



February 29, 2016

Automated Vehicles and the Future of Urban Transport



At first, people used to get around on foot and by public transport. The commute was slow and dreary, it took about an hour to get to work and an hour to get back. As soon as somebody got richer, they'd buy a car. Allowing them to travel faster. They could get to work in 15 minutes.

Soon, more people got rich enough to buy cars. And the roads got a little clogged. And the average travel time rose to about an hour. And this led to more people buying cars and the roads being perennially jammed! And travel time rose to two hours. And people were paying so much more for this slower transport system.

A little parable about transportation

**But then this is no parable.
This is the history of modern transport.**





TOO MANY CARS

Too many people own too many cars—an estimated 1.2 billion vehicles globally. If current trends hold, and China and India make personal vehicle ownership a hallmark of middle-class achievement, the number of vehicles goes up to 2 billion by 2040.





TRAFFIC CONGESTION

Traffic congestion causes waste of time, delays, wasted fuel, increased pollution. Traffic jams result in 5.7 billion person-hours of delay annually in the US. China's traffic jams are the most famous, the longest one from 2010 apparently lasted 10 days. It is estimated that the congestion costs Beijing over 11 billion dollars a year. Congestion is estimated to cost Europe about 1% of GDP each year.

They also increase road rage, and consequently the potential for accidents. The health effects of stress are also significant.



HEALTH AND OTHER COSTS

Breathing street-level fumes for just 30 minutes can intensify stress. Children are at greater risk and more vulnerable to the harmful effects of pollution.

The WHO reports that over a million people die and some 20 - 30 million people are injured in road accidents each year. Add to this, lost productivity, medical costs, legal and court costs, emergency services, administrative costs, congestion costs, property damage, and workplace losses.





SPACE

Roads and parking take up valuable real estate. In countries with a shortage of space such as in South Asia and South East Asia, this diverts space from essential necessities like housing, parks and playgrounds. Parking shortage in Chinese cities range between 30 to 50 percent overall. Indian cities show similar shortages. Congestion in many cities is untenable, and it's getting worse.





TIME AND FUEL

Not to mention the several billion hours spent driving when people could be doing so much else, or the fuel that could be used productively.

All that traffic costs 3 billion gallons of fuel and 7 billion hours of time. In 2014, that added up to \$160 billion.





“Today, cars are people’s second-largest household expenditure, and they sit unused 20+ hours a day. When they’re on the road, a vast proportion of them are looking for parking—wasting time, worsening congestion, and adding to vehicle-miles traveled. If someone described that model to you and didn’t tell you it was cars, you’d say it was ripe for disruption.”

<http://www.wired.com/2016/01/the-metastructure-transportation/>

SELF-DRIVING TECHNOLOGY AND AUTOMATED VEHICLES

Several technological breakthroughs promise to alleviate the situation: vHyperloop vPersonal Jet Packs vElectric Bikes vSolar Flights

But Self-Driving Technologies or Automated Vehicles (AVs) promise the greatest disruptive potential.

They can reduce the cost of transport drastically, offer greater possibilities for sharing and allow for innovation that parallels the IT revolution of the last three decades.



**AVs are expected to hit
the market by 2020.
Yes, they will take the
chore out of driving...**

**... but the disruptive
potential comes from the
system changes that they
enable: SHARED MOBILITY**





**It is the potential to
reimagine the commute
experience that makes
AVs so exciting.**



Automated Vehicles offer several advantages

- Reduced Congestion
- Reduced Emission
- Space freed: No need for parking frees up public space for parks, entertainment spaces; in houses, a kitchen garden, a swing, a basketball hoop... take your pick
- Disabled, elderly, and children are more mobile and safe
- Finance freed up: No need for that car loan
- Move up: Rent a BMW at a lower price than owning a VW
- No Drunk Driving / Accidents
- Less cars needed: Reduced ecological impact.





WHAT DOES THIS DO TO COMMUTE EXPERIENCE?

