Connected and Autonomous Vehicles

University of HUDDERSFIELD
Inspiring tomorrow's professionals

Prof. Alexandros Nikitas

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Future Mobility Centre Director

Huddersfield Business School
University of Huddersfield

ΕΘΝΙΚΟ ΜΕΤΣΟΒΙΟ ΠΟΛΥΤΕΧΝΕΙΟ
ΔΙΑΤΜΗΜΑΤΙΚΟ ΠΡΟΓΡΑΜΜΑ
ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ
ΑΚΑΔΗΜΑΪΚΟ ΕΤΟΣ 2024-2025
ΔΙΑΤΜΗΜΑΤΙΚΟ ΠΡΟΓΡΑΜΜΑ ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ
ΠΟΛΕΟΔΟΜΙΑ – ΧΩΡΟΤΑΞΙΑ
ΜΑΘΗΜΑ
ΜΕΤΑΦΟΡΙΚΑ ΣΥΣΤΗΜΑΤΑ ΠΟΛΕΩΝ
ΜΕΣΑ ΑΠΟ ΤΗΝ ΒΙΩΣΙΜΗ ΚΙΝΗΤΙΚΟΤΗΤΑ




Personal Introduction

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Education:

PhD in Transport and Society – UWE

MA in Applied Social Research (Built Environment) – UWE

MSc in Transport, Planning and Engineering – Edinburgh Napier University

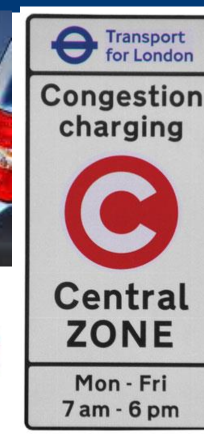
MEng in Engineering (Civil) - Durham University

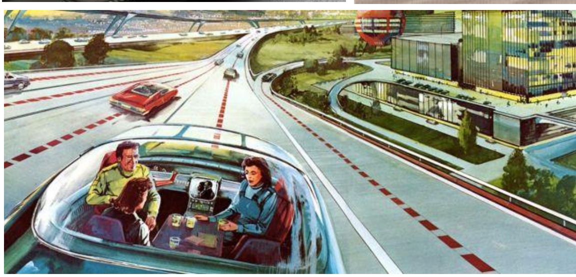
PGCHE – University of Huddersfield

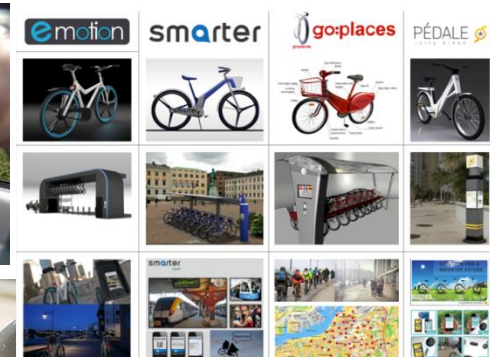
Employment:

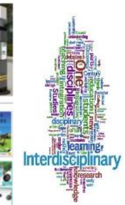
- **Professor in Sustainable Transport Futures** – University of Huddersfield
- **Senior Researcher in Urban Futures and Transportation** – Chalmers University of Technology
- **Civil Engineer and Transport Planner** - Consultant Office in Drama, Greece
- **Hourly Paid Lecturer** - Teaching Transport related modules in UWE
- **Research Associate and Scientific Administrator** - Laboratory of Mechanics and Materials of Aristotle University of Thessaloniki, Greece
- **Consultant Engineer and Coordinator of Sales Services** - HEL-RUS Ltd (a Greek Built Equipment and Services Company)
- **Military Officer** - Served as a Second Lieutenant in the Hellenic Military Forces

Research Expertise









OPTICITIES

BIRMINGHAM
GOTHENBURG
LYON
MADRID
TORINO
WROCLAW

European Commission

SEVENTH FRAMEWORK PROGRAMME

Latest on Sharing economy

Uber Australia to ban low-rated passengers

Why buy jewellery when you can rent it?

Edinburgh locals feeling squeezed by visitors

Sharing economy + Add to myFT

Mobike gives up on bike hire in Manchester

Chinese company's European launch suffers widespread vandalism and theft

Andy Bounds in Manchester SEPTEMBER 5, 2018 66

> **Not every city is destined to become a paradise for cyclists**
>
> **Alexandros Nikitas, University of Huddersfield**

Jan Van der Ven, general manager of Mobike UK, said: "We have a duty to ensure our revenues cover our costs."

However, Andy Burnham, mayor of Greater Manchester, said Mobike had only itself to blame. "The scheme wasn't properly thought out from the beginning," he told the Manchester Evening News, suggesting docking stations were a better idea.

Publication Cover

Proceedings of the Institution of Civil Engineers - Engineering Sustainability

ISSN 1478-4629 | **E-ISSN** 1751-7680

Journal Citation Reports Clarivate Analytics JOURNAL IMPACT FACTOR 2018 Scopus IET Inspec Compendex on Engineering Village

Impact Factor 1.5 (two year); 1.208 (five year); SJR 0.315.

Engineering Sustainability provides a forum for sharing the latest thinking from research and practice, and increasingly is presenting the 'how to' of engineering a resilient future. The journal features refereed papers and shorter articles relating to the pursuit and implementation of sustainability principles through engineering planning, design and application. The tensions between and integration of social, economic and environmental considerations within such schemes are of particular relevance. Methodologies for assessing sustainability, policy issues, education and corporate responsibility will also be included. The aims will be met primarily by providing papers and briefing notes (including case histories and best practice guidance) of use to decision-makers, practitioners, researchers and students.

It is free to submit to this journal. Papers appear Ahead of Print (below) as soon as they are ready to be published. Ahead of print articles are fully citable using the DOI system

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Joanne F. Robinson, Timothy J. Foxon and Peter G. Taylor

193186	Roy Mahapatra, Debiprosa	Indian Institute of Science	ind	301	2000	2024	288,229	3,765
193187	Heiskanen, Juha	Natural Resources Institute Finland (	fin	68	1991	2024	288,230	1,050
193188	Ponzoni, A.	CNR - Istituto Nazionale di Ottica	ita	117	2001	2024	288,234	2,645
193189	True, Hans	Technical University of Denmark	dnk	70	1978	2023	288,236	793
193190	Barlow, David J.	The University of Manchester	gbr	170	1983	2024	288,246	5,354
193191	Palma, Claudio	Università degli Studi Roma Tre	ita	80	1975	2014	288,248	1,636
193192	Fang, Liang	Guilin University of Technology	chn	464	1997	2024	288,251	6,470
193193	Larrosa, Javier	Universitat Politécnica de Catalunya	esp	67	1995	2024	288,252	1,377
193194	Nikitas, Alexandros	University of Huddersfield	gbr	54	2008	2024	288,255	1,256
193195	Kang, Hoon	Chung-Ang University	kor	76	1998	2021	288,257	936
193196	Lengele, B.	Cliniques Universitaires Saint-Luc	bel	147	1984	2024	288,263	3,543
193197	Kao, Chung Yao	National Sun Yat-Sen University	twn	88	1997	2024	288,273	1,492
193198	Griffin, Donald	Rollins College	usa	195	1969	2023	288,277	2,870
193199	Hu, Lingqian	University of Florida	usa	47	2006	2024	288,279	1,035
193200	Resch, Bernd	Universität Salzburg	aut	110	2008	2024	288,280	2,180
193201	Knobloch, Jürgen	Eberhard Karls Universität Tübingen	deu	84	1977	2009	288,283	2,621
193202	Pawson, Adam J.	The University of Edinburgh	gbr	93	1997	2022	288,293	15,139

Ranking 2023 – Career-long List

	A	B	C	D	E	F	G	H	I
46640	Kamal, Tahseen	King Abdulaziz University	sau	116	2012	2024	46,639	681	
46641	Zhang, D. L.	Northeastern University	chn	347	1990	2024	46,640	659	
46642	Bajpai, A. K.	Government Model Scien	ind	292	1994	2024	46,641	671	
46643	Schlapbach, Luregn J.	Kinderspital Zürich	che	251	2006	2024	46,642	1,207	
46644	Halpern, J.	University of California, B	usa	65	1995	2024	46,643	303	
46645	Savage, Martin J.	University of Washington	usa	223	1985	2024	46,644	742	
46646	Hultmark, Dan	Umeå Universitet	swe	110	1977	2024	46,645	583	
46647	Tang, Zhongmin	University of Wisconsin-M	usa	56	2017	2024	46,646	1,454	
46648	Richter, Joel E.	Cleveland Clinic Foundati	usa	434	1978	2016	46,647	668	
46649	Gouterman, Martin	University of Washington	usa	160	1957	2020	46,648	363	
46650	Karvonen, Andrew	Lunds Universitet	swe	54	2004	2024	46,649	383	
46651	Di Renzo, Gian Carlo	Università degli Studi di P	ita	456	1978	2024	46,650	927	
46652	Nikitas, Alexandros	University of Huddersfielc	gbr	54	2008	2024	46,651	440	
46653	Yao, Yao	China University of Geosc	chn	104	2017	2024	46,652	1,402	
46654	Yang, Bo	Shenzhen University	chn	255	2006	2024	46,653	1,971	
46655	O'Connor, David	Royal Agricultural Univers	gbr	68	2014	2024	46,654	1,482	
46656	Prescott, Edward C.	Arizona State University	usa	84	1968	2022	46,655	580	
46657	Bessant, John	University of Exeter	gbr	171	1979	2024	46,656	663	
46658	Montani, David	Université Paris-Saclay	fra	459	2004	2024	46,657	2,604	
46659	Wolford, Wendy W.	Cornell University	usa	50	2003	2024	46,658	388	

Ranking 2023 – Yearly List (2023)

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Prof Nikitas is a world's top 2% career-long researcher according to the latest Stanford/Elsevier c-score based ranking list (#564 all-time researcher in Logistics and Transportation) while he was also ranked #197, #146, #141 and #109 globally in the same area in Stanford/Elsevier's yearly lists for 2020, 2021, 2022 and 2023 respectively.

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Alexandros Nikitas

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Highly Ranked Scholar - Prior Five Years:
#33 Mobilities

Highly Ranked Scholars™ - Prior Five Years are eminent authors (active, retired and deceased) whose Top Percentage Ranks places them above 0.05 % of all scholars due to highly significant impact and quality of their scholarly contributions based on prior five years contributions in the following four categories using latest affiliation (based on publication record) : Overall (All Fields), with respect to their specific Field, their specific Discipline, and all Specialties with which they are/were associated.

Affiliation
University of Huddersfield, Huddersfield, United Kingdom

Affiliation History
View

Field
Business and Management

Discipline
Marketing

Top Specialties
Mobilities | Vehicular Automation | Connected Car | Transport

Metrics Summary

Publication Count	Predicted Citations	Predicted h-index
35	1,552	25

Ranking
View

Top Gear – Driverless Cars

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https://www.youtube.com/watch?v=WsnKzK6dX8Q

Introduction: Definition

An autonomous car (driverless car, self-driving car, automated car) is a vehicle that is capable of sensing its environment and navigating without human input. Vehicle automation is about bringing computerisation into what has, for over a century, been exclusively a human operation: driving.

Introduction: The Impact

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"Automated vehicles have, in theory at least, the potential to completely transform urban development as we know it, with a revolution in ground transport, regulations permitting, that could dramatically change the landscape of cities around the world and have an enormous economic, social, spatial, and mobility impact"

(Alessandrini, Campagna, Delle Site, Filippi and Persia, 2015)

Definitions of Smart Mobility

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Nikitas, A., Michalakopoulou, K., Njoya, E. T., & Karampatzakis, D. (2020). Artificial intelligence, transport and the smart city: Definitions and dimensions of a new mobility era. *Sustainability*, *12*(7), 2789.

×

Table 2. AI–transport–smart city nexus definitions: The lexicon of smart mobility.

Smart Transport Components	Definitions
Artificial Intelligence (AI)	AI refers to a machine's ability to simulate the human mind by interpreting data it receives from its environment, learning from them and using that learning to successfully complete tasks, even in the most unexpected and novel scenarios.
Smart City	Smart cities are those urban landscapes with the ability to embrace an integrated brand of autonomous, connected, shared, digital and cloud-based technologies in their strategic decision-making and operations to become more sustainable, creative, informed, cost-efficient and people-focused.
Connected and Autonomous Vehicles (CAVs)	A CAV is any vehicle that can understand its surroundings, move, navigate and behave responsibly without human input, and at the same time has connectivity functions enabling it to be proactive, cooperative, well-informed and coordinated.
Unmanned Aerial Vehicles (UAVs)	UAVs (also commonly known as drones) are smart aircrafts that can fly without the onboard presence of pilots and can provide robust air transport solutions for the provision of improved military, policing and commercial services.
Personal Aerial Vehicles (PAVs)	PAVs are flying people-movers, bridging the gap between scheduled airliners and ground transport, offering unprecedented levels of fast, on-demand urban mobility by making use of the free air space.
Mobility-as-a-Service (MaaS)	MaaS is a system that offers multimodal packages of personalised mobility that will replace privately owned vehicles through the use of an all-in-one digital platform that is capable of providing integrated journey planning, booking, smart ticketing and real-time information services on a subscription or "pay-as-you-go" basis.
Internet of Things (IoT)	The IoT is a connectivity paradigm that empowers objects of everyday life to hear, see, listen and interpret streams of big data and communicate with one another and with users through integrated cloud technologies, software, sensors and human–machine interfaces.
Physical Internet (PI or π)	The PI is a global concept for sustainable and efficient multimodal freight transportation and logistics that optimises the movement, storage, supply and usage of physical objects through the use of digital, automated, interconnected and big data technologies.
Industry 4.0	Industry 4.0 is a transformative paradigm representing the computerisation, automation, digitisation and informisation of industrial systems through the use of technologies like Cyber-Physical Systems and the Internet of Things.

