Im/mobile Lives in Turbulent Times: Methods & Practices of Mobilities Research Conference

9th July 2021, Northumbria University

Furthering intelligent mobility through the adoption of Artificial Intelligence (AI) in Autonomous Vehicles (AVs)

Richard Kotter – Matteo Conti - Marco Zilvetti

Northumbria University NEWCASTLE

Our brief is to look beyond technology [and even Human Computer Interaction]

We understand, that:

The future of mobility is also about answering users' – and societal - needs

Cultures of auto-mobility

or

how we experience mobility / travel

BRIEF

"The automotive industry will be revolutionised by AI in the very near future, specifically in relation applied to autonomous vehicles (AVs). Radical innovation is just over horizon, with AVs changing everything from the driving and travelling experiences to city planning and commuting patterns.

This is all part of a pioneering plan to prevent traffic fatalities by taking human emotions and errors out of the equation. Through delivering public trials to understand the technical, cultural, societal and legal challenges to AVs is fundamental. In turn, breaking down barriers like trust for the general public, is critical for the adoption of autonomous vehicles.

Through our research, we have been tasked to develop insights in both e-mobility and the future society (including social, economic, regulatory, cultural, safety and liability issues), by exploring smart cities and develop an understanding for new user experiences of self-driving vehicles.

Our research aims are to consider inclusive mobility, a potentially crash-less future, on-board user interface/features, shared inclusive mobility; and the underpinning procurements required to shape, hone or direct future mobility opportunities.

Our goal is develop a clear argument, including formulating appropriate future user/journey scenarios which are to be developed into proposals that rely on the adoption of AI within AVs to enhance individuals' lifestyles."

the brief •

Our Intent Statement for this Multi-Disciplinary Design Research project

Explore: society's emerging & evolving relationship with mobility

Understand: the role of AI and AV within tomorrow's society

Identify: the pain points of mobility & areas of opportunity

Design: a set of ideas, journey scenarios and concepts; *augmented by* Artificial Intelligence (AI) and Autonomous Vehicles (Avs)

Recommend: a suite of proposals for stakeholders within the mobility space

Guiding principles

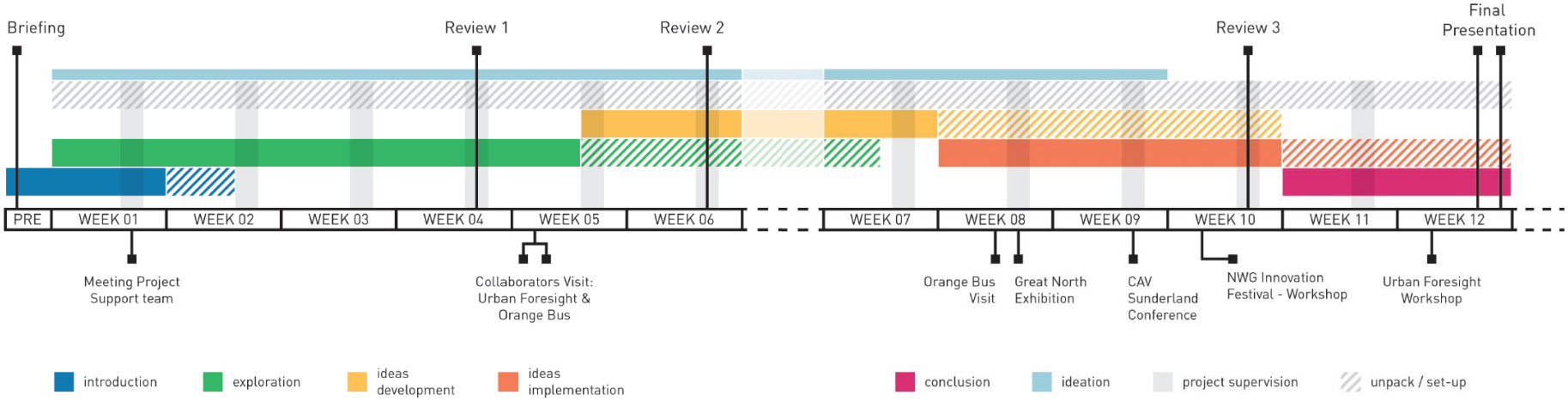
Use of space

Use of time

Use of wellbeing

Multi-disciplinary innovation project (2018)

PROJECT TIMELINE



Multi-disciplinary innovation approach

METHODOLOGY

Throughout this project, we have utilised a range of convergent and divergent design thinking processes and methods as shown;

Research
Megatrends
Insights
Storyboards
Scenarios
Value Spaces
Strategy
Value Proposition
Presentation

Personas
Ideation
Concept Development
Reviews
Workshops
Surveys

Methodology I

Research:
From literature review through to videos, surveys and whitepapers, the team utilised a wide range of primary and secondary sources to help frame areas of value.

Megatrends:
Megatrends informed our research efforts and design outputs.
(See Appendix: Megatrends)

Insights:
Insights from research sparked areas for rapid ideation.

Persona:
Personas were used to consider user pain points and help frame value hypotheses from a human-centric perspective. Persona's included a minor, an elderly person suffering from cognitive issues, through to a hacker.

Ideations:
Generating over 60 ideas, the team grouped, sorted and 'zen voting' upon ideas that held the most value.

