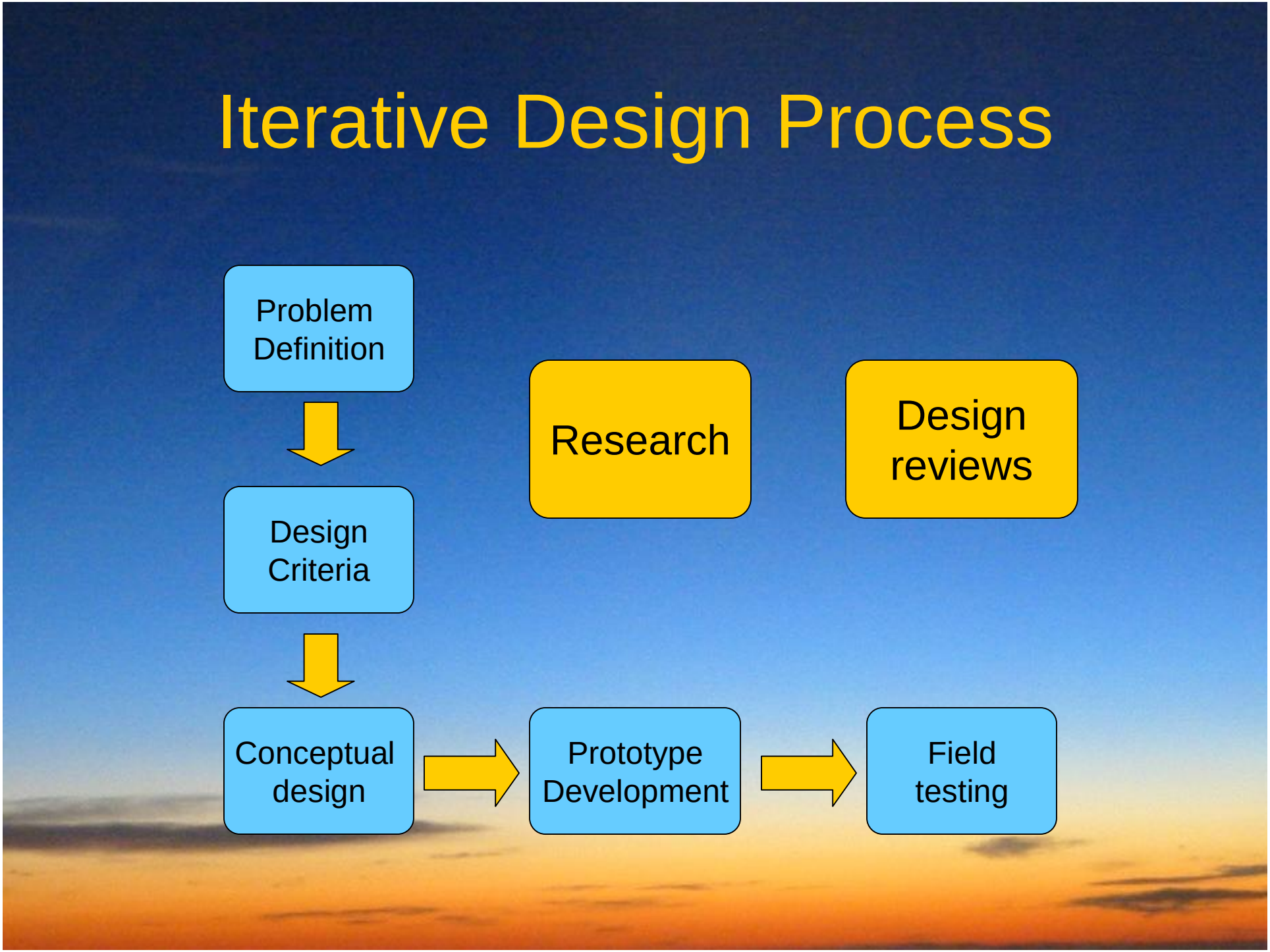
Repairable

Failures

What is available there?