Is the Future Here or Not Really?

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Close but...

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Traffic Ahead

Many carmakers are developing prototype vehicles that are capable of driving autonomously in certain situations. The technology is likely to hit the road around 2020.

	BMW	Mercedes-Benz	Nissan	Google	General Motors
VEHICLE	5 Series (modified)	S 500 Intelligent Drive Research Vehicle	Leaf EV (modified)	Prius and Lexus (modified)	Cadillac SRX (modified)
KEY TECHNOLOGIES	• Video camera tracks lane markings and reads road signs • Radar sensors detect objects ahead • Side laser scanners • Ultrasonic sensors • Differential GPS • Very accurate map	• Stereo camera sees objects ahead in 3-D • Additional cameras read road signs and detect traffic lights • Short- and long-range radar • Infrared camera • Ultrasonic sensors	• Front and side radar • Camera • Front, rear, and side laser scanners • Four wide-angle cameras show the driver the car's surroundings	• LIDAR on the roof detects objects around the car in 3-D • Camera helps detect objects • Front and side radar • Inertial measuring unit tracks position • Wheel encoder tracks movement • Very accurate map	• Several laser sensors • Radar • Differential GPS • Cameras • Very accurate map

MIT Technology Review

Levels of Automation

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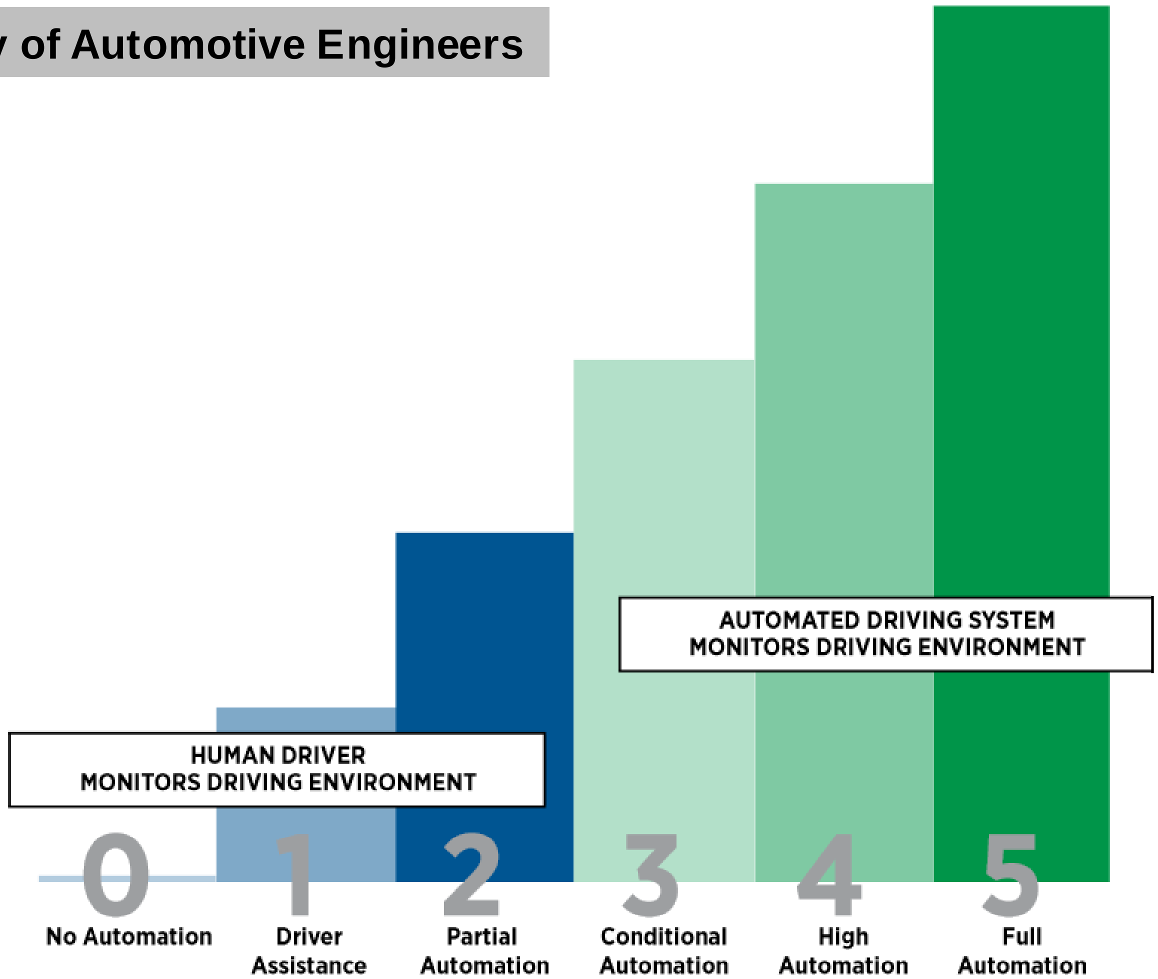
SAE: Society of Automotive Engineers



*The taxonomy and the definitions provided belong to SAE international's J3016

Levels of Automation

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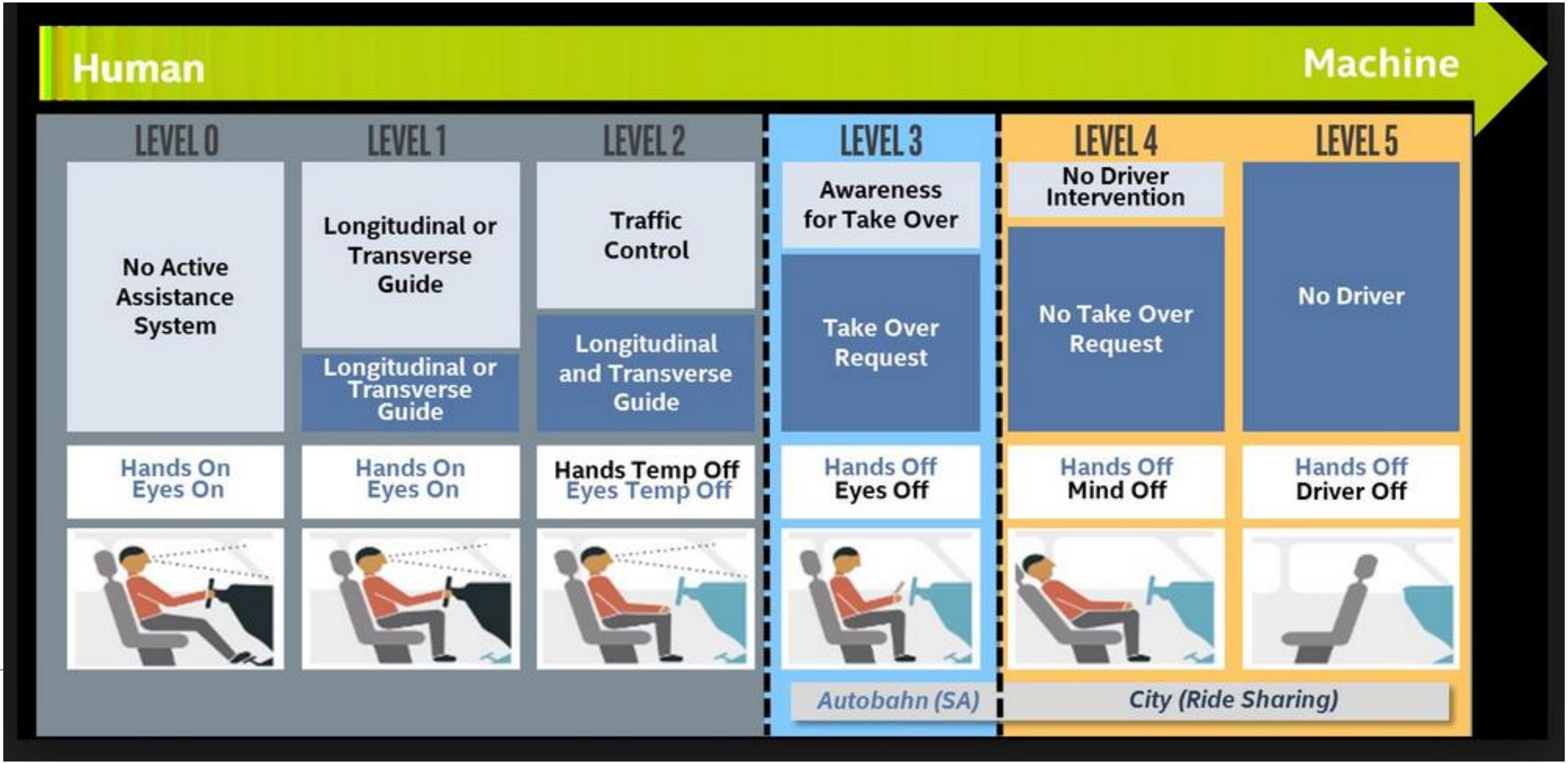
Source: https://iq.intel.com/autonomous-cars-road-ahead/



Levels of Automation

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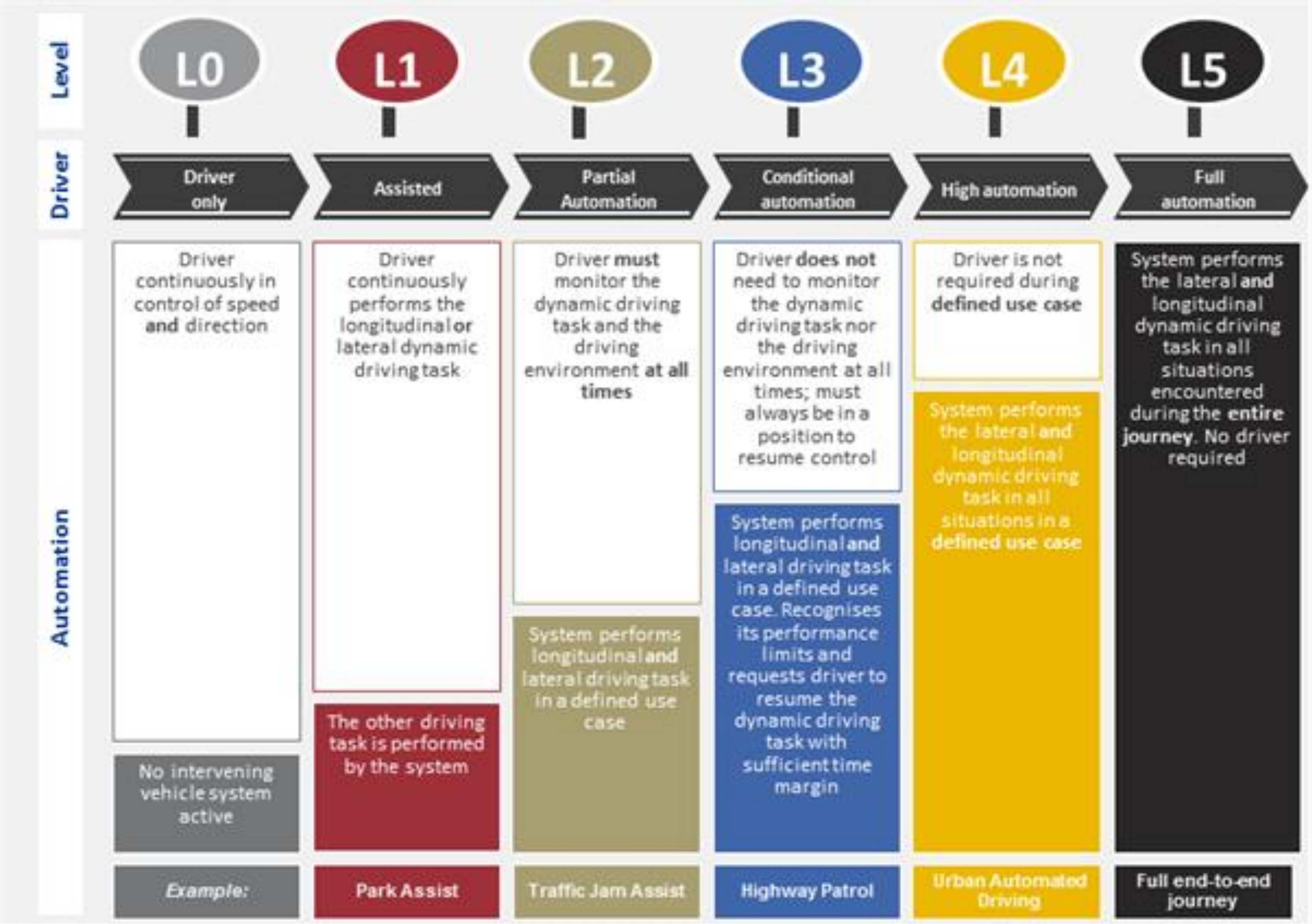
Source: https://www.smmt.co.uk/industry-topics/technology-innovation/connected-autonomous-vehicles/



Levels of Automation

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

Pilot Examples: Heathrow Pods

https://www.youtube.com/watch?v=Byk8LcPovOQ

These driverless pods will be the first autonomous vehicles to hit the streets of London.

