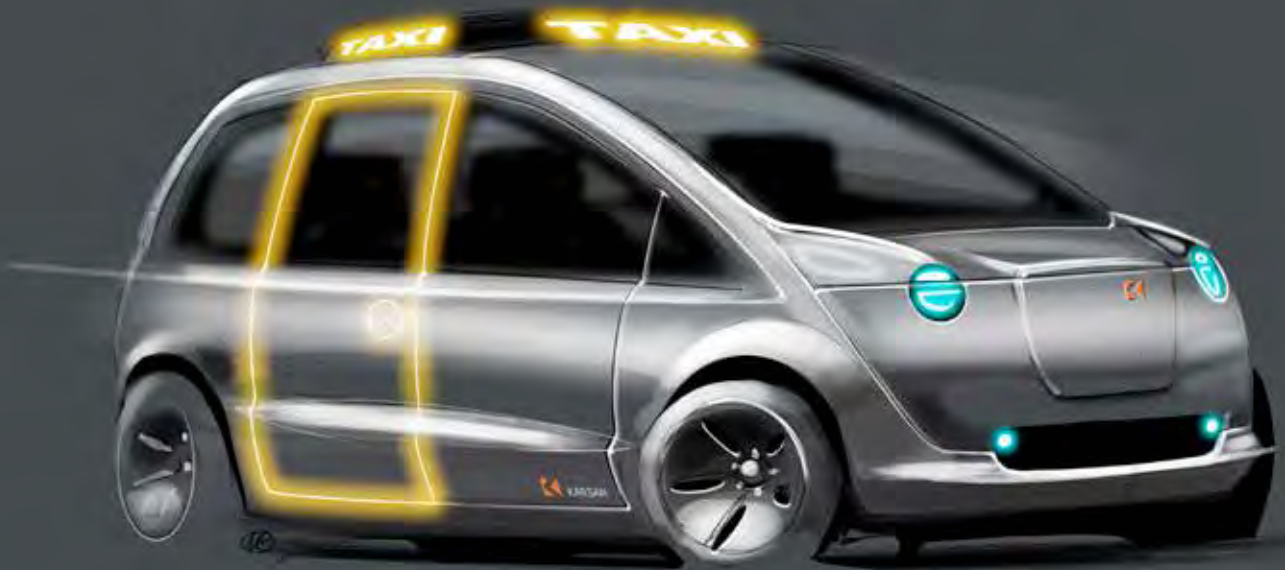


FUTURE LONDON

TAXI





“It is iconic, if you think of London, you think of that taxi”

Taxi driver

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EXECUTIVE SUMMARY

FUTURE LONDON TAXI

This study outlines a new approach to designing an inclusive London taxi for people of all ages and abilities.

Although the current London black cab is one of the few purpose-built taxis in the world, the design is now two decades old and in need of modernisation. This design study looked at how a newly designed taxi could meet the requirements of a new London fleet whilst addressing the needs of passengers of all ages and abilities through an inclusive design approach. The study is based at the Royal College of Art in the Vehicle Design department and the Helen Hamlyn Centre for Design's Age & Ability research lab.

Working with Studio Hexagon and vehicle company Karsan based in Turkey, the research built on their existing prototype vehicle Concept V1 that was developed as a versatile platform with a large, airy interior. The current black cab was reviewed through interviews with taxi drivers, visits to taxi shelters and discussions held at taxi service centres. Desk research included online forums, trade show visits and interviews with vehicle experts.

The study concentrated on inclusivity from the perspective of taxi drivers and passengers. The taxi is the driver's workspace where they spend long hours but the current driver environment does not provide the necessary comfort and amenities. In contrast, passengers only spend a short time in the cab and therefore

have different physical, mental, visual and cognitive needs. Central to the study was a co-creation workshop where participants critiqued a real cab and explored solutions.

Five key areas emerged:

1. The driver area (making it more comfortable and functional)
2. Passenger environment (increasing flexibility and designing it for short journeys)
3. The driver interface (incorporating new technology)
4. Iconic look (important for drivers and tourists)
5. The door aperture (many travellers found access difficult).

These will be addressed in a series of follow-on projects during 2013-2014.



“Show me a London cabby and I’ll show you someone with a back, neck, shoulder or leg problem”

Taxi driver





1 INTRODUCTION

In June 2012, the Royal College of Art (RCA) began a 15-month design collaboration with Studio Hexagon and car company Karsan from Turkey. This looked at creating design guidance for a future London Taxi that would be inclusively designed for the UK's capital city.

The RCA departments involved were the Helen Hamlyn Centre for Design (HHCD) and the Vehicle Design Department (VDD). This brought together a leading Turkish manufacturer and engineering company with the RCA to rethink one of the most iconic vehicles in the world.

Aim

The aim of the project is to apply research findings to the existing Karsan vehicle focusing on London branding and the iconic taxi image, inclusive interior flexibility, and the urban context. This would enable solutions that relate to Transport for London's mobility strategy.

Mobility decreases with age both physically and socially. People lose contact, comfort and convenience. The economy suffers as spending diminishes and functional need increases. The RAC Foundation's

2010 report 'Maintaining Safe Mobility for the Ageing Population' shows the need for ageing mobility, the relative safety record of older drivers, but a reduction in journeys as they age. It outlines their desire to travel whilst recognising the physical, visual and cognitive impairments that occur with age. It also highlights the need for a design approach to counter all of these. It demonstrates the need for vehicles and vehicle technologies that are inclusive and sympathetic to older people's needs and calls for a new taxi that goes beyond the specifications of the ordinary car.

Process

The research project was divided into four distinct phases based on the 'double diamond design process' developed by the UK Design Council as follows:

- 1. Discover:** conduct contextual research that relates to and defines user needs. Expert interviews completed.
- 2. Define:** design and conduct research with taxi drivers and passengers.
- 3. Develop:** develop ideas through co-creation workshops and design ideation.

- 4. Deliver:** create and write up design guidance for five key areas.

Each of the phases involved series of iterative loops spanning literature review, exploration, brainstorming, user research and idea generation to set out the context and develop the conceptual framework for the analysis of the empirical data.

Research

The contextual research and literature review provided a generic overview of the type of taxis used in the world, the London cab and the issues surrounding taxi use in London. Comparing taxis of the world with the London cab also highlighted challenges to address.

The project raised questions regarding the taxi with passengers and drivers of a variety of ages, genders, nationalities and disabilities through a series of visits, interviews, observations and workshops.

The initial statements of the cab drivers gave direction to the project research. Continuous feedback from the research partners, drivers and the passengers were invaluable in developing the findings.



“Where do we put our pens, bags, receipts, coins?” Taxi driver

Findings

Taxi ranks, cab shelters, services, related events, online dialogues and workshops were all used to hold critical discussions with the cab drivers, taxi users and experts on key questions that emerged during

the course of the research.

Outcomes of discussions were initially analysed under eight design challenges, then mapped out as five key design areas by the RCA research team. These are Iconic

Look, Passenger Area, Door Aperture, Driver Area and Driver Interface. Passenger and traveller feedback also helped to develop design criteria.

ROYAL COLLEGE OF ART

The Helen Hamlyn Centre for Design

The Helen Hamlyn Centre for Design provides a focus for people-centred design research and innovation at the Royal College of Art, London. Originally founded in 1991 to explore the design implications of an ageing society, the centre now works to advance a socially inclusive approach to design through design research and projects with industry. A key focus, through its Age & Ability research lab, is on improving mobility for people of all ages and abilities. Its Research Associates programme teams new RCA graduates with business and voluntary sector partners. More than 130 projects have been completed to date.

www.hhcd.rca.ac.uk



Royal College of Art

**THE HELEN HAMLYN
CENTRE FOR DESIGN**

Royal College of Art Vehicle Design

Vehicle Design at the RCA is the world's leading centre for vehicle design education and research. Vehicle Design graduates are in leadership positions with major automotive and transport organisations across the world. In addition to its traditional strengths in design for road vehicles, recent industrial research collaborations include underground rail, urban rail, and, with the Helen Hamlyn Centre, a systemic rethinking of the emergency ambulance. There is an increasing emphasis on strategic design for sustainable transport and intelligent mobility.

www.rca.ac.uk/schools/school-of-design/vehicle-design



Royal College of Art

Royal College of Art Research Team Members

- Principal Investigator: Professor Dale Harrow
- Project Director: Rama Gheerawo
- Senior Associate: Merih Kunur
- Research Associate: Niels van Roij

Royal College of Art Additional Team Members

- Clive Birch: Senior Past Master of the Worshipful Company of Carmen in London
- Professor Jeremy Myerson: Director and Chair The Helen Hamlyn Centre for Design
- Peter Stevens: internationally recognised vehicle designer

TEAM



Dale Harrow

Professor Dale Harrow is Dean of the School of Design and head of its Vehicle Design programme, a global centre of excellence in automotive design education. With a near 100 per cent record in student transition to professional

practice, Vehicle Design was shortlisted for the Queen's Award for Excellence in Education. Harrow is an international opinion former, commentator and media persona on design and the automotive industry. He is an award-winning designer, academic leader and researcher. Always keen to raise the intellectual debate about vehicle design, Harrow has lectured internationally on the subject.



Merih Kunur

Merih Kunur is a designer, researcher and design consultant. He has an MPhil from RCA Vehicle Design and has since been working on inclusive transport and mobility projects at the Royal College of Art's Helen Hamlyn Centre for Design and in Vehicle

Design. These include *Mobilicity*, *Future Emergency Ambulances* and *Connections* funded by Capoco, NHS National Patient Safety Agency and Intel. *Mobilicity* won the Michelin Challenge award at the Detroit Motor Show in 2006, and was later exhibited at the Science Museum. Merih conducts user research projects and workshops, and continues to lecture and write on mobility and transport issues.



Rama Gheerawo

Rama Gheerawo is Deputy Director of the Helen Hamlyn Centre for Design. With over 16 years in the design industry, he is an expert in people-centred design thinking. He leads the Centre's Age & Ability research lab which creates practical

design ideas to improve the lives of people of all ages and abilities. He is in demand as a keynote speaker internationally and writes, curates exhibitions and runs workshops for audiences that range from students to business executives. Knowledge transfer to business is central to his work, building on a track record of over 120 collaborative projects involving companies such as BlackBerry®, Samsung and Toyota.



Niels van Roij

Niels gained his BA at Design Academy Eindhoven. He graduated from Vehicle Design at the Royal College of Art in 2012. His degree project Inclusive Design Interior won the Age UK Award for Inclusive Design, the Lady Hamlyn

Design Award, the Worshipful Company of Carmen Transport Design Award and was shortlisted for both the Pininfarina Design Competition and the Car Design News Interior Motives Design Awards. His project featured in the Futures Gallery exhibition at the London Transport Museum. Setting up his studio Niels has completed vehicle, product and research projects.

