Forecasting the Impacts of Autonomous Vehicles

A SYSTEMIC METHODOLOGY FOR INVESTIGATING THE EFFECTS OF AUTONOMOUS VEHICLES ON URBAN FORM AND QUALITY

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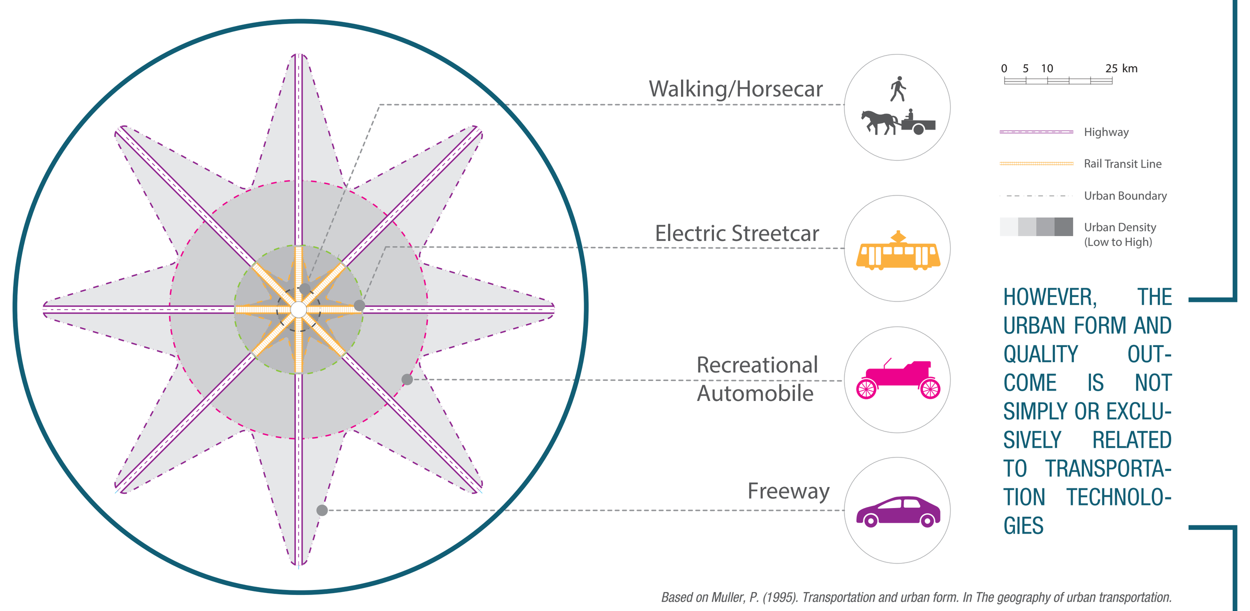
INTRODUCTION AND RATIONALE

HISTORICALLY, NEW TRANSPORTATION TECHNOLOGY HAVE HAD AN IMPACT ON URBAN PATTERNS



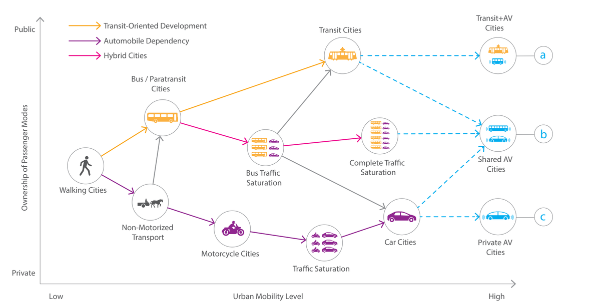
HOWEVER, THE URBAN FORM AND QUALITY OUTCOME IS NOT SIMPLY OR EXCLUSIVELY RELATED TO TRANSPORTATION TECHNOLOGIES

Based on Muller, P. (1995). Transportation and urban form. In The geography of urban transportation.