- Bearings: 6202 from ceiling fans
- Caster tires: Car tire retread rubber
- Axles, bender dies: Machined locally
- Rims, tires spokes,etc: Local imports from China, India

Iterative Design Process



Design criteria

Wheelchair

- Accepted basic ergonomics
- Max Weight
- Adjustable
- Strength ANSI RESNA

Manufacturing

- Common tubing
- Sizeable for different customers
- Minimum tooling
- Minimum skill
- Locally available materials

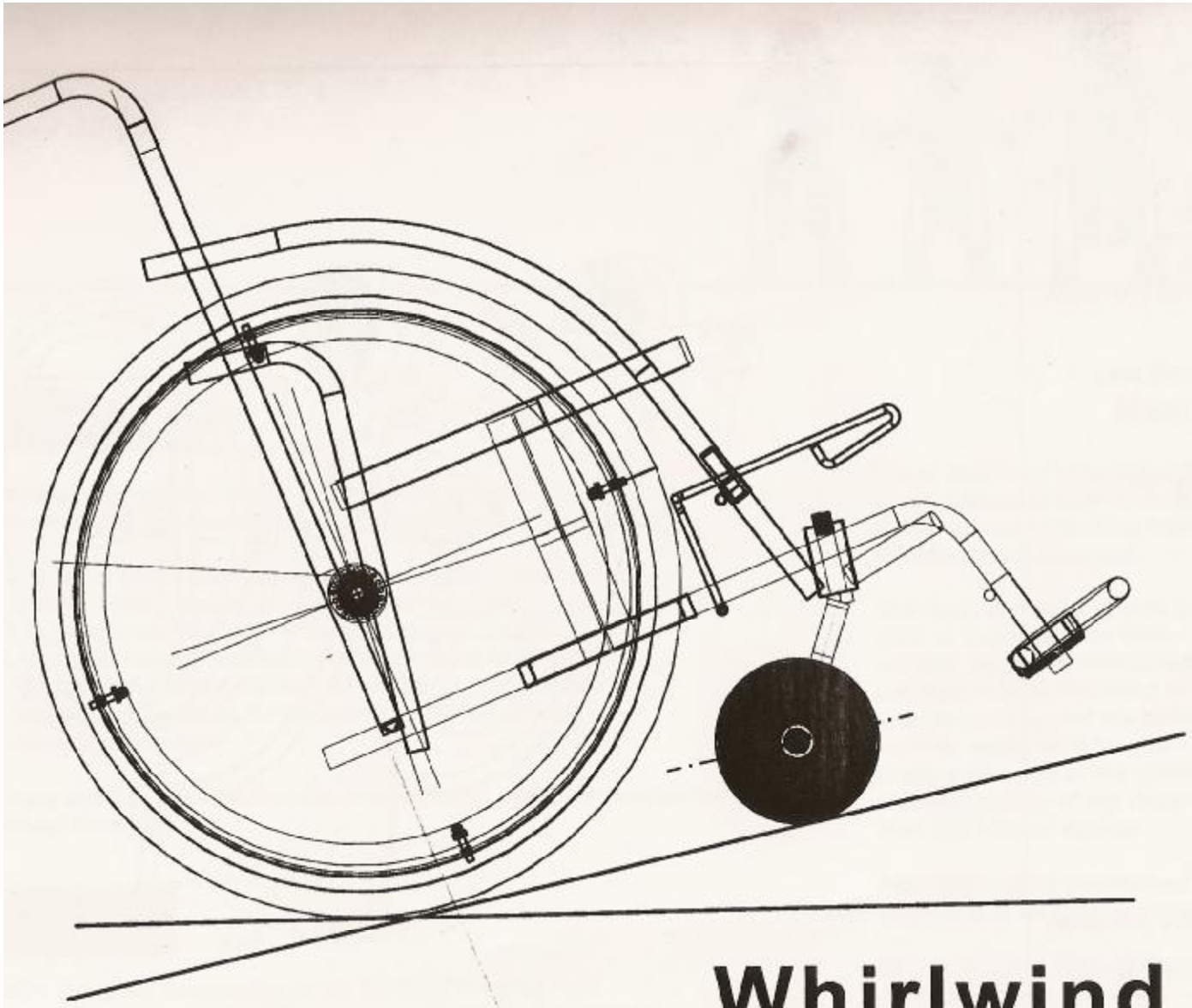
Competitive Collaboration

2 main Competing designs

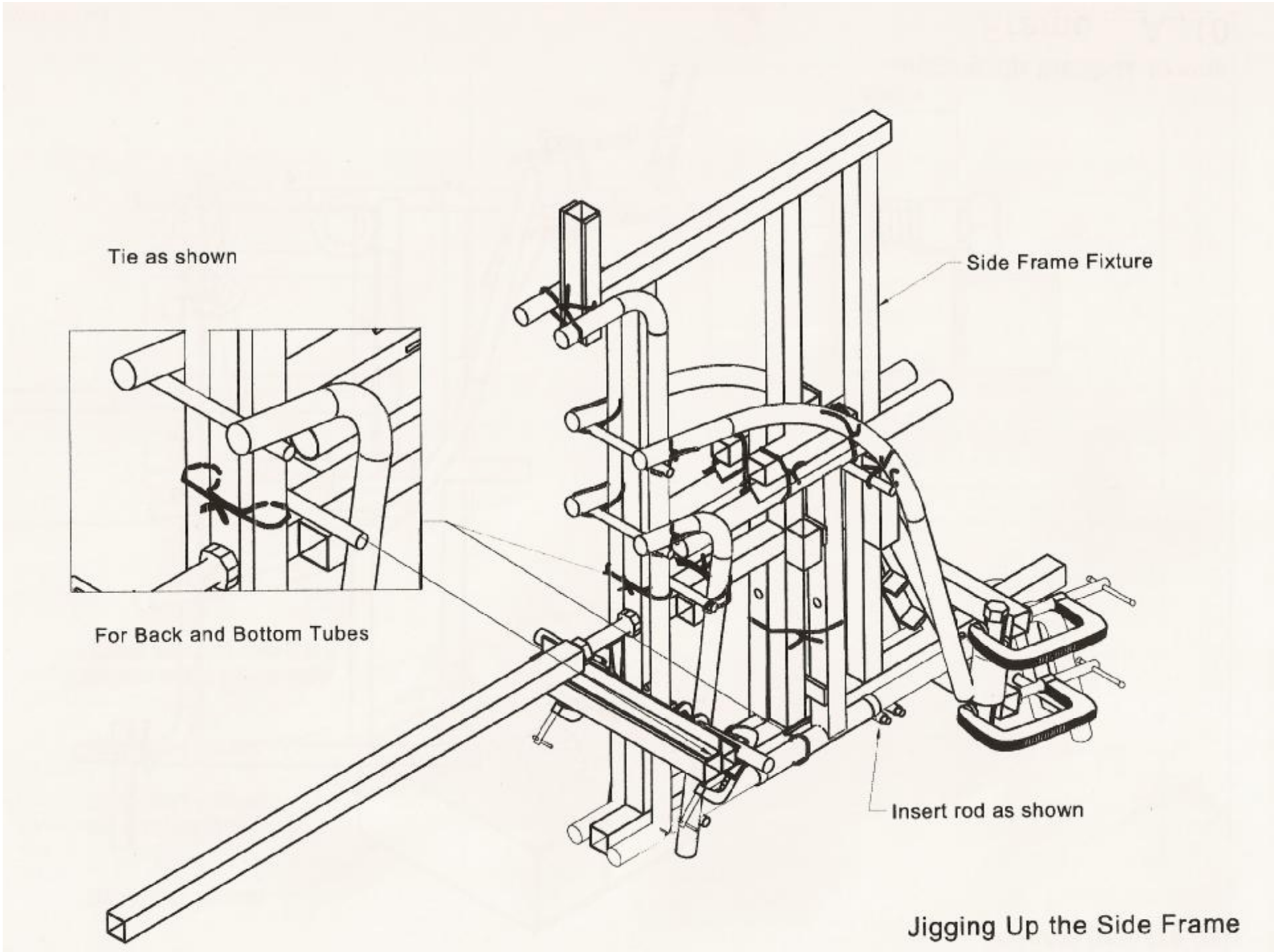
-Vertical X-Brace (Whirlwind III)

