Autonomous Vehicles - Beyond the Hype?

Transport Studies Unit Seminar
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Mission...

"Furthering understanding and influence on the interactions between mobility, lifestyles & society in a context of technological change."

Aims

- improving our understanding of travel behaviour
- promoting greater equity in mobility/ accessibility
- developing innovative transport research methodologies

CTS Research Themes

- technologies and travel
- experience of the travel environment
- car dependence
- promoting inclusive, low carbon, active travel
- mobility and the ageing population
- supporting and evaluating sustainable mobility strategies
- understanding and influencing attitudes and behaviours

Venturer Research on the social context of automation

- Understanding, expectance, acceptance by:
  - range of citizens
  - experts & policymakers
- Research methods
  - quantitative survey
  - focus groups
  - Interviews
  - scenario presentation & analysis

Venturer social research on Materials and Competences

- The role of the ‘safety driver’ in an AV
  - Simulator/vehicle trials to investigate handover to/from human/autonomous modes
  - In-vehicle activities a ‘driver’ can undertake whilst legally responsible for the vehicle
- Sharing streets with AVs
  - Social research/experiments to examine how communication between AVs and human road users could occur
  - And how safety parameters will be defined

Narrative of presentation

- AVs are now approaching becoming a consumer technology
- Government and industry identify clear benefits
- AVs are potentially a ‘disruptive’ technology
- Disruption could bring large social and environmental benefits
- But will be associated with major socioeconomic change
- We need to clarify which trajectory for AV adoption we are on, and which one we should be on

Phases of AV development

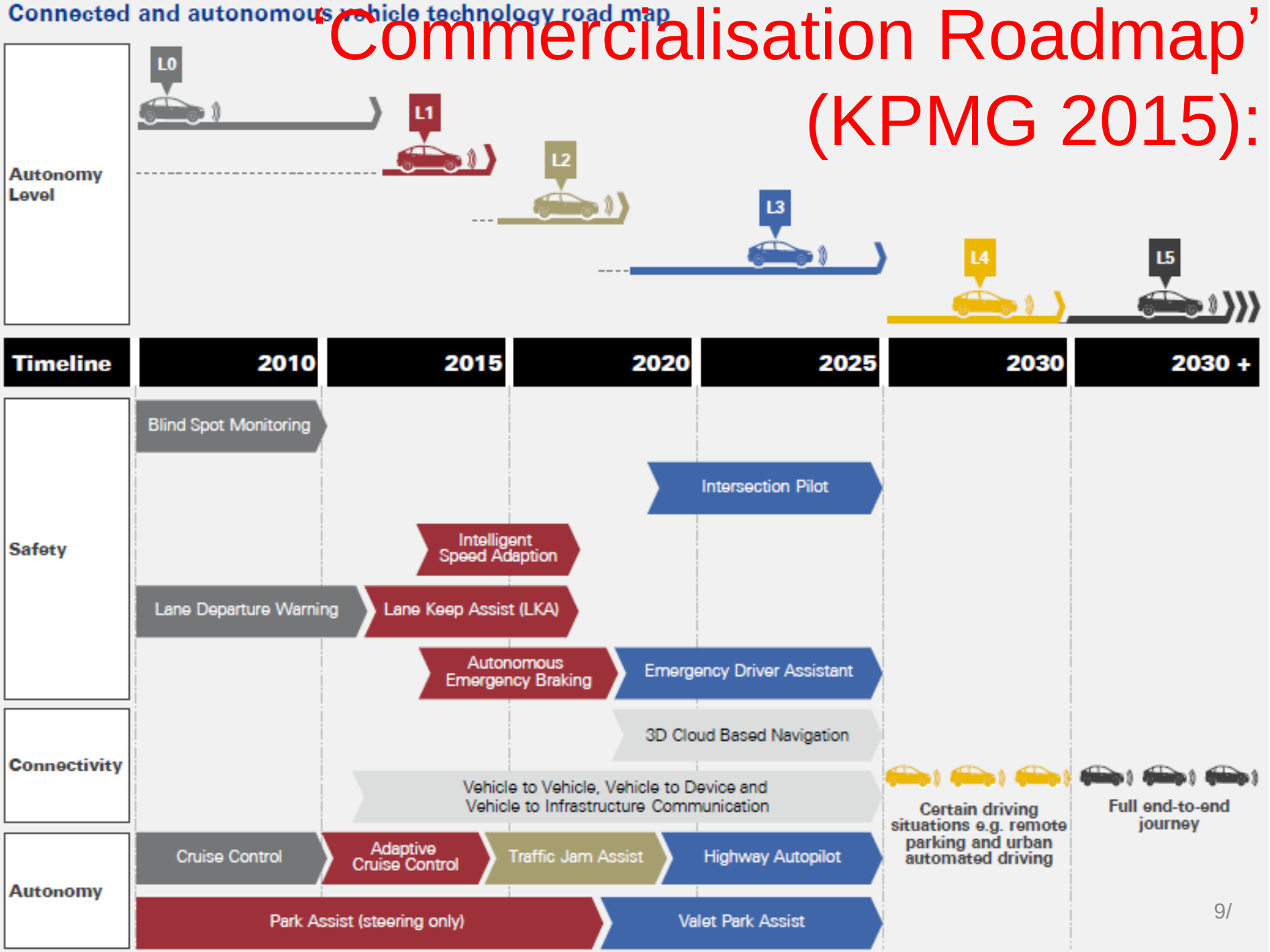
- 1980-2003 Foundational Research
  - Focused on universities
- 2003-2007 ‘Grand Challenges’
  - Defense Advanced Research Projects Agency
- Commercial development
  - major corporations (Google, motor manufacturers) in competition