THIS IMPACT IS DIFFERENT ON EXISTING URBAN FABRICS AND NEW URBAN FABRICS

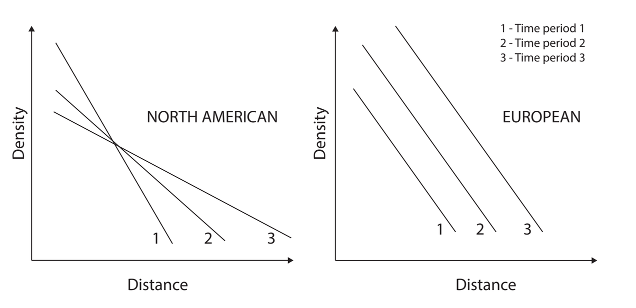
Vancouver's urban fabric from pre (left) and post (right) automobile hegemony eras. Source: Google Street View

IT ALSO DEPENDS ON EXISTING TRANSPORTATION CULTURE AND INFRATRUCTURE



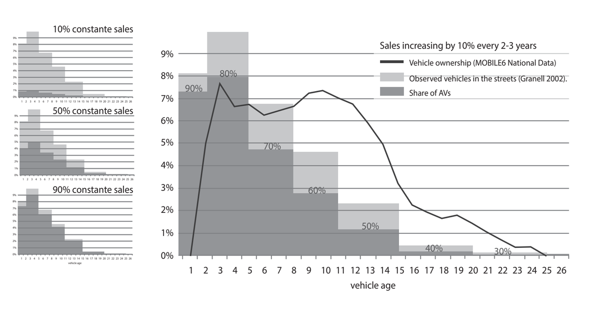
Adapted from Rodrigue, J-P. (2015). The Geography of Transport Systems. Online.

AS WELL AS OTHER URBAN CONTEXTS



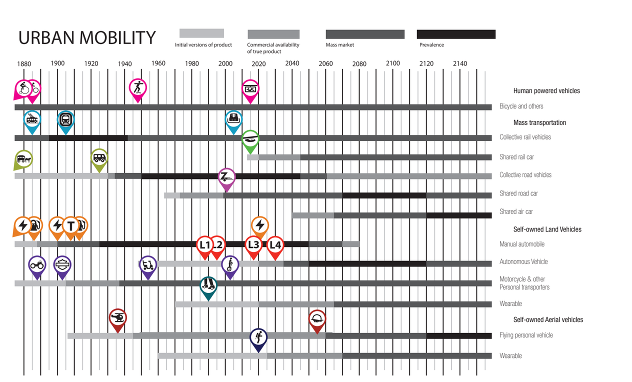
Adapted from Muller, P. (1995). Transportation and urban form. In The geography of urban transportation.

AND UPTAKE RATES OF THE NEW TECHNOLOGY



Anaysis using data from MOBILE6 and Granell, J. L. (2002). Model year distribution... PhD dissertation.