-Horizontal X-brace (Africa-1)

Testing

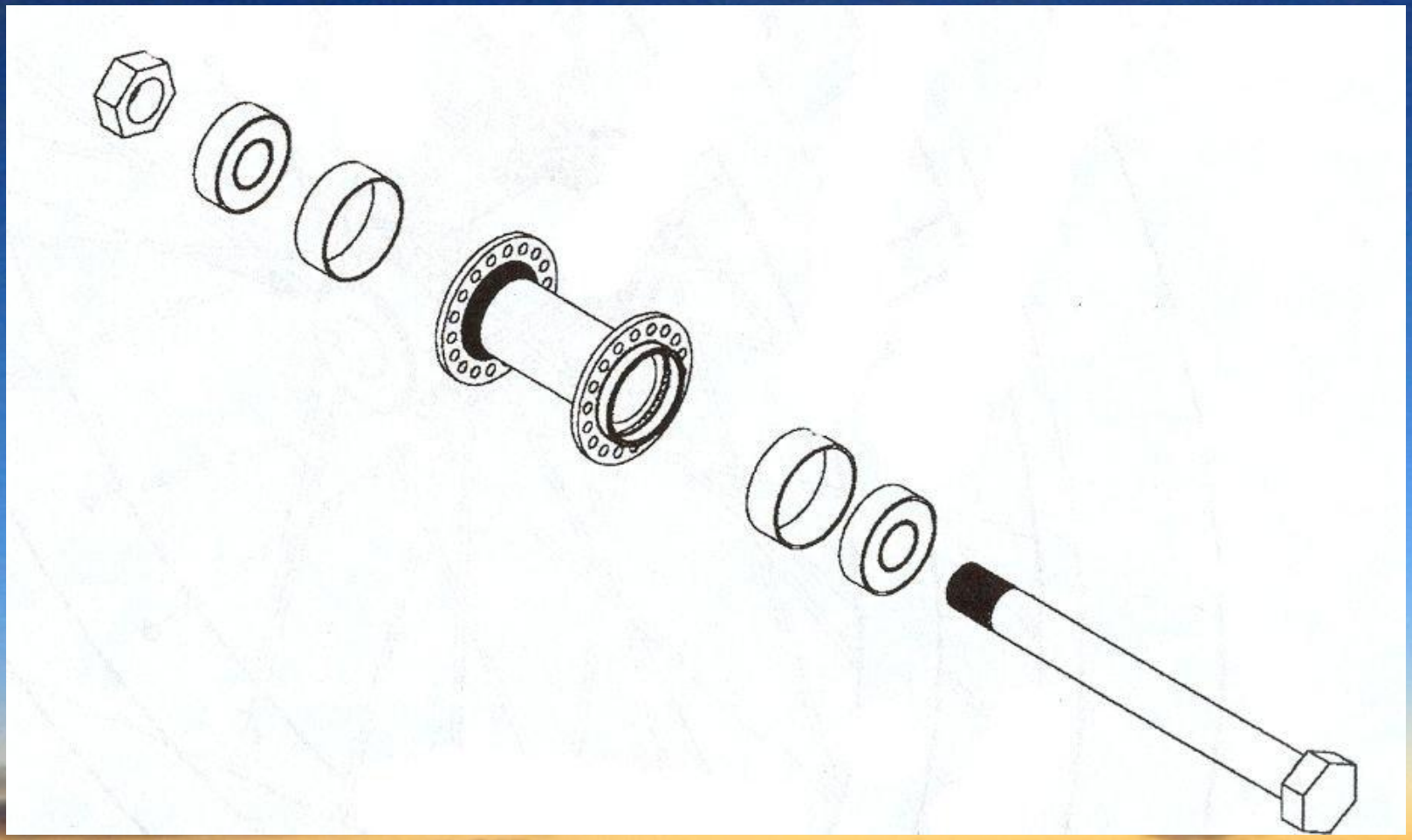


Whirlwind Africa 1
Technical Manual

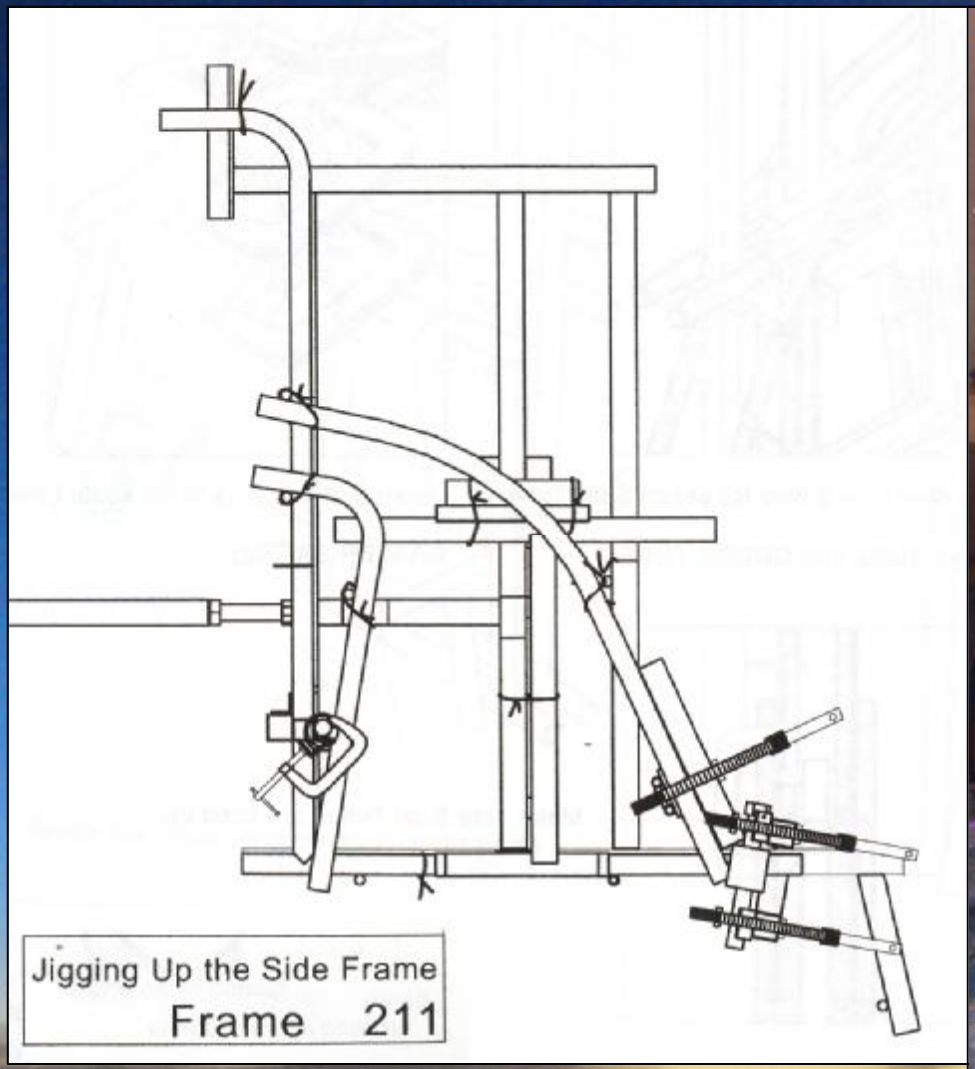


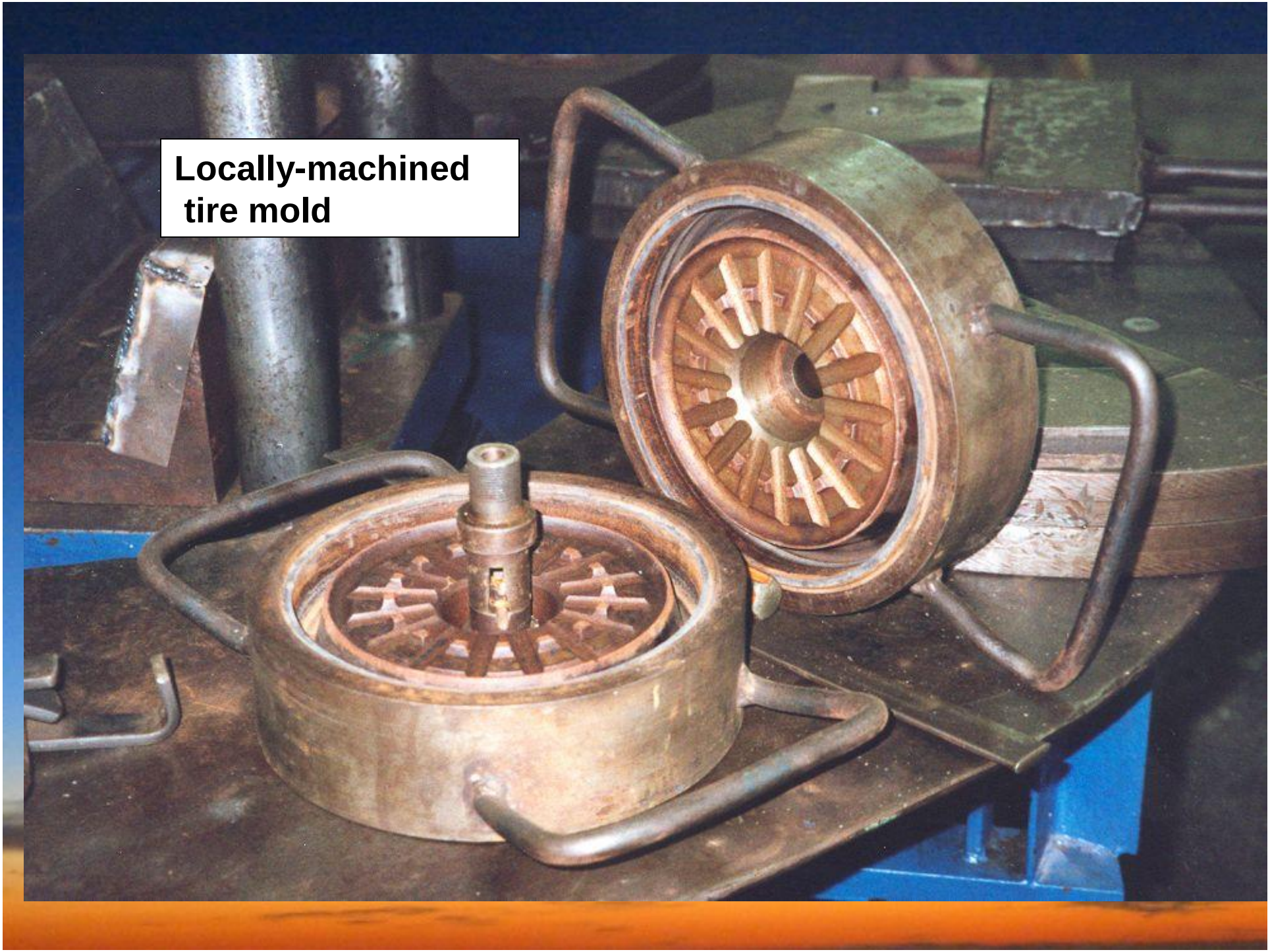
Jigging Up the Side Frame

Modified locally-purchased bicycle hub



Locally-built tooling




Locally-machined
tire mold

Whirlwind Wheelchair/DISACARE in Zambia

Current Development Paradigm:

- Good: Give a man a fish

Current Development Paradigm:

- Good: Give a man a fish
- Better: Teach a man to fish

Current Development Paradigm:

- Good: Give a man a fish
- Better: Teach a man to fish
- Watch out for: No river

Trained Local Technicians

New products

The Goal: Keep our customers out of trouble

Any Questions???