The vehicles, which are already being used on tracks at Heathrow Airport, will be adapted for use in Greenwich. The consortium behind the trial said changes would be made so the pods didn't need to run on tracks.

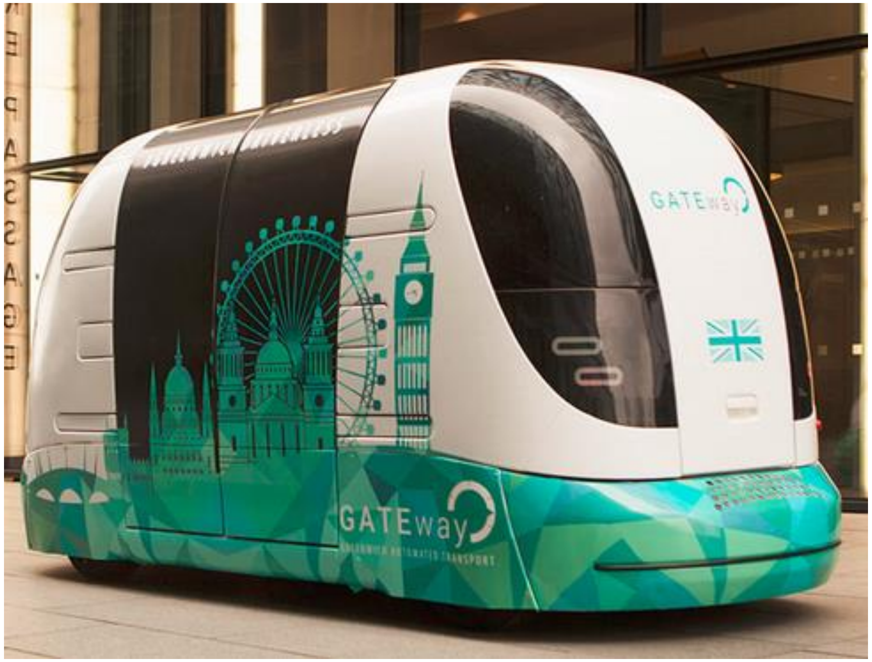
Seven of the electric pods -- developed by the GATEway group -- will be placed on the tarmac of the Greenwich Peninsula, with routes likely to include residential streets and areas close to the O2 Arena.

They will be tested for three months by 'invited' users before being opened up to the general public. Each pod can carry six passengers, although one of the passengers will be a steward whose job it is to press the emergency button in the event of a problem. The pods will be the first driverless vehicles to hit the streets of London and are part of a larger national project.

GATEway (Greenwich Automated Transport Environment) is an £8m research project, led by TRL, to understand and overcome the technical, legal and societal challenges of implementing automated vehicles in an urban environment.

Taking place in TRL's UK Smart Mobility Lab in the Royal Borough of Greenwich, the project will trial and validate a series of different use cases for automated vehicles, including driverless shuttles and automated urban deliveries.

Results will help both industry and policymakers understand the implications of automated vehicles and deliver a safe and validated test environment in the UK, driving job creation and investment in a rapidly emerging technology area.



Project objectives

GATEway

Demonstrate
The safe and efficient integration of sophisticated automated transport systems into complex real world smart city environments.

Understand
The technical, cultural, societal and legal challenges and barriers to adoption surrounding automated vehicles.

Inspire
Industry, public bodies and the wider public to engage with autonomous transport technology.

Generate
Valuable, exploitable knowledge of the systems required for the effective validation, deployment, management and integration of automated transport within a smart city environment.

Create
A validated test bed in the heart of London for the evaluation of next generation automated transport systems, including the detailed testing protocols and benchmark data for independent verification of automated systems.

Position
UK PLC at the forefront of the global connected and autonomous vehicle marketplace, encouraging inward investment and job creation.

Background to the driverless cars competition in the UK

On 30 July 2014, the Government launched a “driverless cars” competition inviting UK cities to join together with businesses and research organisations to host vehicle trials locally.

The results were announced in December 2014 with Greenwich, Milton Keynes, Coventry and Bristol being selected, and £19 million being provided by the Government to allow testing of automated vehicle technology.

This review provides the legal clarity to support the trialling of automated vehicles on UK roads.

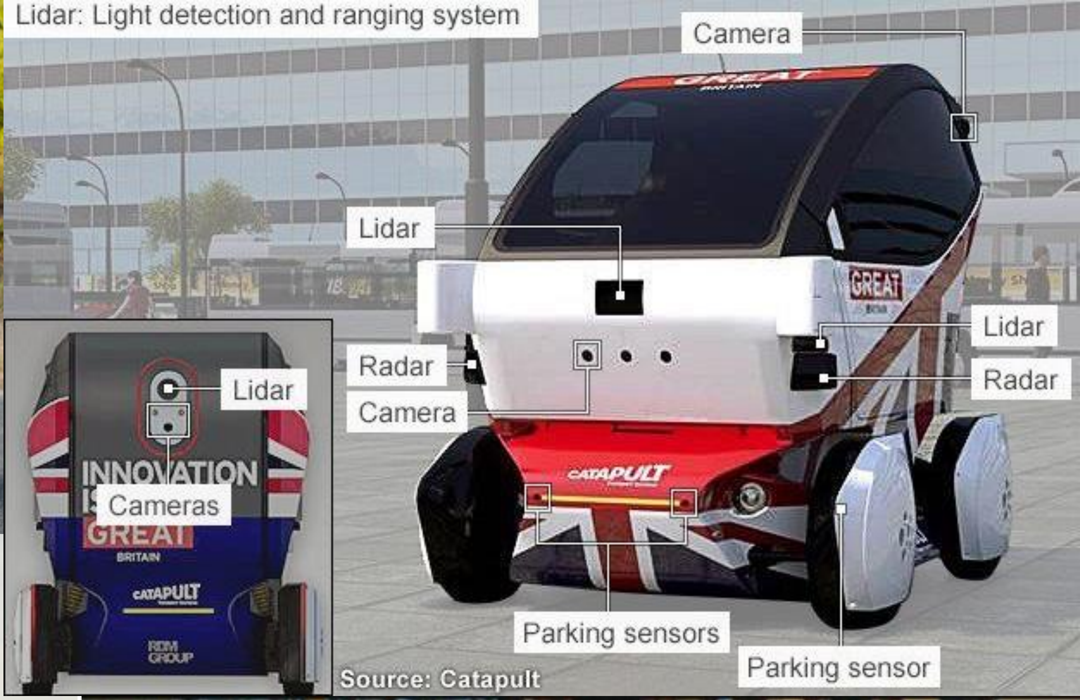
UK Funding Scheme

Figure 1 – An early design concept of the self-driving pods that are due to be tested in Milton Keynes in 2015

The UK government is providing £19m to launch four driverless car schemes in four UK locations. Self-drive pods that will be tested in Milton Keynes and Coventry have been unveiled and the government promised a full review of current legislation by the summer of 2017.

The Lutz Pathfinder Pod is a two-seater, electric-powered vehicle that has 19 sensors, cameras, radar and Lidar (a remote sensing technology that measures distance by illuminating a target with a laser and analysing the reflected light).

Figure 2 – The human control interface from the Oxford Mobile Robotics Group's automated Nissan Leaf vehicle



Examples of Pilots

Google driving to be driverless

Google's modified Toyota Prius uses an array of sensors to navigate public roads without a human driver. Other components, not shown, include a GPS receiver and an inertial motion sensor.

Laser-guided mapping
A rotating sensor with lasers called a LIDAR on the roof scans more than 200 feet in all directions to generate a precise three-dimensional map of the car's surroundings.

Position estimator
A sensor mounted on the left rear wheel measures small movements made by the car and helps to accurately locate its position on the map.

Video camera

A camera mounted near the rear-view mirror detects traffic lights and helps the car's onboard computers recognize moving obstacles-such as pedestrians and bicyclists.

Radar
Four standard automotive radar sensors, three in front and one in the rear, help determine the positions of distant objects.

Source: Google

NEW YORK TIMES; PHOTOGRAPHS BY RAMIN RAHIMIAN FOR THE NEW YORK TIMES

Talking about Impact

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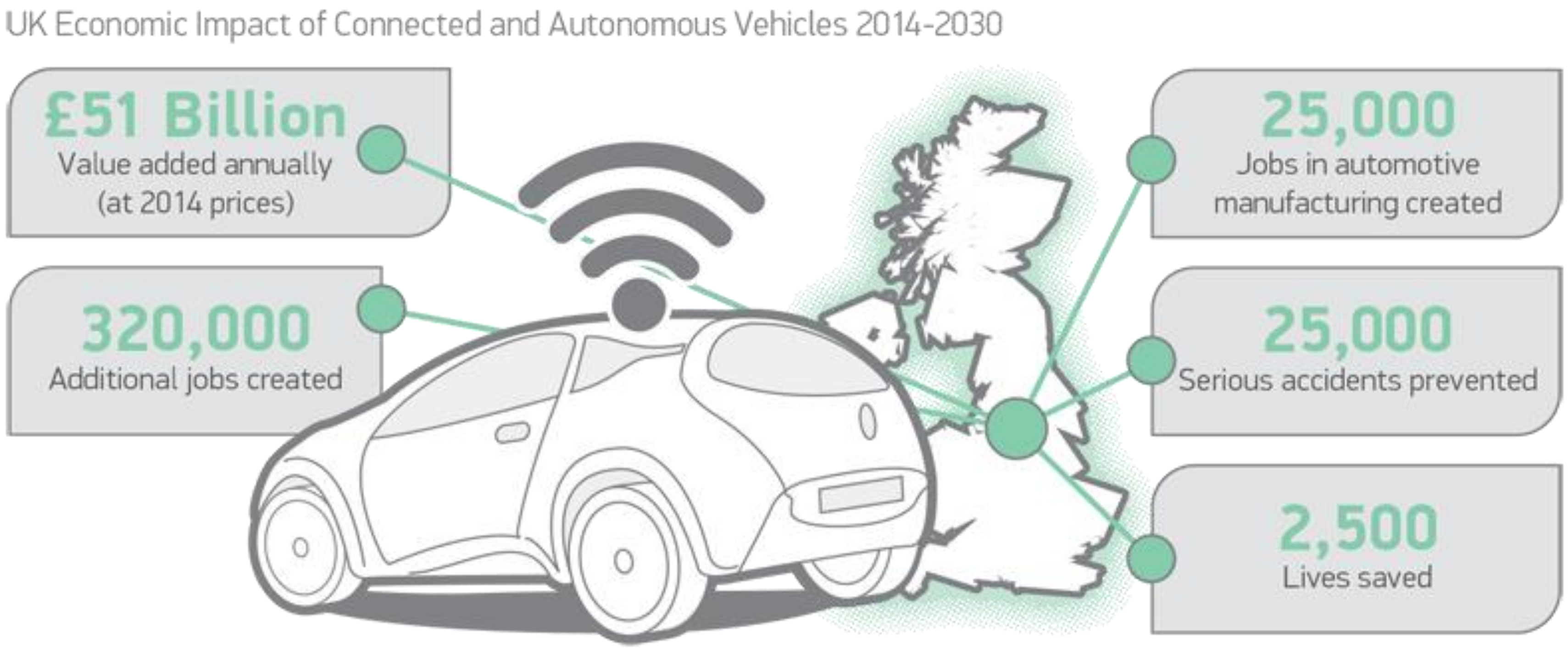
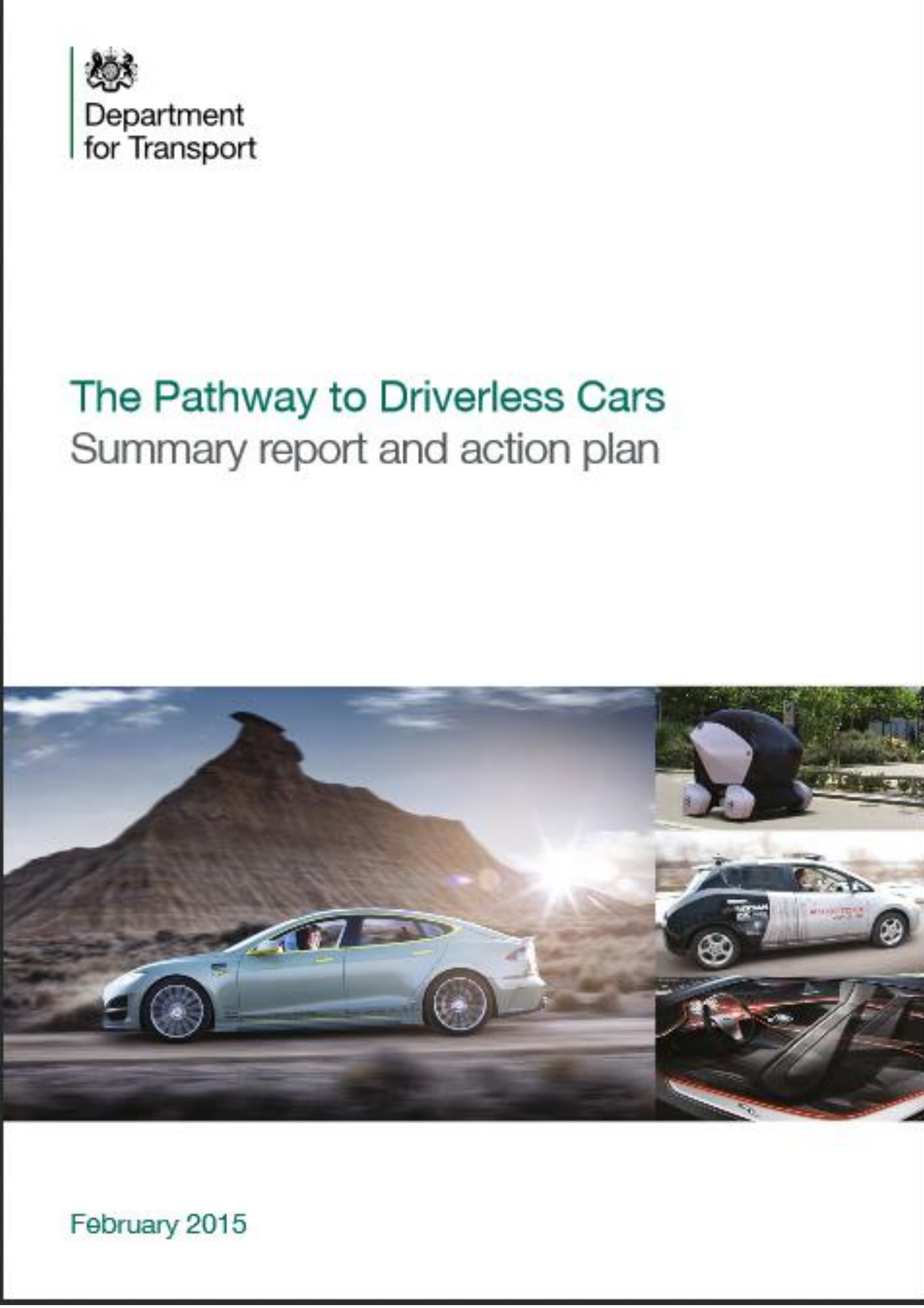


