

# Modification Kits for Retrofitting Exercise Equipment

Michael J. Scott  
RERC Rectech

University of Illinois at Chicago

# Acknowledgements

- Collaborators:
  - Sri Srinivasaraghavan,  
George Vomvoridis
  - Michael Hirsh, Pete Weston
  - Jim Rimmer,  
Bill Schiller
- Support:
  - NIDRR
  - Life Fitness
  - NIH



# Outline

- Motivation (Why?)
- Proposal (What?)
- Development (How?)
- Lessons
- Future Directions

# Motivation: Exercise

- Seek better access for wheelchair users who wish to use cardiovascular exercise equipment.
  - Most cardiovascular equipment is made for lower body use
  - Arm ergometers are most common upper-body alternative – but have the potential of overuse injuries to manual chair users

# Motivation: Opportunities

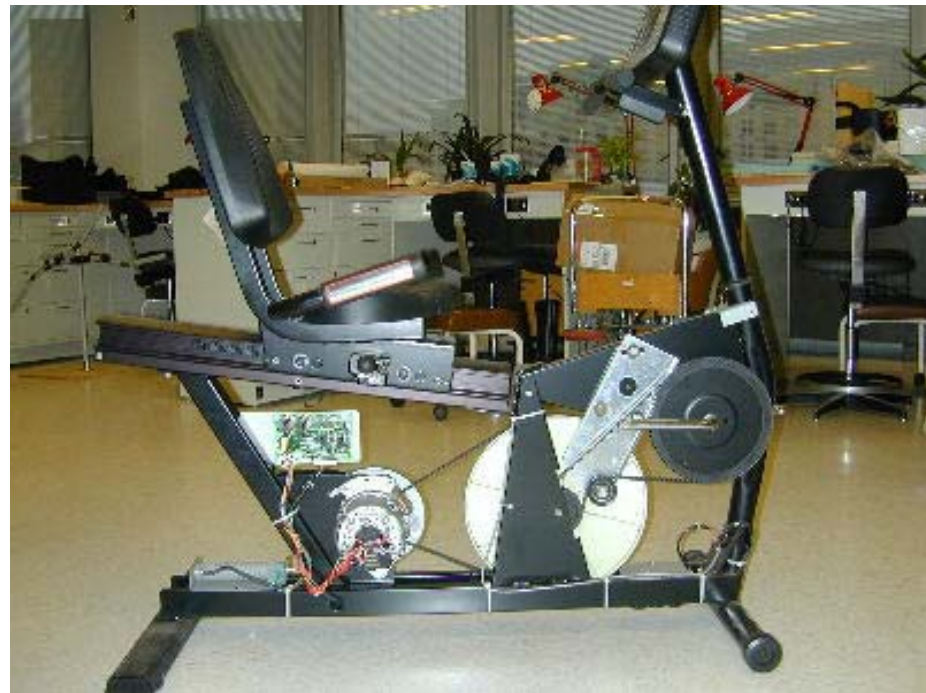
- Regulation (e.g., IFI) requires access to exercise equipment for people with disabilities
  - Providers must ensure accessibility to public
  - Space constraints encourage universal use
- Existing equipment can be adapted at a lower cost than developing new equipment
- Adapter kit technologies can be incorporated in future generations

# Motivation: Adapter Kits

- Adapter Kits
  - Gyms have \$\$\$ in existing equipment
  - Relatively small investment to add capability for wheelchair use
  - Access to the same equipment
- Equipment Manufacturers
  - Life Fitness collaborating with Rectech
  - Retrofit existing equipment, but develop new
  - General principles transferable to other manufacturers