Anderson et al. (2013)

Some Developments in EU and US

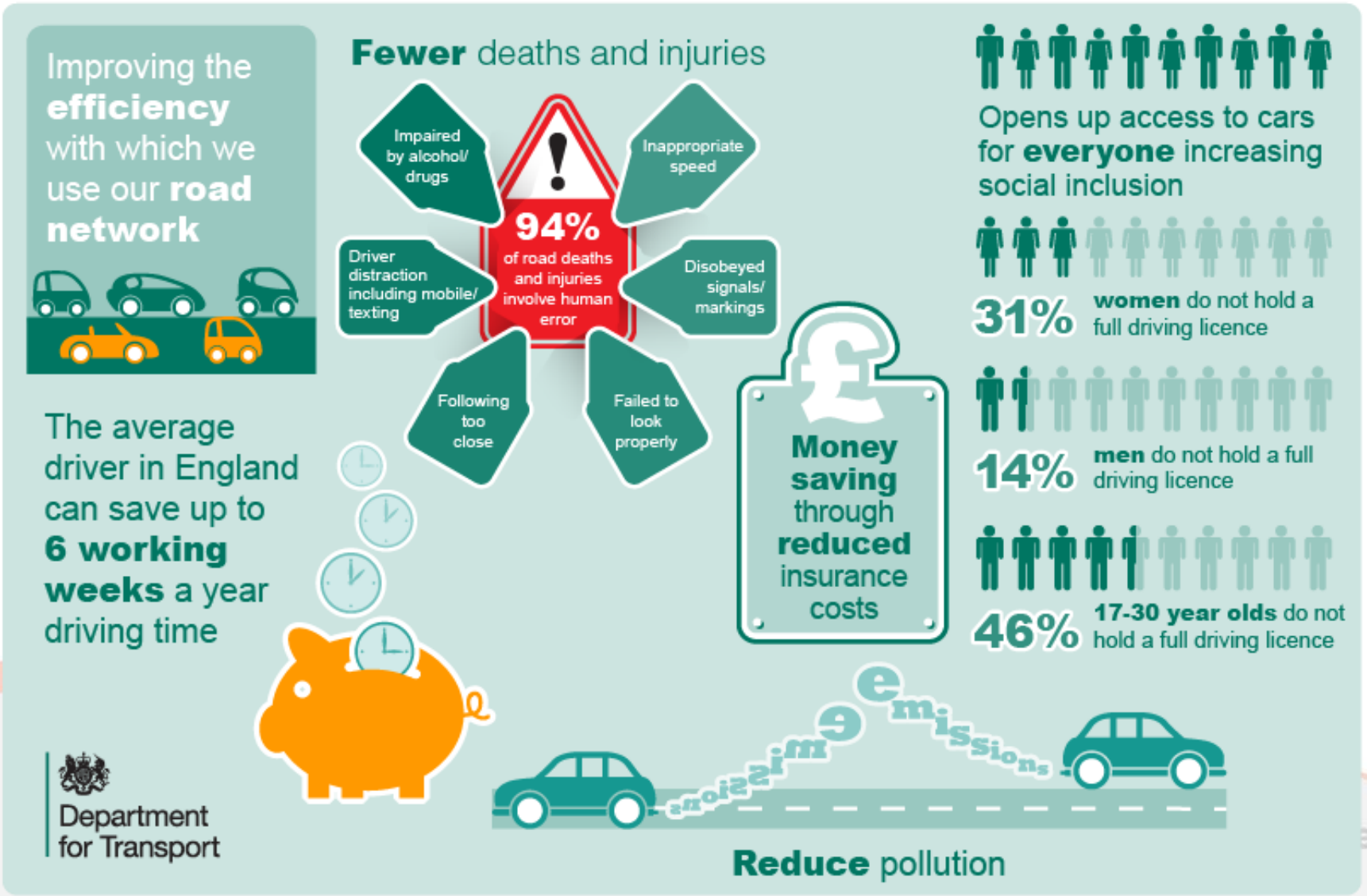
1980s	Munich Federal Defence Force University develops Mercedes van with automatic throttle, brake and steering control on traffic-free streets
1994-5	PROMETHEUS Mercedes car piloted automatically in traffic for majority of 1,600 km between Munich and Odense Carnegie Mellon team crosses US with self-steering Pontiac
2001	University of Parma Lancia able to follow white lines and regulate speed over 2,000 km extra-urban rural road tour
2007	third 'Grand Challenge': 96km urban course on disused airbase: vehicles required to comply with traffic laws and to negotiate other traffic and obstacles
2009-12	Google Toyota and Lexus vehicles complete 500,000 km of trials
2014	Google bespoke AV with no steering wheel or pedals exhbited

