



The Swedish Green Train: Maximum comfort and efficient use of space

Karl Kottenhoff
PhD

Royal Institute of Technology, Stockholm

What is green in the Green Train



Shorter travel times attracts passengers from air

Reduced costs attracts passengers

Attractive passenger environment

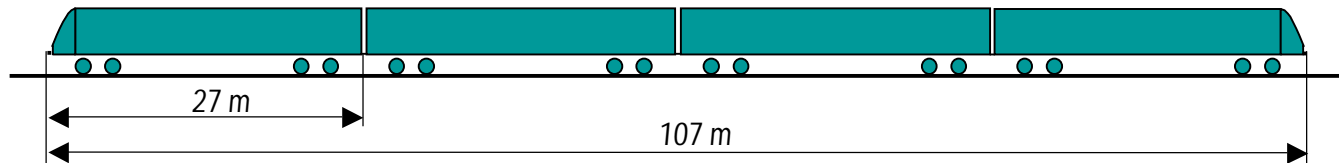
Short train with low weight reduces energy use

Is designed in parallel to the "Green Car"

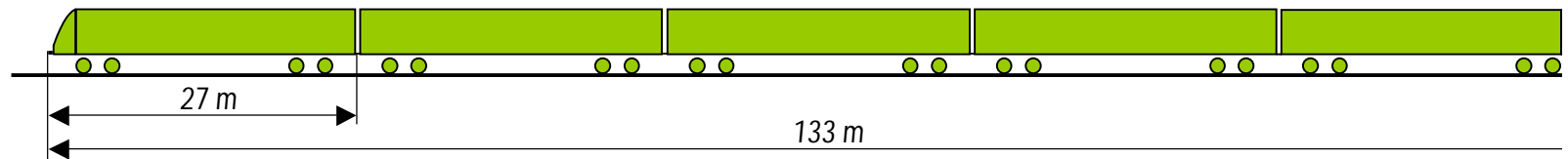
Trains with about 310 seats



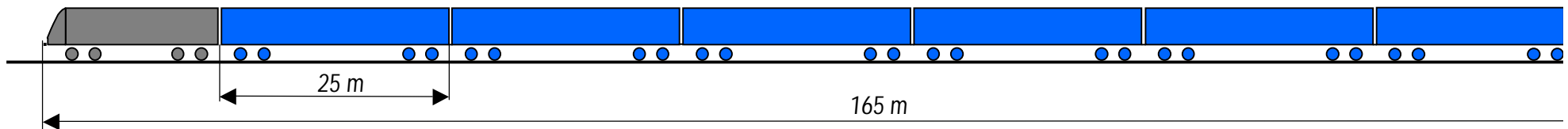
GTW: the Green Train with wide body



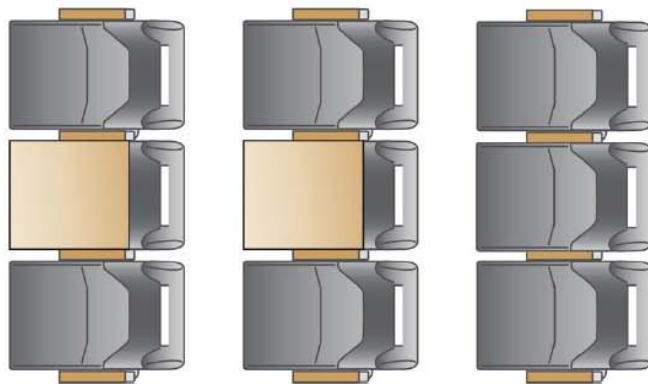
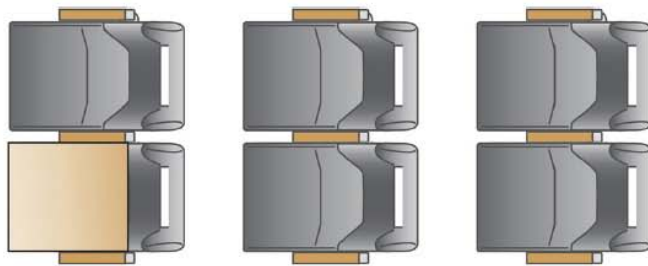
GTC: the Green Train with continental body