AND EVEN THE EMERGENCY OF NEWER AND/OR COMPETING TRANSPORTATION TECHNOLOGIES

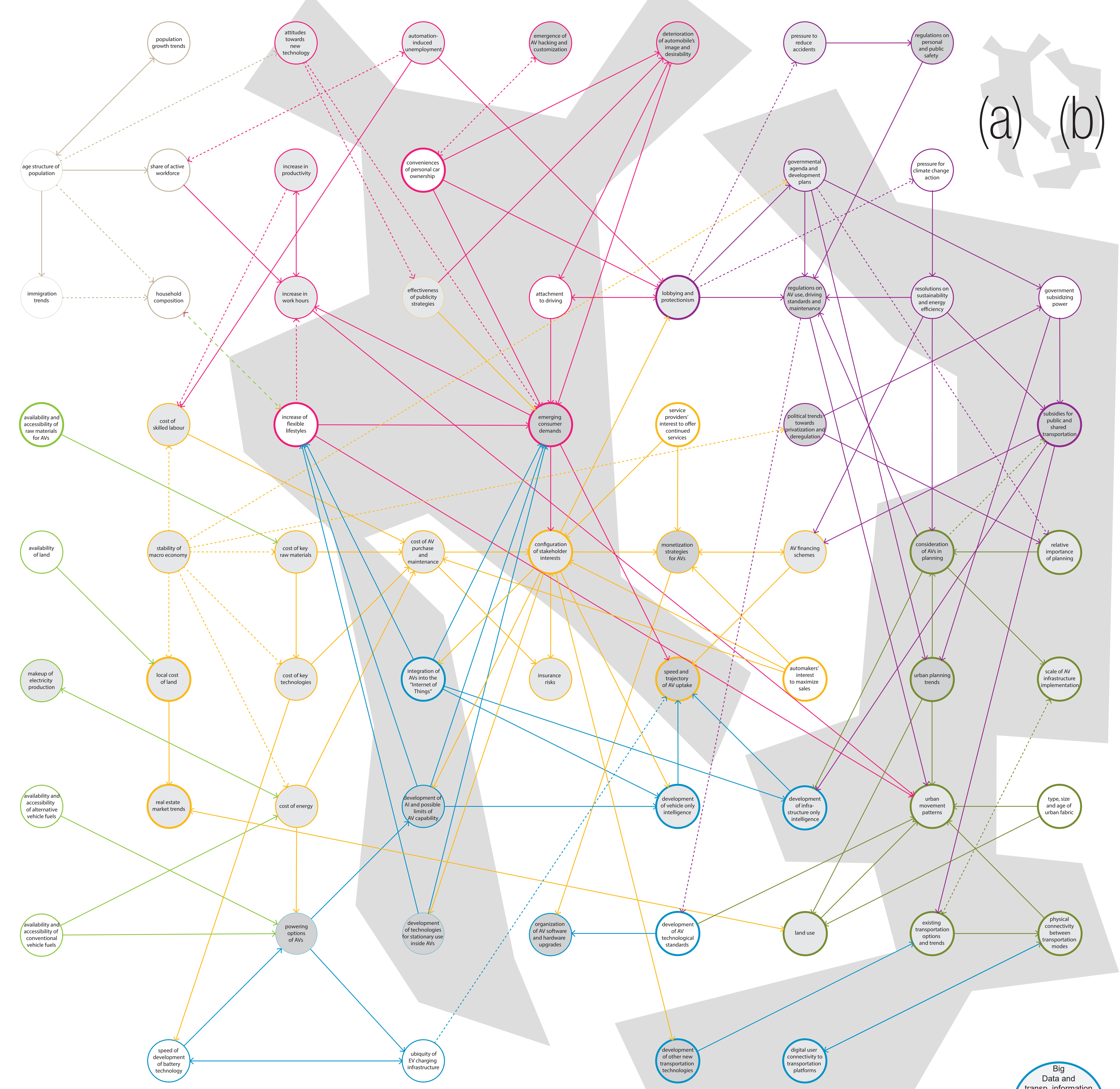


Historical information based on a variety of sources. Future information based on speculation.

INVESTIGATING THE PROSPECT IMPACTS OF NEW TRANSPORTATION TECHNOLOGIES ON URBAN FORM AND QUALITY IS A COMPLEX PROBLEM.

A NEW METHODOLOGY, COMPREHENSIVE AND SYSTEMIC, IS NECESSARY. We base our proposal on existing future envisioning techniques for business decision making, precedent discussions on the impact of AVs, and on visionary traditions of architectural design.