Source: https://www.smmt.co.uk/industry-topics/technology-innovation/connected-autonomous-vehicles/

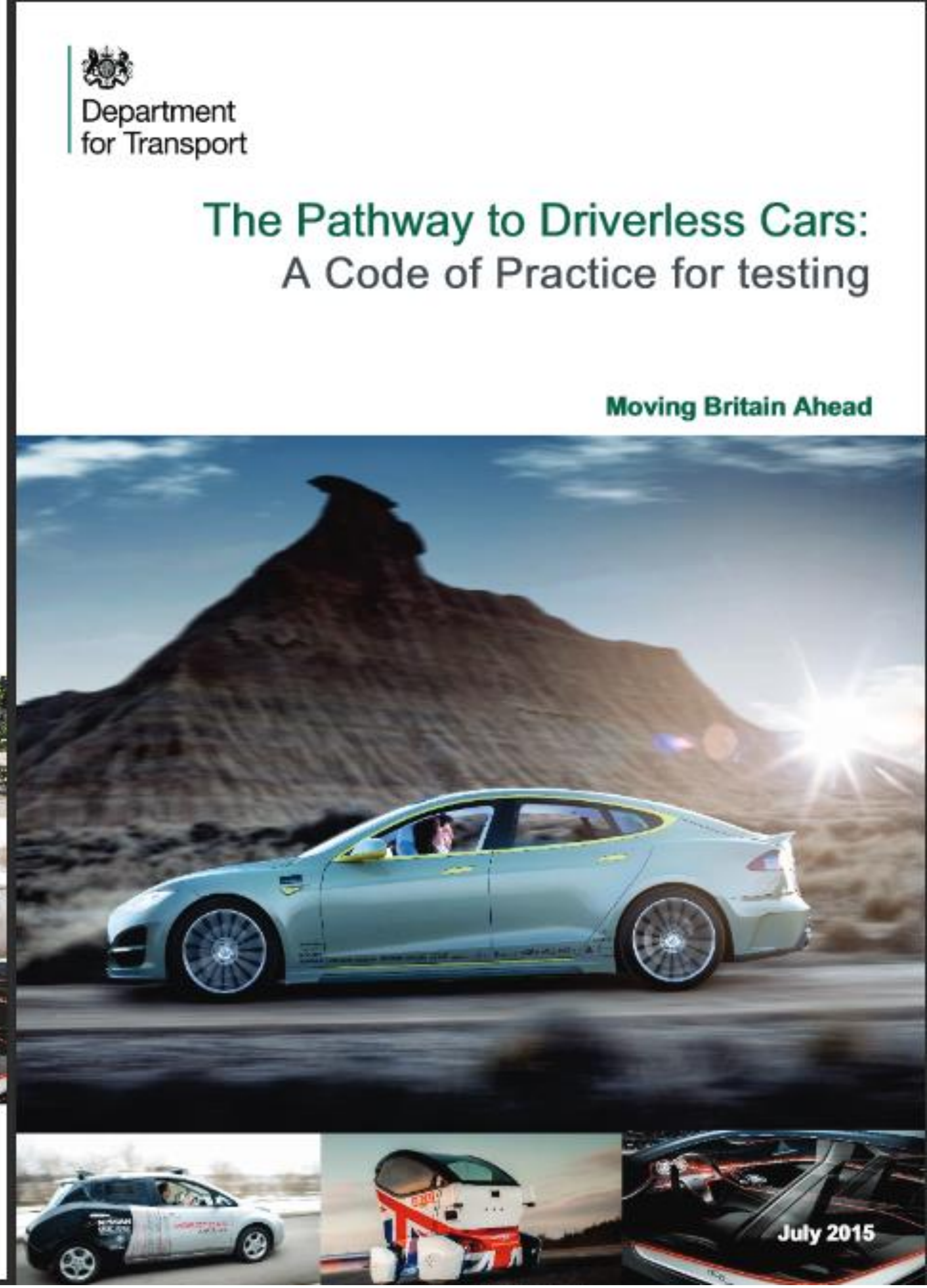


Department for Transport

The Pathway to Driverless Cars

Summary report and action plan

February 2015



Department for Transport

The Pathway to Driverless Cars:

A Code of Practice for testing

Moving Britain Ahead

July 2015

Driverless Vehicles in UK

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“Driverless vehicle technology has the potential to be a real game changer on the UK’s roads, altering the face of motoring in the most fundamental of ways and delivering major benefits for road safety, social inclusion, emissions and congestion. When you consider that the average driver spends the equivalent of six working weeks driving a year, this represents a real opportunity. In addition, automated vehicles that never get tired or distracted could hold the key to substantially improving road safety. We are setting out the best possible framework to support the testing of automated vehicles, to encourage the largest global businesses to come to the UK to develop and test their technologies. ”

(Claire Perry, MP Parliamentary Under Secretary Department for Transport)

Summary

23. In summary the UK is uniquely positioned to help develop automated vehicle technologies and bring these to market:

- The Government is developing a light touch/non-regulatory approach to the testing and development of these technologies – as set out in this review.
- The Government can facilitate long distance and large area public road testing now – our Code of Practice approach can be applied across the UK, unlike many other countries which offer only selected roads or small, restricted geographical areas.
- The UK has some of the most challenging and diverse traffic, road and weather conditions in Europe and London is Europe's only 'Megacity'. This makes the UK the ideal centre for testing and developing these technologies.

In this review the Government has set out clear next steps showing how we will continue to ensure the regulatory and legislative framework is there to support the further development and mass production of automated vehicle technologies.

Benefits: Creating More Free Time

Creating more free time

1.2 The average driver in England spends 235 hours driving every year. That is the equivalent of six working weeks. Despite the increasing sophistication of modern vehicles, and greater application of driver assistance technologies, the driver must still concentrate on driving 100% of the time. Highly and fully automated vehicles will change this. For the first time since the invention of motor vehicles, the 'driver' will be able to choose whether they want to be in control, or to hand the task of driving over to the vehicle itself. This represents a major opportunity – allowing drivers to safely use the journey time however they wish, from reading a book, to surfing the web, watching a film or just chatting face to face with other passengers.

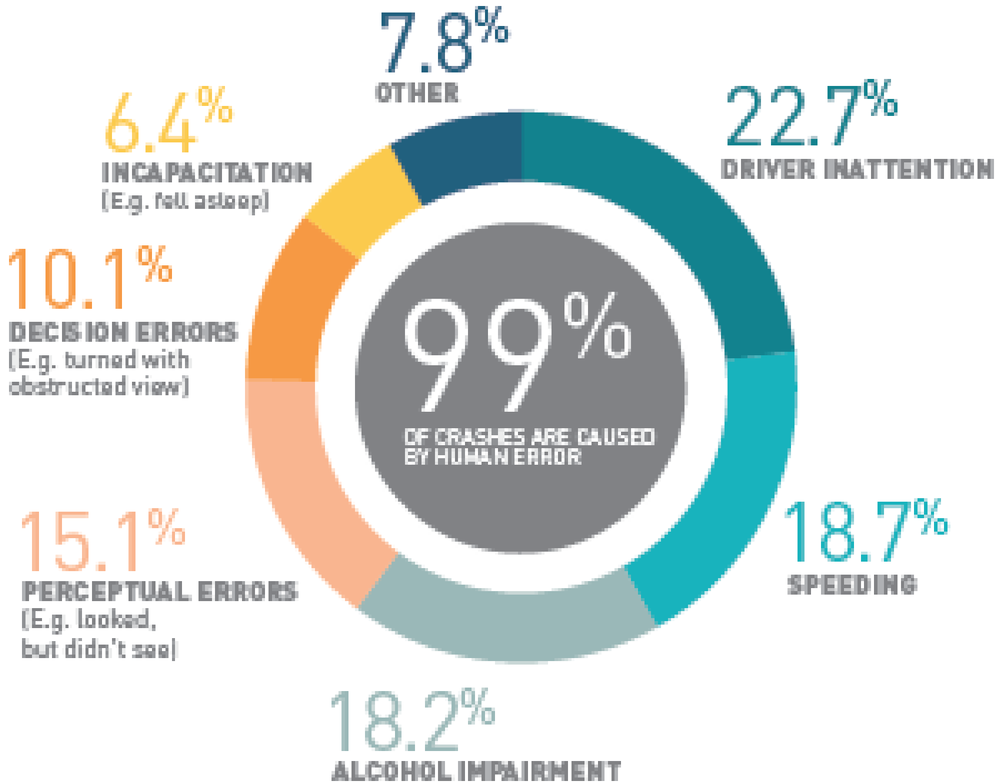
The average driver in England can save up to **6 working weeks** a year driving time

Benefits: Improving Safety

Human error is a factor in over 90% of collisions. Failing to look properly, misjudging other road users' movements, being distracted, careless or in too much of a hurry are the most common causes of collisions on our roads. Automated vehicles will not make these mistakes. They use a range of sensors which will constantly monitor their surroundings. We have come to rely on many technologies that assist the driver of a vehicle, for example Anti-lock Braking Systems (ABS), cruise control or parking sensors. As these technologies evolve, they are reaching the point where a vehicle is capable of operating for periods of time with reduced, or in some instances without, driver input. Evidence from automated technologies available today already demonstrates significant safety benefits.[1] For example automatic emergency braking, lane departure warning and electronic stability control have all been assessed to have improved safety based on existing evidence.

REDUCING HUMAN ERROR

Fully automated vehicles will significanly reduce driving incidents caused by human error. In a study of 723 crashes, driver error caused or contributed to 717*



*Relative frequency of unsafe driving acts in serious traffic crashes; summary technical Report, USDOT NHTSA Traffic Safety Programs, January 2001

Benefits: Reducing Emissions and Easing Congestion

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1.6 By communicating with their environment and other vehicles, automated and driverless vehicles offer the promise of better use of road space, reducing congestion and providing more consistent journey times, through the use of "connected vehicle" technologies. "Connected vehicles" would communicate with each other and their surroundings to identify the optimum route, helping to spread demand for scarce road space. Vehicles could also communicate with roadside infrastructure such as traffic lights and use this information to minimise fuel consumption and emissions.

Benefits: Increasing Access for Everyone

1.7 Most people take driving for granted and could not imagine life without their car. However there are still many people who do not have a driving licence, or access to a vehicle. Disabled people may be unable to drive. Elderly people may be judged unfit to drive. Others may simply not want to drive or be concerned about their ability to do so.

1.8 When automated vehicle technologies develop to the extent that vehicles which can undertake door to door journeys without the need of a driver at all, they could improve mobility for all these people, enhancing their quality of life.

