

# Bicycle & Motorcycle Dynamics, Delft University of Technology, October 2010

© 2010 Han Goes



Where Industry Meets University  
**The Future Of Two Wheeled Mobility**

..... Light Electric Two Wheelers



## Now ..... for something completely different

© 2010 Han Goes

- Common Interest:
  - Bicycles & cycling
  - Netherlands are the #1 bicycle & cycling country (DNA)
- Common Goal:
  - Academic “Bicycle” chair & professorship for “Cycling Science”
  - Embedded relationship industry/products  $\leftrightarrow$  university/science
  - Applied Research (versus fundamental research)
- Common Obligation:
  - Societal importance, relevance and urgency



# Introduction

© 2010 Han Goes

- 25 years bike industry experience
- 15 years experience with E-bikes and Pedelecs
- Last position: Director Product Development Giant Europe & Giant Inc. (Asia)
  - Asia (Taiwan & China) are the world's workshop for bicycle production
  - Obligation: help trainees and graduate students
  - "Contract" Research
  - No embedded applied research
  - Poor results
- Symptomatic for Dutch / European / Global bicycle industry
- Food for thoughts



## Which Direction is the Market for Mobility going to Grow?

© 2010 Han Goes

- Mobility remains one of the most important Basic Needs for mankind
- A Living Condition, as is food
- People will never give up consuming mobility
- Will not accept any governmental intervention
- However ...
- Consumption of traditional mobility has reached it's limits
- And will rapidly change ...
  
- For rational and at least as many irrational reasons





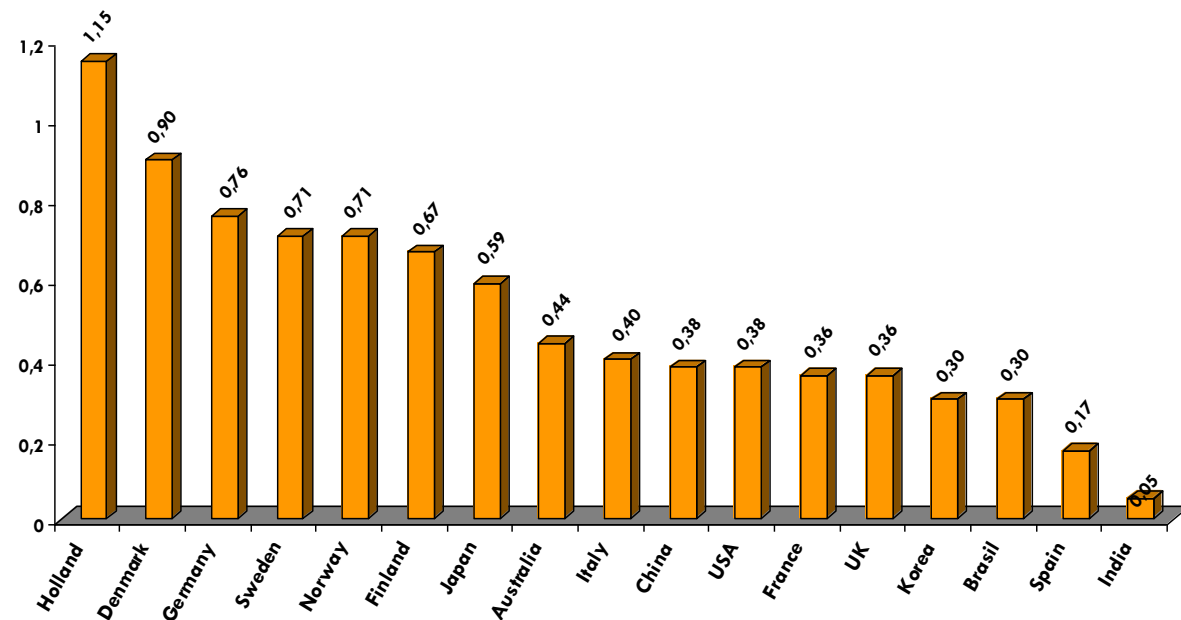
## Holland & Japan Role Models

© 2010 Han Goes

### ROLE MODELS

- Netherlands & Japan have a cycling culture
- Amsterdam is a role model and guiding example for other metropolitan areas.
- Process is already on it's way (e.g. Paris, London, Montreal, Chicago, Tokyo).

Bicycles per capita 2008





## Netherlands 2009

© 2010 Han Goes

- 16 million inhabitants
- **1,3 million bicycles** sold annually
  - of which 200.000 electric bicycles (16%)
- 18 million total bicycle park
- **400.000 cars**
- **40.000 GPT's** (gas powered two wheelers)





## Netherlands 2009

© 2010 Han Goes

- Dutch Mobility System about to implode
  - Freeways
  - Public Transport
- > 75% of all Dutch people live in urban areas
- > 75% of all traffic movements in urban areas is < 5 km.
- In some cities (a.o. Amsterdam) modal split shows new increase for bicycle mobility
- > 50% of all traffic movements
- Mental Maps define consumer's rationale for consumption of mobility:
  - Within urban area LEV 2-wheeler will become preferred means of transport
- Huge new & additional potential for LEV-mobility (2-wheels)
- In the end amount of LEV sales will largely compromise the sales of bicycles



## EU 27 2009

© 2010 Han Goes

- 500 million inhabitants
- **20 million bicycles** sold annually
  - of which 700.000 electric bicycles (3%)
- 250 million total bicycle park
  