KARSAN AND HEXAGON STUDIO

Karsan

Karsan set its vision as “Limitless Transportation Solutions” which aims to cover the commercial vehicle segment from LCV to HCV with multibrands as contractor, licensee and licensor. In order to enlarge the product portfolio, Karsan not only develops its own brand but also proactively proposes new derivatives for its contractors and licensors’ products.

Within the scope of this vision, Karsan is in the course of transforming from a “production company” to an “OEM”. Accordingly, Karsan is managing the whole of its automotive value chain through three different, but strategically partnered companies.

www.karsan.com



Hexagon Studio

Hexagon Studio has expertise at each step of the Product Development Value Chain and provides Design, Engineering, Project Management Support and Prototype Production services’ according to the customer needs.

Hexagon Studio and Karsan Hexagon Studio is Turkey’s largest engineering & design centre. It gives services to the automotive, transport and defence industries covering the product development cycle. Its sister company Karsan, is the main vehicle manufacturer in Turkey and has produced cars for over 45 years, together with trucks and buses for third parties like Renault, Peugeot, Hyundai and Citroën.

www.hexagonstudio.com



TEAM

Claude Nahum

Claude Nahum joined the Koç Group after he graduated from the London University of King's College with a masters in automotive engineering. In 1980, he moved to Switzerland as the President of the Kofisa Trading Company, where he began forming Koç Group's other foreign trading companies. He was appointed as vice president of the International Trade Group in 1991 and was promoted to president in 1997. During the period of Nahum's service to the International Trade Group the gross turnover went from \$10 million to \$1.6 billion. He is currently the managing director and founding partner of the Kıraca Group.

Jan Nahum

Jan Nahum graduated from the Royal Collage of Art with a degree in Automotive Designing after his engineering education in Robert College. In 1973, he joined the Koç Group as Project Engineer. Until 2002, he took part in various positions in automotive companies of the Group. He served as the general manager of Otokar between 1984-1994 and then of Tofaş between 1994-2002. Until 2004, he served as the head of International Business Development at FIAT S.p.A. In between 2005-2007 he served as the General Manager of Petrol Ofis. He is now the founding partner of Hexagon Danışmanlık.

Tolga Doğancıoğlu

Managing Director at Hexagon Studio



The Hexagon production facilities in Turkey



CONCEPT V1

The Turkish automotive manufacturer Karsan, developed this platform as a vehicle for everyone. It was designed for the convenient use of all taxi commuters, operators and drivers, including people with reduced mobility, especially those who travel in wheelchairs, older people, parents with strollers and prams and passengers carrying cumbersome packages.

The platform has been developed specifically for mobility impaired passengers to experience a ride no different than any other passenger would, while travelling in the same space. It is equipped with a patented, factory-installed, automated and illuminated wheelchair ramp extending to the curb on either side, specially designed wide doors opening at 90 degrees allowing easy access, a low floor structure and a security latch for wheelchair stability as well as keyboard and Braille communication for people with hearing and visually impairments.

Concept V1 was initially developed as a solution to satisfy an emerging demand for a dedicated taxi. Unlike conventional taxis that require some sort of retrofitting from a van

or a sedan in order to be able to operate as a taxi, Concept V1, with its unique design specifications, will serve right out of the factory built as a taxi. It is one of the rare vehicles which has been specifically crafted to be a taxi and hence elegantly addresses the most crucial issue of all which is ease of access and ample interior space.

With an unconventionally large interior, it will comfortably seat three passengers in the back seat and one in a backward facing jump seat, still with plenty of room for a wheelchair. Concept V1, even when carrying five passengers, can manage to offer significant legroom, setting a new standard for passenger comfort. Concept V1 reintroduces a superior, satisfying taxi experience that aims to redefine modern urban commute.

2 STATE OF THE ART

“Customers do like the TX shape, I get more fares out of it”

Taxi driver



The first two-months of the study involved a literature review focusing on the taxi, and a comparative analysis in order to identify the international competitiveness of the Karsan V1 concept in terms of inclusivity. This analysis covered both passenger and driver perspective.

When considering the V1 platform, the aim was to critically analyse the existing concept vehicle against an inclusivity index as well as assess the visual aesthetic, conduct extensive passenger and driver user research in London and recommend areas for improvement on the basis of research findings. The idea was to create an inclusively designed taxi cab, with relevance to the global market.

There has been an ongoing discussion in the UK about using accessible vehicles as taxis. Although local authorities across the country have their own rules, in London, Metropolitan Conditions of Fitness are interpreted as the London-style Black taxis (Austin FX4, TX1, TXII, TX4). As a result, accessible taxis as defined and required under the Disability Discrimination Act 1995, are not enforced in all authority areas.

Wheelchair accessible taxi cabs are part of the regular fleet in most cases, and are not therefore reserved exclusively for the use of wheelchair users. They are often used by able-bodied people who need to transport luggage, shopping, boxed items, prams, animals, and other items.

Because of this, and since only a small percentage of the average fleet is modified, wheelchair users must often wait for significantly longer periods when calling for a cab, and flagging a modified taxicab on the street is much more difficult.

An extensive literature search was undertaken using the following sources:

- Transport for London (TfL)
- Greater London Authority (GLA)
- Department for Transport (DfT)
- Office of Fair Trading (OFT)
- Licensed Taxi Drivers Association (LTDA)
- Ipsos MORI: (UK research company)
- European Commission

Books, journal articles, conference papers and web material were reviewed and material was selected

for relevance and research strength.

This review uncovered many issues associated with the transportation and mobility needs of older road users, both older cab drivers and taxi users as well as people with differing degrees of functional loss across the spectrum of capability such as vision, hearing, mobility, dexterity and cognition.

Background

The iconic London black cab was redesigned to meet the requirement of the UK Disability discrimination Act and become accessible by 1 January 2000. Today, there are around 75,500 licensed taxi vehicles in the UK and London has 22,000 licensed taxis in the capital (those that can legally be hailed in the street) and 25,000 licensed taxi drivers. About 1,400 new vehicles are registered each year and according to Manganese Bronze, this is a market worth about 50 million GBP annually. The company says it has supplied more than 100,000 taxis over the past five decades.

In terms of travel in 2007, 23.8 million trips were made in, to or from London on an average day. There were about 28 million

“It must not look like a vehicle for disabled people. It must be capable of picking up passengers from everywhere in town, and it is important that it has access from the side and not from behind.”

Jevon Thorpe, Designer behind the TX1 and Managing Director of London Taxis International

‘journey stages’ on an average day in 2007. The taxi is therefore considered to be an important part of the city, connecting major transport modes as well as providing door-to-door service. There are certain aspects of ‘quality’ of the service offered by a taxi company, other than expected waiting time. These include the safety and cleanliness of the vehicles and road competence and the geographical knowledge of drivers.

Three important areas of concern, namely sustainability, inclusivity and distinctiveness were defined. Although this project concentrated on the inclusive design and iconic look of the taxi, sustainability is also an important factor.

Sustainability

All taxis now have to meet certain environmental standards and meet a minimum of Euro 3 emission standards. TfL continues to work closely with a number of vehicle manufacturers to improve the air quality in London and comply with the Mayor’s Air Quality Strategy (MAQS) that aims to protect

Londoners’ health and increase quality of life by cleaning up the capital’s air.

The strategy sets out a framework for improving London’s taxis to be delivered through a number of initiatives such as the age limit for taxis, encouraging low-emission vehicles (e.g. electric and hybrid vehicles), promoting eco-driving and using the planning system to reduce emissions from new developments.

Policies modelled for the Air MAQS show that implementing taxi age limits from 2012 and 2015 will result in about 30 per cent Euro V or better by 2015. Modelling assumptions for road traffic vehicle classification for taxis show the 2008 Baseline, 2011 (Baseline and MAQS) and 2015 (Baseline and MAQS) vehicle splits by Euro standard of vehicles used in Greater London. This data was used in conjunction with updated emissions factors from Defra and TfL in order to calculate the emissions on each road link within the London model as operated by ERG.

The impact on emissions of policies relating to electric cars, PHV Age policy, and No Idling (Taxi), eco driving and freight reduction policies are based on an educated estimate of the overall impact of the policies via ‘top slicing’ – that is, they are based on a percentage reduction in or a London wide removal of emissions prior to concentration modelling.

Inclusivity

Inclusive vehicle requirements should meet the needs of passengers of all ages and abilities. An Office for Fair Trading report found that disabled people use taxis 67 per cent more frequently than non-disabled people. There is a strong correlation between age and disability as two thirds of disabled people are elderly. Over half the population aged over 75 has some disability.

Car ownership in London is much lower than the rest of Great Britain. About 40 per cent of households do not have access to a car, this proportion remaining fairly stable over recent years. As a result, Londoners are more dependent

on public transport. Many trips being made in the capital may not be single journeys. Senior citizens and disabled people need door-to-door transport. Taxis and private hire vehicles are the best option for single journeys besides the car but also the best complimentary public transport mode for multiple journey stages. A trip using car, train and taxi, for example, involves three journey stages.

Since November 2001, TfL has been funding the Taxicard scheme that provides subsidised trips in licensed London taxis offering a door-to-door transport service for Londoners with serious mobility impairments and for those who public transport is not usually accessible. Taxicard scheme members and the number of subsidised licensed taxi journeys made under this scheme continued to increase in 2007/08, with the number of journeys almost tripling since 2001. It has resulted in over £6 million of funds being spent on additional door-to-door trips for disabled people.

Overall, there has been a 70 per cent increase in the number of disabled people who have taken advantage of the Taxicard scheme since 2001/02, with more than 900,000 people using the scheme last year. So far, over 3,000 extra trips have been taken using the scheme.

All taxis that are wheelchair accessible, and private hire vehicles are now obliged to carry assistance dogs such as guide dogs. On the other hand neither taxis nor private hire vehicles are obliged to carry bikes, buggies, prams or pets - even if space is available. Although children under a certain age and height must use child seats in cars, they are exempted from doing so in taxis and private hire vehicles. A TfL survey has shown that very few operators will provide child seats on request, although most are happy for a child to use a child seat approved, supplied and fitted by an accompanying adult.

Iconic Distinction

The TX taxi came to an end in October 2012 after the recall of 400 TX4 models and the suspension of new sales forced the black cab maker Manganese Bronze to suspend trading in its shares. The biggest rival, the Mercedes Vito Taxi, marketed by Eco City Vehicles has already taken 37 per cent of the London black cab market. The Vito Taxi was licensed for London in addition to existing traditional Hackney Carriage in 2008. It was the first new lower emission six-seat taxi based on the Mercedes Vito Traveliner van targeted at London's 25,000 licensed 'black cab' drivers.

In August 2012 Japanese vehicle manufacturer Nissan revealed their version of new London taxi

claiming that it is 50 per cent more fuel efficient. If TfL approves it, the Nissan NV200 could hit London streets soon.

Trends and Public Opinion

The licensed taxi and PHV services market in the UK is large and growing with an annual turnover of at least £2.2 billion. Turnover has risen 43 per cent in real terms since 1994, although it has fallen slightly in the last couple of years. Taxis provide an important service for the public generally and are especially important for those on lower income who are most reliant on them.