X 2000



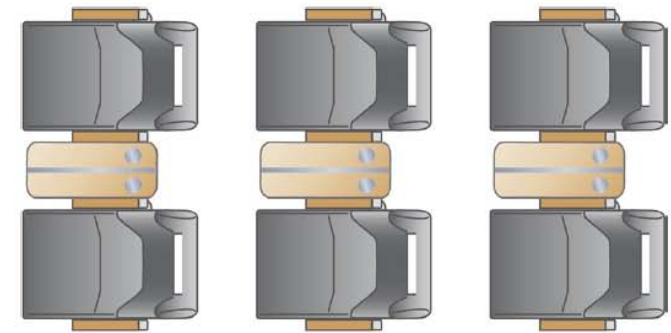
Use of the wide body



Layouts: 1st class,

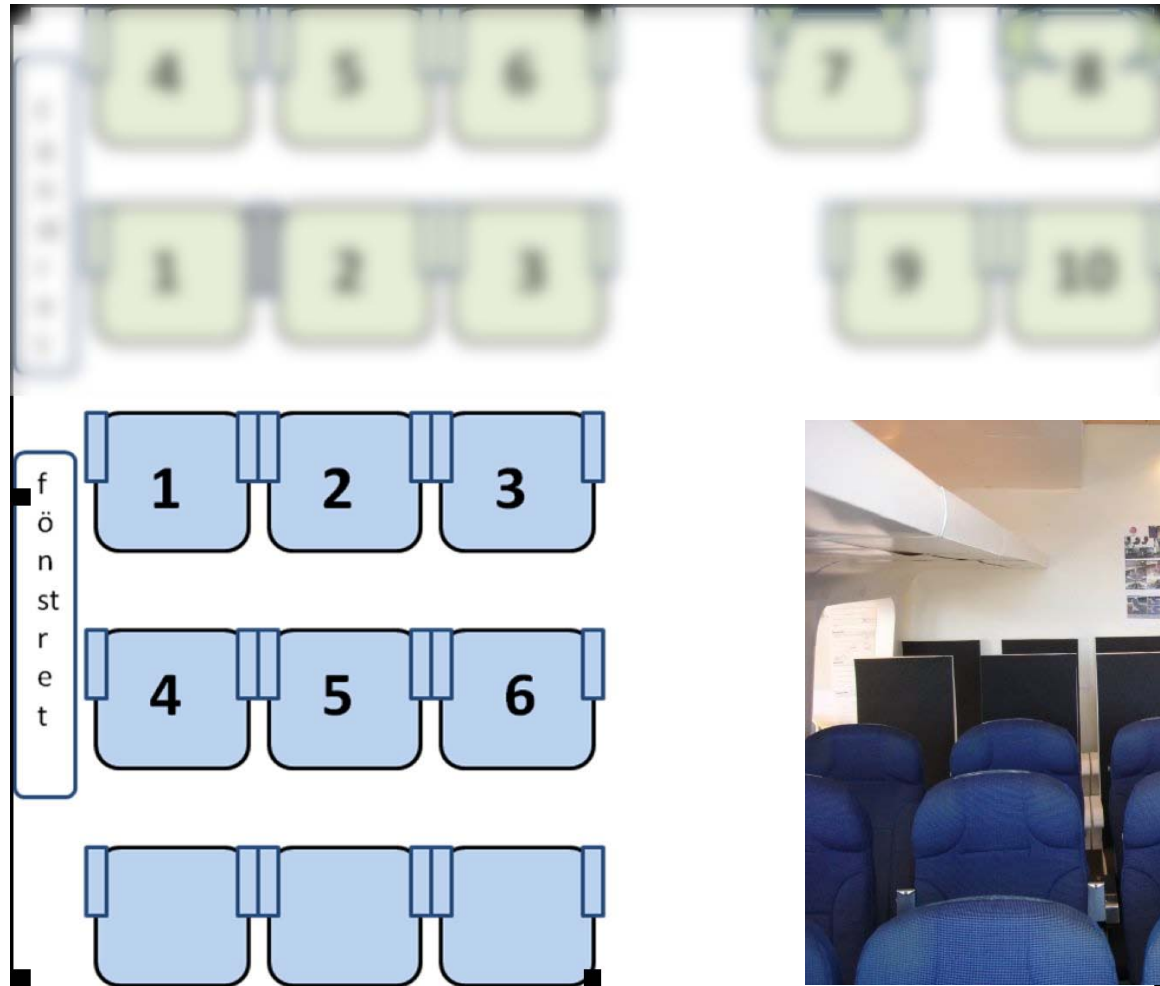
2nd class+

2nd class



Possible layout in 1st Class with small tables.