# Proposal: Adapter Kit for Exercycle

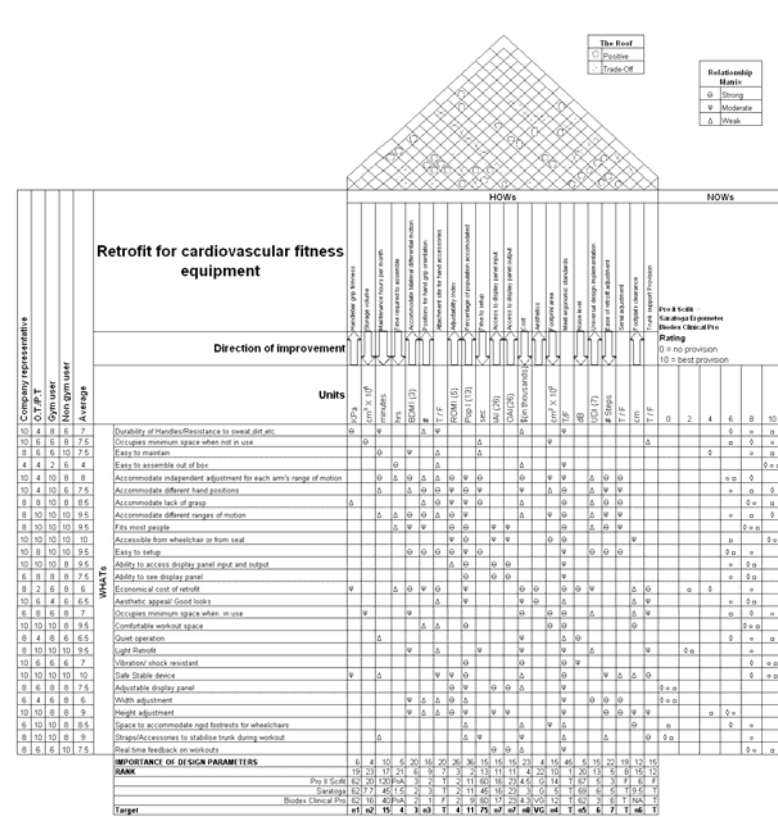
- Equipment: Life Cycle 9500HR recumbent
- Exercise: most appropriate for upper body cardiovascular



# Design Process

## First Step: Determine Requirements

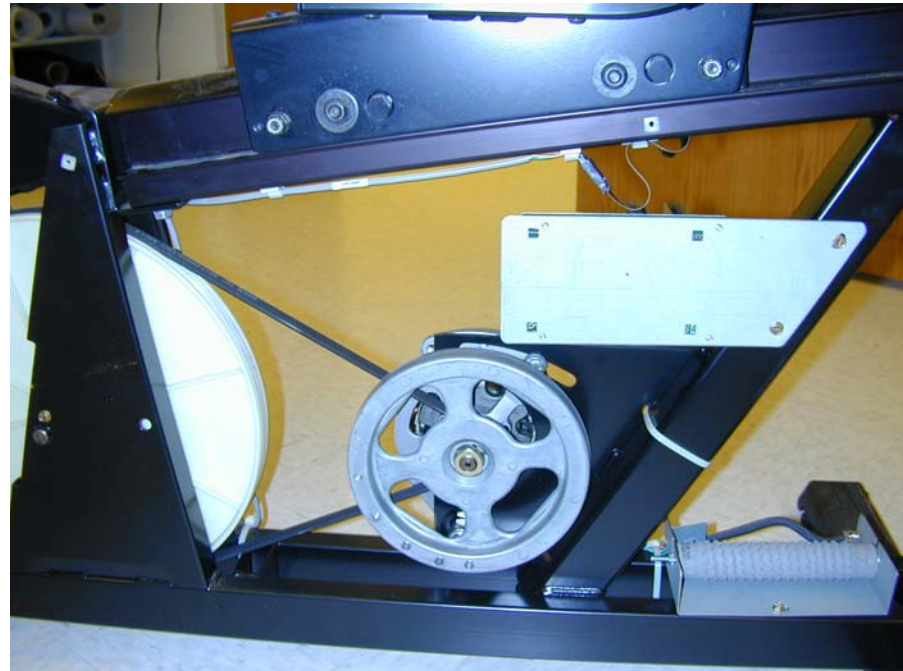
- HoQ
- Input from therapists, users, developers, manufacturers
- Highlighted as important: bilateral differential movement, ease of adjustment, ergonomics, footprint



# Design Process

Equipment constraints:

