



**VIENNA** 2018



A digital era for transport

solutions for society, economy and environment

# A mixed-methods approach to derive vehicle concepts for urban mobility

Gerhard Kopp, Institute of Vehicle Concepts, DLR, Germany

Matthias Klötzke, Institute of Vehicle Concepts, DLR, Germany

Laura Gebhardt, Institute of Transport Research, DLR, Germany

Horst E. Friedrich, Institute of Vehicle Concepts, DLR, Germany

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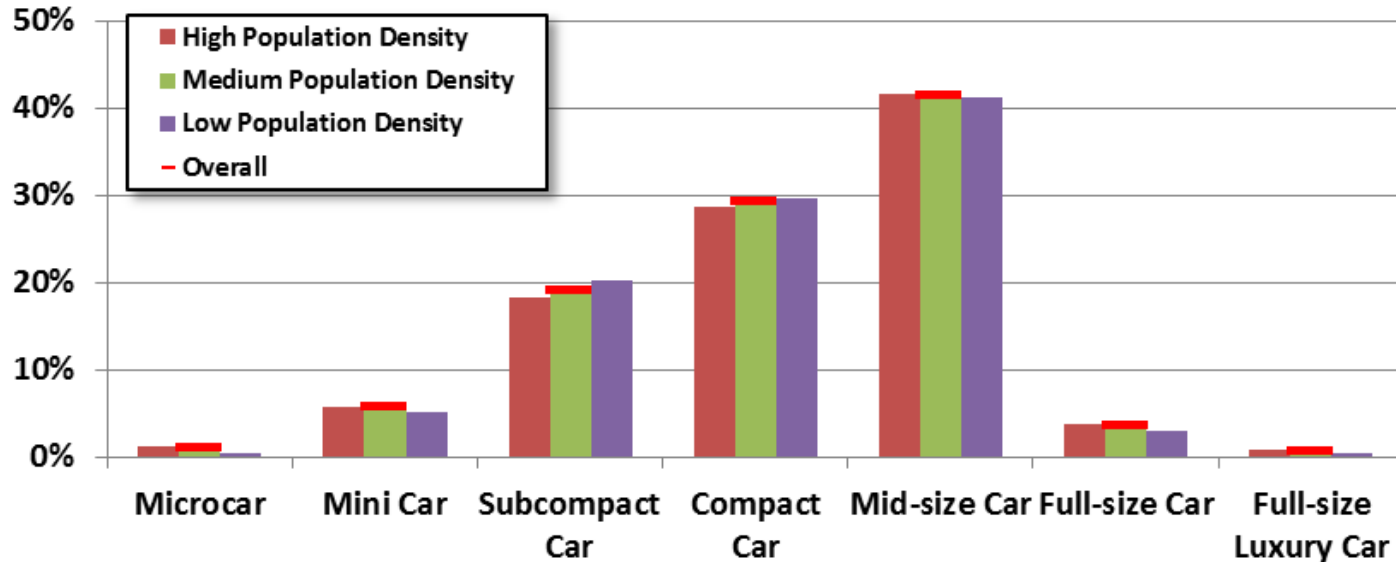
Together with:



# Initial situation



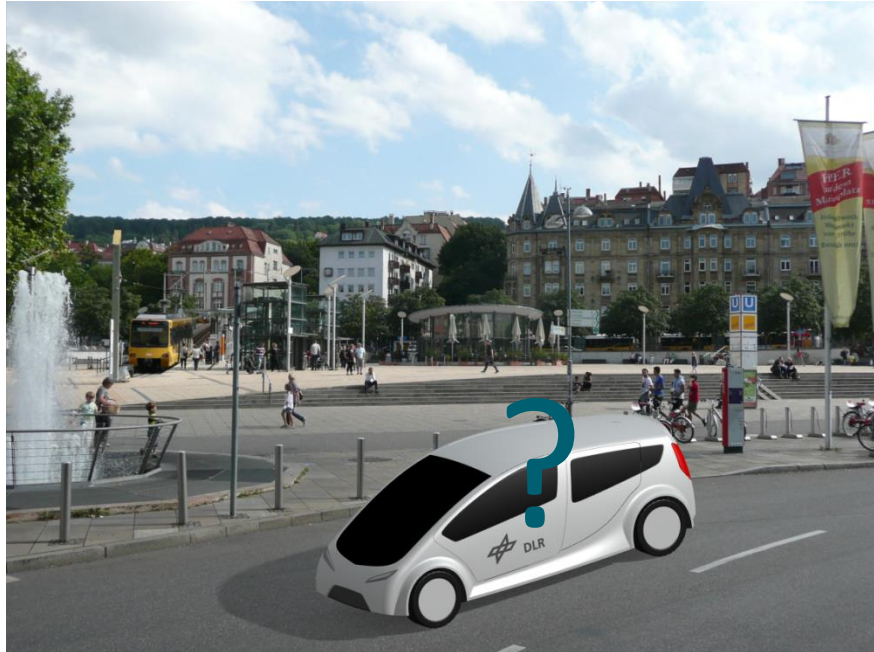
Analyze of the proportion of vehicle classes according to population density\*



\*Proportion of vehicle classes in new registrations for M1 vehicles in Germany 2016 according to population density  
(Source: Own description according to approval data; M. Klötzke)

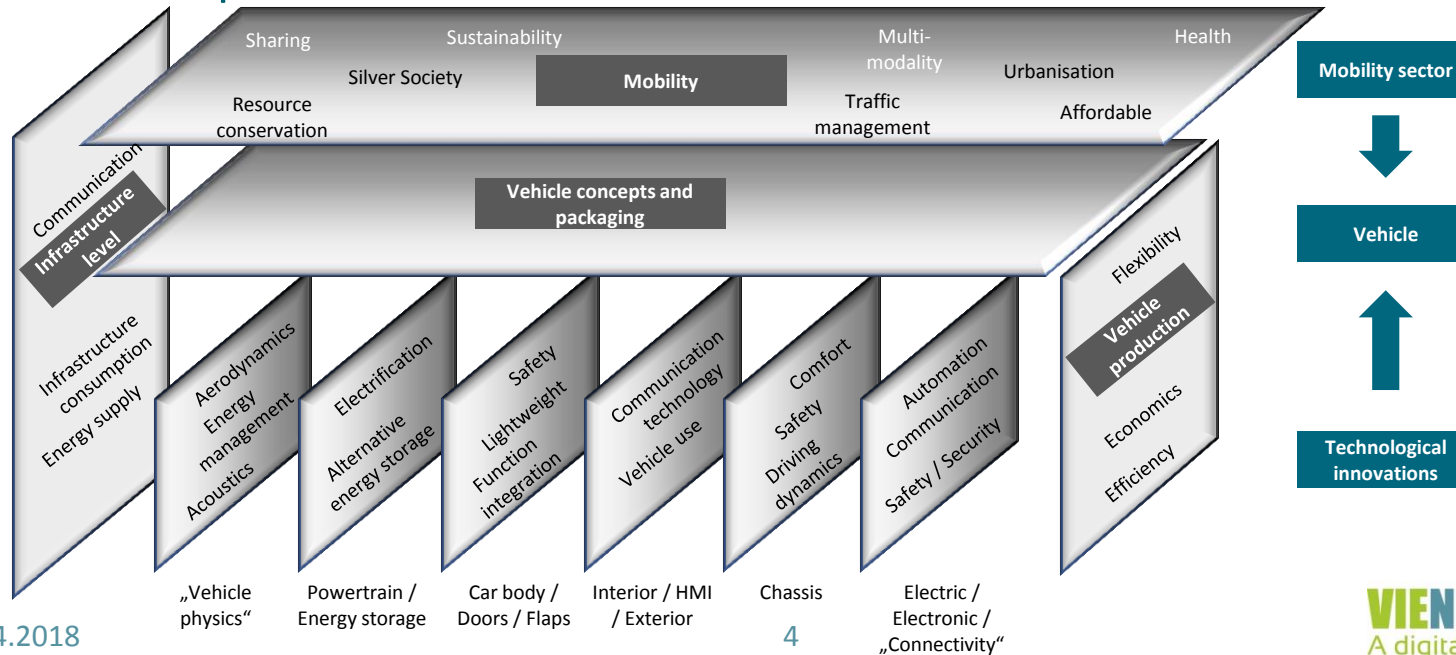
# Research question

- Why are these vehicles used?