- **20 million cars**
- **1.5 million GPT's** (gas powered two wheelers)







## Japan 2009

© 2010 Han Goes

- 120 million inhabitants
- **9 million bicycles** sold annually
  - of which 500.000 electric bicycles (6%)
- 70 million total bicycle park
- **6 million cars**
- **400.000 GPT's** (gas powered two wheelers)





## Consumption of Mobility

© 2010 Han Goes

### MOBILITY IS ABOUT TO CHANGE DRASTICALLY

#### Irrational Component

- FUN mobility
- CONVENIENCE mobility
- COMFORT mobility
- HIP & TRENDY mobility

#### Rational Component

- Clean mobility
- Efficient mobility
- Door-to-Door mobility
- Flexible mobility
- Distance adjusted mobility
- Smart mobility
- Compact mobility





## Consumption of Mobility

© 2010 Han Goes

### MOBILITY TREND

- Compact Mobility →
  - Micro Mobility →
    - 2-Wheel Mobility →
      - Eco-Mobility →
        - E-Mobility →

### LEV-MOBILITY

- Personal / Individual
- Very Light
- Agile and flexible
- Electric
- Vehicles (2-Wheels)
- Automotive styling





## What does the Consumer really want?

© 2010 Han Goes

- In densely populated areas > 75% of all traffic movements < 5 km.
- Qualitative consumer market research in Netherlands, Germany, Japan
- Therefore smart, modern, demanding consumers look for:
  - Personal & compact mobility
  - Clean mobility, that is at the same time:
    - highly functional (door to door transport)
    - fun to ride
    - “No-Sweat” fitness & exercise
  - Electric mobility
  - Modern styling (automotive)
  - Light weight (< 30 kg.)
  - Easy to manoeuvre
  - Easy to handle
  - Easy to park
  - Easy to lift
  - Easy and flexible to use
  - Dedicated, adjusted to the distance to be covered



## What does the Consumer really want?

© 2010 Han Goes

### PHYSICAL SPECS

- Footprint  $\leq 1 \text{ m}^2$
- Weight  $\leq 30 \text{ kg}$ . (handling / manoeuvrability)
- Door to door flexibility (parking / lifting)
- Range  $\geq 40 \text{ km}$ . (sufficient for 1 full day trips)
- Max. speed less important (25 ~ 30 km./h.)
- Max. torque more  $\geq 40 \text{ Nm}$ .
- Max. power  $\geq 250 \text{ Watt}$
  
- → LEV 2-Wheelers



## Consumer related Future Developments for LEV's

© 2010 Han Goes

- 75% of all traffic movements in metropolitan areas is within a range of 5 to 10 km.
- Consumers will clearly and massively opt for
- Light Electric 2-Wheelers in 3 overlapping categories:
  - 1. Pedelecs =**
    - Pedal Assist, < 25 km./h., < 250 Watt
  - 2. Power-On-Demand E-bikes =**
    - Pedal & Throttle Assist, < 32 km./h., < 500 Watt
  - 3. Light Electric Scooters =**
    - Throttle Assist, < 35 km./h., < 1 KWatt



# Consumer related Future Developments for LEV's

© 2010 Han Goes

## 1. PEDELECS = Pedal Assist, < 25 km./h., < 250 Watt





## Consumer related Future Developments for LEV's

© 2010 Han Goes

### 2. POWER-ON-DEMAND E-BIKES = Pedal & Throttle Assist, < 32 km./h., < 500 Watt







## Consumer related Future Developments for LEV's

© 2010 Han Goes

3. LIGHT ELECTRIC SCOOTERS = Throttle Assist only, < 35 km./h., < 1KWatt





## Europe's (EU 27) long term potential for LEV's

© 2010 Han Goes

### LONG TERM 2020 – 2025

- Smart consumer use: “distance dedicated” type of mobility consumption
  - **15 million bicycles annually sold (mainly trip < 5 km.)**
  - **15 million 2-Wheel LEV's annually sold (mainly trip < 15 km.)**
  - **15 million cars annually sold (mainly trip > 15 km.)**
  - *\*\*\* General increase cycling and 2-wheeler usage included!!!*
  - *\*\*\* Consumers changing over from Gas Powered 2-wheelers to LEV-2-Wheelers included!!!*



## Societal Relevance & Urgency

© 2010 Han Goes

### WORK IN PROGRESS

- Drive Train systems
- Smart & elegant frame constructions (compact, foldable)
- Energy technology & storage
- Consumer Interfacing & Fuzzy Logic
- Traffic Safety & Infrastructure (parking)
- Bike sharing and/or battery sharing systems



## Work in Progress

© 2010 Han Goes

### EMBEDDED APPLIED RESEARCH

- Italian Universities' close cooperation with Italian Motorcycle Industry
- University of Padova: V. Cossalter
- Politecnico di Milano: S. Savaresi



## Work in Progress

© 2010 Han Goes

### THESIS

- Hen & Egg (no questions, no offerings)
  - academic “Bicycle” chair would be an incentive
- Lack of real bike industry in Western World
- Success rate is very low
- Bicycles are “low tech” and NOT sexy to research
- Incremental product development, what is there to break through?



## Work in Progress

© 2010 Han Goes

THANK YOU FOR YOUR TIME & ATTENTION