On average, people in the lowest 20 per cent income bracket use taxis and private hire vehicles 40 percent more often than those in the highest 20 per cent. Adults living in households without a car made 30 trips a year on average compared with nine for those in households with a car. Regular use of Black cabs or mini cabs has fallen since 2010 from 16 per cent to 10 per cent.

3 RESEARCH METHODS

The initial focus was on Karsan Concept V1 concentrating on the interior looking at both the passenger and driver needs based on user research. The focus was to combine accessibility and flexibility.

It explored the London taxi, its iconic status, its market in a rapidly changing streetscape and sought solutions which meld existing regulations, strategy, materials and facilities to achieve inclusive mobility and offer a brand-new London taxi, ultimately aimed at a global market.

The research framework was structured across four phases. Each phase involved a series of iterative loops to provide feedback on the literature review, exploration, brainstorming, user research and generation of ideas.

The research project was divided into four distinct phases based on the 'double diamond design process' developed by the UK Design Council as follows:

- 1. Discover:** contextual research and defining user needs. Expert interviews
- 2. Define:** designing and

conducting research with taxi drivers and passengers

- 3. Develop:** develop ideas through co-creation workshops and design ideation
- 4. Deliver:** creating and writing up design guidance for five key areas.

The Discover phase involved the collection of data from a variety of available sources, a literature review including grey literature, multimedia material and academic proceedings. This phase also began the consultation process with interviews of users, service providers and stakeholders as part of the context setting in parallel to data gathering. An analytical review of the concept V1 vehicle and its comparison to existing taxis in key world cities was undertaken.

Key questions that were addressed in the Define phase included: how can a demand-responsive vehicle typology be connected to other types of transport modes within the city? How can this address the needs of a range of users and provide accessible, comfortable, pleasant, and secure journeys? Appropriate research methodology was used to capture passenger and driver user needs typical to

London through interviews and co-creation workshops. This phase continued to assess literature, map out information and set out critical questions. A design thinking session with taxi users aged over 60 and some with disabilities gave many insights about the passenger experience and raised several issues.

The Develop phase focused on the user statements gathered through the questionnaires, interviews, observations, filming, workshops and consultations in order to build a framework of five key design recognition areas. The final phase, the Deliver stage curated the project outputs into a single publication gathering together the evidence-base and delivering the findings in a digestible format (see later text in book).

The co-creation workshop and interviews aimed to deepen understanding of the problems (current and future) for taxi travel by learning from drivers' and passengers' experiences (both positive and negative), identifying obstacles, prioritising the resulting issues, and identifying areas relevant to future design of vehicles. Data was collected using field



notes, workbooks, still camera images and video to capture issues and problems in an open-ended way.

Some common elements were addressed at workshops and meetings with other designers and researchers in the Centre (for example, wheelchair access, and communication between the driver and the passenger). Taxi drivers

and passengers who participated were not treated as passive 'research subjects' but were given a platform to express themselves, and afforded an equal voice to that of the designer through the research methods. This process enabled participants to vocalise criticisms of the existing vehicle and service, to build on each other's creativity and work with RCA designers to co-create ideas.

The methods build on 20 years of design research developed at the RCA. The project also created some novel techniques such as contrasting the critique of a real cab (above) with placing Post-it notes across a life size print out of a cab. This acted as a design provocation for users to express views both verbally and through writing.

4 RESEARCH ACTIVITIES



Research activities involved design research, expert interviews, visits to expos and workshops. These are outlined in this section.

Interviews: online and face-to-face

Interviews conducted at different stages of the research involved cab drivers, service providers, and taxi users. Taxi shelters, cabbie cafés, repair stations and cleaning services, train stations and taxi ranks, and petrol stations gave us good contact with the drivers, taxi owners and fleet owners to gather information about the vehicles they drive, their expectations from the next generation of taxis, and any other issues they had.

The researchers used online and on street dialogue to ask the public and the cab drivers

specific questions about what they thought of the existing London taxi. Feedback was two-fold, gathering opinions from passengers based on their experiences as taxi users, and feedback from cab drivers about working in the vehicle.

Most TX drivers raised the same issues regarding driver space in the vehicle. More room for both driver and storage of personal items is needed. The TX driver position is not in line with the steering wheel and the whole centre stack should be moved to the left to give the driver more space. As a result, TX drivers complain about back aches and injuries due to long shifts spent in an off-centre, twisted, driving position.

In contrast some drivers who have fitted Recaro seats in their rental taxis have told us they never had

bad backs. The mechanism for adjusting the TX is not very good either.

Drivers of the Mercedes Vito taxi on the other hand described their issues as having not enough boot space and a proper shelf for luggage unless they bought an expensive option. They talked about the difficulties of passengers getting into the vehicle, finding it hard to open and close the ramp, as it is manual and very heavy to handle, not having enough headroom for taller passengers and not enough space if additional screens for payment, communication or navigation are required.

Drivers of different taxis gave a number of good insights for the comparison of rival taxi models. One of the criticisms was that they had older people in their taxi, they



“It is hard to identify from a long distance off whether they have their ‘for hire’ light on. It is therefore difficult to spot them and give them enough time to stop. I am not sure how big or bright the light would have to be to make a meaningful difference to this.”

Taxi user with Multiple Sclerosis

had nothing to hold on to in the Vito, whereas with TX they can hold the door when getting out. Many older people will not get in the Vito, as the door slides back and if they are frail, they struggle to get in or out.

User Workshop

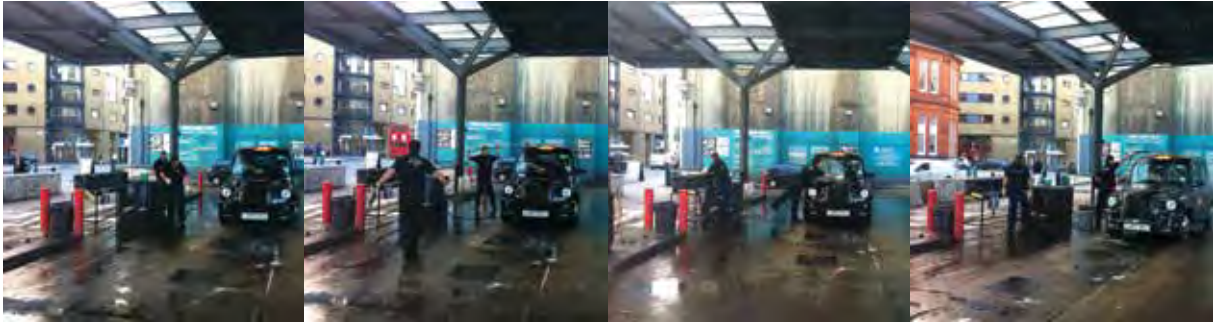
A user workshop took place at the RCA and looked at how taxi users of different ages and disabilities experienced their best and worst black cab journeys in London. The framework of the workshop was a continuation of earlier research

interviews done with cab drivers and with some leading experts in inclusive design. It was important to cover most aspects of London taxi use and document a full list of design failures.

Capturing the passenger experiences involved discussions around four themes in small groups. Qualitative analysis of the statements resulted in five key design areas; passenger area, door aperture, iconic look, driver area and driver interface. Participant

groups were helped by vehicle design visualisers to share ideas and solutions and highlight the participant’s thoughts on poster size sheets. The insights from this were curated and the emerging issues mapped out for further feedback.

Five users participated in the workshop. They were asked to bring along with them three key words that relate to London cab and taxi journeys. They included a retired university tutor who used







a walking stick (Nigel), a lady in a wheelchair (Fiona), a retired engineer who had experienced a stroke (Eddie), a girl in her 20s (Joanna) and a lady in her mid-70s with multiple minor impairments due to ageing (Susan).

The London taxi in three words

Fiona used to work in the City until she retired due to Multiple Sclerosis. She commutes to London by train using taxis to travel from the station everyday. Now using a wheelchair, she found travelling harder than ever before. Her three words were: 'freedom', 'structured independence', and 'annoyance'.

Nigel had been working in higher education for years before he retired. He has been using a walking stick for some time. His captions were 'convenience', 'uniqueness', and 'expensive'.

Susan's words were 'recognisable', 'trustworthy' and 'too high'. Eddie, a retired engineer who had a stroke and now uses a walking stick came up with words that were 'risky', 'obsolete', 'convenient' and 'expensive'. Joanne on the other hand was the only attendee in her twenties. Her words were 'classical', 'scary', 'spacious' and 'expensive'.

The workshop was conducted in five sessions:

1. Introduction

After briefly introducing themselves attendees talked about the three words they used to describe how they see the black cabs of London.

2. Examining the vehicle

A FXII taxi was provided outside for participants to examine. Attendees related their experiences with the London taxi. They tried the vehicle,

opening the doors, stepping inside and sitting down whilst being filmed and asked questions about the experience. The difficulties in getting in and out of the vehicle for those with walking sticks or wheelchairs was recorded.

3. Critique

After examining the taxi, the participants formed small groups to discuss individual thoughts on the London cab, capture existing issues that were experienced and turning highlighted viewpoints into sketch ideas using the help of visualisers (RCA design students). The attendees were asked to talk about their past journeys as well as their observations.

4. Aspirations – your London cab

The participants brainstormed ideas and aspirations and made captions on post it notes, placing them on the full size TX taxi side view



and a smaller interior view of the vehicle creating idea drawings and sketches with the visualisers.

5. Individual Interviews

In interviews lasting around five minutes each, attendees were asked to choose and talk about three ‘theme and mood’ cards for their filmed interviews as a prompt for conversation. They were asked to describe any changes in design and service they would like to see in the future. Each participant was interviewed individually and asked the following questions:

- Explain the images you have chosen
- What were your best/worst journeys?
- Would you share a cab?
- What would you ask designers to change?

Below is a summary of the responses to the theme cards: Susan’s images were: a black cab, lavender flowers and a smiling face. She said that the London cab is a classic. The black cab and red bus should be kept. She thought despite whatever is changed inside the vehicle, the basic shape should stay. Susan chose the image of lavender as it represents a nice smell; she thought this smell would be very pleasant in the cab. She chose the smiling face mood card as black cabs make her generally happy.

Fiona’s images were: the city at night, a limousine interior, a dog, smiling face, and a bedroom. When she comes to London she likes to be able to see the sights of the city whether during the day or at night. The taxi needs a good window area to allow passengers to have a good view of the outside. Her second

image represented a good and comfortable interior that signifies personal space that is clean and special. The dog picture reminded her that faithful cabbies do whatever you want to do and keep you safe. The last image of the bedroom meant that she wanted to come home safely and quickly after a long day or night out. The taxi helps her to get to this destination.