Acceptance of Automated Vehicles

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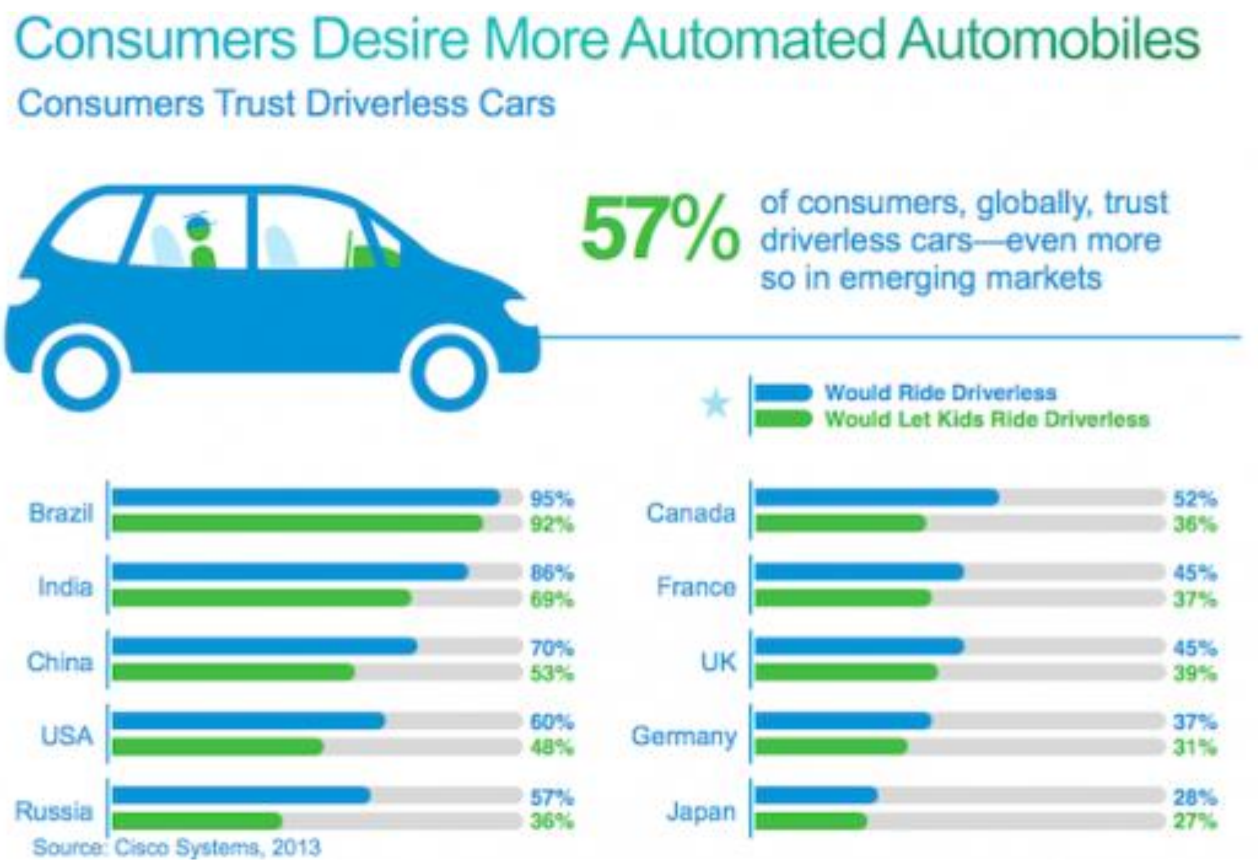

Automated Cars: A Critical Review of the Potential Advantages and Disadvantages of Driverless Technologies

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Workshop on Smart Urban Mobility
Edinburgh Napier University
26-27 November 2015

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Background

Over the last decade the automobile and technology industries supported by the interdisciplinary efforts of numerous research institutes around the world, have made significant leaps in bringing computerisation into what has, for over a century, been exclusively a human operation: driving. Starting from the introduction of functions that nowadays seem fairly conventional such as anti-lock braking systems and traction control and progressively commercialising more complex features such as adaptive cruise control and autonomous parking assist systems urban societies are getting closer and closer to enter a world-shattering new era; the era of self-driving vehicles.

This is because automated vehicles have, in theory at least, the potential to completely transform urban development as we know it, with a revolution in ground transport, regulations permitting, that could radically change the landscape of cities around the world and have a unprecedented socio-economic, spatial, and mobility impact.

Objectives and Methodology

The present paper has a visionary character. It aims to explore some of the potential advantages and disadvantages that will be generated by the introduction of driverless technologies via a state-of-the-art review of the existing literature and via the analysis of a series of semi-structured in-depth interviews with transport scholars that have conducted relevant research studies. The interviews involved discussions meaning to identify and systematically organise the likely positive and negative impacts of vehicle automation and to refine the understanding of how people will adapt to this entirely new transportation paradigm. Although these discussions included several references to semi-automated technologies they primarily addressed future visions of completely driverless and interconnected city-wide vehicle systems that despite their entirely realistic character could actually be not as close as what is currently believed. The focus of the work is also on transportation of people rather than transportation of goods; thus the particular emphasis on automated cars.

Potential Advantages of Vehicle Automation

- Enhanced road transport safety
- Fewer road accidents and fatalities
- Reduced traffic congestion due to more efficient road space allocation
- More efficient travelling (e.g. best routing)
- Time savings
- Reduced carbon emissions and air pollution
- Reduced noise nuisance
- Relief from driving and navigation duties
- Increased potential for teleworking while 'driving'
- More cabin space
- Smoother rides
- Less or no driving restrictions
- A more flexible licensing system
- Transformation of the idea of car ownership as known today
- Huge car-sharing potential
- Potential for revolutionising public transportation services
- Smaller parking requirements in terms of space and time
- Reduced needs for traffic police
- Reduced needs for physical road signage
- Reduced needs for vehicle insurance premiums
- Support to traffic regulations (e.g. no speeding, no drink and drive, no suicide crashes)
- Increased need for IT jobs
- More surveillance could mean more secure road environments

Potential Disadvantages of Vehicle Automation

- User resistance to giving up driving control
- Loss of situational awareness and driving skills
- Behaviour adaptation problems for the passengers
- Communication and integration problems in mixed traffic situations
- Loss of 'freedom' or 'independence' associated with driving
- Loss of 'joy' or 'adrenaline' associated with driving
- Potentially strict entry requirements
- Luck of trust in new technologies (vehicles and infrastructure)
- Luck of trust in governments/operators
- Loss of privacy and thus data sharing and distribution issues
- Risk allocation ambiguity in collisions
- Damage liability allocation ambiguity after collisions
- Need for an entirely new traffic code
- Increased vulnerability to software and hardware flaws
- Increase vulnerability to hacking and terrorism
- Need for different road policing and enforcement approaches
- Automated cars may end up being high-end products
- Rural inequalities
- Likely loss of 'ownership' rights as known today
- Who is going to have control of such a system?
- More car trips could be generated from more people
- Loss of driving-based jobs
- Huge road infrastructure costs
- Bad weather conditions could affect AV navigation systems

Recommendations

- The introduction of automation technologies need to be well-communicated, transparent, methodical and incremental.
- Several pilots will be needed before a full-scale launch so that problems currently unforeseen will be identified and treated when still in embryonic stage.
- The transition period between different 'driving' technologies and the inescapable co-existence for some years of conventional, semi-automated and driverless cars could be critical for the acceptance and adoption of the latter vehicles.
- Early adopters and technology-oriented people should be fully convinced early in the process of 'shifting' so that they will effectively propagate the message of 'embracing driverless cars'.
- 'Replacements' should be given to car fanatics that view manual driving as an irreplaceable 'freedom' or 'joy'.
- Cultural issues could also play a role in how quick and efficient this paradigm shift could be to different urban societies across the globe.
- There is a need for substantial and continuous investments in vehicle and road infrastructure and legislation/policy-making so that autonomous vehicles could be functional, smoothly integrated to the overall transport system and appropriately regulated.

The present paper has a visionary character. It aims to explore some of the issues that will be generated by the introduction of these technologies via a state-of-the-art review of the existing literature but more importantly, perhaps, via the analysis of a series of semi-structured in-depth interviews with transport scholars that have conducted relevant research studies.

Research Methodology

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- Face-to-face or skype interviews with transport experts, all of whom had a degree of experience in road automation research.
- The interviewees covered insights from all the continents.
- The interviews were semi-structured based on an interview guide.
- The interviews lasted about one hour each.
- Thematic analysis was carried out.

- *This analysis was also supported by a literature review looking into some of latest research outputs in vehicle automation.*

Visions of the Future

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- The interviews discussed the likely positive and negative impacts of vehicle automation and how to ease the transition of people to the transportation realities of the future.

- Although these discussions included several references to semi-automated technologies they primarily addressed future visions of fully driverless and interconnected city-wide vehicle/road infrastructure systems.

Workshop: What are the advantages and disadvantages of CAVs then?

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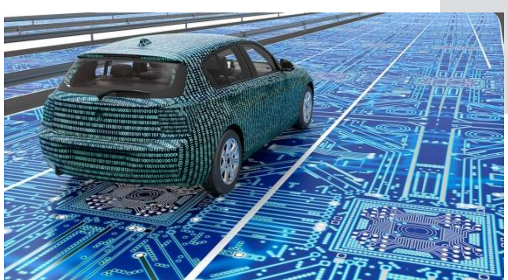

Potential Benefits of Vehicle Automation

- Enhanced transport safety
- Fewer road accidents and fatalities
- Reduced traffic congestion due to more efficient road space allocation
- More efficient travelling (e.g. best routing)
- Time savings
- Support to traffic regulations (e.g. no speeding, no drink and drive, no suicide crashes)
- Environmental benefits in terms of fewer carbon emissions and noise nuisance
- Relief from driving and navigation duties and therefore more occupant flexibility
- More cabin space
- Less or no driving restrictions (everybody might be able to ‘drive’ eventually including people like visually impaired or older people not fit to drive manually)
- A more flexible licensing system
- Transformation of the idea of car ownership as known today (e.g. people might not need to own a car at all)
- Huge car-sharing potential
- Potential for revolutionising public transportation services
- Smaller parking requirements in terms of space and time
- Reduced needs for traffic police
- Reduced needs for physical road signage
- Reduced needs for vehicle insurance premiums
- Smoother rides

The Dream Scenario

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"A fully automated and interconnected system fuelled by electricity that provides a variety of vehicle options strictly on an 'as needed' basis".

Potential Concerns of Vehicle Automation

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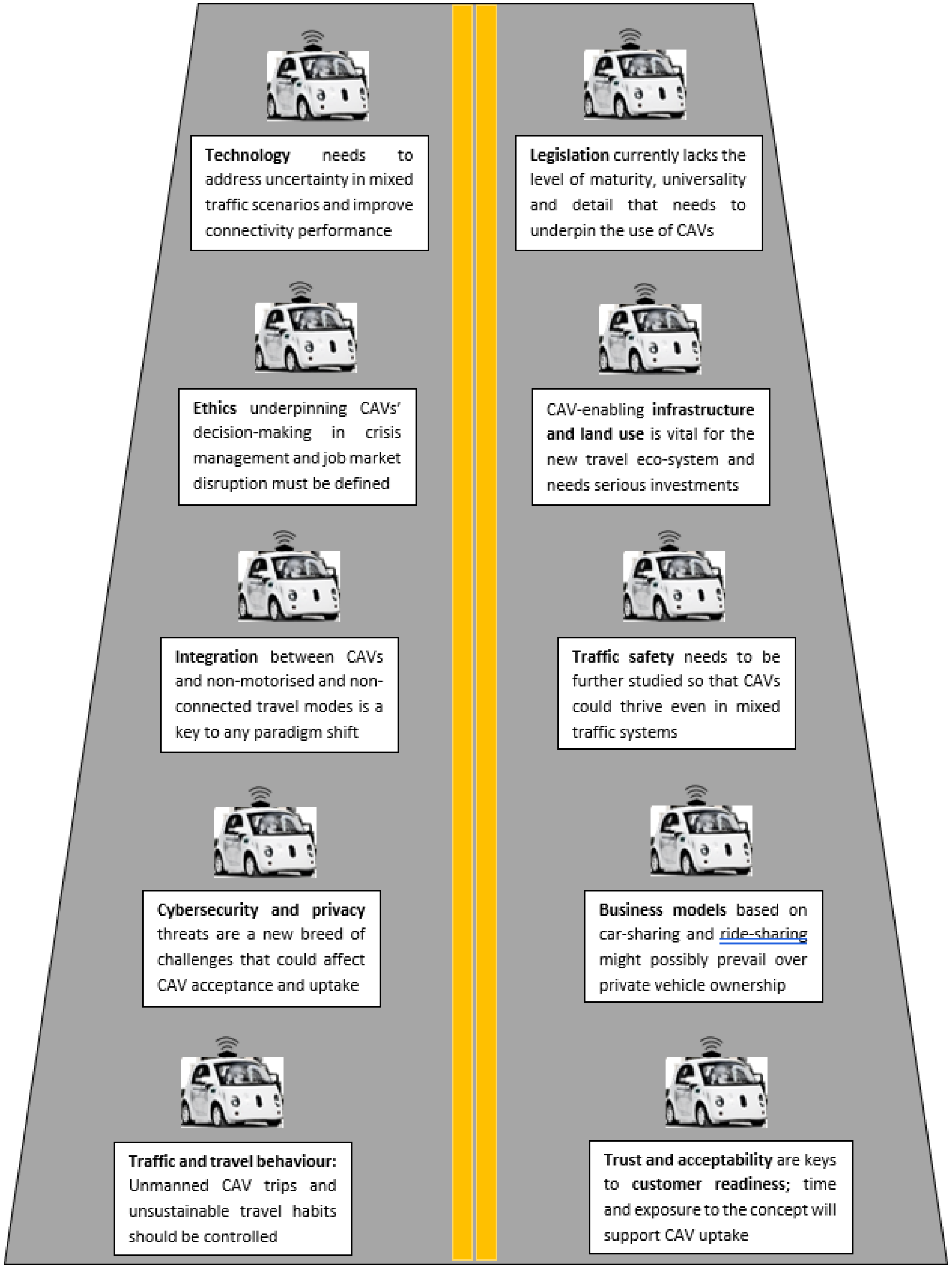
- User resistance to giving up driving control
- Loss of situational awareness
- Loss of driving skills
- Questions arising about what happens when the auto-pilot malfunctions en route
- Behaviour adaptation problems for the passengers
- Communication problems with non-autonomous vehicles in mixed traffic situations
- Integration problems with the rest of the transport system
- Luck of trust in new technologies (vehicles and infrastructure)
- Luck of trust in governments/companies responsible for introducing and running AV systems
- Issues regarding the management of the vast amount of travel data collected
- Loss of personal space
- Loss of ‘freedom’ or ‘independence’ associated with driving
- Loss of ‘joy’ or ‘adrenaline’ associated with driving
- Risk allocation in collisions; particularly in instances where an automated vehicle would not be able to avoid crashing
- Who will be responsible the machine or the user for damage liabilities?
- Will people have to sign agreements surrendering current rights in order to be able to have access to autonomous vehicles?
- Laws regarding data sharing and distribution
- Need for an entirely new traffic code
- Need for different road policing and enforcement approaches