These cars are well behaved. Since they are programmed for safety and caution, and to not break traffic rules, the threat of accidents is greatly reduced.

The absence of the driver allows these to be extremely cooperative as services. Shared Mobility creates options for door-to-door travel, last/first mile trips, reaching underserved areas. Disabled, aged and young people can be served.





WHAT DOES THIS MEAN FOR URBAN PLANNING?

Reduced need for parking spaces. After dropping off one person, AVs move on to the next ride. Parking is only required at night when there is reduced traffic and consequently enough space on the roads. Less vehicles on the road and reduced need for parking imply increased space for other uses like housing, business, playgrounds, parks, etc.





WHAT DOES THIS MEAN FOR CAR COMPANIES?

Auto companies will move from building and selling vehicles to new businesses like Fleet Maintenance, Data and Analytics, and Ride-Sharing.





WHAT DOES THIS MEAN FOR VEHICLE DESIGN?

CAR AS SPACE, NOT JUST COMMUTE

Since there is no more need to orient the driver facing outside, it allows for a more sociable/ interactive commute experience for families and groups.

The increased freedom in the design of cars allows them to be multipurpose vehicles. They can now be used to for several other purposes— business, entertainment, lounging, personal care.



**But for all this to work, there needs to be a shift
in the Car Paradigm: from OWNING to SHARING**

One-tenth of the cars: Same Mobility

An OCED simulation experiment found that a fleet of just 26,000 taxibots – on demand taxis that pooled usage – could replace 230,000 cars of Lisbon, serving a population of 565,000.

A similar effort at modelling usage by the University of Texas, Austin, found that by sharing usage it would be possible to make do with a tenth of the vehicles with little or no change in convenience.

Martyn Briggs of Frost & Sullivan, estimates that “each shared vehicle could ultimately replace between 6 and 15 privately owned cars.”

www.internationaltransportforum.org Urban Mobility System Upgrade: How shared self-driving cars could change city traffic

<http://www.citylab.com/commute/2014/02/imagine-world-where-nobody-owns-their-own-car/8387/>





AN INTERNET OF CARS

Citylab suggests that an "internet of cars" — a world where vehicles, roads, traffic signals, and transportation authorities are all sharing information in real-time — could radically transform the way we commute. It is possible to “rethink business models, selling travel time in shared cars that act like automated taxis,”

The Mobility as a Service model is already in place with the likes of Uber, Lyft, etc. This comes rather timely as we discover a new preference by Millennials to user rather than own.

<http://www.citylab.com/commute/2014/02/world-without-car-crashes/8353/>





THERE'S ALREADY A CHANGE IN ATTITUDE...

More and more Millennials would rather rent than own cars. Around 46 percent of people living in Berlin and 56 percent of New Yorkers manage without their own vehicle.

The Fraunhofer Institute notes a tendency towards using instead of owning in urban regions, owing to advantages like "cost/benefit optimisation, being able to do without maintenance and repairs, sustainability aspects, flexibility through continuous choices."

http://www.isi.fraunhofer.de/isi-wAssets/docs/e-x/working-papers-sustainability-and-innovation/WP3-2011_VIVER-english-Version.pdf



THIS WILL ALSO NEED SEVERAL CHANGES IN THE SYSTEM

Product Innovations such as Google's self-driving cars, Transport Fleet Management Software, Optimization Algorithms, adapting protocols of Internet traffic to transport challenges on the roads.

Process Innovations such as new ways of paying for transport, using chips/ phones/ cards. These will be required in the short term to make smoothen user experience.

Regulatory Innovations to guide and smoothen the operating environment. Data privacy and interoperability. As also liability for accidents and the 'ethics' of the software.

But in the long run, **Market Innovations** like Shared Mobility, and experiments like Free Transport will be the game changers. Look at Singapore to lead the way.

Ford has peer-to-peer car sharing for its employees, and plans to let groups of people lease its cars. BMW's piloted a car share program in the Bay Area. Audi and Daimler have launched their own car sharing services.