Eddie’s images were: a bus interior, a public lavatory, a bus interior, a bus with black smoke from the exhaust. He described the importance of public lavatories in public buildings as being high quality, clean and nice. He said he loves the buses but not the Routemaster types – and the taxi was as loved as a bus. Even the image of the bus blowing black exhaust fumes, was not seen by him as an environmental issue but as a tribute to the public bus!







Nigel's images were: a bus with smoke coming from the exhaust, hailing a cab, a bus interior, a car interior showing driver area, a red parrot, a limousine interior, a smiling face and fruits. Essentially the taxi was a type of public transport for him. The bus represents the basic level with the taxi as the highest. He chose the hailing a cab image as this a difficult task for some. This was due to light, glare and other urban obstructions. His third image, the bus interior, showed a mass of handles and supports that he wanted to be more coherently and usefully designed. The interior of a normal car showed a functional approach to modern design. With the image of a limousine interior he said he did not like a Las Vegas type interior. He showed the images of a happy face and fruit, saying, "if all these are satisfactory, life would be a bowl of fruit".

Joanne's images were: a modern living room, a car interior showing the driver area, a motorboat, and the city at night. She said that

the taxi was a choice when she did not want to take the bus or the underground and wanted comfort within a zone for herself. The second image of a normal car interior was chosen as London cab interiors are like public bus interiors. She preferred private hire vehicles whenever she had to go to important meetings as in private passenger cars she feels like she is in a bubble. She likes to take the front seat next to the driver to be able to see new places and new streets when visiting different cities. The boat image signified sustainability. She liked to share the cabs with friends when going out together otherwise she finds them too large for one person.

Age & Ability Research Lab Meetings

The Age & Ability research lab is one of the three labs at the Helen Hamlyn Centre for Design and the research group where this project is based. Meetings with the other researchers in the lab added insights and expert knowledge.

These sessions helped to explore the project from different perspectives and add creative approaches to the subject matter as well as develop novel research methods. Meetings were attended every two weeks and work shared in an open forum.

One to one discussions were held with visiting international academics and designers. These included:

- **Dr Patricia Moore**, a pioneering American designer and gerontologist who worked with Raymond Loewy
- **Kees Dorst**, Professor of Design at Sydney University of Technology and Director of Designing Out Crime. Professor in Entrepreneurial Design of Intelligent Systems at Eindhoven University of Technology
- **Sean Donahue**, Principle of Research Centered Design, a Los Angeles design practice and Director of Research for the Humanities and Design Sciences at Art Center College of Design in Pasadena, California.



This helped to get perspectives on the work from international inclusive design experts. Meetings discussed not only taxi design but also how diverse user groups, drivers and service providers around the world can benefit from an all inclusive taxi.

Conferences and Trade Shows **Taxi Expo October 2012**

This exhibition took place in Holland and is one of the major events within the taxi trade with many new ideas around services, new products and technologies. It is a major event where contact with experts in the taxi industry was made. Conversations and interviews were held with:

- **Dr James Cooper**, Director, Taxi Research Network Edinburgh
- **Geoffrey Riesel**, Chairman and CEO at One Transport Ltd.
- **Wim Faber**, Taxi Research Network

Discussions explored new inclusive design solutions to help the less-abled passengers and taxi drivers and developments in taxi industry

such as new vehicles, vehicle conversion solutions and green taxis. These included electric, hybrid, biofuel, LPG, green gas and compressed natural gas vehicles – and super high efficient diesels and battery changing solutions from Better Place and the Renault Fluence, produced by Karsan. 'Lightweight' was a key word in new taxi as low weight transformation is a key selling point.

Also examined were interactive navigation and communication systems, and payment using smartphones and Bluetooth. including many new and useful apps such as Tom Tom's system for security and safety for both driver and passengers. Relevant technologies such as wheelchair auto locking systems, pay point or hailing from smartphones were discussed for the potential use on the Concept V1 taxi.

Geneva Motor Show March 2013

The Motor Show was visited to assess automotive trends and look

at the taxi design within the larger context of vehicle development. Among exhibits was the EDAG Light Car that demonstrated a car-sharing vehicle concept featuring an electrically powered vehicle. This light vehicle communicated with its environment via large illuminated surfaces on a plastic body. It showed its availability for use and whether it was reserved by another customer, as well as giving details of its present range. Another idea worth mentioning was AutoAdapt that offered vehicle adaptation solutions for getting in and out of the car with wheelchair lifts, hoists, driver environment adaptations, ramps, and solutions for children, together with various aids.

There were a few autonomous vehicle systems worth looking at such as AKKA Technologies' LINK & GO driverless car automating the process of driving and charging. The integrated connectivity linked the vehicle to social networks. It had both manual and automatic mode with an interior that could be



transformed into a 'lounge' when the car was driving itself. The Rinspeed MicroMAX swarm car offered an intelligent, eco-friendly mobility concept with the benefits of personal transportation and those of taxis, car-sharing services and carpool concepts as well as public transit by using real time data networks.

Taxicol was another driverless system with modules each containing 22 seats and access for disabled passengers linked by electromagnetic chaining to form a convoy of up to 5 modules, 110 seats. Other ideas were the functional Tesla Model X doors, which provided easy access and the Tripod Mobility that converted different types of vehicles with a lowered floor in order to make them wheelchair accessible.

London Canary Wharf June 2013

London Motorexpo in Canary Wharf, UK's largest free-to-attend motoring event, became the first stop for

Karsan to unveil the new V1 London taxi concept. Visitors were asked about the future London taxi. The feedback included black cab drivers and indicated that the exterior of the V1 resembled a minicab rather than a traditional black taxi.

Although it is not a van but a dedicated passenger vehicle (unlike the Mercedes Vito or Nissan NV200) it resembled, for some people Addison Lee's Ford Galaxy private hire cars.

When visitors stepped into the vehicle they admired how spacious the interior was due to the glass canopy roof. They could see the sky and the surrounding buildings.

The physical space created inside the vehicle was aimed at people who have reduced mobility. Access was from both sides with low angle ramps for people with wheelchairs, motorised chairs or mobility scooters (except larger road-going versions).

However, despite the space, there were difficulties with the floor height for walking stick users. Comments from the drivers indicated that the dashboard was underdeveloped in terms of design requiring well-organised and easily reachable sections and better storage space.

Discussions: Experts, Stakeholders and Policy Makers

During meetings with Transport for London (TfL) and the Greater London Authority (GLA) two clear areas of focus for the project emerged as important:

1. Evolving the exterior aesthetics of the iconic black London taxi
2. Producing evidence-based inclusive design for the interior of the taxi that includes passenger space, access, driver space and driver interface.



5 RESEARCH FINDINGS

The ideas that emerged from the workshops, interviews and user research were organised into five areas of design research.

These include the passenger area, door aperture, and iconic look of the exterior, the driver interface and the driver area. This is detailed on the next few pages and provides an evidence-base for guiding principles to develop an inclusively designed London taxi.

It should be noted that whilst some of these areas cross over with each other, there is not any conflict in terms of the design approach. For example, seats are part of the passenger area but their position in relation to the doors make them relevant to the door aperture as some older people and some disabled people find it very difficult to raise themselves from the rear seats and get out of the vehicle. This has been documented in the user trials with TX1 taxi. These key areas of research had their own focused activity and although independent they all are interrelated to produce a homogenous outcome.

Throughout the research phase,

care was taken to develop the exterior appearance of the taxi and retain a classic or iconic look.

It is important for a London cabbie to drive a traditional-looking black taxi and for some passengers to enjoy the experience of hailing and riding in an iconic vehicle. This approach needs to be combined with questions thrown up by the inclusive design research, e.g. how wide and how high does the passenger door aperture needs to be fully accessible for people with a wide range of abilities. What are the physical requirements on basic design elements such as ramp gradient, floor height, doorway width, headroom inside vehicle, and manoeuvring space inside vehicle? For example, if the B-post is removed to widen up the entrance would this spoil the traditional aesthetic of the vehicle?

The driver environment and particularly the dashboard is a highly complicated area of design as it involves interactive design, communication graphics, ergonomics and Information Communication Technology (ICT) with the additional requirement to become a workstation. It therefore warrants focus as a key research

area, with correlating design details considered during design evaluation stage. Each of the following findings needs to be understood within the wider context of the whole taxi design rather than seen in isolation. In this way, discrepancies and conflicts can be avoided.

For each of the five key areas, brief statements from research were captured and mapped out.

1. Iconic Look

The research included interviews with people from across the taxi trade – cab drivers, vehicle owners, fleet owners, service providers and passengers of different ages, professions, nationalities and disabilities Workshops and interviews were held, with researchers visiting places of interest and also accessing insights from online forums. Both drivers and passengers put their views across on the importance of having a traditional black cab on London streets. Similar views were received from TfL, Greater London Authority and other professional bodies.

The notion of being in a taxi that visually belongs to London makes all the difference. It is a cultural icon that people would like to



Initial ideas included both an iconic vehicle (below) and a shared-service vehicle (above)

experience. For many, it is not about travelling with any taxi that is just a converted van or car. As well as its silhouette, the design details and traditional British aesthetics that can be found in the Routemaster bus or Mini makes the London black cab distinct from other vehicles such as the Metrocab or Vito. It is not a van conversion. It is a special vehicle.

Research showed people tend to ignore other taxis and wait for the black TX cabs at taxi ranks at train stations and airports. Visitors are keener to have the experience of travelling in an iconic London black cab when they hail a taxi.

The vehicle needs to be an evolution of the black London taxi. However, this is not about getting any vehicle, painting it black and putting round headlamps on the front and amber taxi sign on the roof. It is much more than that. Further research need to ask the question “what makes the taxi an iconic London black cab?”

2. Passenger Area

The footprint of the vehicle could allow for a completely new layout rather than following convention

and current practice. The standard black cab is licensed to carry five people, with three across the bench seat at the back and two on the rear-facing jump seats. Some of the newer models can hold six. Folding the jump-seat allows a wheelchair to be positioned inside the vehicle.

The passenger section is an important area for study as it overlaps with other areas of research such as door aperture, exterior and driver space. The work packages within passenger space are identified from the user statements and observations, and their connection with other key areas are underlined. Within the passenger area, the work packages that emerged were:

- Seats (including seat belts, child harness)
- Grab handles
- Wheelchair space (including other types of mobility that can be standardised)
- Colour code and graphics
- Light (including sunlight, glare, windows and roof canopy, illumination and lighting)
- Air conditioning and heating
- Communication, information and payment interface (including controls)

- Materials (including tactile surfaces, hygiene and cleaning, floor and interior lining)
- Luggage space (including smaller packages, briefcase etc.)
- Secure area for guide dog or other pets
- Doors and thresholds.

3. Door Aperture

Ingress and egress is one of the essential key areas in a passenger vehicle especially when it is aimed at public use, as it needs to be well researched and carefully designed to be as inclusive as possible. It requires people of all ages and abilities to have full and easy access to the vehicle whether they use a walking stick, wheelchair or motorised mobility vehicle or nothing at all.