Potential Concerns of Vehicle Automation

- Increased vulnerability to software and hardware flaws
- Increase vulnerability to hacking
- Increased vulnerability to terrorism
- Automated cars may end up being high-end products unreachable for the average user
- Is flexible licensing and easy access really good in all cases?
- Rural inequalities
- Will eventual interconnected car-sharing systems be affordable?
- Likely loss of ‘ownership’ rights as known today
- Is a 100% vehicle-sharing system acceptable or even the best solution?
- Who is going to have control of such a system? People or the state and the big automobile/telecommunication companies?
- More car trips could be generated from more people
- Blow to public transport as known today and perhaps to active travel modes
- Car-oriented development growth beyond any forecast?
- Loss of driving-based jobs (but these could be replaced to a degree by an eventual increased need for IT jobs)
- Huge costs meaning to make road infrastructure compatible with the highly computerised requirements of the new vehicles
- How affordable AV will really be?
- Road freight could be revolutionised in terms of economic efficiency (e.g. platooning means fuel economy and reduced air resistance)
- Bad weather conditions could affect the efficiency of the navigation systems of AV

Recommendations



Icebreaker – It is Not a Car

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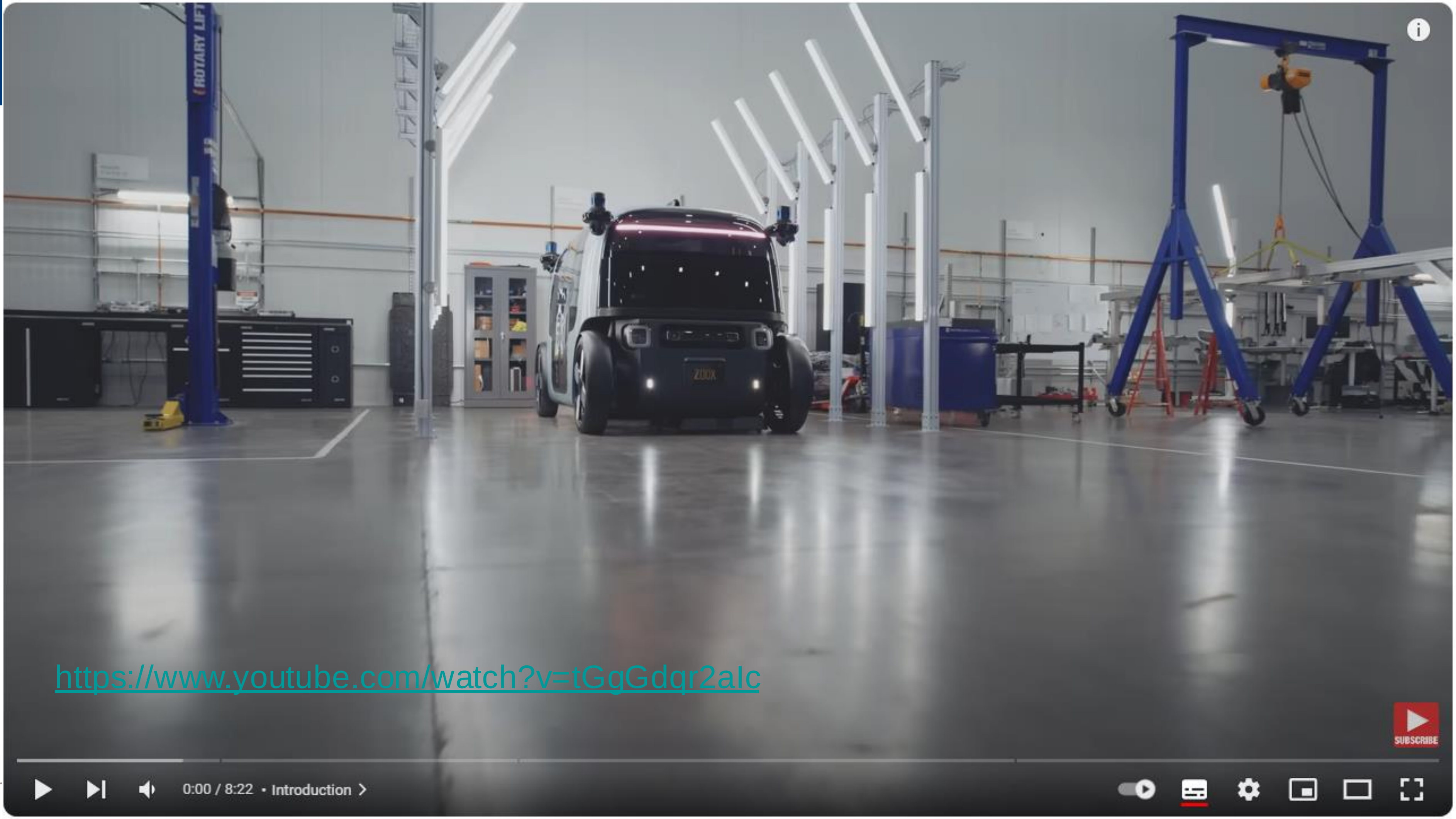

https://www.youtube.com/watch?v=tGgGdqr2aIc

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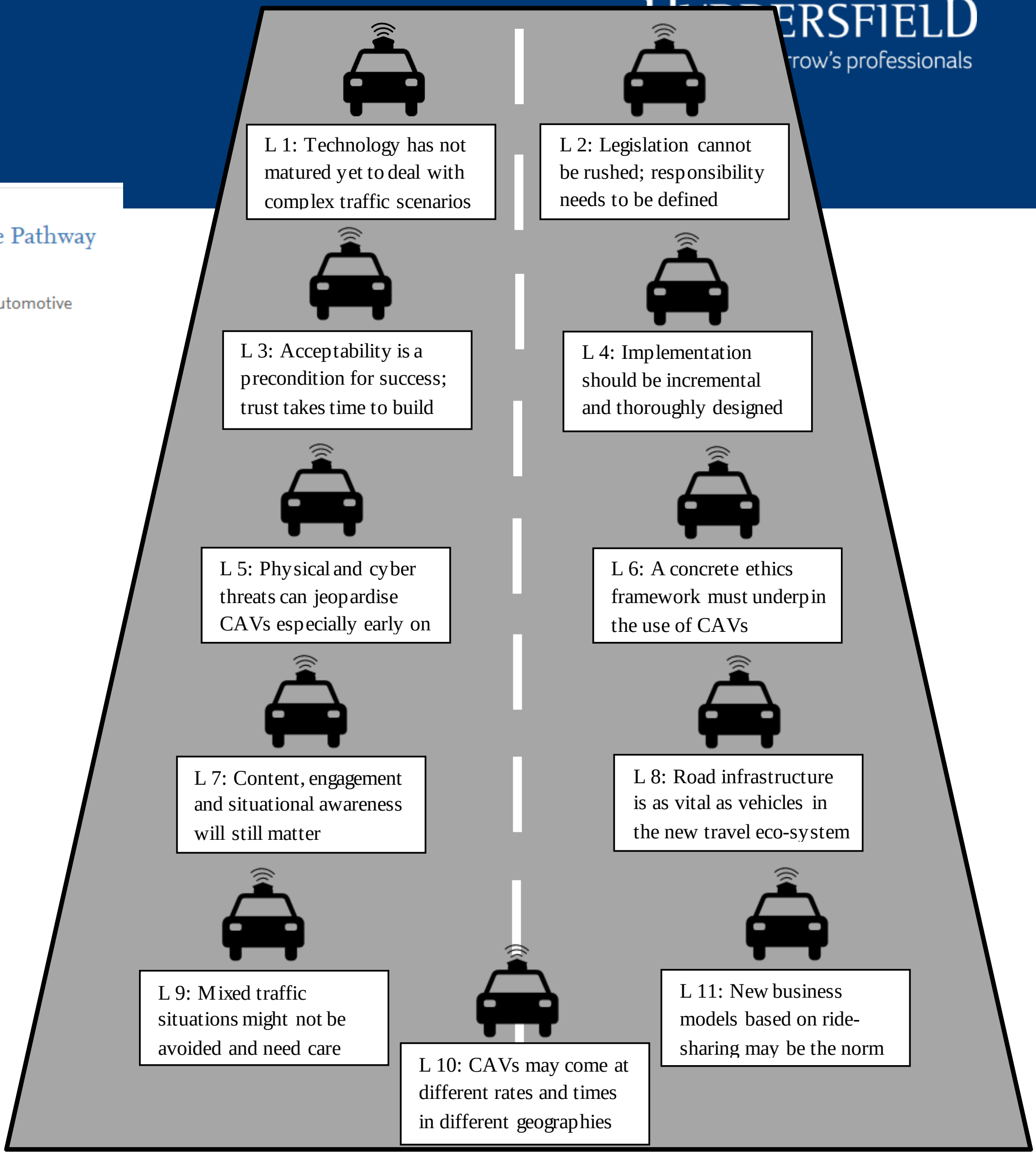
Recommendations

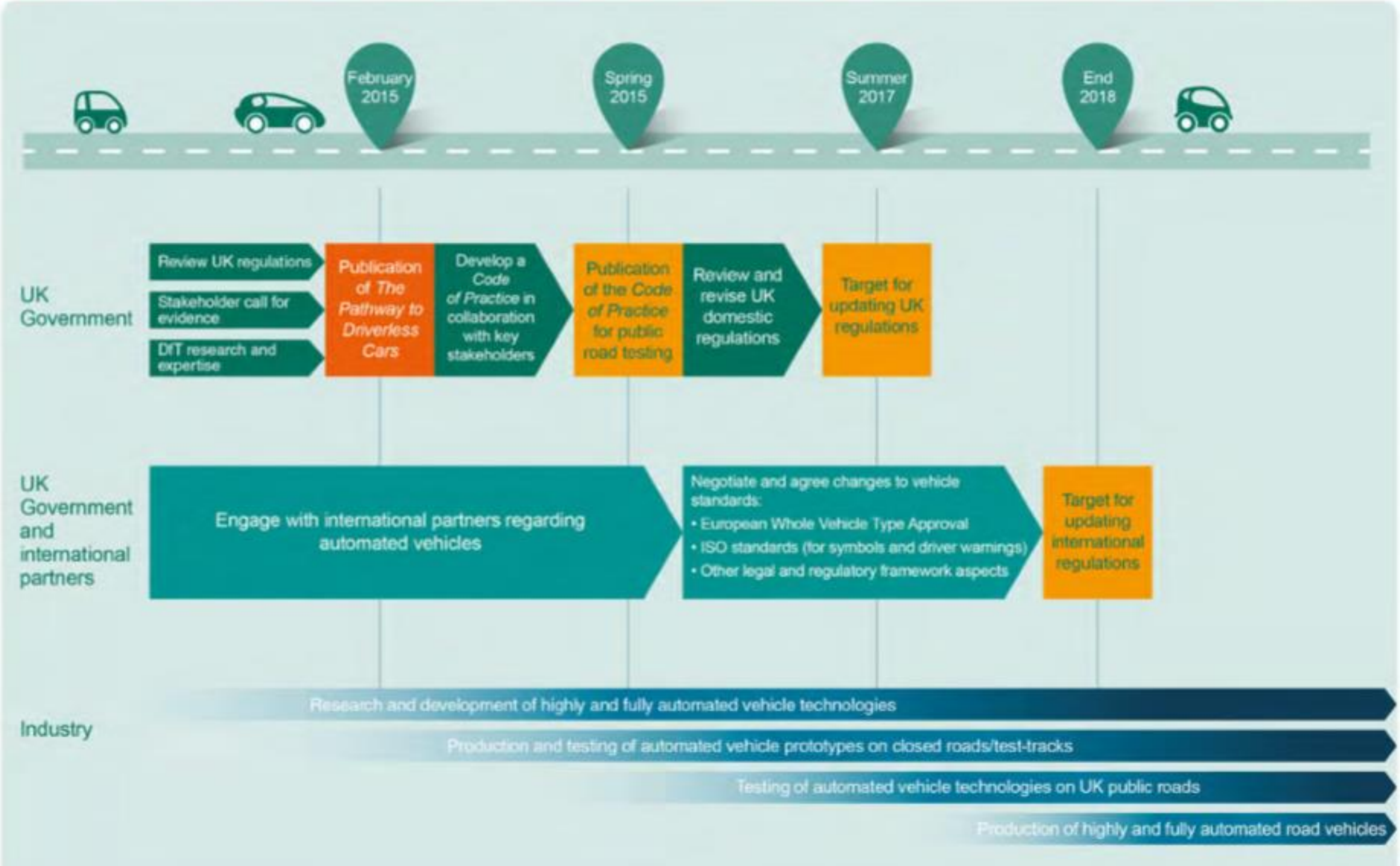
Examining the Myths of Connected and Autonomous Vehicles: Analysing the Pathway to a Driverless Mobility Paradigm

Nikitas, A., Tchouamou Njoya, E. & Dani, S., 8 Nov 2018, (Accepted/In press) In : International Journal of Automotive Technology and Management.

