DEPLOYMENT SCENARIOS FOR FIRST/LAST-MILE OPERATIONS WITH DRIVERLESS SHUTTLES

Scenarios formulation based on literature review and stakeholder survey

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THE FIRST/LAST-MILE PROBLEM

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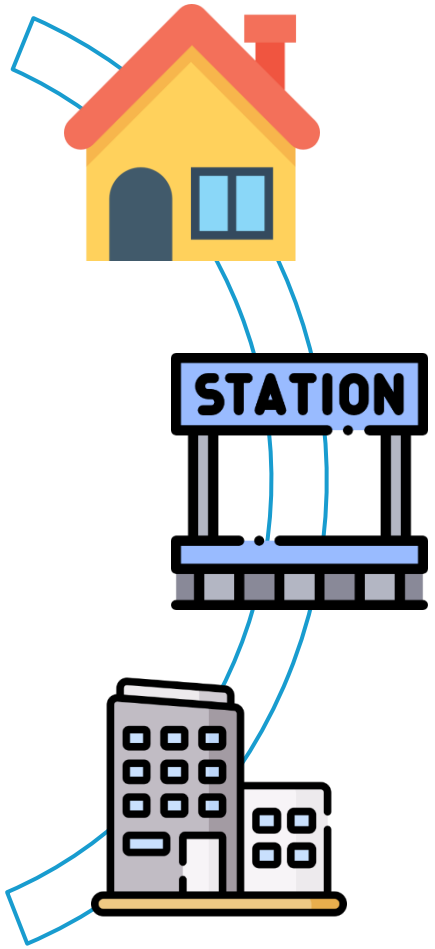


