

Urban planning and design Guidelines for integrating autonomous mobility into cities

Soledad Nogués, Dominic Stead and Esther González-González

Introduction

Autonomous vehicles are widely regarded as one of the most disruptive innovations in urban mobility since the advent of the automobile. Their introduction could profoundly reshape cities, influencing travel behavior, land-use patterns, and the allocation of public space. While AVs offer opportunities to reduce parking demand and reclaim space for pedestrians and cyclists, they also pose the risk of encouraging urban sprawl if not properly managed.

In this context, it is essential to move towards integrated guidelines that steer the deployment of autonomous vehicles within frameworks of anticipatory planning and sustainable urban design, ensuring accessibility, safety, and the quality of public space, while preserving the core city values endorsed by all citizens.

Methods

The methodology consists of integrating the results of multiple related studies on urban planning and design for autonomous mobility, considering public participation. These studies employed a mixed-methods approach, including planning methodologies and participatory techniques to identify desirable urban futures and define planning and design strategies.

Backcasting, which is particularly suited to contexts where disruptive technologies demand structural changes, was employed to identify policies for sustainable urban development. This approach was combined with a participatory **Q-method**, which captured different points of view of experts and citizens and revealed areas of consensus and dissent within the planning process.

Regarding urban design, a **preference survey** was carried out to citizens in two European cities to examine pedestrian behaviour, the attractiveness of public spaces, and street re-design options under AV scenarios. In addition, **semi-structured interviews** with experts provided insights into design requirements for cycling infrastructure in AV contexts.

Guidelines

Urban Planning

Plan ahead and integrate AVs into planning frameworks. Anticipatory planning is essential to avoid uncoordinated adaptation to disruptive technologies. AV-related measures should be incorporated into tools such as planning documents to align deployment with sustainability objectives.

Promote proximity and compactness. Compact urban form, supported by mixed-use and proximity-based models, reduces car dependency. Fiscal and regulatory measures discouraging urban sprawl—such as higher development taxes for distant locations—are considered effective for maintaining compactness.

Prioritise pedestrians and active mobility. Citizens and experts strongly support policies to prioritise pedestrians, widen pavements, and create safe walking routes, particularly for vulnerable groups. These measures reclaim public space and enhance walkability, contributing to healthier, more inclusive cities.

Strengthen public transport. Recommended actions include encouraging transit-oriented development (TOD), as well as increasing service frequency, improving technological systems, and delimitation of exclusive lanes for public transport.

Promote shared AVs (SAVs). AVs integration must be governed by clear regulations before deployment, including restrictions on private AV use in central areas and incentives for shared mobility. Prioritising SAVs reduces car dependency and frees space for green and open public spaces, enhancing active mobility and environmental well-being.

Use positive incentives. Financial incentives and educational campaigns promote sustainable travel choices. Evidence shows that policies such as subsidies for public transport and shared services are generally more socially acceptable than punitive measures, even if the latter may be more effective.

Increase policy acceptability through integrated strategies. Policies limiting personal choices—such as private car ownership and use—often face resistance. Several approaches can help: combining measures rather than isolated actions, implementing pilot projects, and using marketing and communication strategies to build awareness.

Maintain participatory processes. Citizen and stakeholder engagement is crucial to identify consensus and dissent, ensuring socially acceptable pathways and avoiding artificial agreement.

Urban/Street Design

Reallocate space from motor traffic. Reduce the number and width of traffic lanes up to 50% and eliminate on-street parking to free space for pedestrians, cyclists, and public transport. AV lanes can be narrowed to 2.5–2.75m without compromising efficiency. The reclaimed space enables wider pavements and the integration of green areas, cycle lanes, social spaces, and street commerce...

Develop flexible zones. Introduce adaptable areas for multiple uses—such as pick-up/drop-off points, micro-mobility storage, outdoor seating, and kiosks—while prioritising greenery and sheltered spaces. These zones should enhance street vibrancy and support dynamic community needs.

Promote green areas. Convert freed-up parking and traffic areas into green corridors and parks to improve environmental quality and encourage active mobility. Green spaces should be expanded, especially in residential streets where they can exceed 50%.

Prioritise pedestrian accessibility. Expand sidewalks to meet or exceed minimum standards—1.8-2.0 m—and design streets as multifunctional public spaces with greenery, benches every 100 m (especially on busy roadways), and sheltered areas to foster interaction and walkability.