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- Which requirements must vehicles fulfil in urban areas?

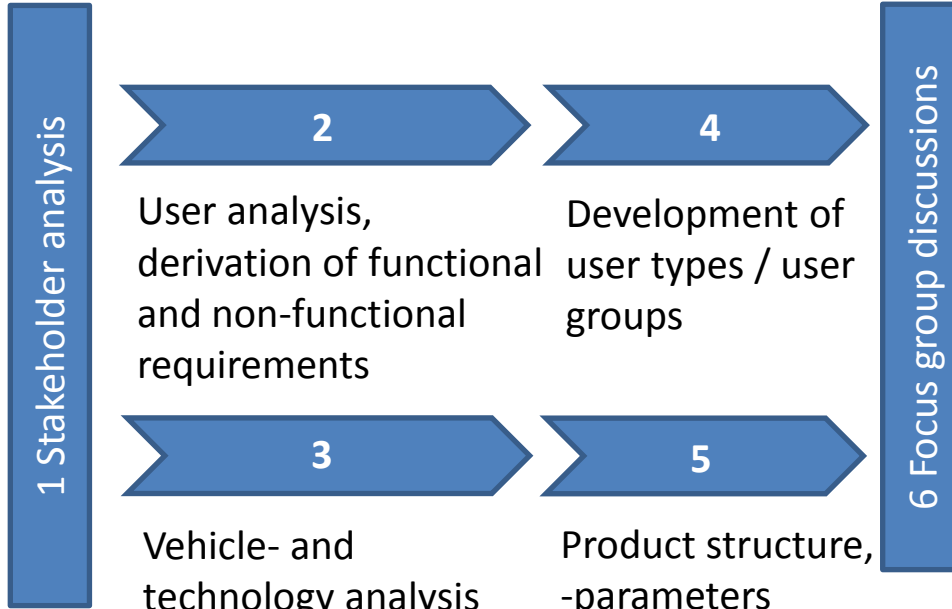


# Research question

- Why are these vehicles used?
- Which requirements must vehicles fulfil in urban areas?
- How can a mixed-methods approach be used to derivate vehicle concepts for urban mobility from the user's point of view?