DRIVERLESS SHUTTLES

Low operating speed

- 15 – 25 km/h

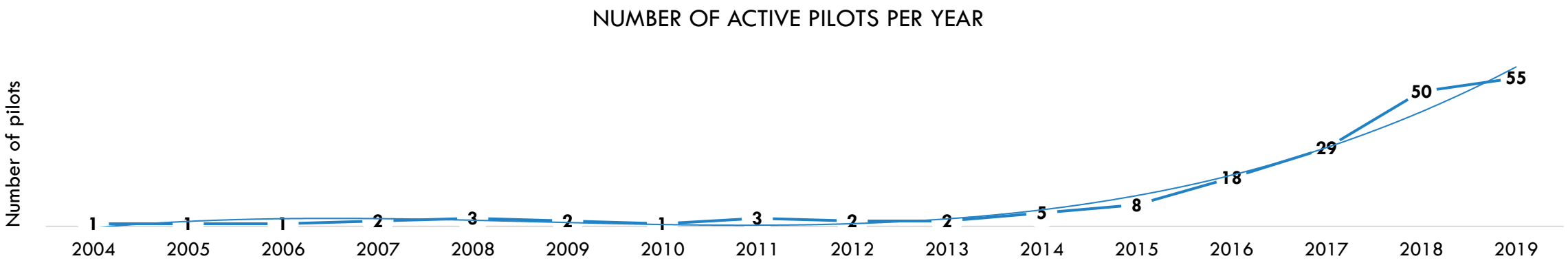
Small passenger capacity

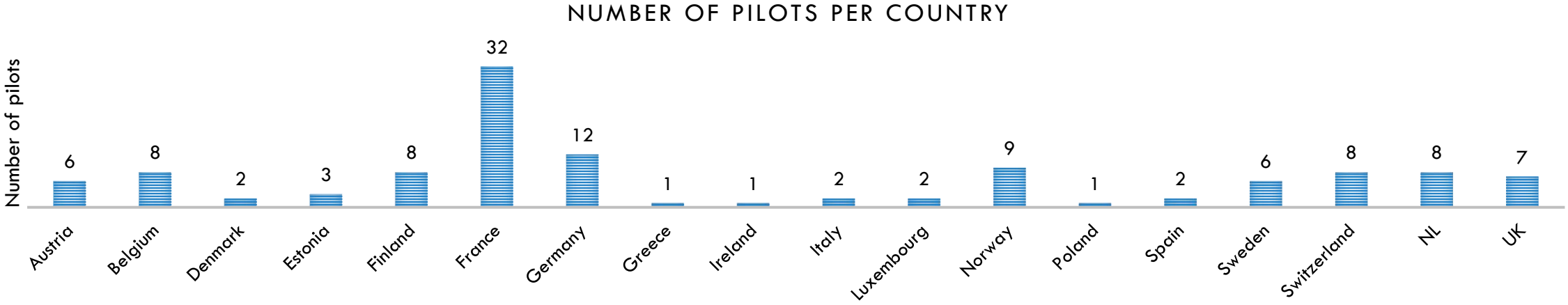
- Between 8 and 12 pax

SAE automation level 4+

- Driver-less operations
- No user interfaces
- No driver engagement
- Limited ODD

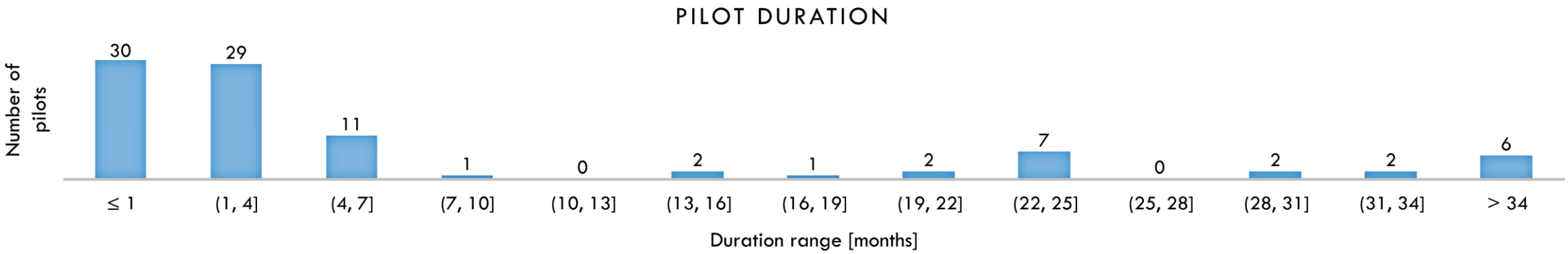
FROM PILOTS…





https://www.researchgate.net/publication/339916105_Automated_Buses_in_Europe_An_Inventory_of_Pilots_version_10

FROM PILOTS… TO IMPLEMENTATION

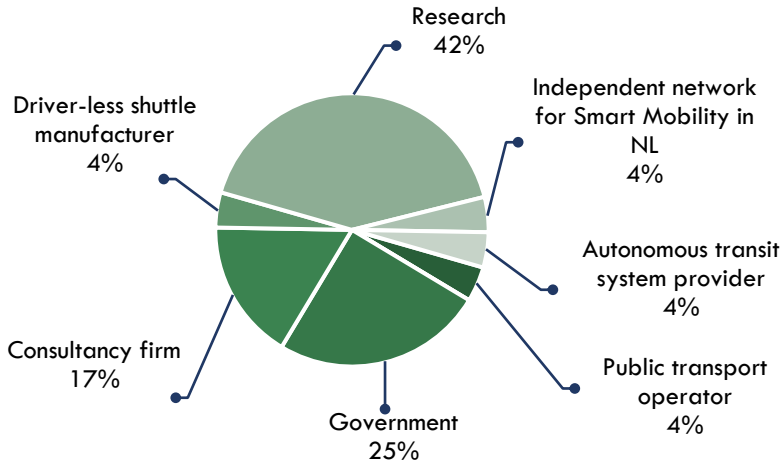


- Interest in bringing forward these pilots
- Goal: Analyse alternative scenarios
  - Infrastructure design
  - Operational design
  - Operational areas
  - Type of supervision

https://www.researchgate.net/publication/339916105_Automated_Buses_in_Europe_An_Inventory_of_Pilots_version_10

A STEP-WISE APPROACH

Background of respondents



Description of the scenario field

- What: Description of the topic and formulation of the problem statement
- How: Literature study