‘Commercialisation Roadmap’ (KPMG 2015):



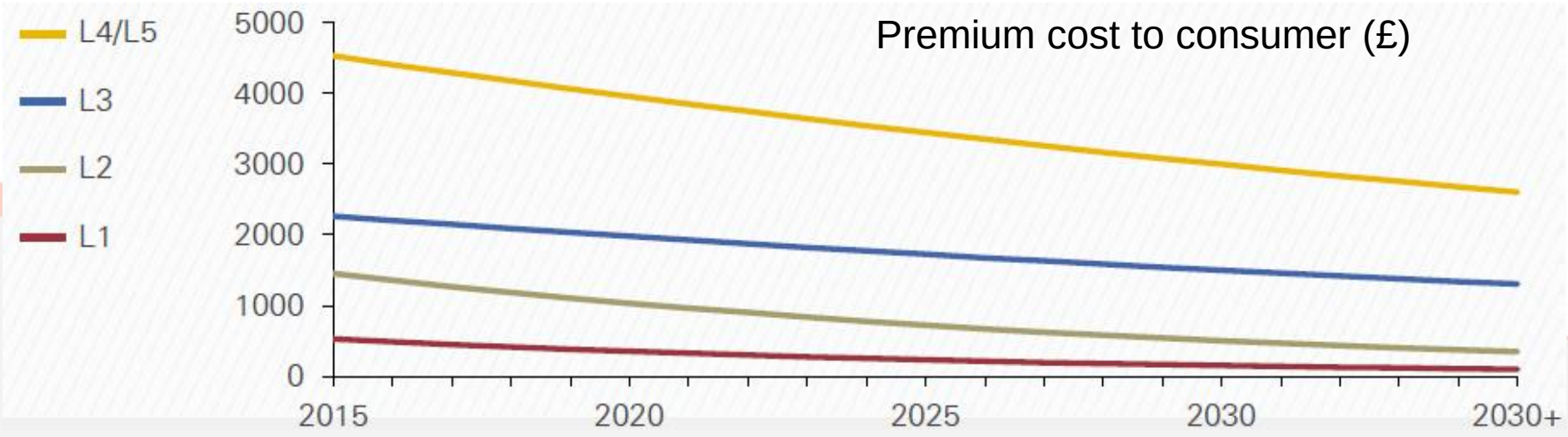
Usefulness: benefits claimed for AVs

The Pathway to Driverless Cars: A detailed review of regulations for automated vehicle technologies