NETWORK OF KEY FACTORS + DRIVING FORCES



Step 1

Identifying key factors + driving forces in the system

Based on the methods described for scenario learning, the largest possible number of relevant factors and driving forces must be collected through collective brainstorming sections. In TIPSLab, we found nearly 70 key factors that we judged pertinent to the problem of AVs and urban form, across several categories. In the diagram to the right, the different categories are identified by different colors, as follows:

Driving Forces

- Demographic
- Social & Lifestyle
- Natural Resource
- Technological
- Political & Regulatory
- Market
- Environment & Planning

Step 2

Classifying the key factors

All the key factors and driving forces are studied individually and classified based on level of uncertainty (i.e., how certain we are that a certain factor will develop a certain way) and level of impact (i.e., how impactful a certain actor can be). In the diagram to the right, Level of Uncetainty is indicated by fill shade and Level of Impact is indicated by the thickness of the outline, as follows:

Degree of Uncertainty	Level of Impact
Low	High
Medium	Medium
High	Low

Step 3

Connecting the system

All the factors must be connected in a network of influences. The diagram presents the final network diagram defined by TIPSLab. Strength of connection is defined as follows:

Connectivity between Forces

→ Important ⇢ Moderate

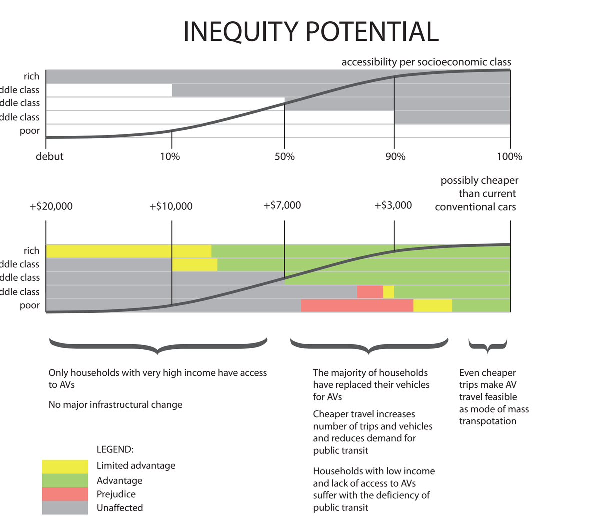
INFORMING THE SCENARIOS TO FURTHER DETAIL

Supporting information for developing the scenarios

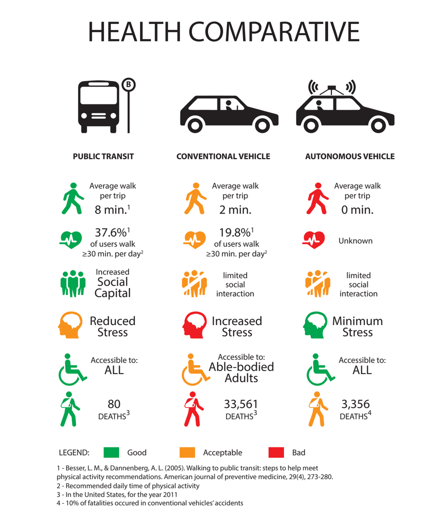
Supporting information to populate the scenarios are generated through a series of unstructured theme-specific investigations. These investigations preceded the beginning of the methodology itself and continued throughout the entire process. They are the result of exploratory conversations taking place in lieu of the data that is currently unavailable regarding AV impact.

Here only a few diagramatic figures, summarizing some examples of what was investigated, are presented.