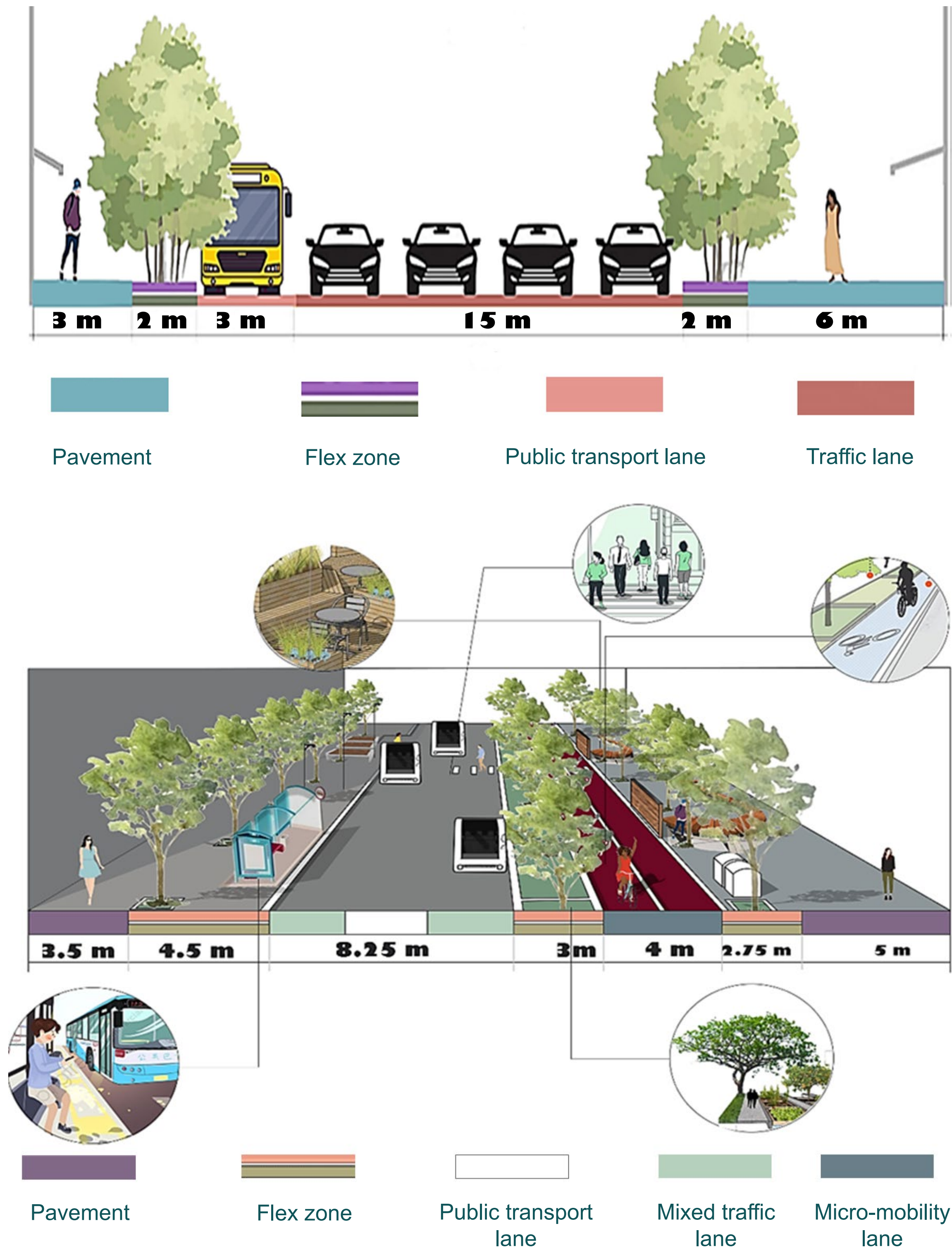
Promote context-sensitive solutions by street type. On primary corridors, provide segregated infra-structure for pedestrians and cyclists and allocate space for public transport and AV lanes. On secondary streets, use shared layouts with traffic calming and signage to maintain low speeds (≤30 km/h). On mixed-use streets, integrate flexible zones and visual separation between modes.

Integrate cycling infrastructure. Allocate reclaimed space to continuous, well-maintained cycle lanes. Two-way lanes should be 2.4–3.2 m wide, one-way lanes 1.8–2.5 m, ensuring separation from motor traffic. Where space is limited, prioritise reducing carriageway and parking space over the pavement.