Consideration should be given to how parents with young children or buggies get into the vehicle, and how do they get off. What happens when a person with a large amount of shopping or luggage uses the taxi? How do they lift heavy or bulky items into the vehicle and enter themselves?

Wheelchair-using passengers are helped into the taxi by the driver

via a lift or more commonly a ramp at the rear or side of the vehicle. However, this feature is a subject for concern amongst Licensing Authorities who feel that the wheelchair passenger could not easily exit the vehicle in the event of accident involving damage to the rear door. The latest generation of accessible taxis features side loading with emergency access possible from either of the two side doors as well as the rear.

The wheelchair is secured using various systems, commonly including some type of belt and clip combination, or wheel locks. These can take some time to secure. Usually, wheelchair accessible taxis are capable of transporting only one wheelchair-using passenger at a time but can usually accommodate four to six additional able-bodied passengers.

Research on door aperture not only includes the passenger door but also the driver door. Apart from passengers, older, tall or overweight taxi drivers may find it harder to use current taxi doors. The security aspect is also important for drivers who need to feel protected in the cab.

4. Driver Space

Driver space covers not only spacial issues for the driver but also elements such as light, sound, temperature, comfort, communication, and information sharing. Although controls and displays for most of these functions appear on the dashboard area, some extend into the cabin such as the roof light, door, mirror and window controls, air conditioning vents, microphone and speakers, and seat controls. It is also important to provide the driver with a sense of security and trust as this is the cabbie's working space where they spend the majority of the day.

Findings from the TX taxis showed that there are serious issues with the driver space. This is mainly because there is a lack of space for the driver. Legroom is limited and off centre. There is not enough headroom for taller drivers. Age has a major effect on how many hours taxi drivers work everyday. There are more licensed cab drivers aged over 70 than under 30, and drivers under 30 work on average twice as many hours per week as those aged 70 and over. 70 per cent of those aged over 60 have a disability therefore good attention should be

given to the driver area looking at both comfort and ergonomics.

Apart from the driver seat area, the rest of the space must be reorganized according to the driver's daily needs as they spend long hours in the vehicle and it is their work space. They also do much more than drive – they relax, wait, talk and sit in the space. There is little space for personal or professional belongings.

A large proportion of bus, train, taxi and truck drivers have disorders in lower back, extremities, neck and shoulders. For this reason, pain and fatigue are important factors to consider in the design of driver space when a driver spends a lot of time in the vehicle to avoid car-related discomfort and disorders.

The Mercedes Vito taxi has more room in the driver area and a much better organised driver space. Unfortunately, it is a van conversion and the most expensive, approved London taxi. The space in Concept V1 is a good platform to work on with a fully adjustable driver seat.

What drivers need is a functional organisation of the space according to their requirements, trials with

drivers test prototypes and mock-ups and design iterations.

5. Driver Interface

A well-organised driver interface combining user experience with the latest technology is the main concern of this research area. The dashboard, instrumentation and related workstation is part of the driver space but it needs to be focused on in some depth due to multiple ergonomic considerations.

Unlike other vehicles such as cars and vans there is no front passenger seat next to the driver seat therefore a specific driver-centric dashboard has to be explored. Anthropometric considerations whether dynamic or static should be made according to the characteristics of the specific population, in this case the London black cab drivers.

It is very important to understand age-related disabilities that occur among older drivers. Design of the instrument panel, the dashboard and the surrounding space should be fully inclusive. Visibility of Instruments as well as the visibility of the road and vehicle surroundings has to be assessed. The taxi is a public transport

vehicle and passengers get in and out in a busy and crowded city environments, sometimes in very awkward places. Drivers must have a clear vision of pedestrians, passengers, cyclists and almost everything around the vehicle. User experience and ergonomics has to be considered right at the beginning of the design stage otherwise making significant changes into the design could be very costly.

Considering that there is an average age of 52 for London's cab drivers, the design of the dashboard, with all the controls and displays, and its relation to the seat and surrounding space should be fully inclusive.

The important issues of safety and health should be explored in detail for the purpose of building an ergonomically sound, inclusively designed dashboard for the cab driver. Readability of the displays and reachable and easy to use controls should help with age related motor, sensory and cognitive disabilities of the older drivers. Driver fatigue due to long hours of city driving needs to be examined in depth to develop the design criteria.

In-vehicle controls should be

coded and grouped by function to differentiate them both visually and by touch. Controls should also be kinaesthetic responsive in order to increase driver awareness, together with warning lights to provide additional feedback.

Wider use of haptic cues in car control and displays is very helpful for older drivers as their visual and auditory capabilities decrease significantly with age. According to research the ability to discriminate using the sense of touch is more resilient to the effects of age, therefore haptics can be very beneficial for the increasing number of older taxi drivers.

Today, specific fixed instrument layouts and displays used in cars cannot be altered for individual drivers. Current in-vehicle controls such as radio and environment controls are not driver-centred because the user has to adapt to the control layout. A closer look needs to be taken at Human Machine Interface (HMI), Advanced Camera Technologies (ACT), Road Transport Informatics (RTI), Intelligent Vehicle Highway Systems (IVHS) and Advanced Transport Telematics (ATT), Transport Information and Control Systems



(TICS) and Intelligent Transport Systems (ITS).

Instrument panels should be adjustable and adaptable for differing individual abilities due to age or disability of the taxi driver. Such advances in technology may offer situational display and controls according to the required real-time information. The primary display speedometer may change place with the secondary display

navigator. If the driver is focusing on the directions to find a place in confusing urban streets then the navigation display becomes more important.

Finally, attention has been given to zero-emission vehicles as an electric taxi will be different to the combustion engine taxi currently in use today. The display needs to give information to the driver about specific functional issues such as

battery life, range or power drain. It will be very silent and people may be unaware of the approaching taxi on streets. This may bring along some issues that need to be solved within the instrument panel to make the driver more alert to such dangers.

1. ICONIC LOOK

PROBLEM



Keep the classic shape. Tourists and visitors envisage London with double-decker red buses and black cabs. The Hackney Carriage is the symbol of the capital that most people want to ride on at least once.



Some people think the Mercedes Vito is more luxurious than the black cab.



The black London cab gives a feeling of security because of the license number.

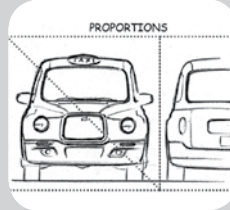


Black taxis are expensive to maintain.



The glare on the 'For Hire' sign is annoying as you cannot see if the sign is lit or not. You can only see the sign from the front of the taxi.

SOLUTION



The Hackney Carriage has always been associated with the silhouette of the black London cab. The body proportions must be kept similar retaining major characteristics such as the curved rear roof and front grille. It should look like a purpose-designed vehicle, not a gimmick.



The new London taxi needs to build up the image of comfort and reliability that the Mercedes taxis have. However, doing this should not compromise inclusivity measures on the vehicle. People want the limousine experience on the way out, and to be sped home after a night out.



Design elements need to emphasise that the London cab is a very secure taxi. Passengers put their trust in the driver and disabled passengers often require extra help at either end of the journey. The vehicle needs to reinforce this feeling of security and service.



Easy maintenance solutions such as removable or replaceable units and body panels are very important. This includes replacing damaged or end of life parts such as body panels and seats, as well as removing for cleaning, repair and maintenance.



The illuminated taxi signage on the roof and other information graphics and screens should work even under conditions of reflection and glare, in sunlight and at night. Older and partially sighted people need to be involved in the testing of solutions.

PROBLEM

SOLUTION



Hailing a cab is hard from a wheelchair especially if the driver does not want to stop and get the floor ramp out.



There should be different ways of flagging a cab on the street, such as physical or digital. Some people cannot move their hands or arms in a full range of motion. It is much more difficult to be noticed by the cab driver when in a wheelchair.



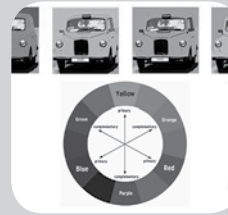
Some passengers use minicabs as they find them more convenient to call up and book.



One of the main reasons why some passengers prefer minicabs is due to cheaper and prearranged fare for the destination so there are no hidden costs. Technology could help alleviate some of these issues.



Some people find black cabs depressing as they remind them of hearses.



The iconic black taxi colour can also work against the aesthetics of the cab. Some creative colour and graphics could be introduced but such ideas should be developed with public opinion.



People usually get drivers that are known to them, with some families using one taxi firm. They are careful not to give personal details.



Passengers want to have a way of choosing the taxi driver or the firm they feel most comfortable with. There should be digital and physical solutions such as apps.







NIELS VAN ROU



2. PASSENGER AREA

PROBLEM



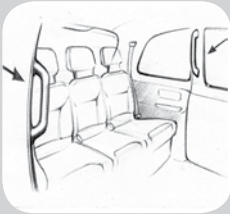
Yellow grab handles are excellent features but can be further designed to be more inclusive.



A recessed handle in the ceiling is needed for safety, helping passengers steady themselves as they move around the cabin. Older taxis with the handle in the middle were regarded the best version.



The grips above the door are brilliant. Some passengers were observed lifting themselves up into the cab by holding onto these.



Adjustable handles for passengers with different abilities are needed. Disabled passengers differ in the way they hold the handles when getting in and out of the vehicles.

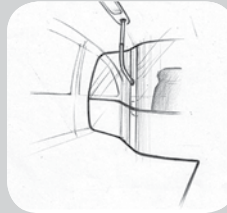


The handle behind the driver on partition wall is important.

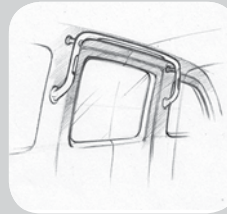
SOLUTION



Handles are not always easy to find especially when passengers are in a hurry or distracted. Although yellow handles are used in most public transport vehicles, vivid colour illumination is more effective for older or partially sighted people.



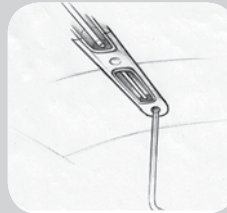
Some passengers feel insecure when they cannot hold onto anything inside the vehicle. A handle on the ceiling can provide confidence for passengers needing assistance getting in and out of the vehicle. Handles should not just be placed at the side of the cabin.



Most passengers feel vulnerable when getting into the vehicle if there are not enough handles to hold on to. With wider doors or sliding doors it is essential to provide grips above the door as well as to the side.



The grab handles should be adjustable or positioned to provide a choice for people according to their dexterity or mobility aids. Tactility as well as shape, thickness and size should be well researched and tested.



Depending on where they sit, some passengers use the handles on the driver partition panel to keep their balance during journeys. These handles complement the side and ceiling handles and are important for the wheelchair users also.

PROBLEM

SOLUTION



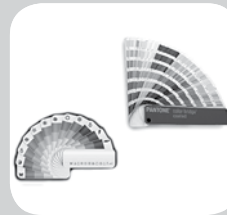
The seat belt locks cannot be seen easily and are not always easy to use.