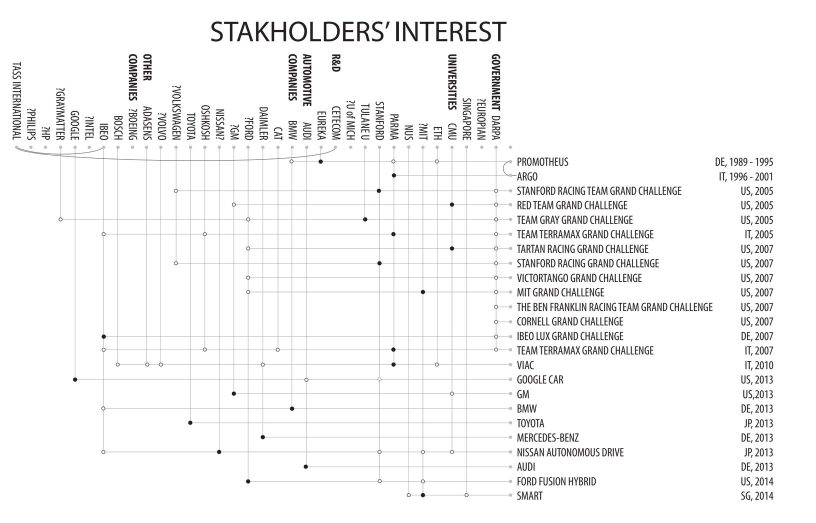
INEQUITY POTENTIAL

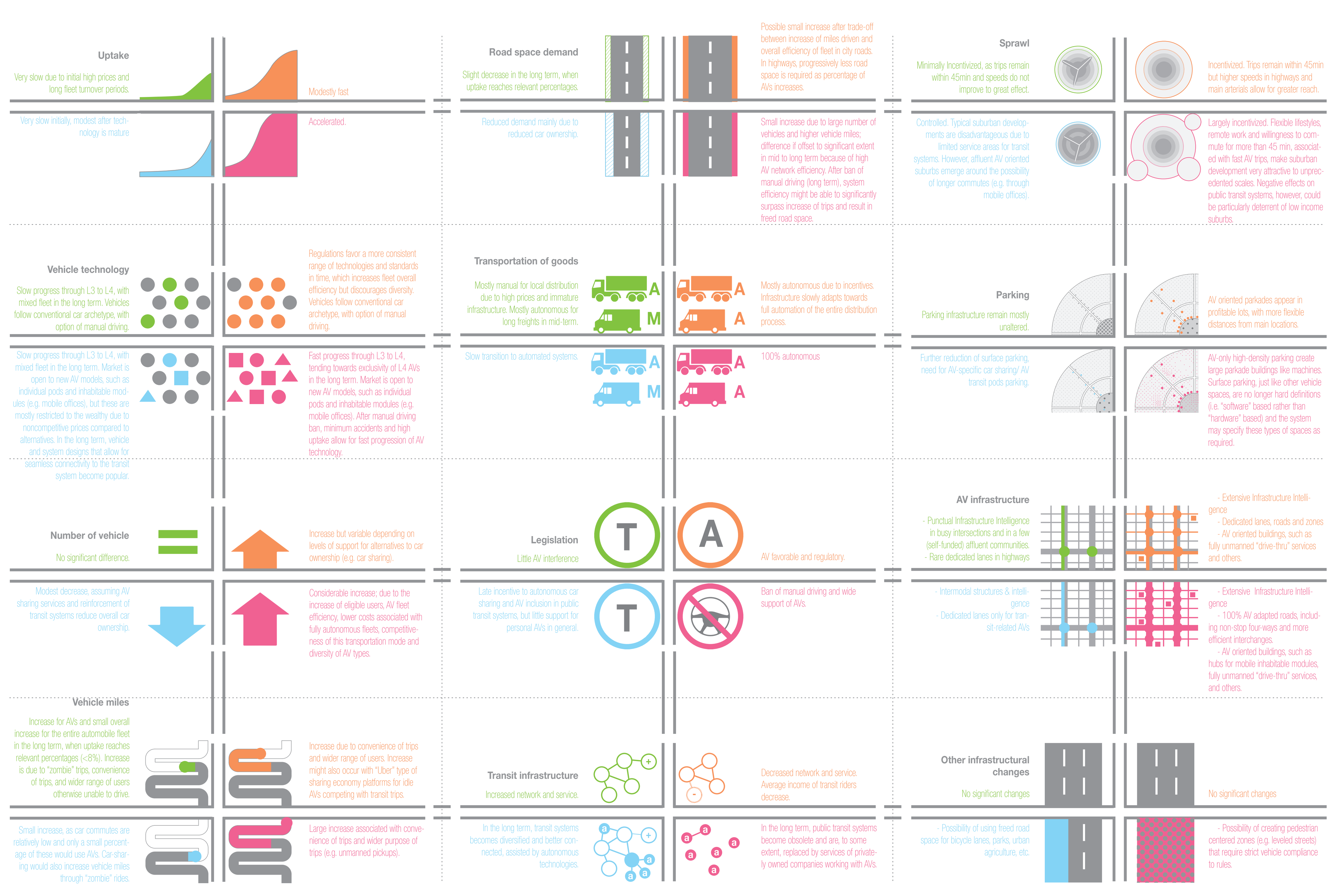


HEALTH COMPARATIVE



STAKHOLDERS' INTEREST





Studying coherent sets of assumptions

Considering the set of driving forces systematically laid out in steps 1 to 3, and considering the crossing of possible outcomes for key forces (step 4), four different scenarios could be outlined. The table below describe the overall contexts that define the scenarios.