Industry Motive for Automation

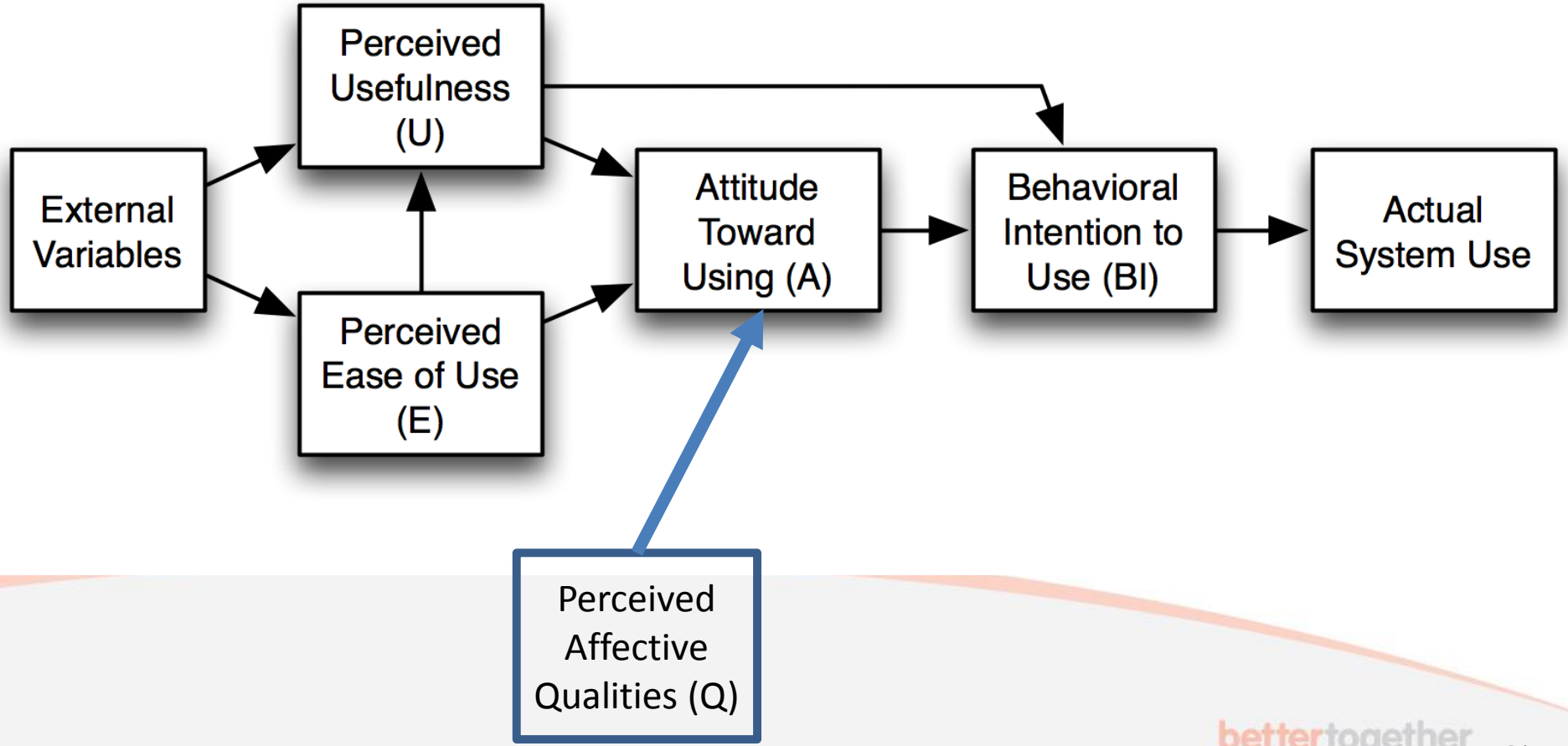
- Little/no profit in ‘low end’ car sales
- KPMG identifies £51 b. p.a. UK market ‘prize’
  - 320k new jobs
- ‘Added value’ of automation significant



Govt and Expert Perspectives Emphasise

- Inevitability of transition
- Economic growth opportunity
- Technical barriers to be overcome
- Regulatory conditions to be created
- Need for UK to move first/fast

Technology Acceptance Model



In theoretical terms, discourse and actions are:

- Opening up market niches
- Beginning to shape new social practices
  - Although with limited strategic management
- Potentially influencing public opinion towards acceptance

But is there a disconnect?