Research output: Contribution to journal › Article



Timeline for the development of highly and fully automated vehicles



Autonomous Future of Transport

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FLYING MACHINES

UAVs, PAVs and Flying Machines

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- Unmanned Aerial Vehicles (UAVs), also commonly known as drones or unmanned aircraft systems, is a new powerful intervention that brings the revolution of AI and wireless technologies to air transport and aviation. With the emergence of high-power-density batteries, long-range and low-power micro-radio devices, cheap airframes and powerful microprocessors and motors, UAVs are tools with the potential to provide robust solutions towards the provision of improved military, policing and commercial services.

- More specifically, UAVs can support tasks related to *intelligence, surveillance and reconnaissance, border patrol, target identification and designation, counter-insurgency, attack and strike, civil security control, law enforcement applications, environmental monitoring, surveying and geospatial activities, remote sensing, aerial mapping, weather monitoring and meteorology, forest fire detection, traffic control, cargo transport, accident reporting, emergency search and rescue, disaster control and management, wireless coverage, cloud support and communication relays*.

- The applications of UAVs are still fairly limited, while PAVs are still in the infancy phase of their development trajectory despite claims from Germany's Volocopter that it will start trials of a flying taxi in Singapore in 2020 and Uber's plans to launch commercial flights in the USA by 2023.

Nikitas, A., Michalakopoulou, K., Njoya, E. T., & Karampatzakis, D. (2020). Artificial intelligence, transport and the smart city: Definitions and dimensions of a new mobility era. *Sustainability*, *12*(7), 2789.

UAVs, PAVs and Flying Machines

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- Personal Aerial Vehicles (PAVs), Manned Aerial Vehicles (MAVs) or Personal Aerial Transport Systems (PATS) promise to combine the best of ground-based and air-based transportation making use of free space in the air.

- PAVs will be an innovative mobility intervention capable of bridging the niche between scheduled airliners and ground transport by offering unprecedented levels of fast, on-demand urban mobility. If higher automation and falling prices are achieved, PAVs will soon be able to serve the urban settings of smart cities. Automation will allow PAVs to carry passengers with no piloting skills, making them much more accessible to anyone in practical terms.

- Infrastructure requirements, such as *the number of landing and parking spaces, proper flying corridors, interaction with other modes and synergies with autonomous ground vehicles (PAVs and CAVs can benefit and complement each other),* may allow PAVs to contribute significantly in the decrease of congestion and pollution if planned and implemented in a right way

- Nonetheless, despite innovation progress in the PAV concept development and related technologies, there are still key challenges that remain regarding *public acceptance, traffic safety, expensive infrastructure, disaster management, trespassing and unnecessary surveillance, visual intrusion and excessive air traffic concerns.*

Nikitas, A., Michalakopoulou, K., Njoya, E. T., & Karampatzakis, D. (2020). Artificial intelligence, transport and the smart city: Definitions and dimensions of a new mobility era. *Sustainability*, *12*(7), 2789.

Personal Aerial Vehicles – The Era of the Flying Taxi

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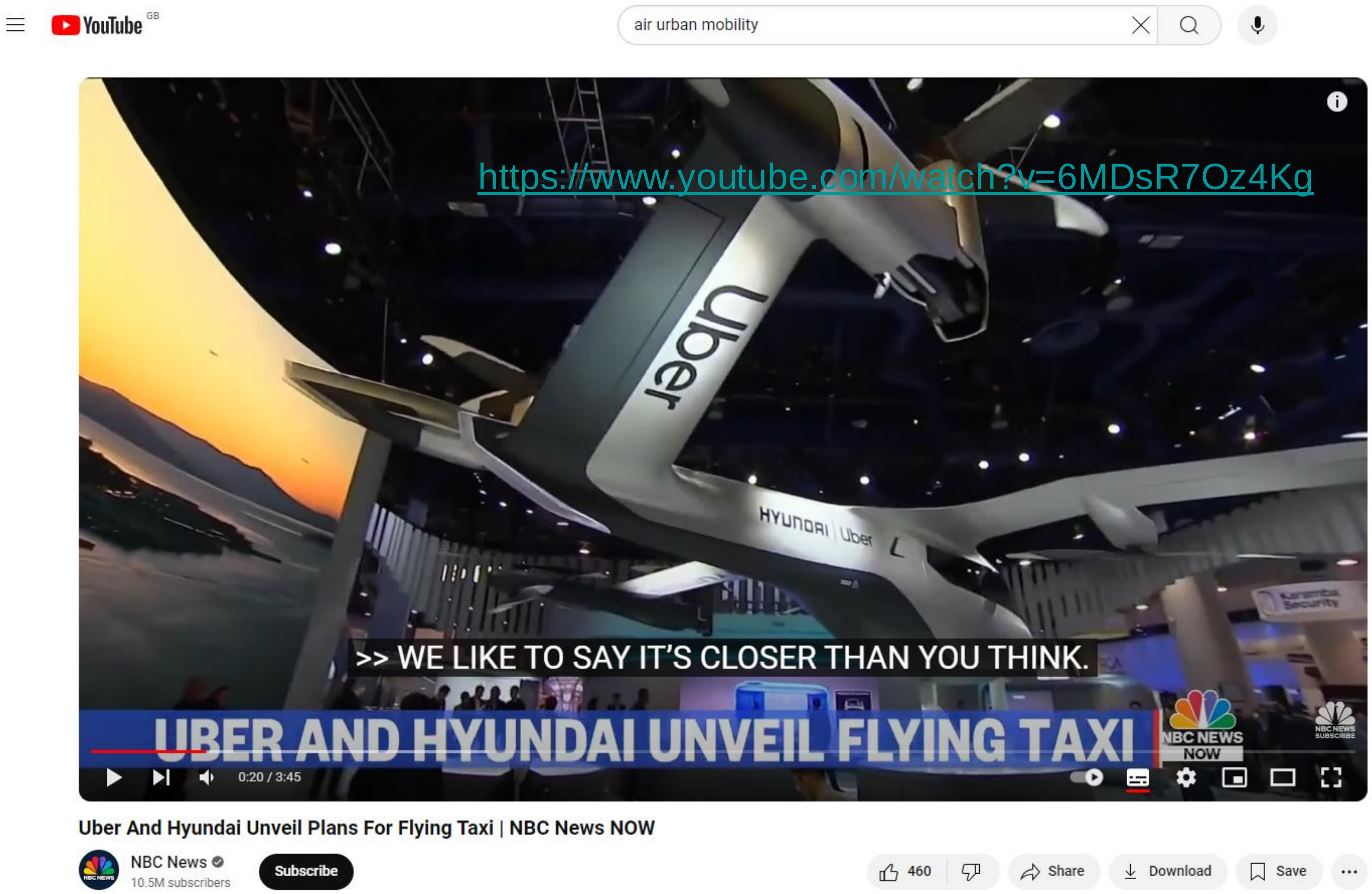
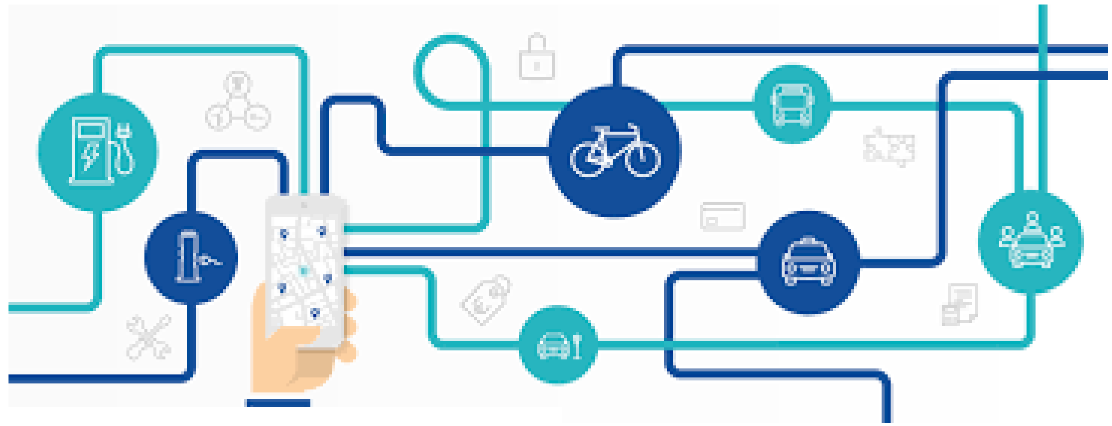


https://www.youtube.com/watch?v=6MDsR7Oz4Kg

Critical Areas for the Future of Transport

Mobility App

Travel Planner



Mobility-as-a-Service: MaaS

Mobility Hub

Source: https://www.smmt.co.uk/industry-topics/technology-innovation/connected-autonomous-vehicles/

The Environmental and Resource Dimensions of Automated Transport: A Nexus for Enabling Vehicle Automation to Support Sustainable Urban Mobility

Annual Review of Environment and Resources
Vol. 46:167-192 (Volume publication date October 2021)
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Abstract

Automation carries paradigm-shifting potential for urban transport and has critical sustainability dimensions for the future of our cities. This article examines the diverse environmental and energy-related dimensions of automated mobility at the city level by reviewing an emerging and increasingly diversified volume of literature for road, rail, water, and air passenger transport. The multimodal nature of this investigation provides the opportunity for a novel contribution that adds value to the literature in four distinctive ways. It reviews from a sustainability angle the state of the art underpinning the transition to a paradigm of automated mobility, identifies current knowledge gaps highlighting the scarcity of non-technical research outside the autonomous car's realm, articulates future directions for research and policy development, and proposes a conceptual model that contextualizes the automation-connectivity-electrification-sharing-multimodality nexus as the only way forward for vehicle automation to reach its pro-environmental and resource-saving potential.

SUMMARY POINTS

1. The literature tends to narrow down the terms CAVs and AVs to car-equivalents; however, other automated travel modes, especially those with a public transport dimension, offer significantly higher sustainability potential.

2. There is a scarcity of research examining the environmental and energy-related aspects of the automated transport paradigm for city travel, especially when it comes to non-CAV applications of vehicle automation—there is barely any such research for bus, rail, water, and air transport automation initiatives.

3. Simulations and early AV stage experiments have generated conflicting results that do not reach a clear consensus on whether automation can yield genuine benefits for the environment.

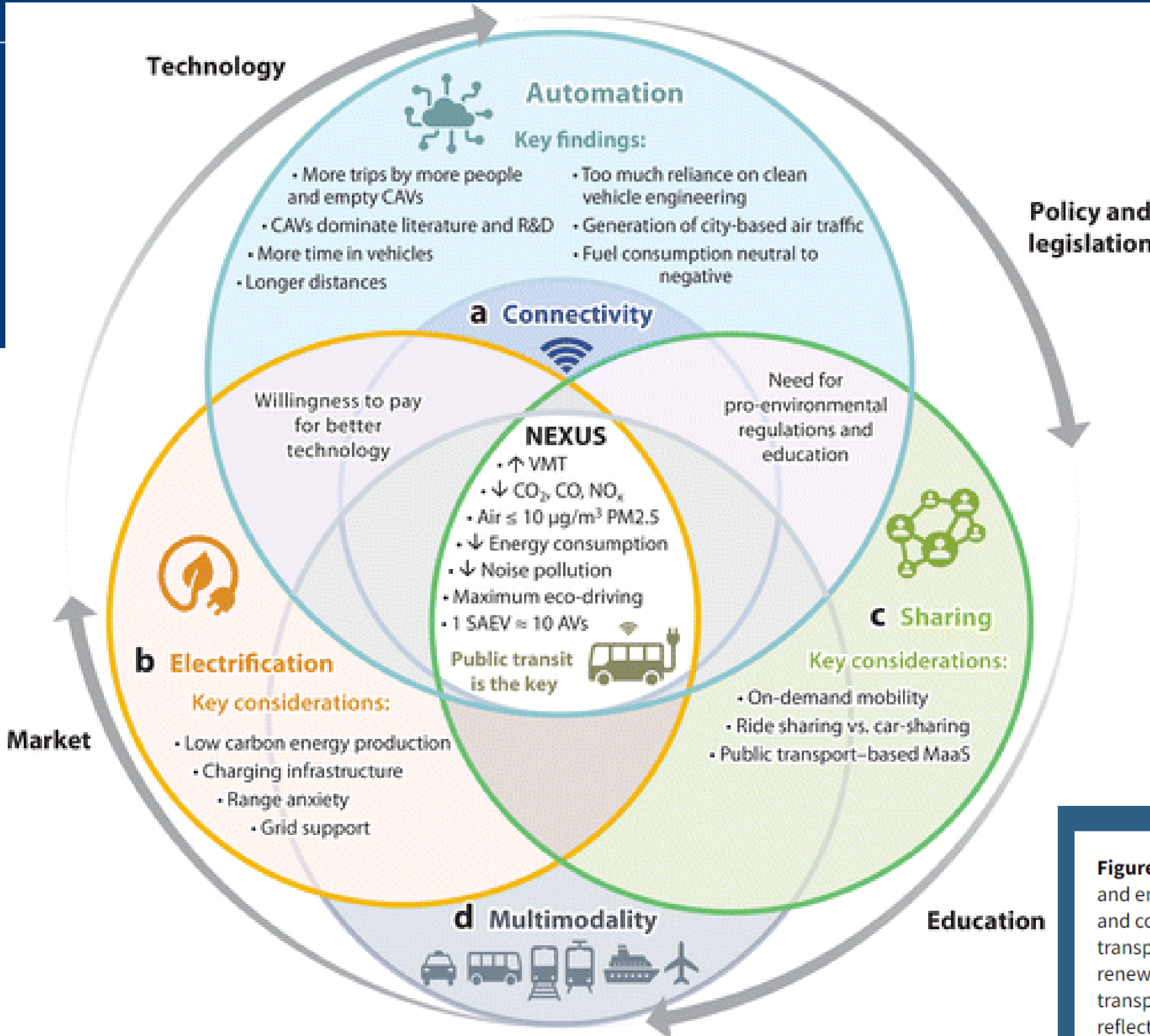
4. In all likelihood, the uptake of vehicle automation in isolation, and with an emphasis on autonomous cars, will result in moderate reductions in GHG emissions per mile that would be critically outweighed by a potentially high growth in VMT.