Some passengers do not have enough strength to pull the belt or enough grip to lock them. They should be easily identifiable with distinctive colour, illumination and texture. Different disabilities and age groups require easy adjustment. Some passengers may require help.



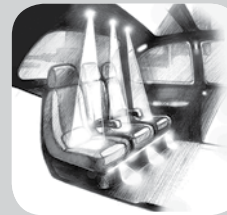
Use of different colours, not just yellow, is more noticeable for high visibility areas such as handles, locks and switches.



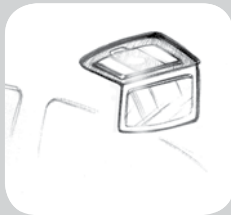
People identify functions better if they are colour-coded. There should be a colour distinction between the seat edges and the handles, between the security devices such as seat belt locks and the comfort adjustment controls. This should be standardised.



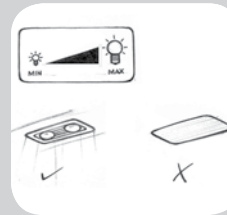
Dark and black areas are difficult to see for most passengers. For passengers with poorer sight it becomes very difficult to see their surroundings and this can affect both comfort and safety.



Proper lighting is required especially where the colour black is used and for areas that do not get sufficient light such as the floor, corner areas and under the seats. Bright and reflective materials can be used with dynamic illumination where necessary.



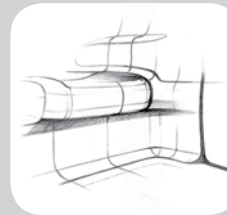
Vanity mirrors and lights are useless. Diffused lights cause glare, making vision worse especially for people with poor eyesight. People need to be able to see, read or look for things when in a taxi.



Adequate lighting is necessary when it is dark. However, the intensity of the light, its direction and diffusion should be easily adjustable as there are many light conditions throughout the day and night with various types of reflection and glare.



Cleanliness in the passenger area can be a problem. Dirty seats and unclean floors reflect poorly on the vehicle and passenger comfort. This can be worse during bad weather. Heavy staining needs to be easily cleaned. This is very important for night cabbies.



Material for interior panels, floor, and seats should be easy to clean. Textures should repel dust and debris. Dirt collecting areas must be avoided and handles specially coated for hygiene.

PROBLEM

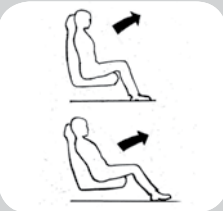
SOLUTION



A spacious interior can allow people to consider sharing a taxi and reduce expenses.



Although taxis carry a single passenger most of the time in Central London, people share taxis from stations or events, especially at night and for short journeys. A Vito can carry six people. Payment systems need to be more flexible.



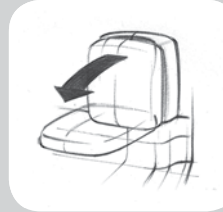
Older passengers can find it very difficult to get up from their seats and dismount from the vehicle. This can sometimes take time and put pressure on both the driver and passenger in busy city streets.



The height and depth of the seats should always be considered with older passengers in mind, so that people can get out of them without struggling. They could be motorised to lift passengers out of their seats. They should also be very close to the door for easy access.



Passengers, including older people, find it easier to exit the cab from the jump seats due to their orientation and proximity to the door. They prefer them to the rear bench seat.



Even people who do not like to ride facing backwards find the fold-up seats comfortable. They are rigid and high enough to get up in a confined space. Supplement traditional bench seats with other seating solutions that offer a wider range of choice.



Swivel seats on modified passenger vehicles make some people feel insecure and even fearful due to a sense that they are rotating.



Swivel mechanisms help to transfer disabled people onto the seat from their wheelchair but some people feel insecure with the rotating movement. Solutions should work safely and smoothly to give confidence. They could also help able-bodied passengers get in and out.



Some passengers prefer a fold-up front seat for occasional use if they were allowed in black cabs.



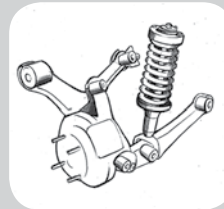
Most cabbies are against having a passenger seat next to the driver, however this could benefit some disabled passengers if optional use of this space can be designed. However, more study is needed to look at cultural and operational issues.

PROBLEM

SOLUTION



Due to the suspension and seating position, passengers can feel insecure whilst travelling over cobbled streets, passing over speed bumps, and going through roundabouts and corners.



The suspension needs to be more compliant and passengers need to be better located in their seats. Due to large interior space there are no barriers to stop passengers flying forward in the event of a sudden stop or swerve except seat belts.



London cabs have good headroom for passengers sitting at the back and good legroom. However, some people hit their heads on the roof when getting in and out.



Although there is adequate legroom people may feel insecure without a footrest. Aircraft seating could inspire new design solutions. Passengers should be able to walk into the vehicle without unduly bending their heads due to lack of headroom.



It is difficult to move in the vehicle whilst travelling with heavy luggage as there is limited luggage space in the boot. A van-type taxi such as the Vito is more suitable for airport runs where passengers want to keep their luggage next to them.



The taxi needs to accommodate luggage within the passenger area in the most appropriate way so that it does not interfere with passenger movements. This is very much the same when a wheelchair user is on board.



Wheelchair users prefer travelling sideways against the door on the passenger side of the vehicle so they can see where they are going, instead of travelling backwards which is currently the regulated way of travelling.



A wheelchair user positioned sideways on the opposite side of the driver can see the driver and talk face to face. This arrangement allows better communication and gives a good sense of security to them. This is preferable to facing backwards.



Wheelchairs positioned inside the door can damage interior trim and door cards, which can be unpopular with the drivers.



New solutions should investigate alternative approaches; the forward-facing wheelchair position needs to be engineered properly to satisfy crash requirements.

PROBLEM

SOLUTION



Luggage on board can fly around during the dynamic environment of the moving vehicle, for example taking corners, passing through the roundabouts and accelerating or stopping suddenly in traffic.



Passengers need a simple way of being able to secure their luggage properly without having to hold on to it. Luggage may fall over whilst travelling and hurt people. Some passengers bring in their bicycles.



Passengers often cannot find the 'talk to the driver' button and when they use it cannot hear what is being said. Communication with the driver is really important for safety, trust and to build understanding in a short time.



Passengers and drivers need to be able to clearly communicate with each other. The intercom button should be bold and distinctive from the rest of the controls. Alternatively a voice-activated intercom that adjusts itself to surrounding noise levels could be a better solution.



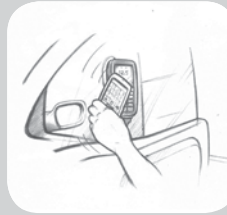
Passengers do not like having to lean forward to speak to the driver. This is especially difficult for older passengers with reduced dexterity, balance and hearing.



Background noise, the partition and tone of the driver's voice can affect hearing within the vehicle. Noise causing factors within the vehicle could be minimized by the use of sound absorbing materials. A good intercom system is essential.



Payment should be made in several ways such as online, debit or credit card, touch screen or cash. Conducting a transaction through the small slot in the partition can be ergonomically difficult for both passenger and driver.



Taxis need to accommodate different forms of payment. Some older people want to pay cash and receive hand written receipts. Using tiny buttons to key in pin numbers can be difficult for passengers. Transactions should be easy to perform and give a sense of trust.



Flexible and functional interior design makes it easier to move inside and gives more interior space.



Flexible, modular space arrangements for passengers, luggage and mobility carriages would create a better passenger area and accommodate the wider needs of a diverse population. Opportunities should be explored.

PROBLEM

SOLUTION



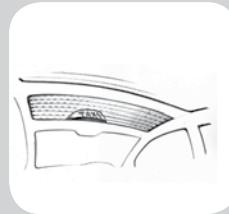
Passengers want to be informed about the route being taken, the final destination, traffic, the time it takes, estimated fare and other local information potentially. This is important for building trust, especially for tourists and those feeling less secure.



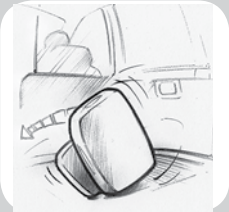
An interactive information screen can be included in the passenger compartment. However the interface and graphics should be fully inclusive. Navigation could be combined with the fare counter to reduce passenger anxiety regarding the fare and route.



Passengers, especially tourists, benefit from more daylight and window space allowing them to see buildings at full height and to see the surroundings.



Feedback showed people like the overhead window of Karsan Concept V1. However elements such as UV filter, adjustable tint, heat resistance, and blinds should be carefully considered.



Some people mentioned not having a lockable or secured space for luggage which can fly around the cab during the journey.



This has pros and cons and needs to be investigated. It should allow easy load, and unload, clean, easily visible and light and illuminated usage. It may be good to have space under the seats for smaller bags to give an extra sense of security.

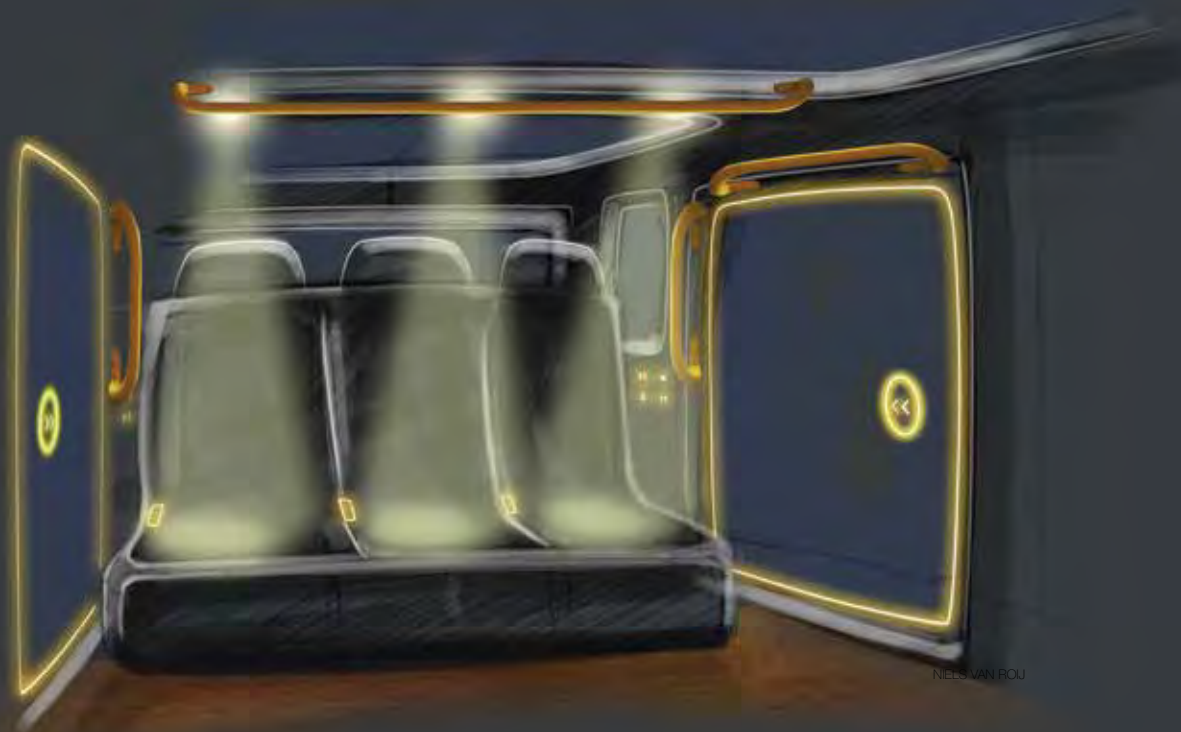


Passengers like a little separation from the person sitting next to them.