- Resistance provided by an alternator driven by a belt
- Wish to use same resistance mechanism
- Options: mechanical linkage, cable



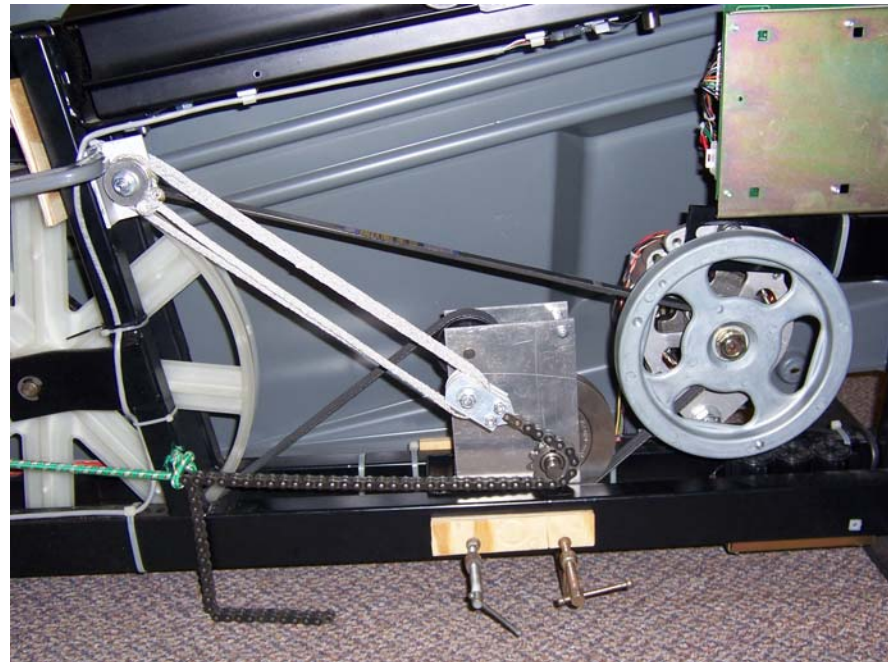
# Kit Attachment Mechanism

- Several basic motions available
  - Rotary crank
  - Lever
  - Cable: rowing, poling, various other pulling motions
- Cable is superior on all counts:
  - Interface with existing mechanism
  - Appropriateness of exercise
  - Footprint



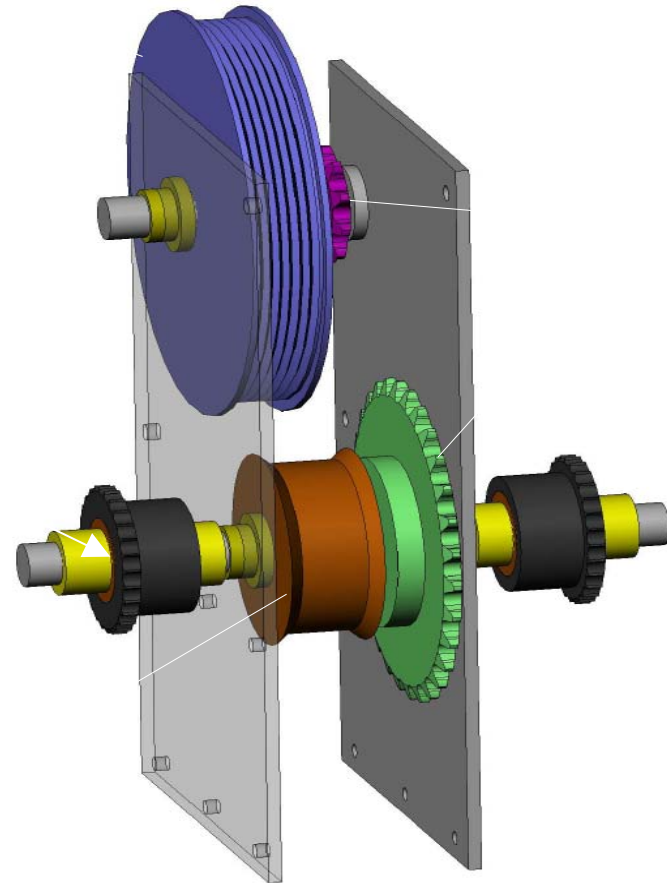
# Mechanism Design

- Drive the alternator, not the pedals
- Allows dual (even simultaneous\*) use without reconfiguration
- Transfer cable pulling motion to rotary motion
- Gear transmission for correct range; other adjustments can be done in software