Key factors and driving forces

- What: Definition of key factors and driving forces
- How: Literature study

Development directions

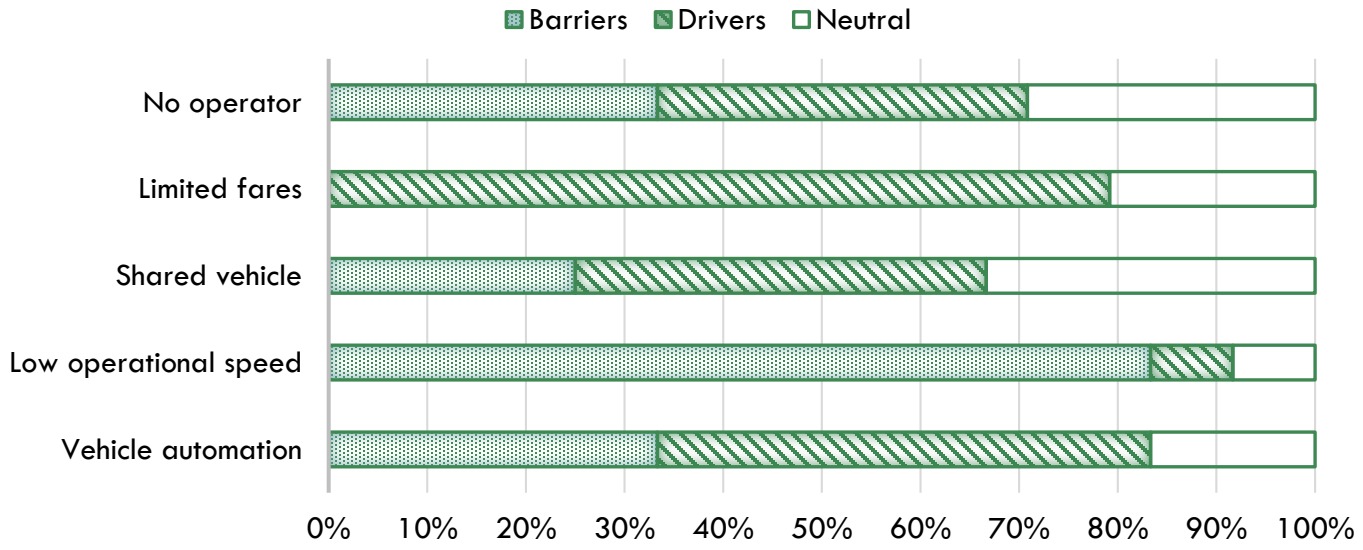
- What: Analysis of each key factor and definition of their characteristics
- How: Experts interviews

Scenarios formulation

- What: Combination of key factors and definition of their characteristics
- How: Experts interviews