Concepts Development:
Output from research, workshops and ideation were crystallized into concepts within value spaces and formed the foundation of value propositions.

• methodology

Methodology II

Storyboards:
Storyboards and user journey maps were to used juxtapose users in situations and extreme scenarios to address user needs.

Scenarios:
A number of road-based extreme scenarios were used to consider, frame and test the role of AV and AI within given roleplay situations.

Value Spaces:
Value spaces were used to consider the interplay between AV and AI and users. Value spaces included construction through to commuting and medical logistics.

Reviews:
Reviews with academics were held to review project progression, research insights, and run workshops to test ideas and consider next steps.

Workshops:
Running 6 co-creative workshops with academics, industry and the general public, a number of different scenarios were used to test ideas and concepts.

Surveys:
Surveys with the general public gathered results on mobility pain points and public perceptions of the benefits and concerns of AV and AI within their lives.

• methodology

Methodology III

Strategy Development:
Mapping ideas across a strategic roadmap the team positioning ideas over a delivery timeframe and the necessary stakeholders needed along the way.

Value Proposition:
Value propositions formed the foundation of our main deliverables, positing future user journeys reliant upon AI within AVs.

Presentations:
Presentations demonstrated our value propositions and recommendations to stakeholders.

• methodology

Multi-disciplinary innovation approach

REVIEW 1
24 May

REVIEW 2
14 June

REVIEW 3
6 July

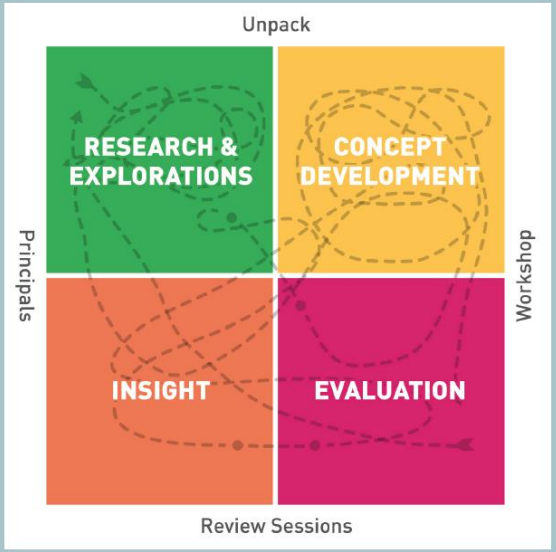
PRESENTATIONS
26 - 27 July

ORANGEBUS
5 June & 27 June

GREAT NORTH EXHIBITION
28 June

INNOVATION FESTIVAL 2018
10 July

URBAN FORESIGHT
4 June & 24 July



THE PROCESS

The illustration (see left) conveys the full gamut of design thinking approaches that the team used throughout this design-led innovation project.

This non-linear, iterative process led the team to consider the wide range of possibilities and horizons to help frame solutions within the innovation context.

Who we worked with...

Northumbria University NEWCASTLE

URBAN FORESIGHT

THE NWG INNOVATION Festival 2018

orangebus.

GREAT EXHIBITION OF THE NORTH

Innovate UK Knowledge Transfer Network

ZERO CARBON FUTURES

Megatrends informed our research

AI and data economy

Demographic shift

The future of mobility

Rapid urbanisation

Sources: PWC (2012) & UK Gov Industry Strategy (2017)

Contested Voices on AI and AVs

"AI as a *moral* actor"

"The self-driving car raises more possibilities and more questions than perhaps any other transportation innovation … self-driving cars have become the archetype of our future transportation.

Still, important concerns emerge. Will they fully replace the human driver? What ethical judgments will they be called upon to make?

What socioeconomic impacts flow from such a dramatic change? Will they disrupt the nature of privacy and security?"

M. Cunneen, M. Mullins & F. Murphy (2019)
Autonomous Vehicles and Embedded Artificial Intelligence: The Challenges of Framing Machine Driving Decisions, *Applied Artificial Intelligence*, 33:8, 706-731, DOI: 10.1080/08839514.2019.1600301

Contested Voices on AI and AVs

PESSIMIST

Martin Mose
Associate Professor
DTU Management Engineering,
(Ravnsborg (2018))

"Before driverless cars are released into everyday circulation, they must be equipped with values and ethics so they can make the right choices in critical situations [...] we need to explicitly define their behavioural values."

Prof. Stephen Hawking
Theoretical physicist
Crofts, A. (2017)

"Success in creating effective AI could be the biggest invention of this period of civilization, or the worst [...] unless we learn how to prepare for and avoid the potential risks, AI could be the worst invention of the history of our civilization."

PESSIMIST

Christian Wolmar
Writer and broadcaster
(National Road Safety Conference (2017))

"The world predicted by driverless car enthusiasts is a fantasy. Driverless cars is a future that will never happen [...] all cars will have to be driverless, the transition period to driverless cars will be endless."

David Mindell
MIT Professor
(Dizikes (2015))

"We need to rethink the notion of progress, not as progress toward full autonomy, but as progress toward trusted, transparent, reliable, safe autonomy that is fully interactive: The car does what I want it to do, and only when I want it to do it."