# Mechanism Details

- Clutches
- Pulleys
- Belts
- Shafts
- Sprockets
- Chain
- Rope
- Shock cord



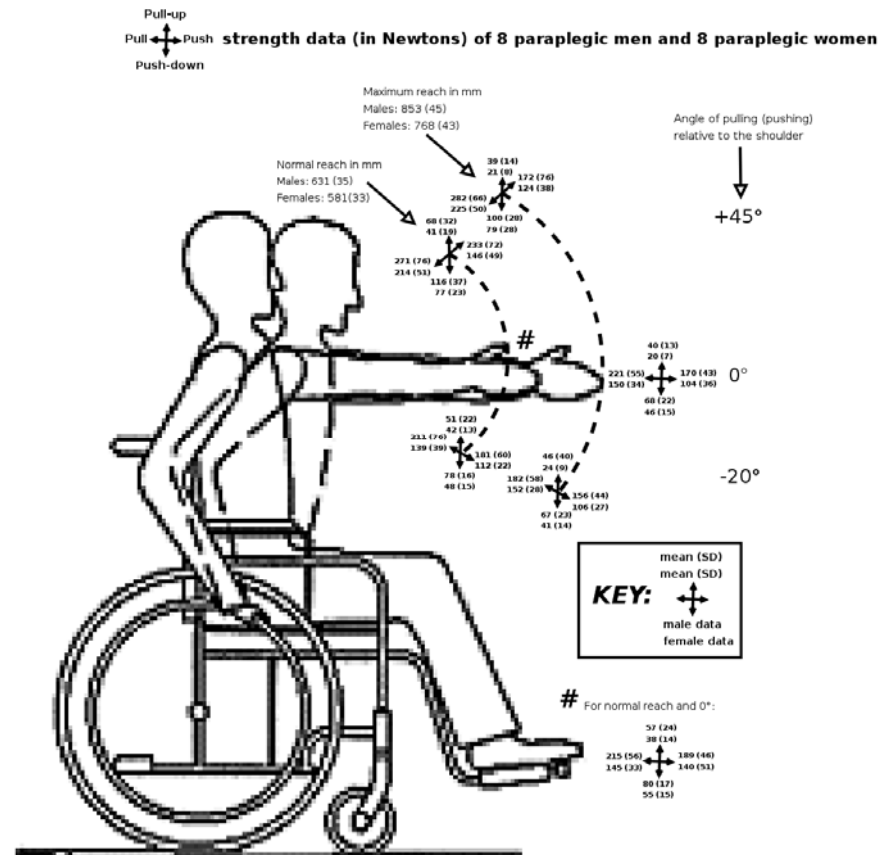
# Meeting User Requirements

- Length of stroke: pulleys and gears
- Height adjustment: unnecessary
- Seat adjustment: unnecessary
- Installation: no\* new holes
- Display: redundant†
- Cost: reasonable



# Ergonomics

- Process analysis
- Reach data
- Strength data
- Display height
- Single cable height = no need to adjust
- Handles
  - Type
  - Interchangeability



# General Principles

- Rowing and poling (pulling motions) excellent for cardiovascular exercise
- Rotary resistance mechanisms (such as Life Cycle alternator) easily driven by cables
- Cable mechanisms need not add to footprint, and preserve form and aesthetics
- Transmissions/software can provide proper start-up and moving resistance
- Adapter kits can be attached with compression elements, avoiding drilling

# Future Directions

- Wheel lockdown mechanism
- Superior displays
- User/usability testing of preliminary design
- VO2 testing with completed design using different exercise motions
- Kits for other equipment
- General approach to adapter kit design