- the significant benefits claimed mainly arise at Level 5

- AVs have limited relevance for wider society until the technology moves beyond L3/L4
  - at least 2030 according to KPMG

Multi Level Perspective on Technological Transitions

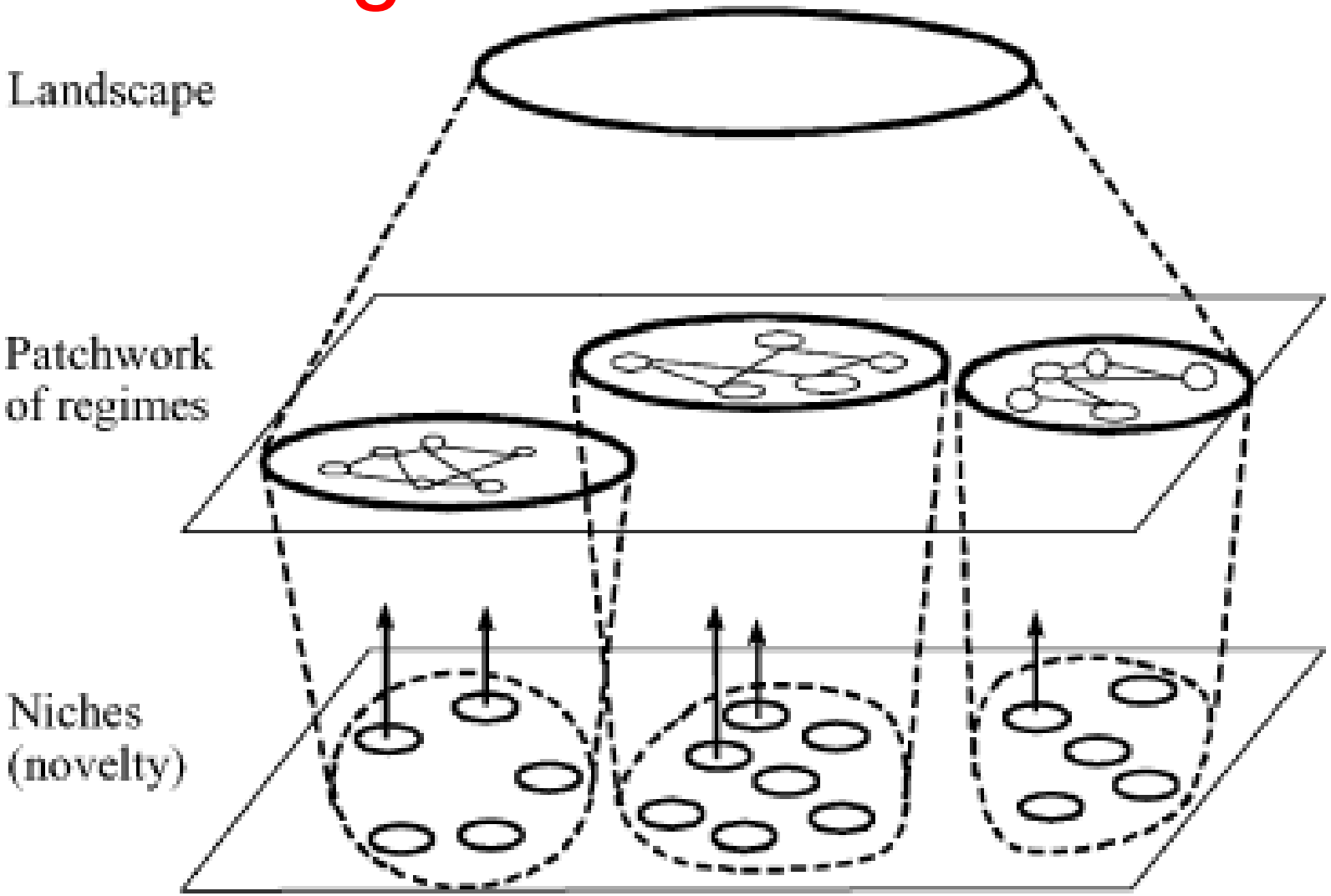


Fig. 3. Multiple levels as a nested hierarchy.