OPTIMISTIC

Ray Kurzweil
Computer scientist, inventor & futurist.
(Thompson (2017))

"Technology is always going to be a double-edged sword. Fire kept us warm, cooked our food, and burned down our houses. I think where we [...] that we have a moral imperative to continue progress in these technologies."

Steven Pinker
Professor of Psychology,
Harvard University
(BigThink (2016))

"I think the arguments that once we have super intelligent computers and robots they will [...] take over [...] comes from Prometheus and Pandora myths. It's based on confusing the idea of high intelligence with megalomaniacal goals."

OPTIMISTIC

Jim O'Sullivan
Chief Executive, Highways, England
(Strategic Road Network Initial Report, (2017, p5))

"The new generations of electric, connected, and autonomous vehicles will offer our customers, and the country, a new era of safer, easier, and less polluting travel - a roads revolution"

Chris Grayling
UK Transport Secretary
(Department for Transport (2017))

"The potential benefits of these new technologies for human mobility – and for wider society – are tremendously exciting. Many who can't currently drive will be able to take to the road. They'll discover a new sense of freedom and independence."

research, findings & insights • debate within AI

Smart city - Building tomorrow's cities

Contested Voices on AI and AVs

Still an evolving (academic / industrial) field

- Better obstacle detecting sensors
- Fuzzy logic and Artificial Neural Networks (ANN)

Sagar, V.D. & Nanjundeswaraswamy, Y.S. (2019) Artificial Intelligence in Autonomous Vehicles – a Literature Review, *i-Manager's Journal on Future Engineering and Technology*, Iss. 3, pp. 556-562.

A" conceptual synthesis of the autonomous vehicle issue is made in connection with the artificial intelligence paradigm. It presents a classification of the tasks that take place during the driving of the vehicle and its modeling from the perspective of traditional control engineering and artificial intelligence…."

Ionita, S. (2017) Autonomous vehicles: from paradigms to technology, *IOP Conf. Ser.: Mater. Sci. Eng.* 252

some workstreams on AI and AVs

sensors

an Open Access Journal by MDPI

IMPACT FACTOR 3.576

Covered in: PubMed

Artificial Intelligence and Internet of Things in Autonomous Vehicles

Guest Editors:

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University of Surrey, UK

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Deadline for manuscript submissions:
31 December 2021

Message from the Guest Editors

Dear Colleagues,

The continuous progress of automated vehicle driving functions as well as the global deployment of Cooperative Intelligent Transport Systems (C-ITS) both motivate the research, innovation, and development of new traffic control strategies and ITS services. These activities will enable the transition from fully conventional traffic flows towards fully automated vehicle traffic. However, fully automated operation remains a challenge due to the inherent difficulties and safety concerns of real-world driving, especially in an urban setting, which is characterised by uncertainty over the intentions of other road users. Integration of V2X communication has the potential to reduce uncertainty by sharing information between road users and government-owned road infrastructure. However, traditional manual vehicles will dominate road use in the short-to-medium-term future.

electronics

an Open Access Journal by MDPI

IMPACT FACTOR 2.412

CITESCORE 2.7 SCOPUS

AI - Based Autonomous Driving System

Guest Editors
Prof. Dr. Dong Seog Han
Co-Guest Editors
Prof. Dr. Kalyana C. Veluvolu, Prof. Dr. Takeo Fujii

Deadline
31 August 2021

Special Issue

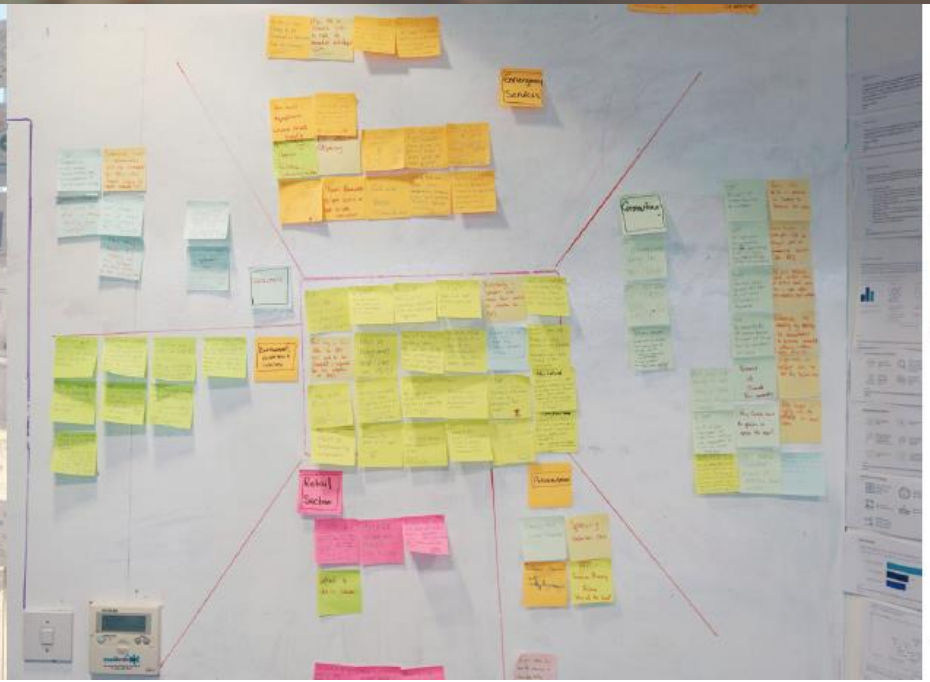
mdpi.com/si/38926

Invitation to submit

Research insights & analysis

RESEARCH, FINDINGS, & INSIGHTS

Using both primary and secondary sources to inform our thinking, we used research to frame and support our design and innovation efforts; translating insights into value propositions.



research, findings & insights •

Research insights

MOBILITY TRENDS

Trends, issues and opportunities for Urban Mobility

Urban mobility is facing radical changes all over the world — society's relationship with mobility is undergoing an unprecedented evolutionary transformation due to a new mobility ecosystem, driven by social trends and revolutions in autonomous technologies.