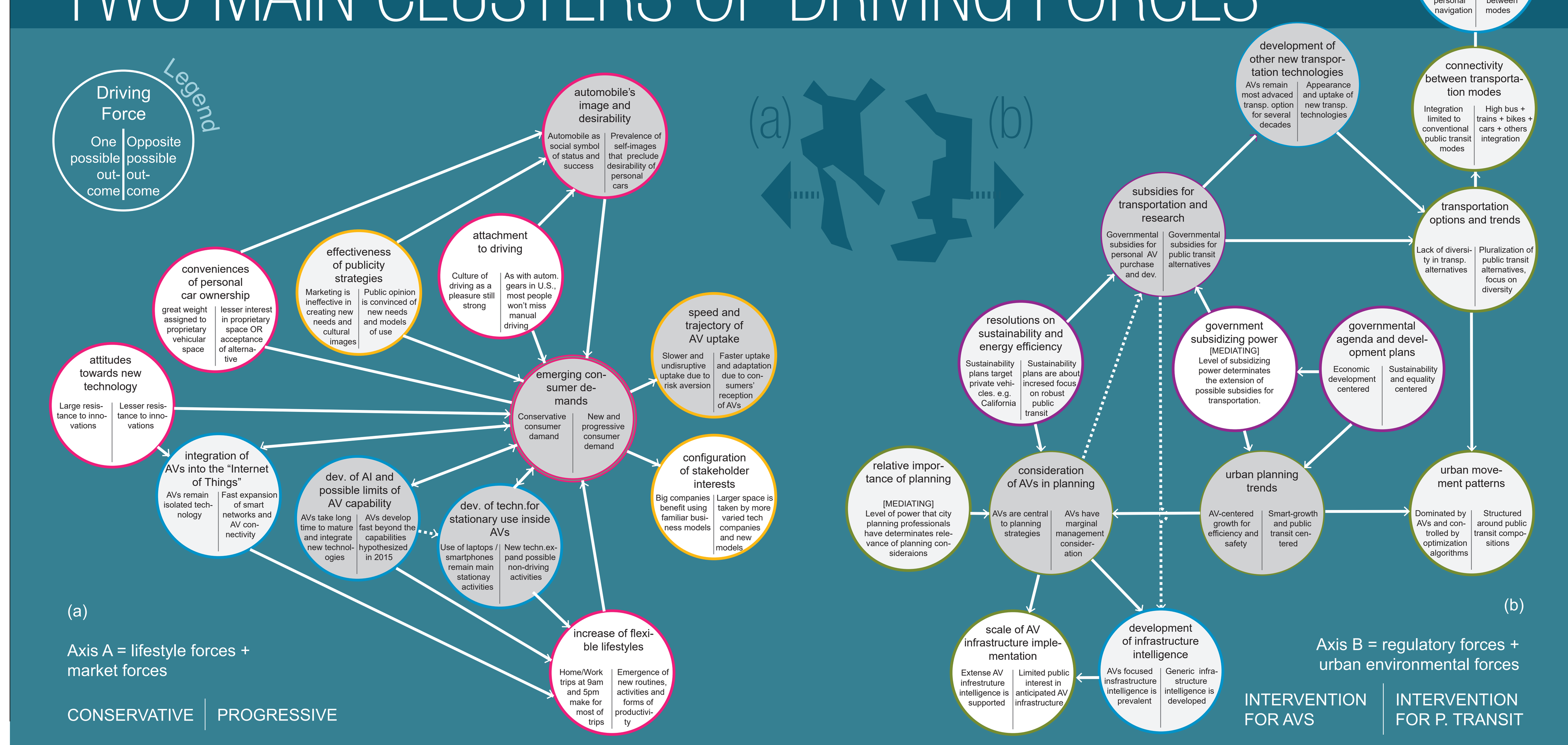
Based on these contexts and the assumed outcomes of the key driving forces being considered, several more specific assumptions could also be studied. Since the purpose of this research is speculating on the possible impact of AVs on future cities, a few specific assumptions are crucial in coherently populating future scenarios and understanding AV impact on urban form and quality.