# Methodological approach

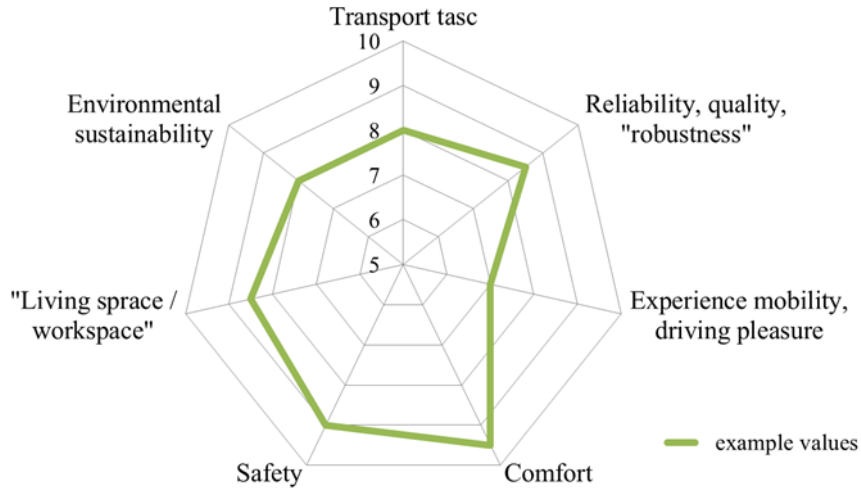


# (Functional) Requirements (2)

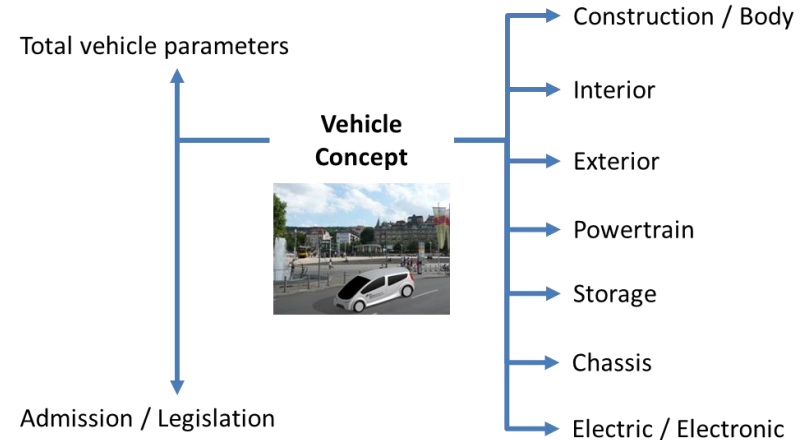
## Vehicle analysis and parameters (3, 5)



### (Functional) Requirements





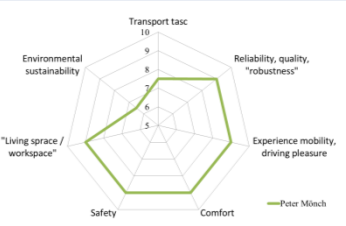
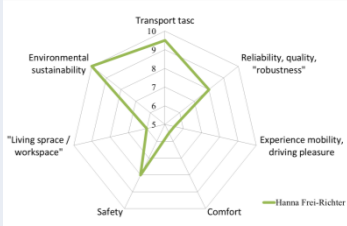
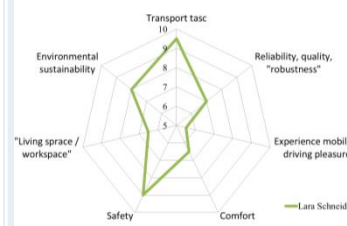
### Vehicle Parameters





# User types / Focus groups (4, 6)

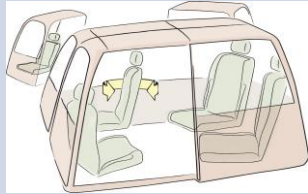

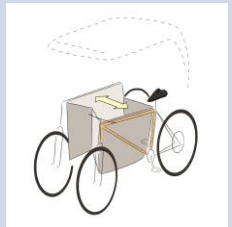
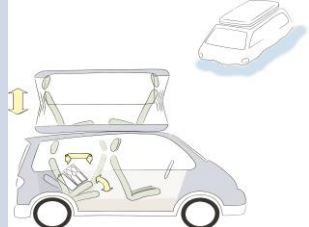
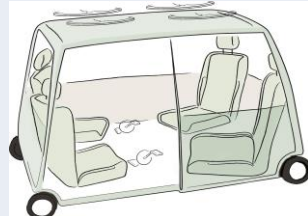
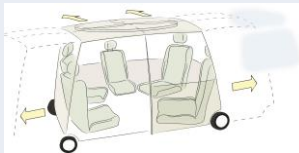




User Group	The young inter-modal	The (all-purpose) car users	The urban bike lovers	The multi-modal
<b>Requirement</b>	<p><b>Dimensions:</b> Small / Adaptable</p> <p><b>Capacity:</b> 2 - 6 persons big luggage space</p> <p><b>Parking Space:</b> Solution: Sharing</p>	<p><b>Dimensions:</b> Adaptable</p> <p><b>Capacity:</b> 1 - 2 persons + luggage space or add. persons</p> <p><b>Parking Space:</b> Small</p>	<p><b>Dimensions:</b> Very small</p> <p><b>Capacity:</b> 1 - 2 persons</p> <p><b>Parking Space:</b> Very small</p>	<p><b>Dimensions:</b> Adaptable</p> <p><b>Capacity:</b> 1 – x persons</p> <p><b>Parking Space:</b> Solution: Sharing</p>
				