Population growth by 2025 & urban sprawl movement

The world's population is increasingly city-based; 51% or 3.5 bn people currently live in urban areas and by 2050 this is expected to reach 6.3bn people. (Lerner (2011))

More drivers on the road

Within 20 years there could be another 7m drivers in the UK meaning that, if current trends persist, the total will leap to 43m (RAC Foundation. (2014))

Rise in car sharing

In India, Car sharing is a trend that has received nationwide acceptance among India's youth. The biggest selling point of this sharing model lies in its cost-effectiveness (Vij (2016))

Fragmented bus services

More than 30 companies now run services in Greater Manchester, deciding their own routes, timetables and fares. Consumers find it confusing, overpriced, and a system where the private interest dominates over the public interest (Topham and Perraudin (2018))

Autonomous Buses

Autonomous public buses like the ones being introduced in China can literally work around congestion—carrying 1,200 passengers at a time above congested roads—to bypass traffic and improve commute predictability. (CityPossible (2017))

Smartphone ticketing systems

In cities such as Boston, New York, Athens, London, and San Diego an app-based simple payment process, helps commuters in terms of convenience and cities in terms of long-term cost cutting. (CityPossible (2017))

Micro-mobility for the first mile & last mile

From bikes, dockless scooters to ride-sharing solutions, brands like Bird, Lime, Mobike offer cheap, reliable, inexpensive & ubiquitous solutions. In China, the share of overall trips on bike has doubled from 5.5 percent to 11.6 percent (Lambe (2018)).

Internet of vehicles

By connecting a car's sensors and GPS transmitters; drivers can stay informed via a real-time sharing of traffic information. (Siemens (2014))

Research insights

PROMISE OF AVs

AVs promise a future with multiple benefits:

Reduced deaths on roads

AV's projected to reduce 90% of all auto accidents in US alone (Futurism (2015)), and by 2070, AVs will have saved over 500K lives (Rand (2017)).

Increase in productivity

AVs offer $1.3tn annual savings in the US from increased productivity. (Atlastrend (2016))

Environmental benefits

AV's could help reduce CO2 emissions by ~300 millions tons per year. (UK Business Insider (2016)).

Financial benefits

By 2030, £51bn market worth, adding 320k additional jobs (KPMG (2015)); with a further potential $158bn fuel savings identified. (Morgan Stanley (2013))

Increased mobility

AV's will enable the elderly to be mobile but also empower those with disabilities or without a car. (UK Business Insider (2016))

Increased highway capacity

Platooning of vehicles can increase highway capacity by 500%. (UK Business Insider (2016))

Research insights

CONCERNS OF AVs

Cybersecurity & data safety

AVs will prove an irresistible target for hackers (Hern (2014)). What happens if a hacker can take-over a vehicle; or injects malware, or steals data or extorts vehicle usage?

Ethics on the road

When a crash is inevitable and a human is at the wheel, the result is a spontaneous reaction, but in a car controlled by algorithms what does it do? (Boudette (2016))

Poor weather conditions

AV are vulnerable to poor weather conditions. Falling snow & heavy rain make it difficult for laser sensors to identify obstacles. (Boudette (2016), Goodman (2016))

Roadblocks & detours

AVs rely upon maps to navigate; but on-road conditions can quickly change (Boudette (2016)). AVs understanding traffic signage is also a concern (Knowing Better (2017))

Reliance on maps

Creating (and maintaining) maps for self-driving cars is difficult work (Plumer (2016)). GPS isn't always accurate, Australia moves north by about 7 cm annually (Foxx (2016), Bavas (2016))

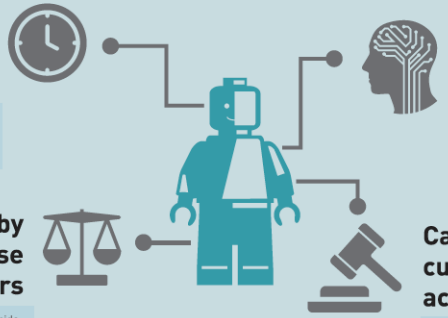
Complexity of the road

Driving involves intricate interactions with other road users. In many of those situations, humans rely on generalized intelligence and common sense; things that robots still very much lack. (Plumer (2016))

Research insights

SHOULD ROBOTS HAVE AN ETHICS & A MORAL COMPASS?

The idea that machines should take over responsibility for human lives prompts ethical questions of whether robots should even be making ethical decisions that have consequences for the safety of people.



Split second decisions can cost lives

When a driver in a situation where other road users are at risk from their actions, they may not be able to make an informed decision.