Passengers sharing a taxi prefer to have separation perhaps similar to coach and train interiors that have foldable armrests. Elbow support is also required by many and should be adjustable. This could have an innovative design that allows two people to share a space.





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3. DOOR APERTURE

PROBLEM

SOLUTION



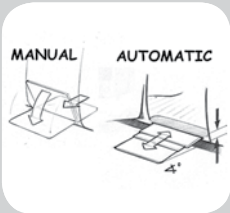
The floor level should be as low as possible for easy access. As the height goes up, passengers struggle to step inside the vehicle. This can pose problems for older people as well as younger people.



Doors are too low and their corners get caught and damaged on the curbs where pavements have slope.



The ceiling position is too low and deep.



The ramp must be easy to unfold.



Ramp users sometimes think they are too heavy. Or some wheelchairs such as motorized and large ones are too heavy for the ramp.



The maximum gap between the vehicle floor and ramp, ramp to pavement or street, maximum acceptable angle of the ramp, maximum acceptable step height are given. However, having no step would be the ideal solution.



The door's bottom corner often gets caught on the curb as it is too low. In some cases the door can get stuck open on the pavement especially when passengers get in. These problems cause damage to the doors. A sliding door could alleviate the problem



Although the door height is designed for the maximum head clearance research showed that older passengers especially with walking difficulties struggle to get out of the vehicle. They hold on to grab handles on the roof with both hands, bend and bring their head out of the vehicle.



Ramps should not be manual as drivers have to bend to open up the ramp. It is a strain on their backs and their hands get dirty and greasy when touching the ramp. Automatic ramps at each side should be opened from the dashboard as well as by wheelchair users on the side of the vehicle with safety sensors.



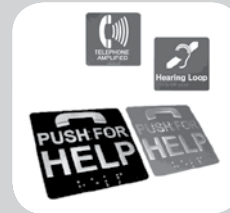
Some passengers with wheelchairs were embarrassed when they could not be pushed in due to ramp height and weight of the wheelchair. Assistive technologies should be examined for the best possible options to eliminate such situations.

PROBLEM

SOLUTION



Use of Braille as well as embossed signs helps.



Where Braille is used, grade one Braille is permissible for single words but for signs with more than one word, contracted Braille must be used. Most blind and visually impaired people do not read Braille, so embossed signs will be more generally useful.



Switches on the doors are not easily readable.



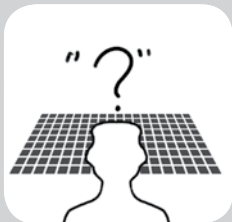
Characters of the captions should be large and bold enough so passengers with visual impairments can read them. Contrast, colour, tactility and typeface should be chosen according to user experience guidelines. Conditions like reflection, glare, shadow and variation of lighting should be tested.



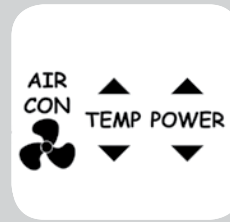
The controls on the door are located well for wheelchair users but not other passengers.



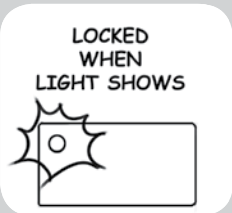
The height of the door handles, and touch buttons should be well placed for both standing passengers and wheelchair users. Problems due to dexterity, hand movement and poor sight should be considered and proposed designs should be validated accordingly.



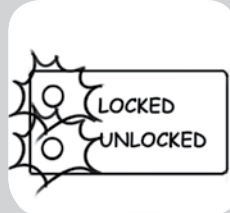
Icons on the door switches and other symbols are hard to identify and understand what the function of the switch is.



Both pictogram and captions should be used for each button to inform function. Pictograms should be clear and easily understandable. The same recommendations given for the captions apply for the symbols. Illuminated text and icons give the best results.



Handles that lock indicate doors are secure but for some they cause insecurity. Typically a red light is used to indicate when the door is locked.



It is good to have a red light when the door is locked and another colour when it is not. There should be an intelligent system to solve this issue and give more confidence to the passengers.

PROBLEM



Audio announcements are helpful to most passengers, especially to those with visual impairment.

SOLUTION



It is essential that there is a significant difference between the level of background noise and the level of the signal or announcement. People with hearing impairments require at least a +5dB S/N ratio. In environments that are noisy, any spoken information should be repeated at least once.





4. DRIVER AREA

PROBLEM



Printed receipts are generally great, handwritten ones are generally bad. The exception is that some older people like a handwritten note, but this is in the minority.



A separate talk button for the passenger could be useful, but what about a sliding door to speak with the driver?



Drivers are without any reliable knowledge of when and where traffic jams occur or where one-way streets are.



Drivers should be helpful all the way from cab to house door.



There should be good legroom and headroom for the driver.

SOLUTION



Printing two copies of receipts is helpful if one can be printed out from the payment point inside the passenger area for the customer and the other inside the driver area for the cabbie. Prints should be clear and easily readable.



An amplified intercom sound helps passengers with hearing difficulties. It is essential to get the right sound level adjusted to the background noise. Otherwise conversation between the driver and passenger is preferred. This may require noise isolation of the vehicle and interior acoustics.



Use of information technology with real time audio and graphic information would help the driver choose the best routes according to the time of day. Use of such a system makes passengers more comfortable with the driving and they can follow part of the information from an in-cabin screen.



Some vulnerable and disabled people expressed concern about whether they would get help from the driver to walk them to the front door. There should be an illuminated sign or colour code on the vehicle that reassures the passenger that the taxi driver would help if assistance is required.



Good legroom and headroom is essential for the driving space to accommodate overweight and tall drivers as well as those wearing winter clothing. Just using the driver seat and dashboard is not enough for a professional taxi driver.

PROBLEM

SOLUTION



The language barrier is a problem between the driver and the passenger. Some drivers do not speak the language well or they speak with a heavy accent.



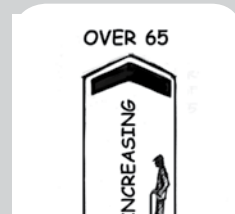
Many visitors to London find it very difficult to spell out where they want to go but also struggle to understand the driver especially if the driver has a strong accent or is from another country. ICT or messaging may help to reinforce the destination.



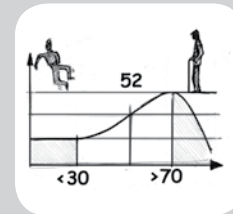
Are we too trusting to the drivers? How do I know taxi driver is not a rogue driver?



London taxi cab drivers must study and take a test to drive a cab in London. It is the most reliable cab service in the world. However, there may be additional ideas introduced, such as information about 'your cab driver'.



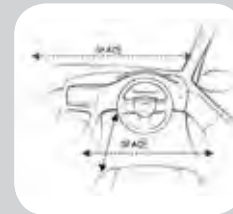
There are many drivers who are over the age of 65.



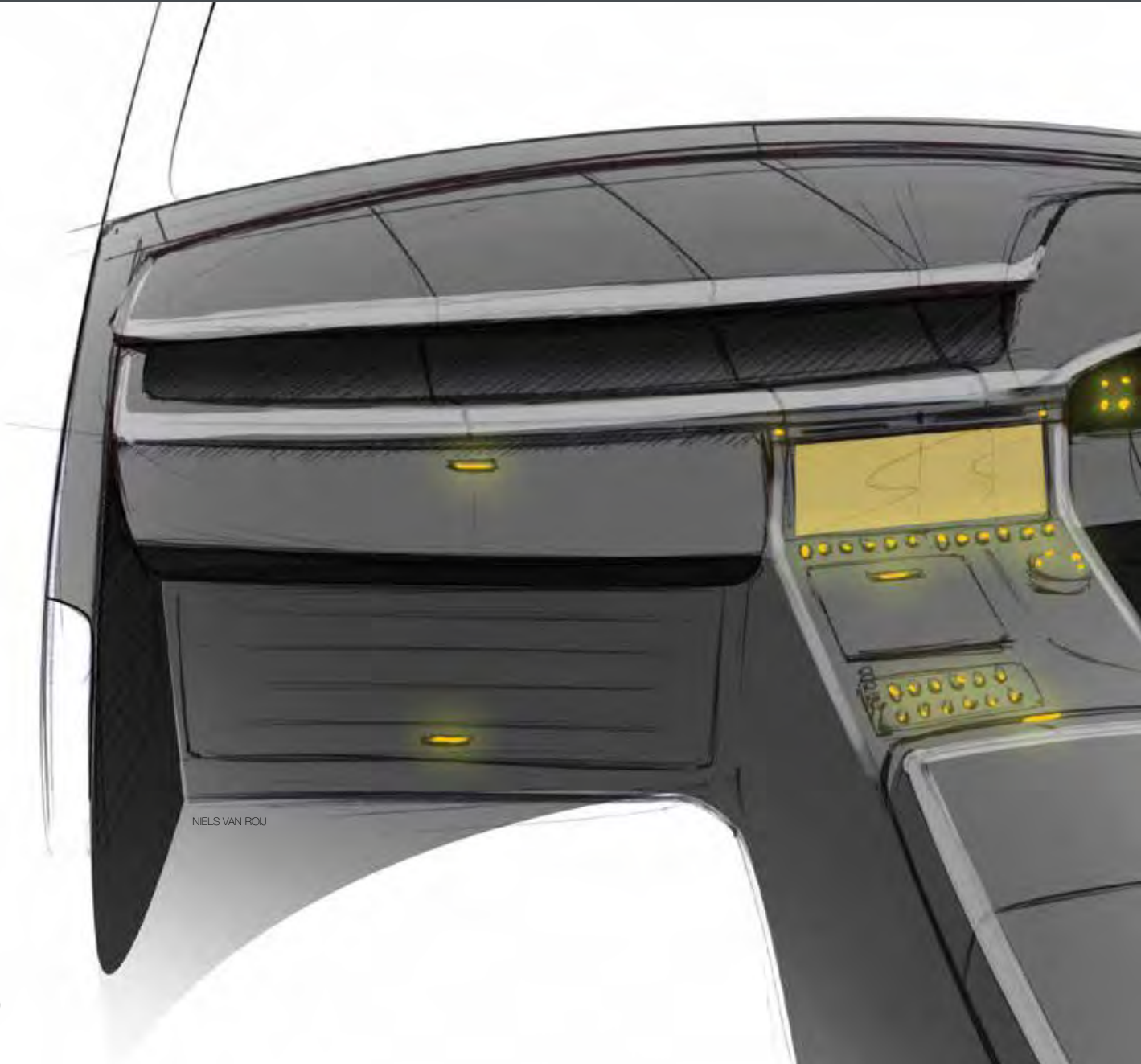
There are more than three times as many taxi drivers over 70 as under 30 with an average age of 52 for the 25,000 cab drivers. Therefore, attention should be given to inclusive design of the driver space as well as the dashboard. Spending long hours in cabs affects age-related disabilities