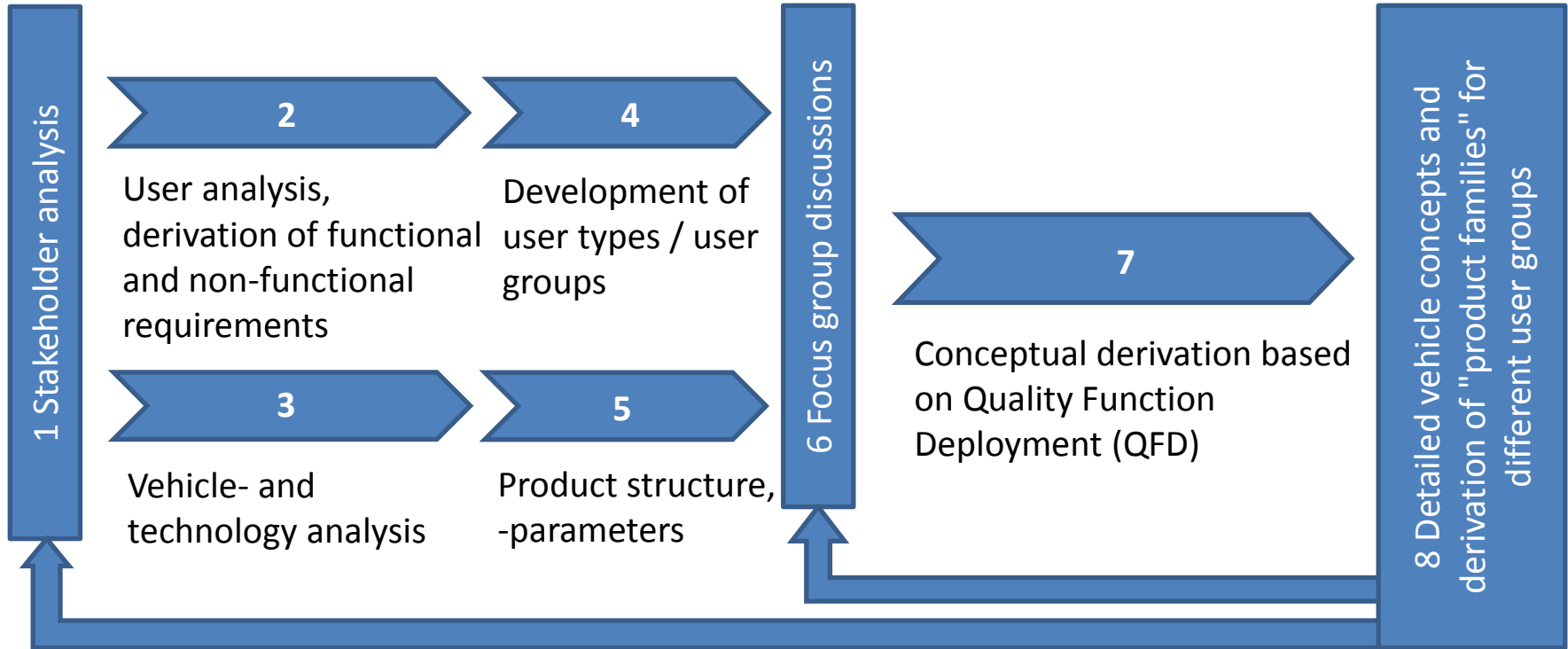


# User types / Focus groups (4, 6)



User Group	The young inter-modal	The (all-purpose) car users	The urban bike lovers	The multi-modal
Concept idea from focus group 1				
Concept idea from focus group 2				

# Methodological approach



# QFD and vehicle concepts (7, 8)



Length,  
width, height

Doors and  
flaps

Range

Wheels,  
Turning circle

Interior  
layout (seats,  
trunk)