Computers can make decisions in nanoseconds

What it will do when a robot comes to harming someone through a decisive action or decisive inaction?

A decision by computer may cause harm to others

In extreme scenarios, an AV may decide:
(a) to harm the driver to save others
(b) to do everything it can to save the driver, over others
(c) it makes a decision randomly

Can robots be held culpable for their actions or inactions?

Just who is responsible in a crash involving an AV? Is it the driver? Is it the OEM? Is it the programmer? Can the AI itself be held culpable?

THREE LAWS OF ROBOTICS

(Asimov (1950))

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

VS

THE TROLLEY PROBLEM

"The trolley problem" (Wikipedia (2018))

Consider this scenario:
A runaway trolley is on collision with five people. You can:

1. Do nothing and allow the trolley to kill the five people on the main track.
2. Pull the lever, diverting the trolley onto the side track where it will kill one person.

Can we trust the robot to make the right ethical descision?

Research insights

A CRASH-LESS FUTURE?

AVs are projected to reduce deaths by removing human error from the equation, saving ~350K lives in the US (Maddox (2018)) in the process. But what could the unintended consequences be of a crash-less future?

Induced demand & Increased congestion

As road capacity increases, so do numbers of drivers causing even more congestion. (Medium (2017))

Impacts to health & wellbeing

Driving is a positive activity, a complex task that requires a variety of skills (physical, cognitive and other abilities); how will AV affect our long-term health & wellbeing?

Reduced organ donations from road traffic accidents

"1 in 5 organ donations comes from the victim of a vehicular accident" (Lipson & Kurman (2016, p.263)).

Lack of human interaction

The loss of human interaction in journeys may increase anxiety and stress in commuters, the elderly and the disabled.

Action Research, Workshops & Reviews

Workshop talking points on AVs

In a crash, who is liable?

Will we actually own a car in the future?

Would people feel comfortable being in a car with no driver?

What is the role for smart cities in all of this?

What would a vehicle interior look like, without a driver?

Privacy & data concerns

Talking points within AI

Privacy

Trust

Coding

Decision Making

Complex Scenarios

Pregnant woman in an AV

Bus crash during rush hour

Peloton on country road

Border control

Extreme Scenarios

Situational challenges arising in complex emergencies

EXTREME SCENARIOS

For scenarios, we explored a multitude of situations; here are just some of the highlighted areas we tested.

Scenario	Rationale
Pregnant woman in an AV	How should an AV react when placed in a situation where an emergency requires you to drive radically? What affordances need to be in place? How do you inform other road users around you?
Bus crash during rush hour	In a bus crash, how would an AV handle this? Could it connect with the city to talk to other vehicles, or route medics to the situation?
Peloton on a country road	How does an AV navigate a road with a group of cyclists, how does it signal intent and ensure other road users are safe?
Border control	What can an AV do to aid, enable frictionless borders? What data can be handed over and where else could this data be actioned? (ie: car parking, tolls, congestion zones)

research, findings & insights • reviews & workshops

Users' Insights

"Public transport is slow, overcrowded … not a pleasant experience!"

"No joined up thinking in services"

"I don't like rush hour or being late"

"I wish people would move out of the way for emergency vehicle"

***36** respondents from:* GREAT EXHIBITION OF THE NORTH · THE NWG INNOVATION Festival 2018

92% happy to use AV delivery service.

83% happy to use AV for public transport.

75% happy to use AV for car sharing.

75% happy to use AV for Emergency Services.