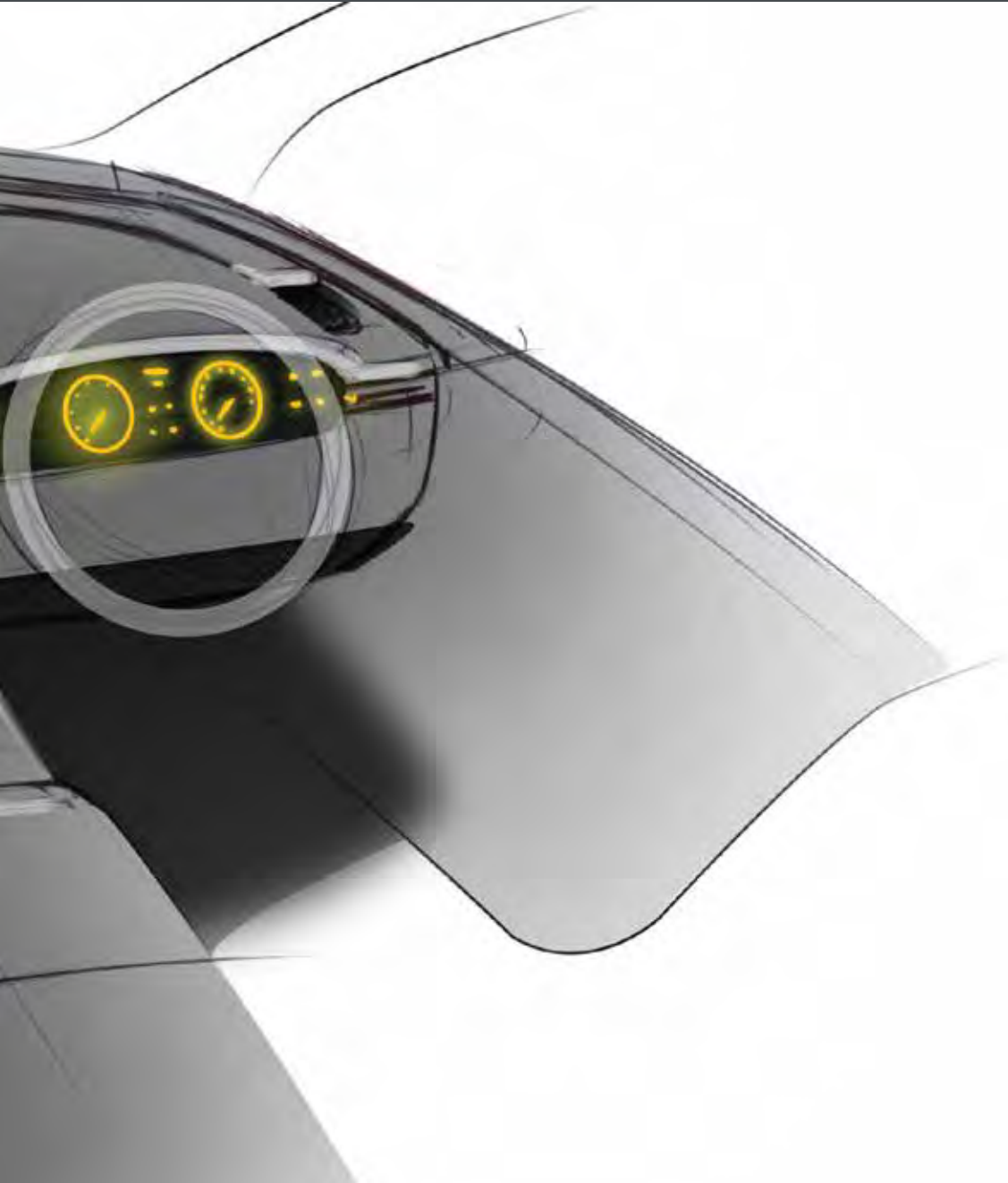
A number of taxi drivers are overweight.



The driver area should accommodate overweight taxi drivers as there are many of them. Limited space around the seat was a major problem in TX model taxis. Headroom, legroom and driver door aperture should allow as maximum dimensions as possible for the overweight and tall cabbies.



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5. DRIVER INTERFACE

PROBLEM



There is no space for the driver's needs such as drink bottle and cup, lunch box, medicine, money, pen and receipt book, glasses, keys, book, and newspaper.



An icebox could be useful in the summer as for a cup of hot tea would be in the winter. Drivers need to drink and eat in their space.



Better lighting is needed. Many drivers are older and need better light for reading and ambience. It can take three times longer for the ageing eye to adjust to lighting conditions especially after being dazzled by oncoming headlights.

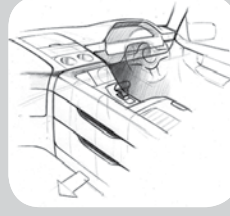


Good air conditioning and heating should be provided.

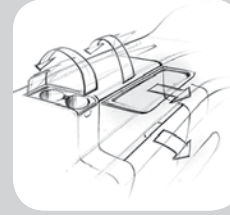


Taxis are more exposed to street dust and exhaust fumes than other cars. Interior areas such as seats, handles dashboard, and LCD screens get covered with black dirt quickly. Areas with electrostatic surfaces, corners, grooves, pockets, open compartments and vents collect dirt easily

SOLUTION



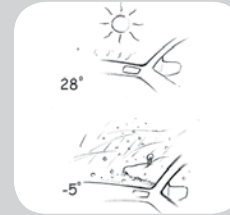
More specific research is needed to set criteria for the functional elements according to drivers' specific experience. Clutter should be avoided; functions should be grouped according to the frequency of their use, and colour-coded with some tactility.



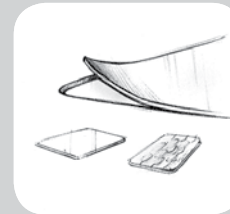
Elements such as a containers, cup holders, foldable trays and pop up bins need to be cleverly integrated within the dashboard area. Fold-out surfaces could help to transform it from a driving space into a dining space.



Strong lights, and reflective surfaces should be avoided. There should be lighting for anywhere that is dark including the floor and under the seats. Intensity and direction of the lighting should be adjustable. Diffused lights are not good for the eye and can distract whilst driving.



One of the major problems people complained about was getting very cold in winter and hot in summer due to having no proper air conditioning. There should be well-designed, easily adjustable and well-placed vents both for the driver so they can regulate their thermal comfort.



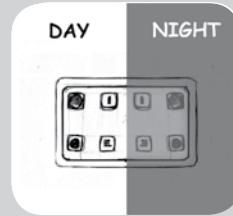
Hygienic or easy clean materials should be used wherever possible.

PROBLEM

SOLUTION



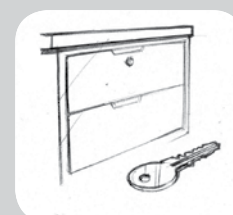
Staring at the dashboard can become very tiring especially for older drivers with reduced visual acuity.



The dials, graphics and colour of the information on the dashboard need to be carefully designed. Some colours are more calming on the eye. The lighting could automatically be adjusted for different conditions. Screen technology instead of physical dials could allow for personalisation



There is nowhere to store personal belongings.



Most office workers have a lockable space but taxi drivers have nothing. A safe, lockable compartment could provide some sense of security and personalisation.



How should the driver respond to someone waiting to hail a taxi?



This is an issue when the passenger is not sure whether they are seen by the driver and needs a way of communicating with them.



There is no adjustability in the current dashboard that takes account of time of day, activity or driver needs.



The instrument panel should be more adjustable. Dials could be changed, controls repositioned especially if digital rather than physical systems are used. The dashboard needs to support activities from driving, to eating, to resting.



The current driver interface is not working in terms of ergonomics.



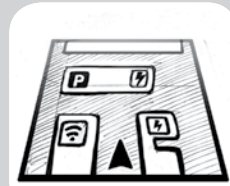
More specific research is needed to be able to set the criteria for driver interface layout to create a more comfortable experience. Clutter should be avoided; functions should be grouped.

PROBLEM

SOLUTION



Digital services will increase impact on the driver interface architecture and functionality with QNX systems and Wi-Fi or Bluetooth connectivity increasing.



The dashboard will not just be a driving interface, but will be a digital one also linking the taxi to charge points, parking spaces, Wi-Fi updates and even music playlists. This will be important for communication, operation and driver comfort.



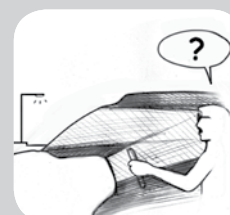
Doing transactions at night in the cab is difficult for the driver.



Improving light conditions for the driver requires purpose-built ambient lighting, task lighting and security lighting.



Illumination on the instrument panel is not sufficient enough under certain conditions such as flickering and bright city lights.



Lighting of the displays and controls should consider the glare and reflection as well as temporary blindness from powerful flashing lights especially when driving on dark rainy days, at night or on bright sunny days.

CONCLUSION



Current accessibility guidelines are not sufficient for a truly inclusive taxi design. Further research should focus on defining the parameters and requirements of such a vehicle. This means creating a set of evidence-based guidelines.

- To be fully inclusive the guidelines should be focused across the whole range of users such as mothers with children, people with impaired vision, major disabilities such as wheelchair access, people with temporary mobility problems such as a broken leg. The management of luggage needs to be a main consideration.
- The guidance needs to reflect the functional aspects of the vehicle such as seating layout, passenger area and driver environment in one coherent, overall package.
- The guidance should also be based on real people's needs, aspirations, and behaviour.
- More in-depth research is needed on the five identified research areas in order to create a realistic prototype that meets the functional and aspirational requirements for a class-leading London taxi.
- Learnings can be transferred to the global market to rethink taxi design internationally.

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The Helen Hamlyn Centre for Design
Royal College of Art
Kensington Gore
London SW7 2EU
hhcd@rca.ac.uk
www.hhcd@rca.ac.uk

Credits

Editors:

Rama Gheerawo and Dale Harrow

Author:

Merih Kunur

Images and Illustrations:

Merih Kunur and Niels van Roij

Graphic Design:

Niels van Roij

Layout:

Margaret Durkan and Niels van Roij



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