DEVELOPMENT DIRECTIONS

- Drivers and barriers for driverless shuttle integration



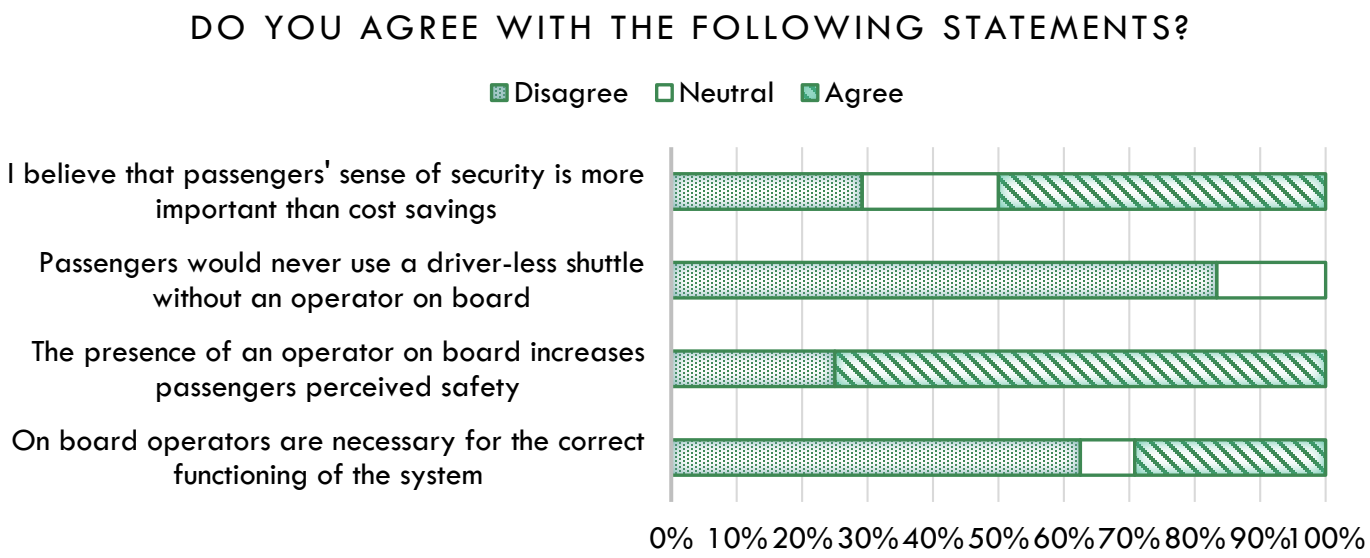
Biggest drivers
- Limited fares
- Vehicle automation