With all this in place, the transition to AVs is likely to happen in 3 stages.

2020 – 2030: Engineering-led

The key driver will be the improved technological gains of AVs. Setting up Human Machine Interaction protocols will be among the early challenges.





AVs will debut in small towns where the ‘cautious programming’ that runs self-driving will work. This will primarily be in the luxury segment where self-driving will be the cool in-thing and the aspirational value will drive growth for the first half decade.

Through the decade, the software that runs the car will get sophisticated enough to handle denser traffic and the public will gain enough confidence in AVs to begin depending on them regularly.



CHALLENGES AND REQUIREMENTS

The first round of challenges will be in the space of human-car communication. How will the presence of self-driving cars change the driving environment?

How will pedestrians deal with the strange cars that move by themselves?

Key players will lobby to remove legal barriers ensuring quick adoption of AVs. Where feasible, a separate right of way may be implemented. When taxi operators begin to induct them in their fleets, protests from drivers will lead to regulatory checks on AVs in some places.

Regulatory frameworks will have to be put in place to enable the next stage of growth, which will involve shared services. Liability, terms of service, constraints on ownership, etc. will have to be spelt out.

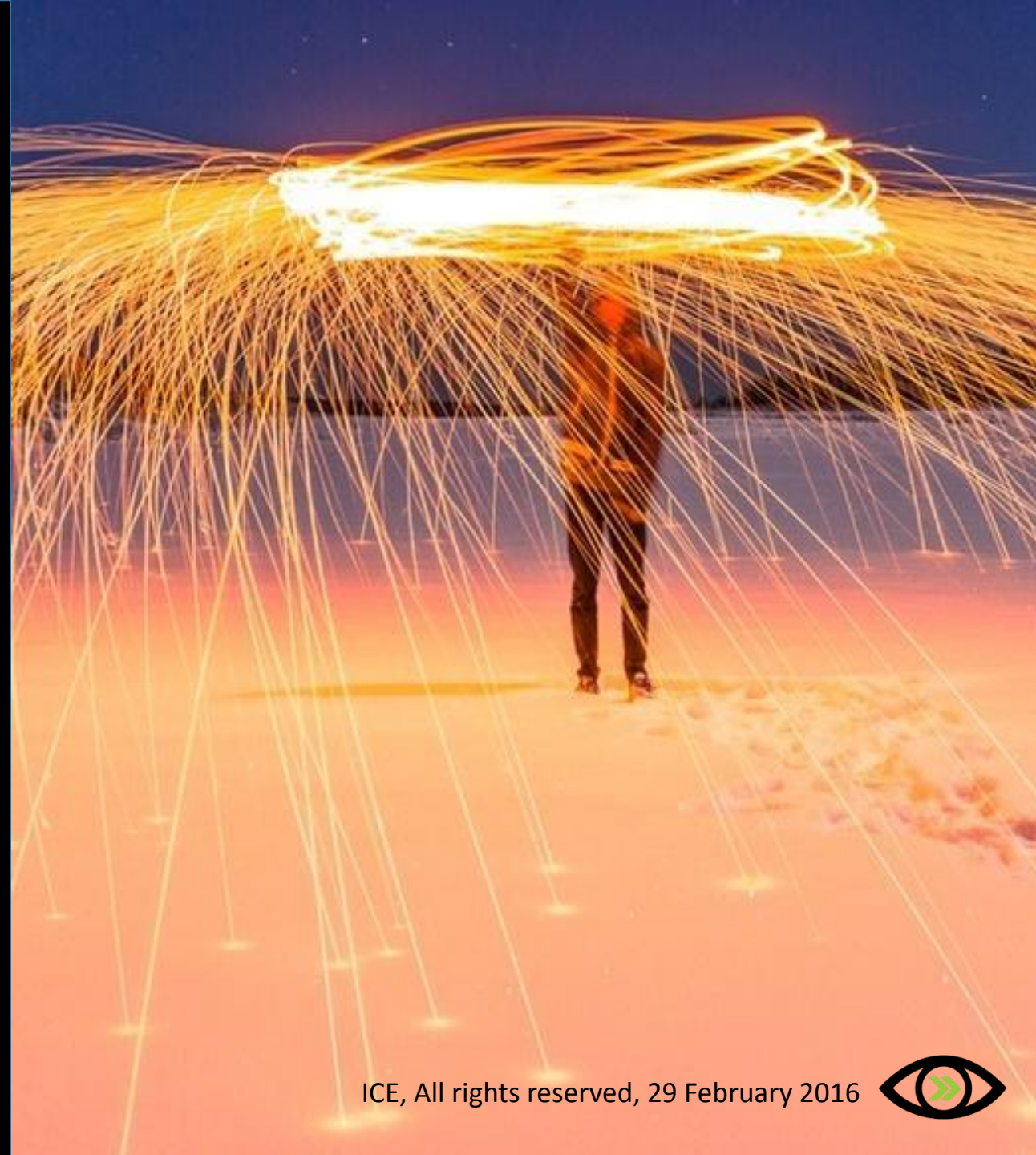
The regulatory framework will have to be kept nimble to deal in a quick and timely manner with the rapid changes of the next two decades.