Experimental seating in the Green Train mock up



What we wanted to know

- How can one make 2+3 seating feeling roomy and comfortable?
- Can passengers sit comfortably, roomy and with privacy?



Experimental design for the test



Factors (attributes)

- Seat spacing (83/93 cm)
- Height under seat in front (22/30 cm)
- Armrest width(45/58 cm)
- Own backrest folded
- Backrest in front folded
- Sitting in middle seat
- Sitting by the window

Your own armrest – seat width

Downfolded armrests –
narrow seat (45 cm)



Upfolded armrests –
wide seat (55 cm)



We made a statistical experiment with 12 versions of seats and 60 test persons



Place no 2

Please rate the feeling of comfort in this seat:

Very un-comfortable Very comfortable

Please rate the feeling of roominess:

Very narrow Very roomy

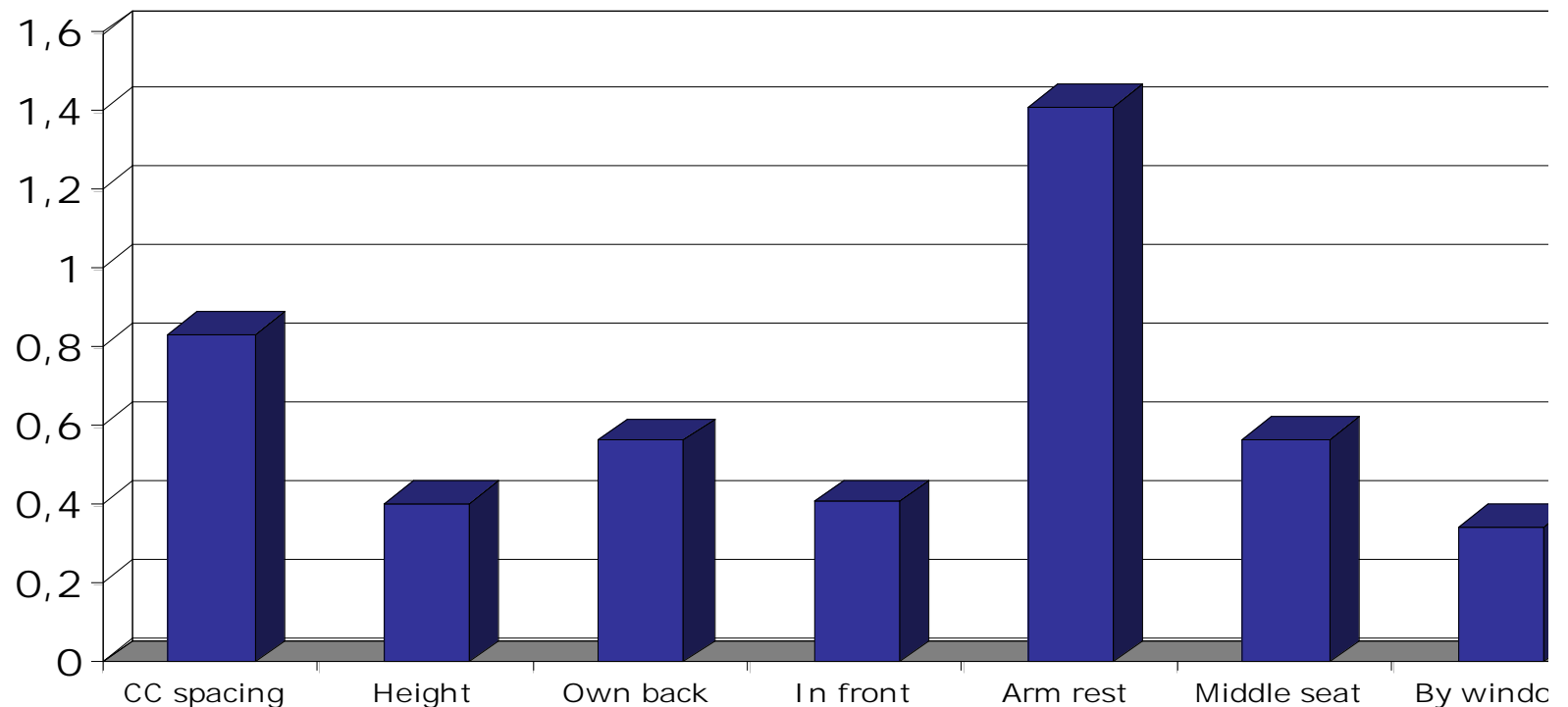
Is your space big enough? Yes No

Please rate your feeling of privacy

Very low Very good

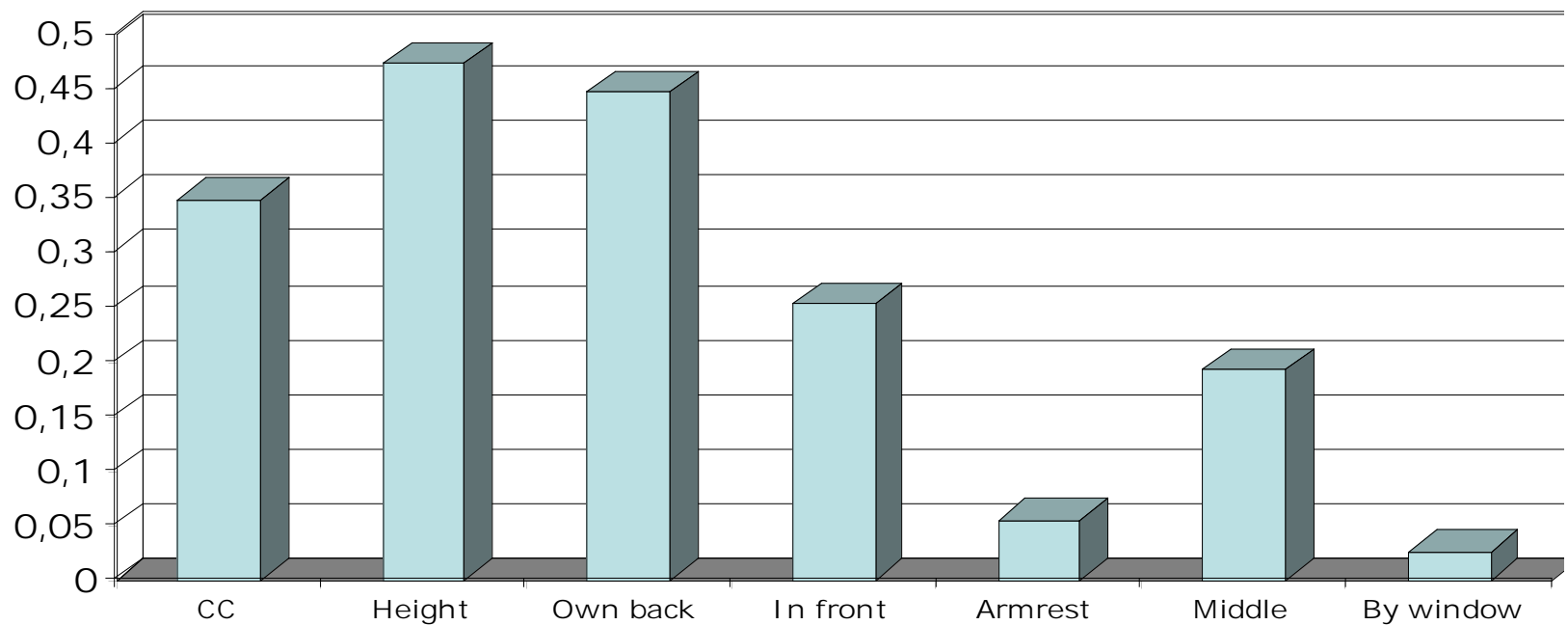
Reasons for the perceived space

- Upfolded armrests in the middle seat increase the roominess perception (1,4 points)
- A 10 cm bigger spacing is important (0,8 points)
- If you recline your own seatback your feeling of space increases (0,6). The opposite for the seat in front of you.