Ideation

Ideation Journey

12
VALUE SPACES

60
IDEAS

4
VALUE SPACES

6
WORKSHOPS

2
VALUE SPACES

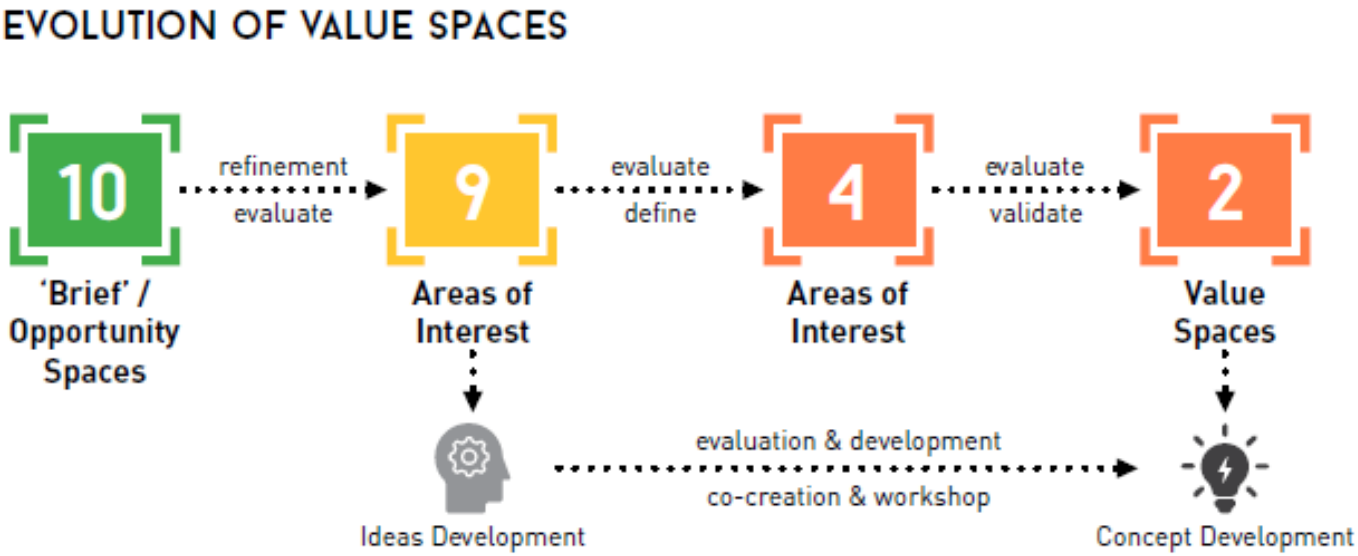
Ideation Journey

IDEAS

Ideas generated from reviews & workshops include;

Ideas	Insights
Emergency stop button / Dead man's Handle	A user must be able to stop an AV, either through an emergency stop button or dead man's handle.
Collision mesh	To reinforce safety, a detection zone is needed by default and is able to be commandeered by emergency services to get through traffic.
"Ambulance mode" conversion	A user must be able to convert their AV into an ambulance mode when appropriate and legal to do so.
Retrofit for legacy vehicles	AVs lack anthropomorphised features, and it's hard for legacy vehicles and other road users to read an AV's road intent; a retrofit would help understand intent, and help reduce anxiety.

Approach to create 2 value spaces



Value spaces

Commuting

Emergency Services

| Commuting

Problems & Pain points

Millions of people spend two or more hours commuting a day (Guardian, 2015)

Fragmented privately-run bus services & poorly coordinated **services**. (Andy Burnham MP, 2017)

The average UK employee spends £146 a month commuting, **totalling £135,871** over a lifetime (TotalJobs, 2018)

45% reduction in funding for bus services from 2010 to 2018 (Better Transport Study, 2018)

From Warehousing to the next gen bus ...?

Lessons to learn?

‘Organised Chaos’ – Multi-Bus Concept

CONCEPT 1: MULTI BUS

The multi bus is a demand-led, continuous, AI-driven bus system that radically disrupts the traditional bus transport model. Supported by a smart city infrastructure, the AV bus of tomorrow will be driven by demand, use separating modular carriages to service areas on shared inbound and outbound routes to and from city centres.

HIGHLIGHTED ISSUES

FRAGMENTED BUS SERVICES

Bus usage in Manchester is declining; it has over 40 different bus operators & 160 different types of ticket.

(GCMA (2017))

INCREASED COSTS & OVERHEADS

Operator costs for local bus services increased to £3bn, with an 80% increase in bus fares across the UK

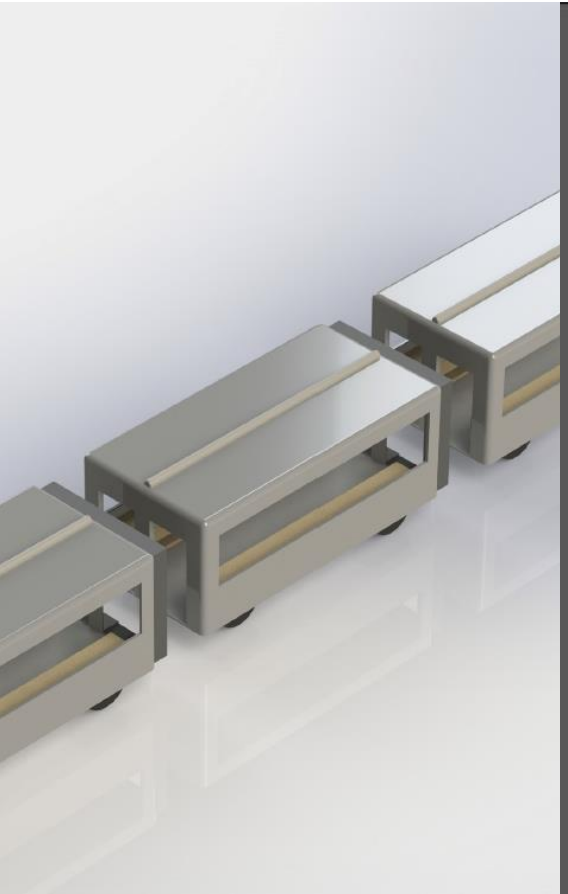
(Department of Transport (2017))

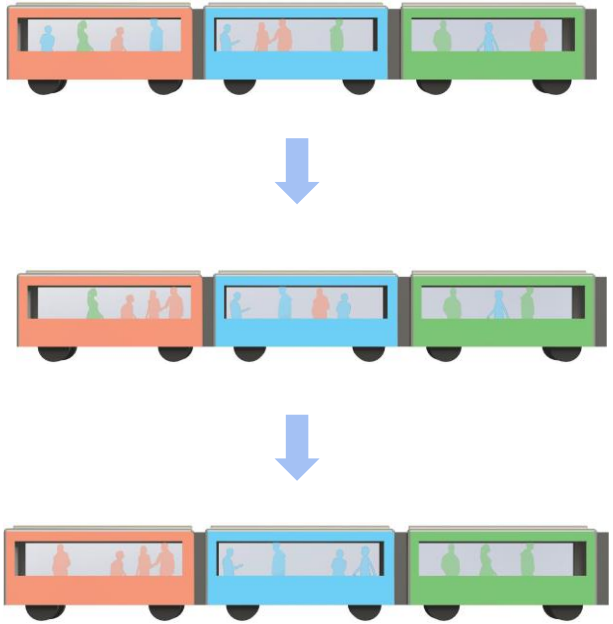
REDUCTION IN FUNDING

45% reduction in funding for bus services from 2010 to 2018.