Enhance safety at intersections. Implement advanced stop lines, coloured pavements, and clear signage to improve visibility and reduce conflicts between AVs, cyclists, and pedestrians. Lighting and priority rules must be reinforced to ensure safety during the transition phase.

Design recommendations

Adaptation to real Spanish case: Calle Calvo Sotelo (Santander)



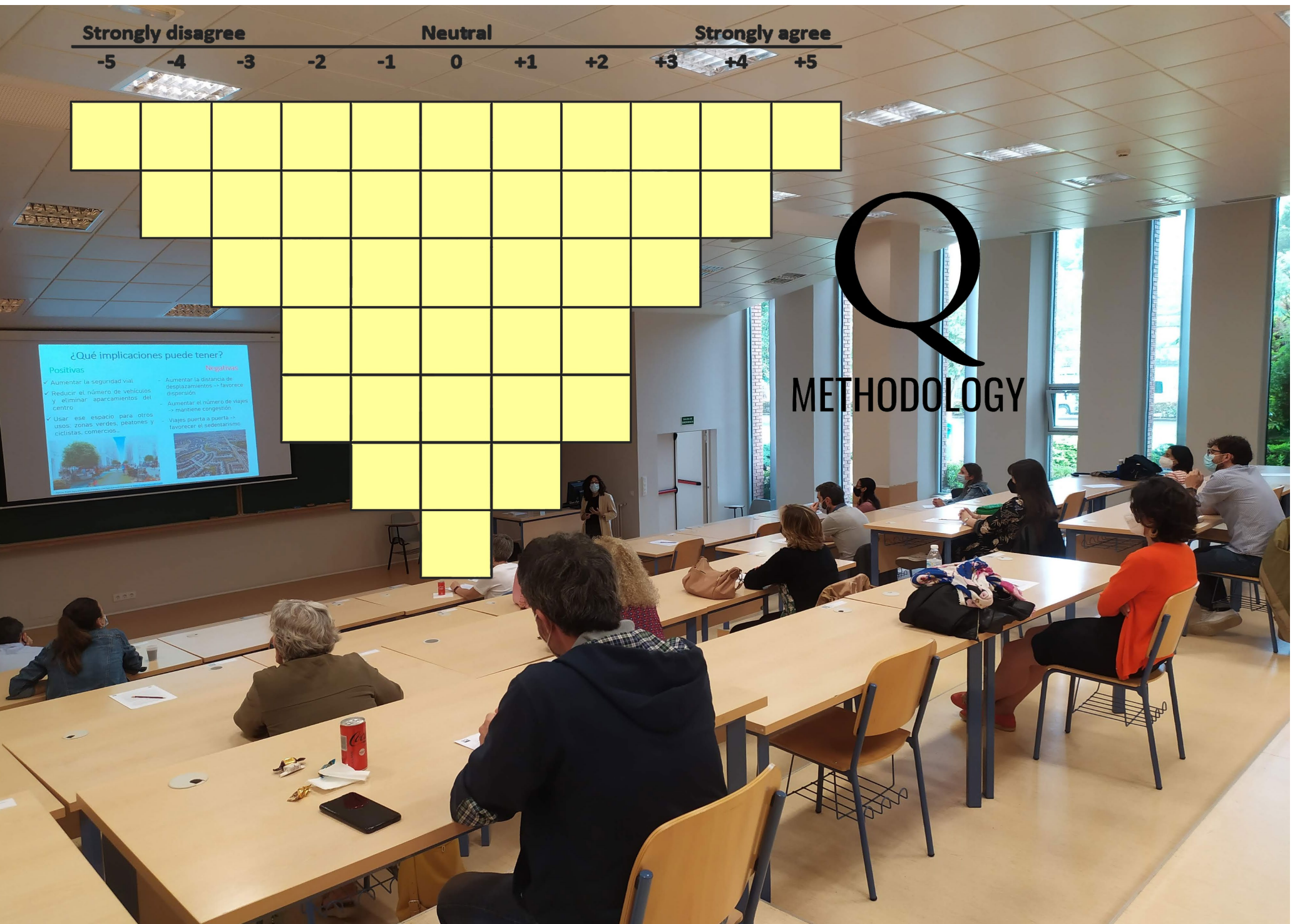
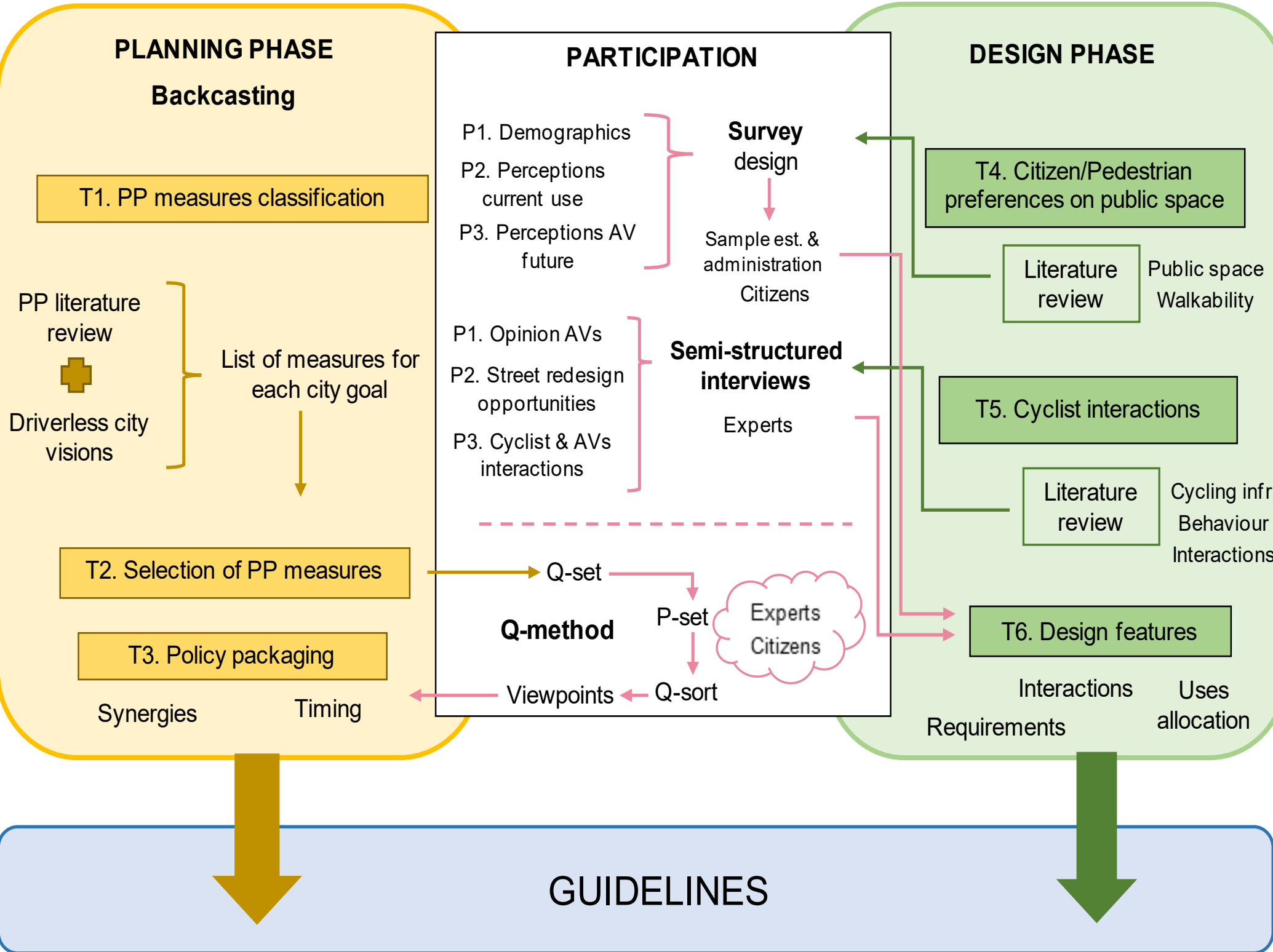
Conceptual visualization of urban streets with AVs



(Image generated with Gemini)

Conclusions

The advent of autonomous vehicles offers a unique opportunity to reshape cities towards more sustainable, inclusive, and liveable futures. This research demonstrates broad consensus among citizens and experts on prioritising active mobility, compact urban form, and green public spaces. Ultimately, the transition to autonomous mobility should be leveraged to advance broader goals of urban resilience, equity, and environmental quality.



Participatory Q-Method sorting session

Figure shows current situation (top) and adaptation with AVs (bottom)