The series of diagrams and descriptions below describe these assumptions for each scenario. The assumptions are grouped in the following topics: AV uptake, vehicle technology, number of vehicles, vehicle miles, road space demand, transportation of goods, legislation, sprawl, parking, transit infrastructure, AV infrastructure and other infrastructural changes.

In a next step of the present research, these assumptions can be inputed in predictive models, further informing how different approaches to AV and planning may impact our cities.

Step 5

TWO MAIN CLUSTERS OF DRIVING FORCES



Step 4

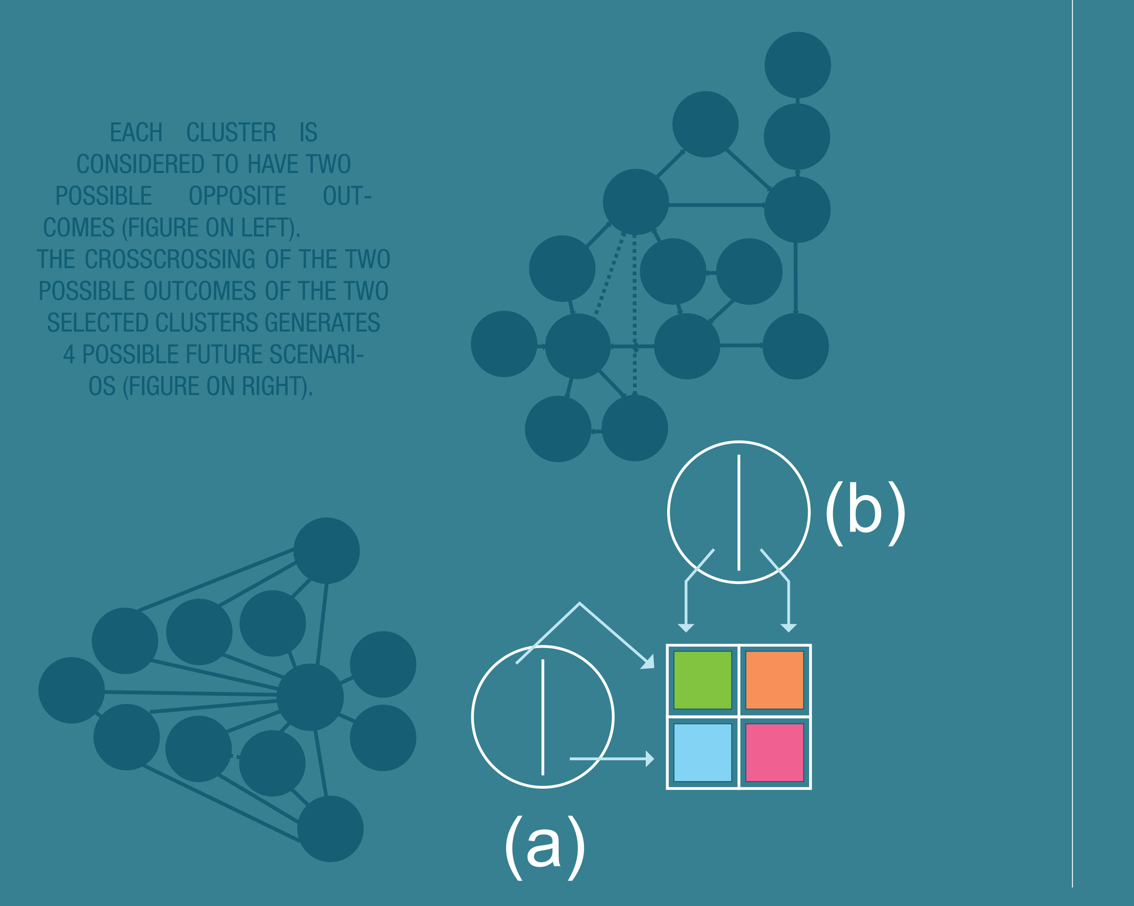
Defining the scenarios' structure

For manageability, we will focus only on two clusters of factors for structuring the scenarios' main variances. They are expected to be very uncertain and very impactful. Because of their uncertainty, at least two opposite behaviours can be defined for each key factor. Finally, the combination of these variations would result in 4 scenarios, a reasonable number for in depth exploration. All the remaining factors should be then considered in relation to the structuring variances in each scenario.

In the network composed by TIPSLab, it was observed that the factor named "emerging consumer demands" occupies an evident central role in the disposition. We titled its cluster "lifestyle forces + market forces". The two opposite outcomes of the cluster were organized under the titles "conservative" and "progressive". The second most relevant cluster identified was named "Regulatory forces + urban environmental forces". This cluster comprises factors that planners and decision makers can directly act on, and that are of great interest to the developers of this study. The two opposite outcomes of the cluster were organized under the titles "transit oriented investment" and "AV investment".

FUTURE SCENARIOS: CONTEXT

EACH CLUSTER IS CONSIDERED TO HAVE TWO POSSIBLE OPPOSITE OUTCOMES (FIGURE ON LEFT).
THE CROSSCROSSING OF THE TWO POSSIBLE OUTCOMES OF THE TWO SELECTED CLUSTERS GENERATES 4 POSSIBLE FUTURE SCENARIOS (FIGURE ON RIGHT).