5. The net energy and GHG emission balance for automated urban passenger mobility, without moving to a transformative paradigm where automation, connectivity, electrification, sharing, and multimodality form a nexus that is at the epicenter of the shift, seems, at best, to be neutral or most likely negative.

6. Autonomous, connected, electrical, shared, and multimodal mobility will need to be the primary form of future travel service provision for achieving environmental benefits such as traffic congestion decline, decreased atmospheric emissions, cleaner air, fewer contributions to global warming and climate change, optimized energy usage, greener fueling, and reduced resource overconsumption.

7. This nexus-based transition is not an easy one and has technological, market-based, behavioral, educational, and regulatory elements that need to be thoroughly studied and understood.

8. Automation carries positive paradigm-shifting potential for mobility as long as it is not a techno-fix and a stand-alone intervention and appreciates its critical sustainability implications for the future of our cities.



Nikitas A, et al. 2021
Annu. Rev. Environ. Resour. 46:167–92

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Copy caption

Figure 1 Vehicle automation in relation to its four complementary and empowering counterparts: (*a*) connectivity that allows AVs to communicate and cooperate (e.g., platooning), (*b*) electrification that makes automated transport oil-free and less polluting provided that electricity is based on renewable energy sources, (*c*) sharing that allows on-demand and public transport services to move more people simultaneously, (*d*) multimodality that reflects a departure from a road transport-based monoculture and also emphasizes the mass transit side and potential of mobility. The figure also highlights the importance of technology development, policy and legislation, market dynamics, and education as mechanisms defining the principles and nature of transport automation. If the automation-connectivity-electrification-sharing-multimodality nexus (i.e., represented in the graph by the area where the five circles/counterparts intertwine) is genuinely prioritized with an emphasis on public transport provision, then vehicle automation may help facilitate a transition to more sustainable futures. Abbreviations: AV, autonomous vehicle; CAV, connected and autonomous vehicle; CO_2, carbon dioxide; MaaS, Mobility-as-a-Service; NO_x, nitrogen oxides; R&D, research and development; SAEV, shared autonomous electric vehicle; VMT, vehicle miles traveled.

FUTURE ISSUES

1. More experimental studies at both the vehicle and the network system levels need to be produced before we understand the extent and significance of environmental and energy effects that could be generated by those systems.

2. The wider impact of automation deployment should be evaluated for both users and non-users explicitly, including the essential infrastructure requirements from curbside amendments to maintenance areas at ports and vertiports, including information communication technologies investment and infrastructure.

3. The bidirectional relationships between CAV transport systems and (*a*) the physical and cultural shape of the smart city, (*b*) the emerging shared mobility economy, (*c*) the user willingness and market readiness to embrace electrification, and (*d*) the embracement of multimodality, especially in its public transit forms, have not yet been entirely defined—some future opportunities and challenges are not yet visible based on contemporary knowledge.

4. Given the multifaceted nature of the autonomous transition, it is important to assess the environmental implications of SAEVs, acknowledging that on the one hand these vehicles may have significant impacts on energy demand and, in turn, drive variation in energy cost and reliability, and on the other hand can also act as energy storage and distribution units.

5. MaaS can become the elevator of the automated mobility nexus discussed herein with the precondition that its backbone is multimodal public transport and car-centric services are seriously disincentivized; if MaaS establishes as the mainstream but suffers from "uberization," then there will be no environmental or energy wins.

6. Legislation, travel demand measures, meticulous planning, trials and living labs, awareness campaigns, and training schemes with a pro-environmental emphasis as well as robust investment projects comprise a policy toolbox that influences travel behavior; without it the ideal automated transport formula for crafting pathways to sustainable urban futures described herein will remain unrealized.

Conclusions

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Driverless automation will be an unprecedented urban development revolution that will radically change automobility as known today for the better but at the same time may carry its own unique set of challenges and social dilemmas that need to be treated accordingly so that something that could be a 'bless' won't end up being a 'curse'.

Source:
https://www.youtube.com/watch?annotation_id=annotation_1737656915&feature=iv&src_vid=DeUE4kHRpEk&v=VjcMZJm0L9A

Examining the myths of connected and autonomous vehicles: analysing the pathway to a driverless mobility paradigm

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Abstract: Connected and autonomous vehicles (CAVs) could become the most powerful mobility intervention in the history of human race; possibly greater than the conception of the wheel itself or the shift from horse-carriages to automobiles. Despite CAVs' likely traffic safety, economic, environmental, social inclusion and network performance benefits their full-scale implementation may not be as predictable, uncomplicated, acceptable and risk-free as it is often communicated by a large share of automotive industries, policy-makers and transport experts. Framing an 'unproven', 'disruptive' and 'life-changing' intervention, primarily based on its competitive advantages over today's conventional automobile technologies, may create misconceptions, overreaching expectations and room for errors that societies need to be cautious about. This article 'tests' eleven myths referring to an overly optimistic CAVs' development and adoption timeline. This approach highlights unresolved issues that need to be addressed before an inescapable CAV-based mobility paradigm transition takes place and provides relevant policy recommendations on how to achieve that.

Keywords: connected and autonomous vehicles; CAVs; driverless and self-driving technologies; artificial intelligence and mobility; smart urban futures; transport policy and planning.

Reference to this paper should be made as follows: Nikitas, A., Njoya, E.T. and Dani, S. (2019) 'Examining the myths of connected and autonomous vehicles: analysing the pathway to a driverless mobility paradigm', *Int. J. Automotive Technology and Management*, Vol. 19, Nos. 1/2, pp.10–30.

Biographical notes: Alexandros Nikitas is a Senior Lecturer in Transport at the University of Huddersfield. He is a member of the Executive Committee of the Universities' Transport Study Group in the UK and Ireland and the editorial board of the journal *Case Studies on Transport Policy*. He is conducting research examining the societal importance of sustainable and smart transportation with an emphasis on shared use mobility and bike-sharing, electromobility, mobility-as-a-service and connected and autonomous vehicles. Earlier in his career, he was a Senior Researcher in Urban Futures and

sustainability MDPI

Article

Artificial Intelligence, Transport and the Smart City: Definitions and Dimensions of a New Mobility Era

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Abstract: Artificial intelligence (AI) is a powerful concept still in its infancy that has the potential, if utilised responsibly, to provide a vehicle for positive change that could promote sustainable transitions to a more resource-efficient livability paradigm. AI with its deep learning functions and capabilities can be employed as a tool which empowers machines to solve problems that could reform urban landscapes as we have known them for decades now and help with establishing a new era; the era of the "smart city". One of the key areas that AI can redefine is transport. Mobility provision and its impact on urban development can be significantly improved by the employment of intelligent transport systems in general and automated transport in particular. This new breed of AI-based mobility, despite its machine-orientation, has to be a user-centred technology that "understands" and "satisfies" the human user, the markets and the society as a whole. Trust should be built, and risks should be eliminated, for this transition to take off. This paper provides a novel conceptual contribution that thoroughly discusses the scarcely studied nexus of AI, transportation and the smart city and how this will affect urban futures. It specifically covers key smart mobility initiatives referring to Connected and Autonomous Vehicles (CAVs), autonomous Personal and Unmanned Aerial Vehicles (PAVs and UAVs) and Mobility-as-a-Service (MaaS), but also interventions that may work as enabling technologies for transport, such as the Internet of Things (IoT) and Physical Internet (PI) or reflect broader transformations like Industry 4.0. This work is ultimately a reference tool for researchers and city planners that provides clear and systematic definitions of the ambiguous smart mobility terms of tomorrow and describes their individual and collective roles underpinning the nexus in scope.

Keywords: artificial intelligence; smart city; smart transport; connected and autonomous vehicles; personal and unmanned aerial vehicles; mobility-as-a-service; internet of things; physical internet; industry 4.0

1. Introduction

In a time that is dictated, more than ever before, by a need to shift to a more sustainable techno-social paradigm to avoid the adverse repercussions of a resource-intensive and unthoughtfully opportunistic livability philosophy that does not look far in the future, Artificial Intelligence (AI) has the potential to provide a vehicle for transformation. AI is a concept that is defined as a system's

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Nikitas, A., Michalakopoulou, K., Njoya, E. T., & Karampatzakis, D. (2020). Artificial intelligence, transport and the smart city: Definitions and dimensions of a new mobility era. *Sustainability*, *12*(7), 2789.

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Autonomous vehicles and employment: An urban futures revolution or catastrophe?

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ABSTRACT

Paradigm-shifting technologies such as Autonomous Vehicles (AVs) despite a wealth of promised benefits for the future of our cities may generate new unprecedented threats. The transportation industry will be the first to experience the aftermath of AVs since these can kill driving professions and create new layers of employability-related social exclusion. This paper appraises public perceptions of AVs and their employment repercussions as a forecasting tool that can drive equitable policy planning that prioritizes humans over machines. The study is based on an online survey of 773 responses from an international audience. Descriptive statistics and ordinal regression modelling have been used. Most respondents recognized that the arrival of AVs is likely to revolutionise the distribution of jobs within the transport industry. They also believe governments are not prepared for the transformations AVs will force upon workplace arenas. Age, field of work/study, level of understanding AVs, income, gender, awareness about the risks on own employment were factors influencing the respondents' perceptions of whether transport professionals' job security will be jeopardised. The study argues that AVs are perceived as a significant employment disruptor and that reskilling, public engagement and awareness exercises should be widely adopted by the stakeholders 'responsible' for the transition.

1. Introduction

The unprecedented progress in Artificial Intelligence (AI) and robotics over the last two decades and the continuous cost reductions in technology production empowered innovation adoption in every industry and occupation. Driverless vehicles are the automotive industry's response to autonomous technology innovation, emerging as a culture-shifting intervention destined to change the way mobility is perceived and the way cities function (Gavanas, 2019; Milakis et al., 2017; Thomopoulos & Givoni, 2015). According to the driverless paradigm, the human driver will no longer be the epicentre of driving but will be replaced by powerful safety-enhancing autopilots. Adopting driverless vehicles means that human driver errors that have been the leading root for road traffic accidents for a century now (Crayton & Meier, 2017;

and Connected and Autonomous Vehicles (CAVs) are widely projected to become the cornerstone of smart urban transport systems (Nikitas et al., 2017; Papa & Ferreira, 2018) and one of the prime areas for research and development investments in urban planning (Arakawa et al., 2018; Knowles et al., 2020; Strand et al., 2014). However, AV-related impacts constitute an uncharted territory and many gaps exist in understanding how this transition will be managed (Csiszár & Földes, 2018; Földes et al., 2018; Földes & Csiszár, 2016).

The notion of an AV, by definition, refers to vehicles that operate in the absence of any human involvement (Nikitas et al., 2019). Autonomous driving currently entails six varying levels of automation: Level 0 refers to standard vehicles without automated driving functions while Level 5 refers to self-driving cars capable of completing the full dynamic driving activity deprived of limitations (Skeete, 2018). Today, AVs are

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Exploring expert perceptions about the cyber security and privacy of Connected and Autonomous Vehicles: A thematic analysis approach

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ABSTRACT

Connected and Autonomous Vehicles (CAVs) constitute an automotive development carrying paradigm-shifting potential that may soon be embedded into a dynamically changing urban mobility landscape. The complex machine-led dynamics of CAVs make them more prone to data exploitation and vulnerable to cyber attacks than any of their predecessors increasing the risks of privacy breaches and cyber security violations for their users. This can adversely affect the public acceptability of CAVs, give them a bad reputation at this embryonic stage of their development, create barriers to their adoption and increased use, and complicate the business models of their future operations. Therefore, it is vital to identify and create an in-depth understanding of the cyber security and privacy issues associated with CAVs, and of the way these can be prioritised and addressed. This work employs 36 semi-structured elite interviews to explore the diverse dimensions of user acceptance through the lens of the well-informed CAV experts that already anticipate problems and look for their solutions. Our international interviewee sample represents academia, industry and policy-making so that all the key stakeholder voices are heard. Thematic analysis was used to identify and contextualise the factors that reflect and affect CAV acceptance in relation to the privacy and cyber security agendas. Six core themes emerged: *awareness, user and vendor education, safety, responsibility, legislation, and trust.* Each of these themes has diverse and distinctive dimensions and are discussed as sub-themes. We recommend that mitigating the cyber security and privacy risks embedded in CAVs require inter-institutional cooperation, awareness campaigns and trials for trust-building purposes, mandatory educational training for manufacturers and perhaps more importantly for end-users, balanced and fair responsibility-sharing, two-way dynamic communication channels and a clear consensus on what constitutes threats and solutions.

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The Environmental and Resource Dimensions of Automated Transport: A Nexus for Enabling Vehicle Automation to Support Sustainable Urban Mobility

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Bristol – Driverless Cars

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Thank you for Listening
Do you Have AnyQuestions?

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