(Campaign for Better Transport, 2018)

‘Organised Chaos’ – Multi-Bus Concept





Multi-Bus Concept | Benefits

Demand-led

Pre-calculated routes

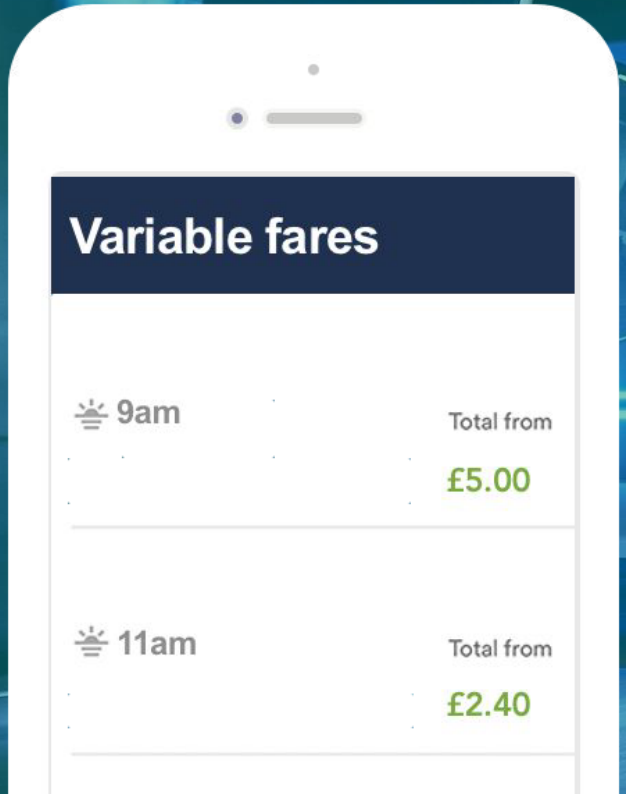
Central pickup & drop-off zones

Integration of personal calendar

Continuous System

Inclusive Fare Schemes

Multi-Bus Concept | Inclusive Fare Scheme



Potential Variables:

- Predetermined route -

- Convenience

- Demand

Impacts & Limitations

Loss of Jobs

Infrastructure rebuilds

Technology dependent

Relies on mass adoption

Heavy AI dependency

High maintenance

Emergency Services

Problems & Pain points

Ambulances are failing to reach thousands of seriously-ill patients within an 8-minute target time frame

(Forster, 2017)

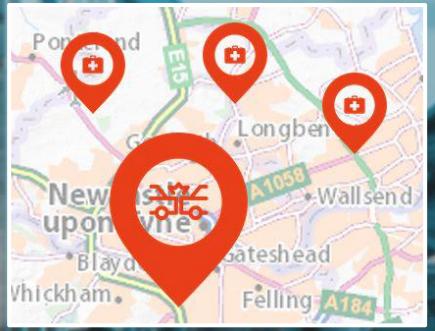
Missed appointments cost the NHS £1bn in 2017

(Matthews-King, 2018)

Frequent 999 callers cost NHS millions of pounds a year

(Meikle, 2015)

First (emergency) response



First (emergency) response

Benefits

- Faster response
- AI plans out routes for ambulances
- Finds best hospital
- Schedules doctors & specialists
- On-video call assistance for medics
- Devices to measure vitals

First (emergency) response

Impacts & Limitations

Sharing medical data

Liability

Severity vs Priority

Public acceptance

Health & Wellbeing

Cost to Implement

Recommendations from the MDI project for different clusters of actors

Road vehicle OEM's

Cities & Government

Academia

Future design challenges

Road Vehicle OEM's

1. Emergency stop button
2. Collision mesh for all AVs
3. Retrofit for legacy vehicles

Cities & Government

1. Agree on standards for AVs and AI
2. Traffic-type restrictions (extension of UVARs?)
3. PPP (Premium Privacy Policy)

https://www.infineon.com/cms/en/discoveries/adas-to-ad/

Academia

1. Investigate ways AVs can support emotional needs; not just functional ones
2. How can AVs further support an ageing, as well as a rural, population?
3. How can AVs and AI enable frictionless borders for trade?
4. How can AVs and AI create value for specialised use functions (e.g. emergency services) and beyond cities?

Future Design Challenges

1. Design a city for humans, not for the roads (or at least road vehicles)
2. Outside-in and inside-out design (AVs for all)
3. How will trends in micro-mobility usage impact society during both the first mile and the last mile?

Supporting recommendations

POLICY CONSIDERATIONS

Supporting recommendations for cities and government, a number of policy considerations have been identified:

1 SECURE SPACES OF INTEREST

Around public spaces of interest technological infrastructure is needed to enforce regulated speed zones to reduce AV speed to the designated speed.