Insights for AV adoption

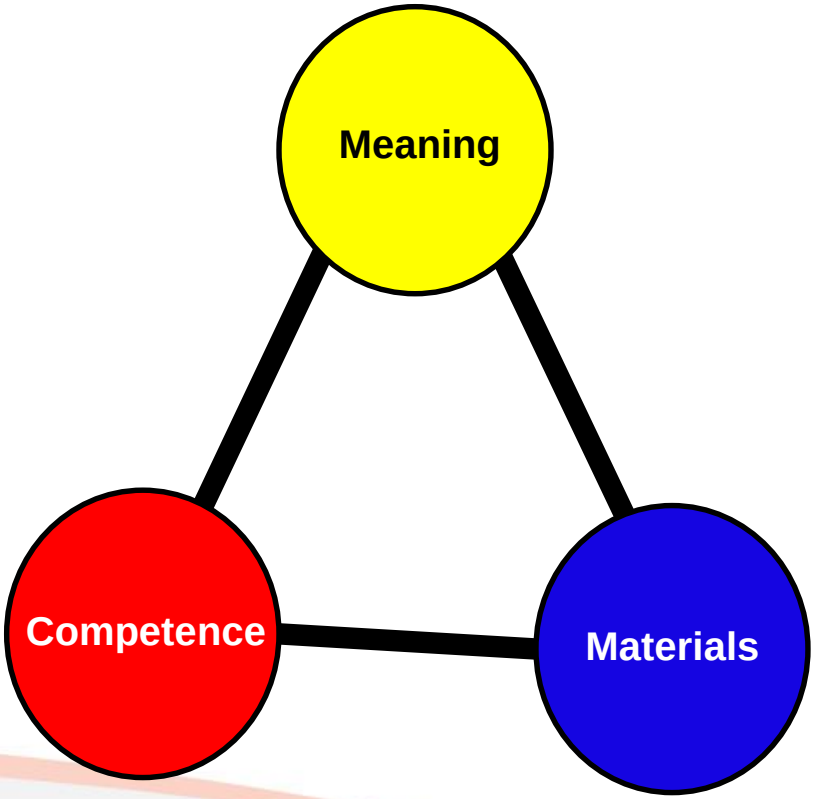
- *landscape level* changes
  - migration to cities, impact of mobile ICTs on lifestyles, peak car (?)
  - strengthening agendas around climate change, energy-power systems
- problems with automobility *regime*
  - Inefficiency, high external costs, particularly in urban areas
- emergence in applied market *niches*
  - airport parking, local urban taxis
  - Functions of driving process e.g. parking, cruising

Possible Early Adoption Niches

- In segregated environments already (Heathrow, Docklands Light Railway
- L3 private vehicles with greater AV technology for specific driving tasks (e.g. valet parking, adaptive cruise control)
- Mass transport on dedicated routes/lanes to reduce labour costs (platooning, bus rapid transit)
- Flexible route taxi or bus systems increasingly trialled in less controlled but still defined urban environments

Social Practice Theory: will change to enable AV adoption occur?

- **Materials** – changes to design of vehicles and roads
- **Competence** – changes in road-user skills, employment
- **Meaning** – new aspirations and understandings of being mobile



Changing practices?

- Level 3
  - New expectations about maintenance

- Level 4
  - the ‘sleeper car’

- Level 5
  - AV-chauffeuring?

Highway code to become an operating manual?

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Encounter with the Google car today...

a Google self-driving Lexus has been in my neighborhood for the last couple of weeks doing some road testing.

near the end of my ride today, we both stopped at an intersection with 4-way stop signs.

the car got to the stop line a fraction of a second before I did, so it had the ROW. I did a track-stand and waited for it to continue on through.

it apparently detected my presence (it's covered in Go-Pros) and stayed stationary for several seconds. it finally began to proceed, but as it did, I rolled forward an inch while still standing. the car immediately stopped...

I continued to stand, it continued to stay stopped. then as it began to move again, I had to rock the bike to maintain balance. it stopped abruptly.

we repeated this little dance for about 2 full minutes and the car never made it past the middle of the intersection. the two guys inside were laughing and punching stuff into a laptop, I guess trying to modify some code to 'teach' the car something about how to deal with the situation.

the odd thing is that even tho it was a bit of a CF, I felt safer dealing with a self-driving car than a human-operated one.

What do we know about Citizen Acceptance to date?