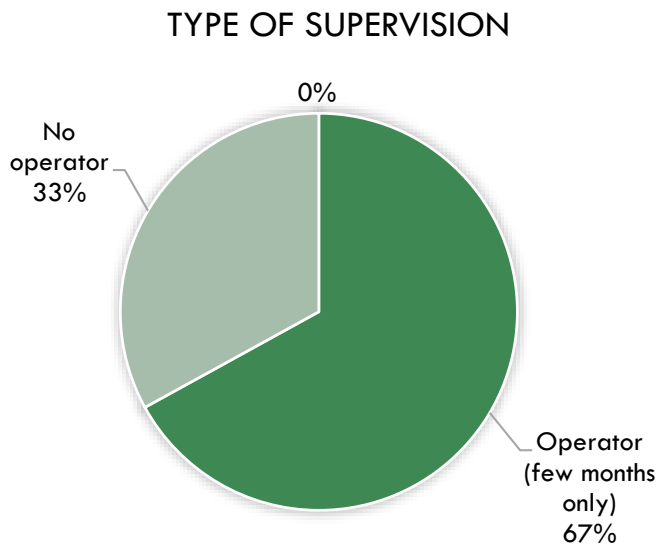
Biggest barrier
- Low operational speed

Not relevant
- No operator
- Shared vehicle

DEVELOPMENT DIRECTIONS

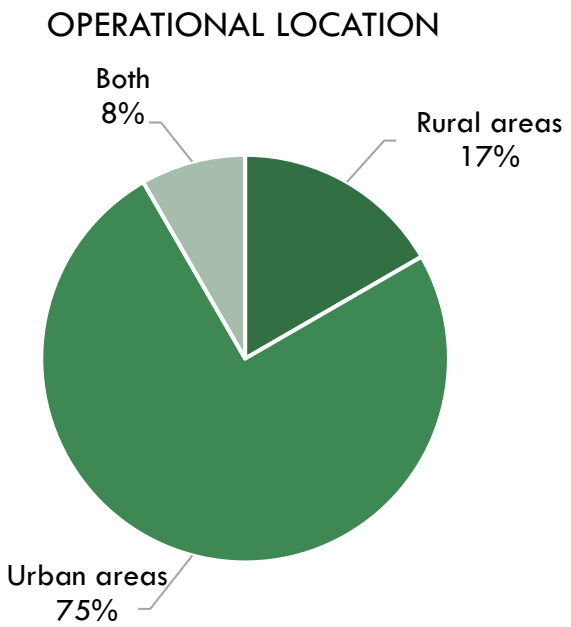
- Type of supervision





DEVELOPMENT DIRECTIONS

- Operational location

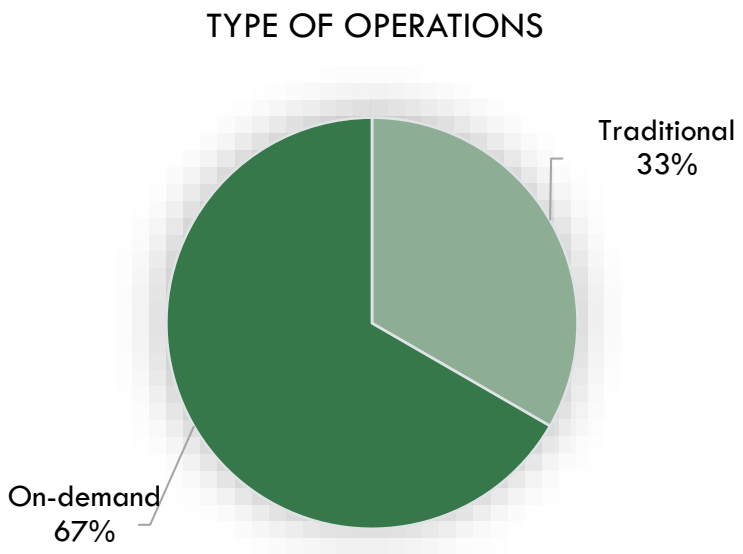


	Benefits	Challenges
Urban areas	Flexibility	Complicated traffic situation
	Reduced congestion and emission	Space on roadways
	Option for high intensity PT	Perceived safety
	Reduced costs	Public acceptance
	More options for (especially) egress	Competition with walking and cycling
	Improved comfort and accessibility	Create and efficient multimodal node

	Benefits	Challenges
Rural areas	Less operational costs	Low demand
	Alternative to private vehicles	Public acceptance
	Accessibility	Low speed compared to usual flow
	Increased mobility	Reliability
	Alternative for low quality PT areas	Many charging stations