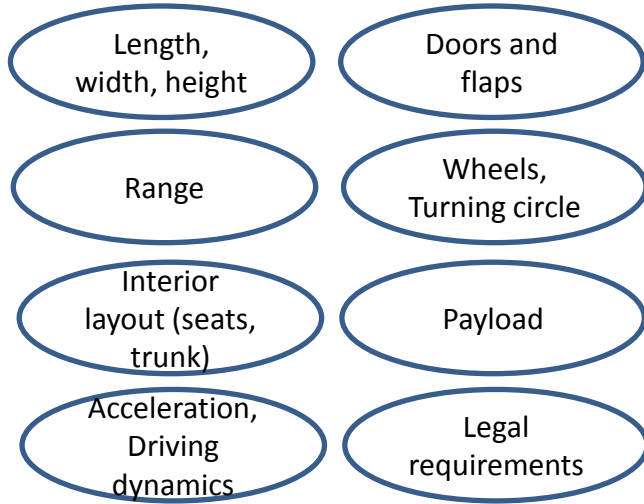
Payload

Acceleration,  
Driving  
dynamics

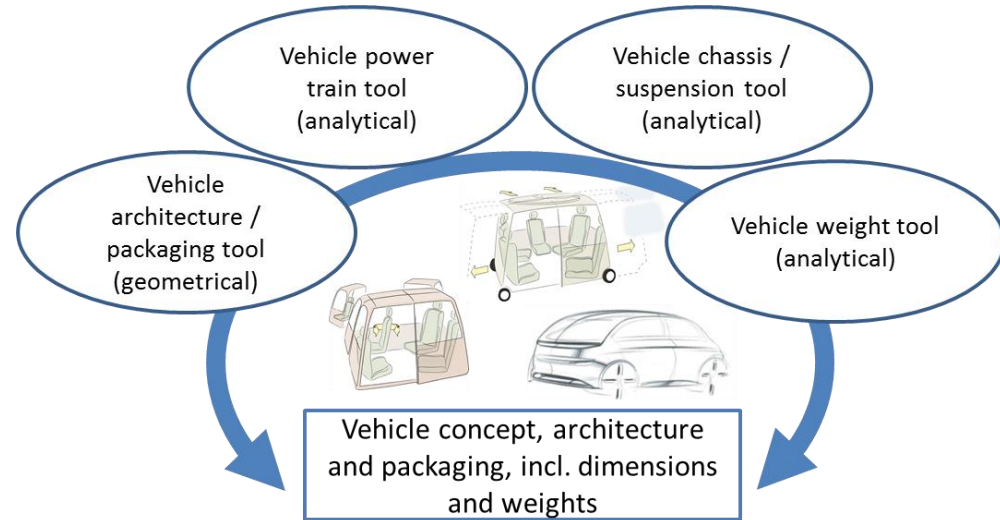
Legal  
requirements

Quantifiable criteria and requirements from  
user, infrastructure, regulation, operation ...

# QFD and vehicle concepts (7, 8)



Quantifiable criteria and requirements from user, infrastructure, regulation, operation ...



# QFD and vehicle concepts (7, 8)



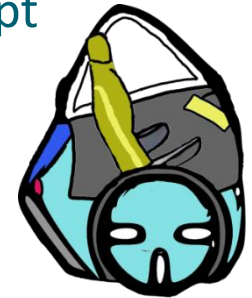
- The young inter-modal: example of possible vehicle concept

Hop-on – hop-off  
variant



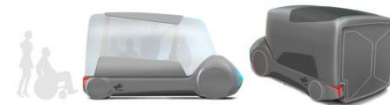
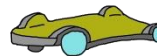
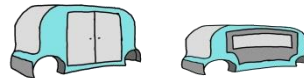
NGC UMV