- Awareness high
  - Schoettle and Sivak (2014) 2/3rds in US/UK/AU
- Opinion survey findings inconsistent and variable
  - Vary by country, driver status, gender, personality
  - Influenced by question framing
  - ‘Driver experience’, control, security strongest negatives
  - Safety and full automation strongest positives

Citizen Expectations

- Howard & Dai (2014) ‘multi-tasking’ and not having to park as positives
- Schoettle & Sivak (2014) 41% expected to ‘watch the road’ (8.3% would read)
- Casley (2013) fuel efficiency, shorter journey times, environmental credentials more important than productive use of travel time
- Wide range of estimates of willingness to pay
  - One outlier study indicated a $30k premium, but several others only around $1-3k more

Citizen views from a science festival

Positive	Conditional	Negative
Safer	Environmental credentials depend on manufacturers!	Loss of control
Independent travel by young/old/disabled/ disqualified	Clean fuels?	Pleasure of driving
Can drink alcohol and 'drive'	Cybercrime?	Loss of driving jobs
Can relax in journey	Trustworthy?	Reduced practice by human drivers (loss of skill)
Collective form of transport	Legal responsibility?	Loss of choice e.g. route
Can use journey time productively	Support if public (collective) transport	Poor interaction with other road users
More comfortable ride		Loss of identity, personality
Create inclusive society		Low trust in technology
Reduced congestion		

Additional citizen views from a technology fair

Positive	Conditional	Negative
Guaranteed journey times	Affordable by all?	Lack of 'sex appeal'
Managed system	Need to understand technology	Power consumption of autonomous system
Standard vehicle type: no social 'display'	Prefer as second car	Enjoy 'sporting-style' driving
Benefits particularly for those travelling for work	If can switch between human / auto. Control	Won't solve transport problems
Smoother traffic flow	Ability to cope with unexpected incidents	
No requirement to park vehicles	Technical problems won't be solved	
Maintenance and cleaning by public operator		
More fuel efficient		

Association of AV concept with:

- collective ownership
- standardised vehicles
- Immediate achievement of ‘Level 4’ automation
- Socially positive goals
- Logical, efficient transport system
- Better quality of journey (as passenger)
- Electric/clean power

Low awareness of:

- significant outstanding technological challenges
- transition from current technology to full automation
- financing/funding model
- non-transport sector implications
  - E.g. land value changes if car parks redundant
  - Public health if walking/cycling discouraged

?

Regime Scenario 1: “business as usual or incremental substitution”

- Gradual development and exploitation of technology
- Replacement of private cars
  - current ownership and use model
- Significant investment in infrastructure
  - Public funds and toll revenue
- Pressure for regulation of other road users
- Increased mobility for those with restrictions on driving capabilities (if able to afford an AV)

Possible outcomes for Scenario 1

- L3 constraints on using (high-specification, expensive) cars reduced
  - (L4 AV empty running, constraints further reduced)
- car ownership and traffic increase
- public transport use, car occupancy fall
- Social exclusion of those without car access
- Worse urban living conditions
  - More vehicles parked
  - Limited decongestion/emissions benefits of AVs offset
- Public health threat of reduced active travel

Regime Scenario 2: “collective efficiency”

- Higher L3 capital cost favours collective ownership of vehicles
- L4 link vehicles further favour collectivity
  - ‘driver experience’ no longer a factor in ownership
  - Immediate availability achieved through summoning rather than own car on drive
  - Removal of owner-driver vs guest-passenger distinction encourages collective use
- Fleets (commercial, public, third-sector) offer a range of automated mobility services
  - Differentiated by price and service attributes

Possible outcomes for Scenario 2

- Efficient ridership + collective ownership minimise vkm
  - Absolute fall in traffic possible
  - Emissions benefits maximised by smoother, lighter traffic
- Parking at origins/destinations largely eliminated
  - Accessibility of city centres favoured
  - Residential streets decluttered
- Social inclusion enhanced by more flexible 'public' transport e.g. in low density areas
  - Accessibility and perhaps mobility increased
- Concerns about levels of active travel remain
  - But walking and cycling for part of journeys more possible with collective ownership

Conclusions

- Government / industry emphasise AV benefits
  - Promoting ‘regime’ change
- Citizens more ambivalent, particularly if accept current role of car in society
  - Some reject the new practices expected to emerge around AV automobility
- Current AV transition focussed on adapting current practices to minimise ‘disruptiveness’
  - Societal benefits only emerge if AVs are part of a universal shared, electrified, optimised system combining features of private and public modes

Questions?