DEVELOPMENT DIRECTIONS

- Type of operations

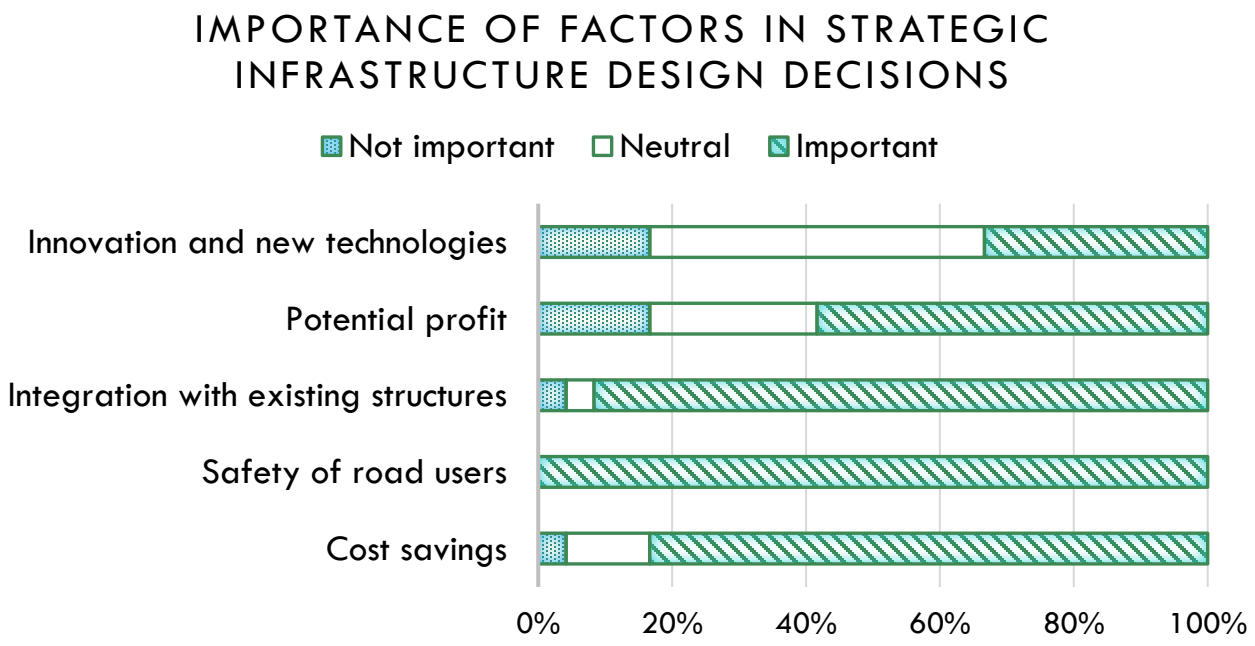


	Benefits	Challenges
Traditional	Less costs	Waiting times/denied boarding
	Simplicity and predictability	Empty rides
	Simpler logistics	Safety concerns at stops
	Effective in case of high frequencies	Flexibility

	Benefits	Challenges
On-demand	Willingness to use	High frequencies
	Flexibility	Digital literacy
	Reliability	Complex
	24/7 customer availability	ODD in case of SAE 4

DEVELOPMENT DIRECTIONS

- Infrastructure design

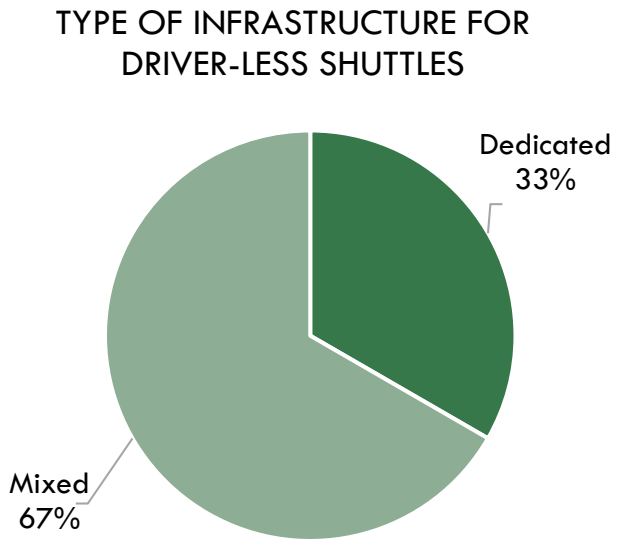


Most important factors

- *Safety of road users*
- *Integration with existing (infra)structures*
- *Cost savings*

DEVELOPMENT DIRECTIONS

- Infrastructure design



	Benefits	Challenges
Mixed environment	Less space required	Space allocation
	Flexibility in case of disruptions	Speed
	Lower costs	Automation technologies
	Faster to implement	Interactions with other road users
	More accessible in case of on-demand services	Safety

	Benefits	Challenges
Dedicated lanes	Safety	Space
	Predictability	High investments
	Higher speed	Reliability (in case of obstructed road)
	Service optimised for a single route	Scalability

SCENARIOS FORMULATION

Assume that driver-less shuttles operate on an on-demand basis, with passengers able to book a trip choosing the origin, destination and time. Which of the following would be a best match for operating driver-less shuttles?

Type of supervision:

- ☐ On-board steward, to guarantee immediate support to the passengers
- ☐ No steward aboard and remote control supervision to maximise profit

Strategic infrastructure design:

- ☐ Dedicated lanes with small hubs for pick-up and drop-off locations
- ☐ Mixed infrastructure with vehicles reaching customer's location

Area of operation:

- ☐ Urban areas
- ☐ Rural areas

SCENARIOS FORMULATION

	Supervision	Area	Infrastructure	Operations
Scenario A	Remote control	Urban	Dedicated lanes	Schedule-based
Scenario B	Remote control	Urban	Dedicated lanes	On-demand
Scenario C	Remote control	Rural	Mixed infrastructure	On-demand
Scenario D	Remote control	Urban	Mixed infrastructure	On-demand
Scenario E	On-board steward	Urban	Mixed infrastructure	On-demand

Next steps:
Model these scenarios using SUMO Simulation tool