- The (all-purpose) car users: example of possible vehicle concept



- The multi-modal: example of possible vehicle concept

swap body



MAUDE

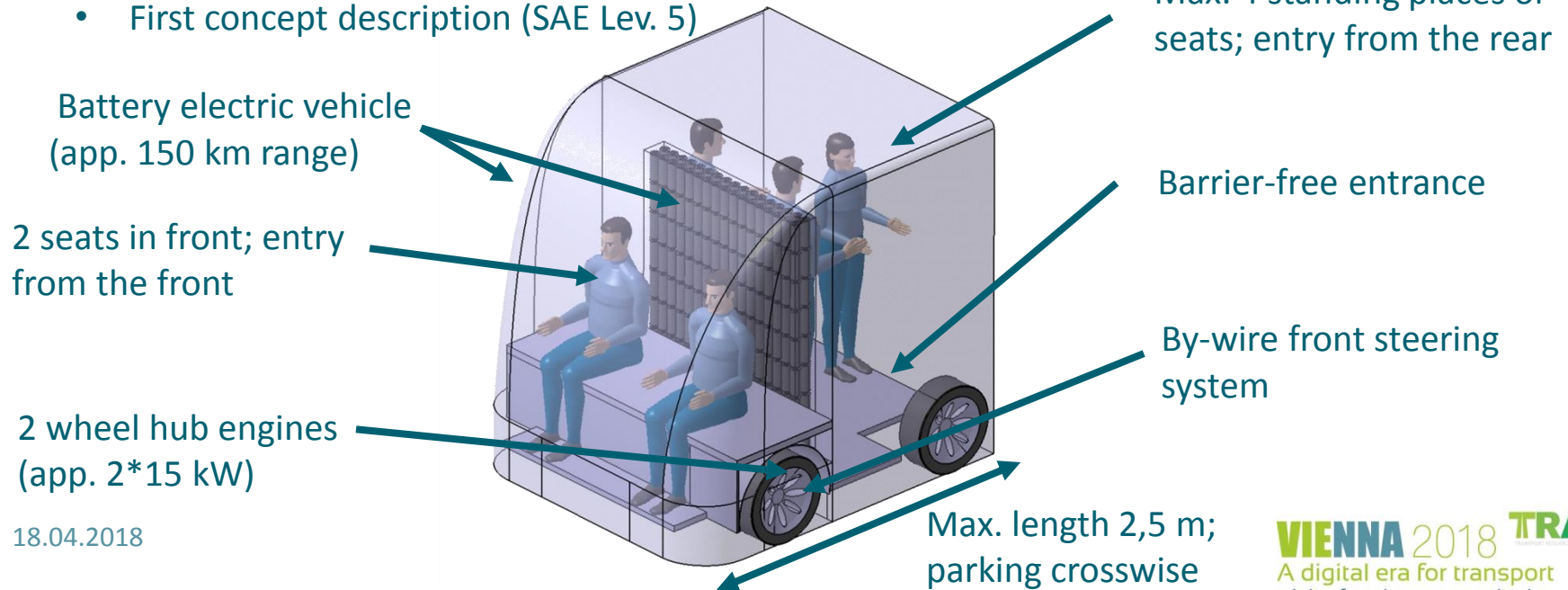
Picture source: DLR, Institute of vehicle concepts

# QFD and vehicle concepts (7, 8)



## ○ The young inter-modal: example of possible vehicle concept

- Hop-on – hop-off variant
- First concept description (SAE Lev. 5)



18.04.2018

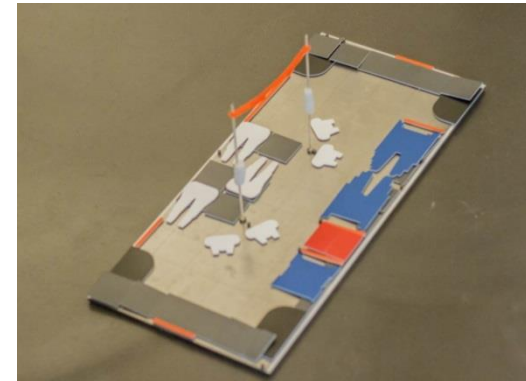
# Transfer of the approach to concepts for public transport

## ○ User types

- Senior citizens
- Mobility-restricted people
- Regular bus users
- Regular private car users