ASSUMPTIONS PER SCENARIO

CLUSTER B Regulatory forces + urban environmental forces

CLUSTER A Lifestyle forces + market forces

	POSSIBLE OUTCOME W INTERVENTION FOR PUBLIC TRANSPORTATION	POSSIBLE OUTCOME Z INTERVENTION FOR AUTONOMUS VEHICLES
POSSIBLE OUTCOME Y CONSERVATIVE	AV uptake progress very slowly (mostly by the wealthy) and governments continue to focus on public transit to reduce congestion, pollution and accidents. Variety and connectivity of public transit is retarded by users' conservative needs and expectations; this includes AV integration in public transit systems, which takes a relaively long time to be considered. No drastic changes to fleet composition and infrastructure is expected in the mid to long term.	Level 4 AV uptake happens at relatively accelerated pace, as favorable incentives, legislation and planning (e.g. subsides and dedicated lanes) make AVs a competitive option, thus boosting uptake. Commute related habits are similar to today's. Car sharing services take the market share of taxis, with small relative growth. Popular vehicles typology remain similar to non-autonomous models and option of manual driving is protected by public demand.
POSSIBLE OUTCOME X PROGRESSIVE	Governments continue to focus on public transit to reduce congestion, pollution and accidents, giving little immediate attention to AVs. In time, a robust public transit system supports the success of AV car sharing services as alternatives to car ownership. In the long term, autonomous mass transportation (e.g. buses) and individual pods are gradually incorporated in the public transit network.	Level 4 AV uptake happens at most accelerated pace, as favorable incentives meet fast changing and progressive needs and demands. Different companies and vehicle models appear in the market, offering a diversity of services, features and even roles for personally owned AVs. A variety of ownership models exist. Vehicles that function as office space or sleeping space, among others, are common, and commute habits change.