2030 – 2040: Innovation-led

Self-driving technology will be good enough to run in larger cities and complex conditions.

Cheaper, better technology will make AVs the preferred mode of transport. Businesses will develop around AVs. Innovative models of shared ownership and services will proliferate, and vie with each other to deliver personalized differentiated experiences.



CHALLENGES AND REQUIREMENTS

Having managed to run successfully in the first world, these cars will make their debut in the much more complicated and chaotic third world.

As self-driving expands into the third world, increased protests and resistance to AVs will turn violent. But certain services will be so dramatic in their usefulness that public opinion will tilt strongly towards AVs.

As drivers lose jobs, it will be necessary to put in place schemes to help them take advantage of the new opportunities that AVs offer.

Cities will tend to sprawl, negating many of the promised advantages of AVs. It will take enlightened governments to keep this in check.

The growing power of the AV lobby will also need to be restrained to keep them from completely undermining the fundamentals of town planning.





AV services will need to seem fair and honest (as opposed to Uber today). They will require support from and control by the regulatory framework.

2040 – 2050: Regulation-led

Slowly but steadily, human driving will be banned or outlawed in the city. They could be limited to courses and drives, not unlike the horse riding tracks and race-courses of today.

CHALLENGES AND REQUIREMENTS

Regulation will have the opposite challenge now: to ensure that AVs and their overarching power does not result in monopolistic or exploitative practices.

(This is possible on account of the shortage of private vehicles and the complete dependence on mobility service providers – not unlike the dependence by farmers on seed companies today.)

Precautions will also have to be taken to ensure that vital transport services and networks are not compromised in the event of hacking of the transport management system or if the corporate managing it turns hostile.





**While developing services,
much can be learnt from the
airline business..**

- **Delight experiences**
- **Personalization**
- **Business enablement**

Let us now explore

Three Scenarios Circa 2030



SCENARIO 1: BERKELEY

The first places to see self-driving vehicles in a big way are likely to be university towns. Where the traffic is usually slower and the pace on the street easier. The low density of traffic allows the well behaved AVs to navigate comfortably and efficiently.