2 AFFORDANCES FOR OTHER ROAD USERS

Cities that enforce regulated congestion zones for Level 4 and above AVs must give affordances for pedestrians, cyclists and other road users, including public transport options.

3 INSURANCE PROCUREMENT

Vehicle collisions involving AVs must enable users to share any private insurance data between the parties involved, including any relevant insurance providers where appropriate.

4 PRIVACY FIRST

AVs must reaffirm consumer data-safety privacy guarantees by providing AVs in a private-mode by default in all models.

5 LEGAL REQUESTS

Instances where law enforcement requires AV data must be sanctioned through an official court order.

6 PREMIUM PRIVACY

Insurance providers should offer consumers a "Premium Privacy Policy", a package that allows users to pay a premium to ensure their data is not collected, or shared with third parties.

7 THE RIGHT TO REPAIR

From tractors to smartphones, mending things is getting harder as companies seek to consolidate their intellectual proprietary. To protect consumers, all auto brands must allow customers the right to repair and modify their own AV.

8 AGE RESTRICTIONS

Users whom are under the age of 16 must have their AV journey pre-approved by their parent or guardian.

9 NEW DRIVERS

New drivers must know an AV's operations, functions, behaviours and limitations. To enable this, learner drivers must undergo a series of scenario-based exercises to demonstrate their competency and proficiency in an AV.

10 SPECIAL REASONS

In extraordinary circumstances, in scenarios pre-validated by local law enforcement, AVs are enabled to drive radically to ensure driver safety. All AV's must display clear unambiguous visual and auditory signals to other road users to communicate intent.

recommendations • policy considerations

Supporting recommendations

1

EMOTIONAL AND THE FUNCTIONAL

Journeys are more than just about getting from A to B. Any journey includes many human and emotional needs, such as human interaction.

2

BUILD TRUST INTO THE EXPERIENCE

User anxiety in AI-driven AV technologies need to be alleviated for their early adoption and continued use. Build trust early, and keep it going throughout the lifetime experience.

3

COMMUNICATE UNDERSTANDING OF SURROUNDINGS

It is important that people know what the AV see's and it understands its surroundings for them to trust it.

4

MAKE THE AV'S INTENT TANGIBLE

Whenever a car intends to maneuver, another road user can infer intent from reading a driver's body language or gesture. An AV has no such equivalent. Therefore, AVs must acknowledge intent through gestures and acknowledgements; an AV's intent must be clear, understandable and tangible to all other road users.

5

COMMUNICATE CAPABILITIES & LIMITATIONS

A user must be able to understand the capabilities and failings of an AV so that they can either operate it appropriately, or know when it is safe to enter autonomous mode.

6

OFFER FALLBACK CONTROLS

There should always be reasonable fallbacks for AV interactions. If an AV cannot operate reasonably within a situation it should offer users a manual fallback for control of the vehicle.

7

LET THE USER STOP

Whilst in operation, an AV must adhere to the "three laws of robotics" (Asimov (1950)) whenever possible; however, all AVs must have a dead man's handle or emergency stop button installed by default to allow a user to stop an AV in emergency situations.

8

BE EMPATHETIC AND INCLUSIVE

People should feel independent and empowered around an AV irrespective of mobility issues. Affordances should be designed to enable people to feel respected and treated with discretion, ie. the AV's floor base lowering itself to allow any person to enter without aid.

9

BE CONNECTED AND INTEGRATED

AVs that are connected and integrated to smart city options out of the box will offer unique user journey experiences that are driven by AI; and led by user needs.

recommendations •


the experience itself
will need to remember
to be human.

MDI Postgraduate Team

AMARJIT DEO 1
Background in mobile & web application development. Passionate to explore the role of design thinking, lean thinking and agile development.
Role in Team: Product Dev., Product Owner, Task Lead, Boardgame Player.

AVANTI SUKMA 2
Indonesian born & bred Visual Communicator (Graphic, Signage, Wayfinding), experienced in the Design Consultancy industry & Intercultural Comm. (AFS).
Role in Team: Visual Comm., Camerawoman, Pessimist, Production Crew.

CHARLIE RICHARDSON 3
I'm always looking for the next difficult and diverse challenge, there's always more to be done. Industrial Design Graduate.
Role in Team: Ideator, Communicator, Adaptable, Challenger.

CHARLOTTE KNOTT 4
A proud sandancer with a passion to travel the world (and take pictures along the way). Graduate in international business management (IBM).
Role in Team: Analytical, Creative Thinker, Listener, Asks "Stupid Question".

5 **JOE IACOMO**
Cardiff programmer who graduated from Teesside University before moving to Newcastle for tech based career opportunities.
Role in Team: Technical Thinker, Team player, Prototype production.

6 **JOSH ROBSON**
An avid cyclist, geordie and dynamic individual who always tries to be the energy in the room. Graduate & experience in Project Management.
Role in Team: Strategist, Ideator, Project Driver, Energy-ball.

7 **YAN SHUM**
Northumbria University Design for Industry Graduate who is interested in design strategy and enjoys using different design methods to help with problem solving.
Role in Team: Project planner, Team shaper, Sketcher, Ideator.

MDI Team studio activity

Northumbria University NEWCASTLE

Thank you