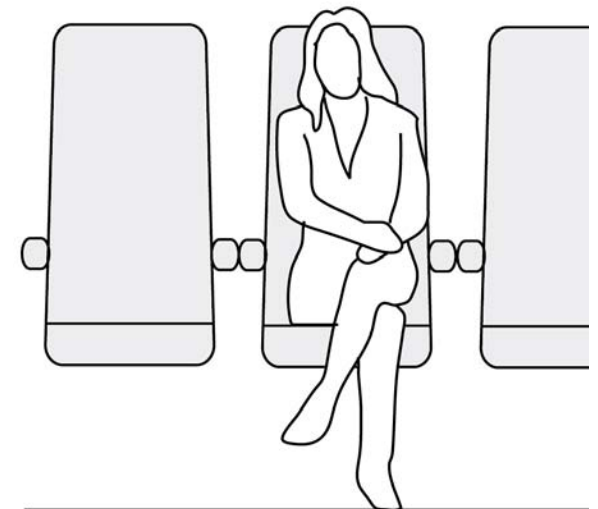
Reasons for the perceived comfort

- The perception of comfort relies mostly on:
 - the height under the seat in front of you (for your legs) (0,5)
 - if your seatback is reclined (0,45)
 - 10 cm legroom (0,3)

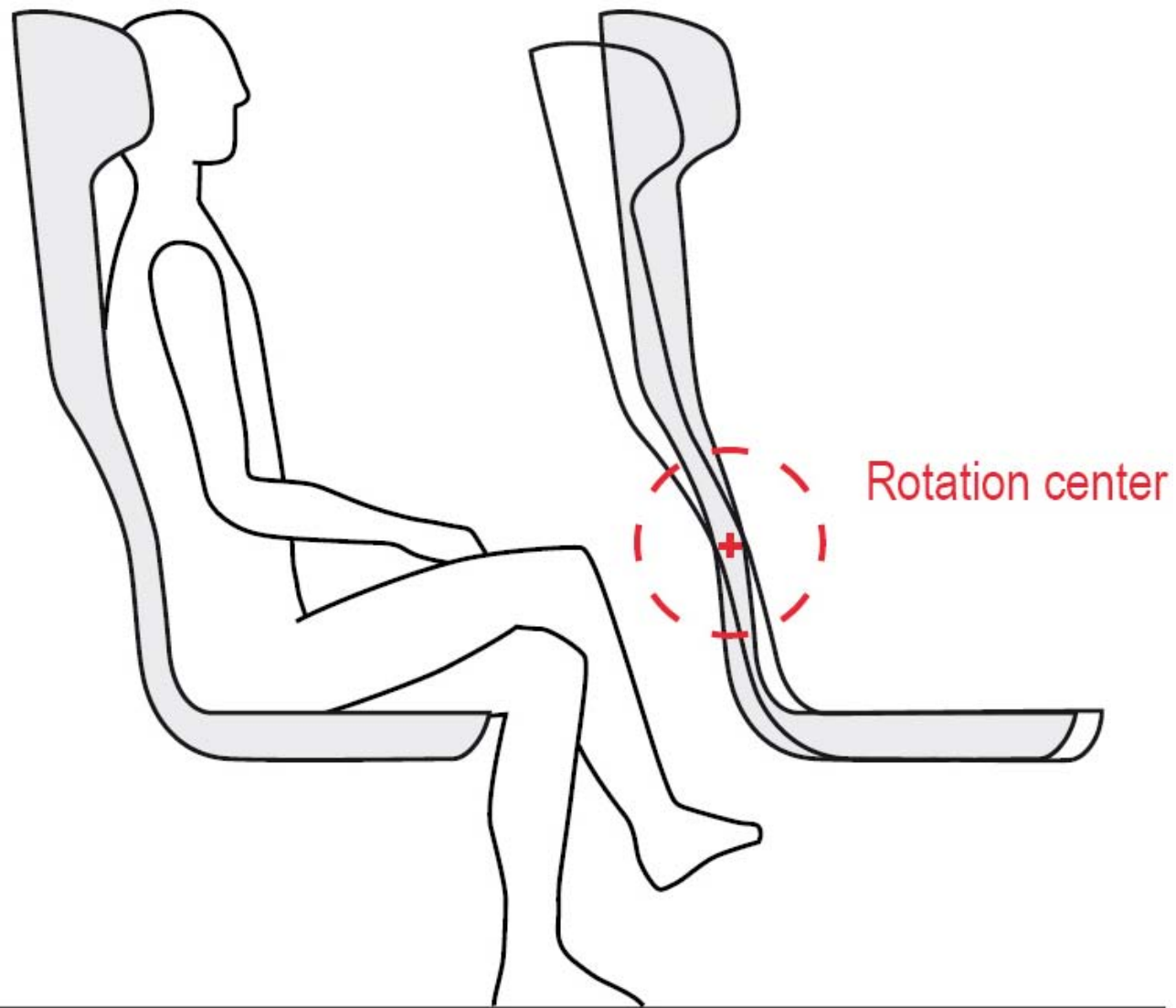


More about the middle seat

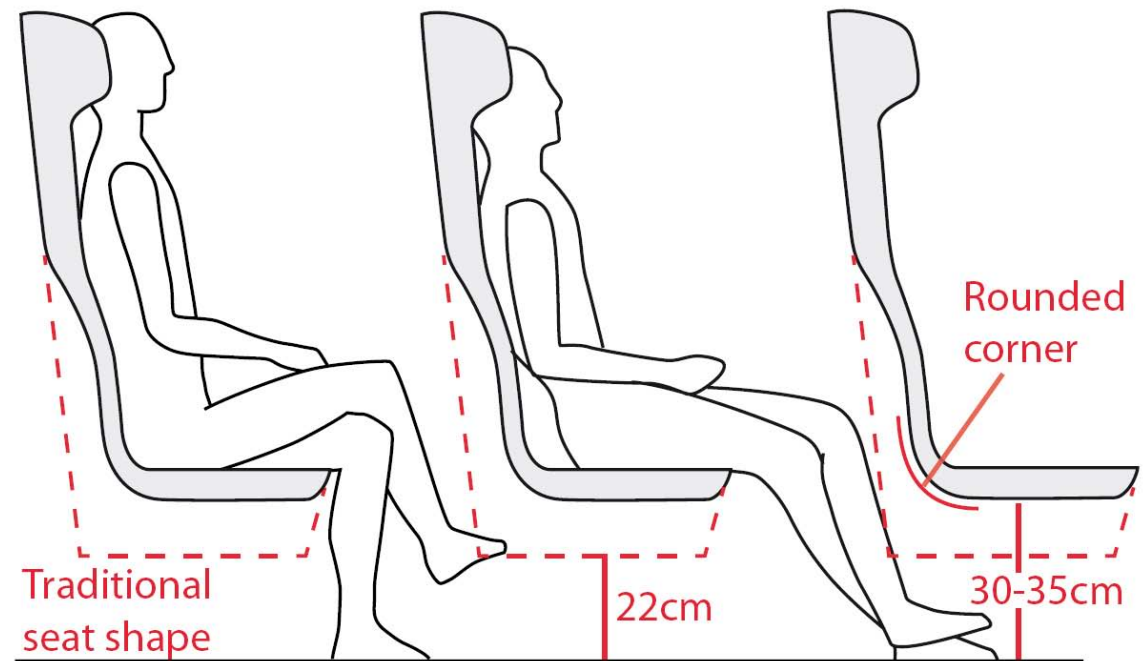
- A bigger seat spacing with more legroom combined with a reclineable seat give a feeling of space
- Our best middle seat version was appreciated by more than 70% of the respondents
- The middle seat gives low privacy but making the middle seat wider may compensate



Intelligent seat adjustment



Summary



- Space efficient seat (≥ 30 cm height under seat + rounded corner + thin seatbacks + wide enough + intelligent mechanism)
- Possible seat spacing (2nd cl) is then
 - 86 cm in two seat arrangement
 - 90 cm in three seat arrangement (instead of 95-100 cm as in Swedish X2000)