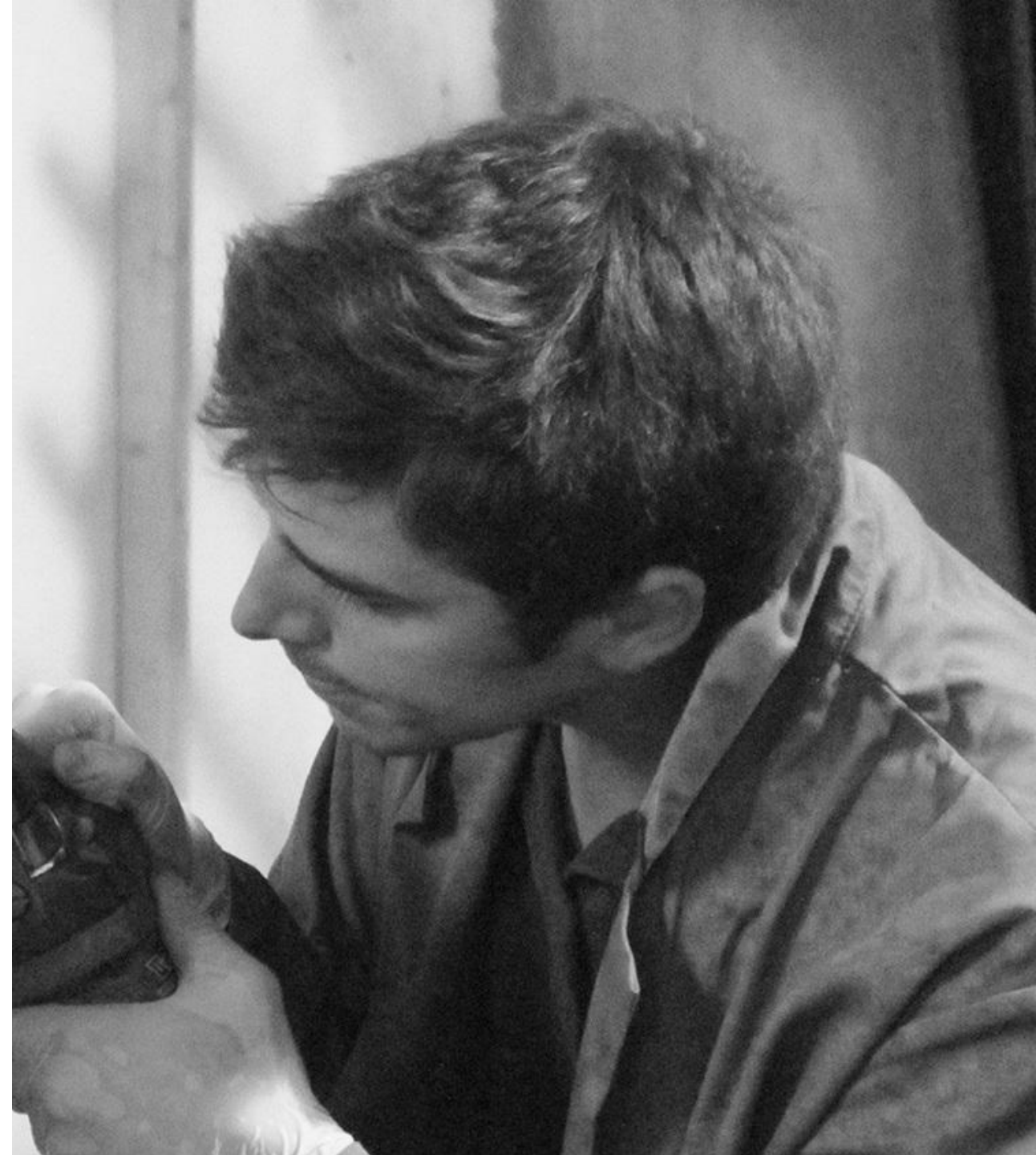
The advantage of being rentable rather than owned, combined with the convenience of allowing interaction makes them extremely popular with students.



Joe Stiegler is an Asst Professor of Linguistics in the New Humanities Department of the college. A single father with a not unduly fast-paced life, he likes to spend time researching on his pet interest—the histories of alternative medical practices.