## ○ Concept ideas from the groups

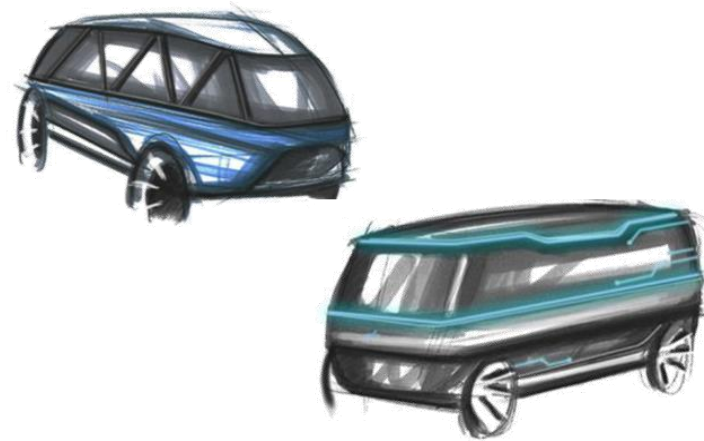




# Transfer of the approach to concepts for public transport



- User types
  - Senior citizens
  - Mobility-restricted people
  - Regular bus users
  - Regular private car users
- Examples of possible vehicle concept
  - Max. 12 seats
  - Barrier-free entrance
  - Battery electric vehicle
  - SAE Lev. 5
  - ...



# Transfer of the approach to concepts for public transport

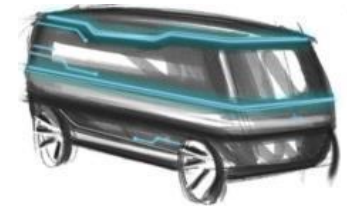


## ○ Vehicle Concept

**Topic vehicle architecture**

z. B. L101

**Topic body**



**Topic interieur / exterieur**

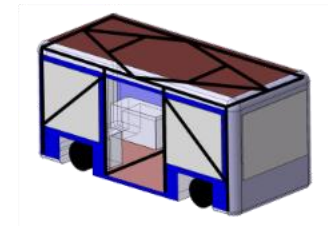
**Topic Powertrain / Chassis**

$$W_x = \left( F_R + K_1 \cdot \overset{0}{\nearrow} + K_2 \cdot v_{eff}^2 \right) \frac{x_{tot}}{\eta_{tot}} + \frac{m \cdot g \cdot h_x}{\eta_{tot}} - \frac{m \cdot g \cdot h_x}{\eta_{tot}} \quad \text{nur bei Re-Auspersion}$$

$$+ BE \cdot \frac{x_{tot}}{100km} \cdot \frac{\lambda \cdot m \cdot v_{eff}^2}{2} \left( \frac{1}{\eta_{tot}} - \frac{1}{\eta_{tot}} \right) + P_{\overset{0}{\nearrow}} T$$

→ Masse Batterie

→ Volumen Batterie



Source: DLR, Institute of vehicle concepts and HS Esslingen

# Conclusion and outlook



- A systematic approach was presented about how future vehicle concepts for urban mobility can be derived in conjunction with a wide range of requirements and influencing factors.

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- A systematic approach was presented about how future vehicle concepts for urban mobility can be derived in conjunction with a wide range of requirements and influencing factors.
- This approach is characterised in particular by the strong involvement of the user with the help of the persona method and the use of the QFD approach for the derivation of new vehicle concept.

# Conclusion and outlook



- A systematic approach was presented about how future vehicle concepts for urban mobility can be derived in conjunction with a wide range of requirements and influencing factors.
- This approach is characterised in particular by the strong involvement of the user with the help of the persona method and the use of the QFD approach for the derivation of new vehicle concept.
- By utilising the application of the methodology in the area of private car use and the derivation of demand-oriented bus concepts, a systematic addition to the product development process could be presented.



## Contact

Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) - Institut für Fahrzeugkonzepte  
Abteilung Fahrzeugarchitekturen und Leichtbaukonzepte  
Pfaffenwaldring 38-40, 70569 Stuttgart, Germany

Dr.-Ing. Gerhard Kopp  
Gruppenleiter Leichtbaukonzepte und Methoden Straßenfahrzeuge  
Phone 0711 6862-8307, [gerhard.kopp@dlr.de](mailto:gerhard.kopp@dlr.de), [www.DLR.de](http://www.DLR.de)