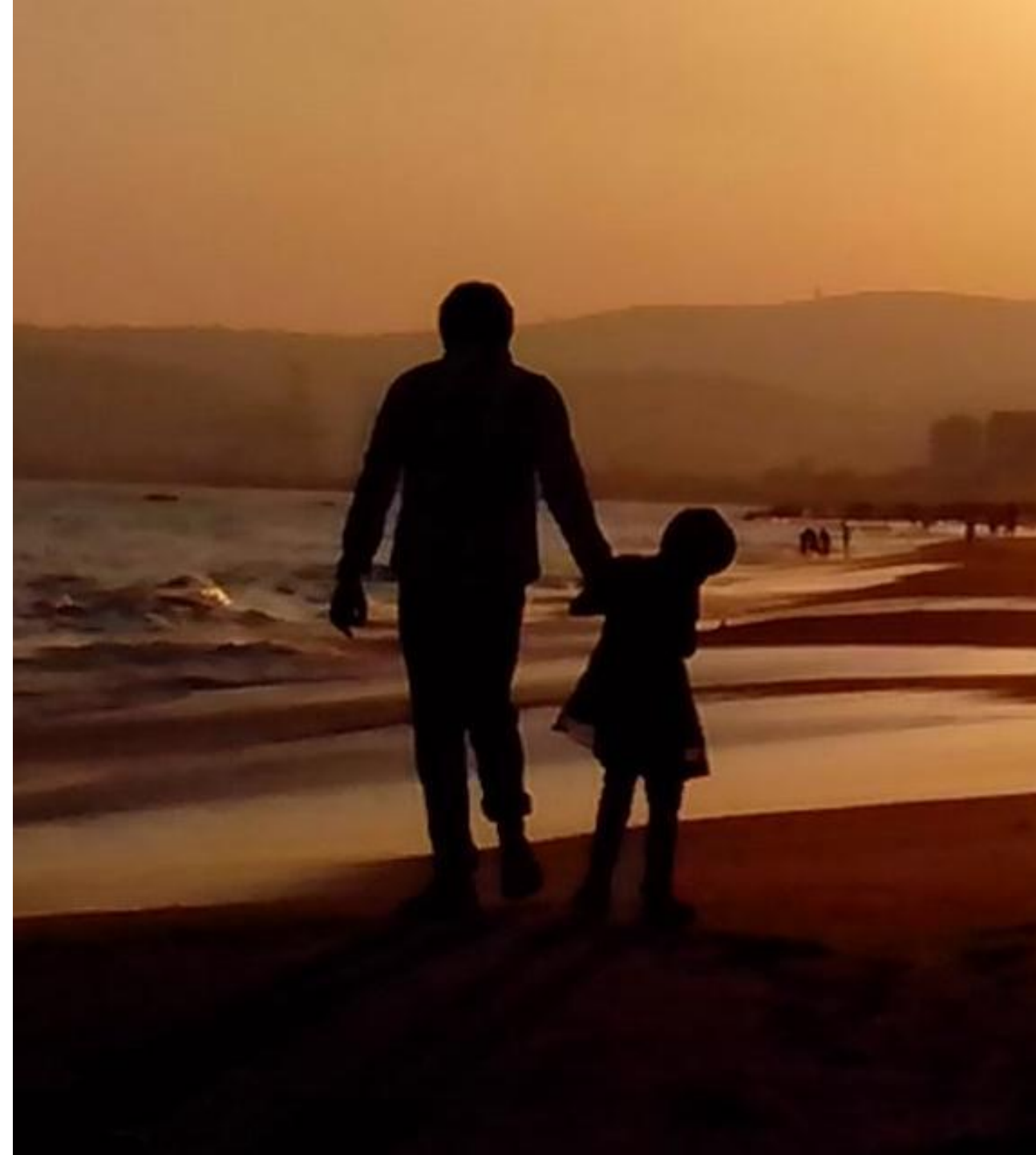
He wakes and fixes a quick breakfast for his daughter before her school bus arrives to pick her up. He then gets ready and a single seater car-pod comes to take him to the department.

His mother is visiting. The Transport App allows him to have her picked up and dropped at his department as he finishes class. They have lunch together and she waits in the library.



After her school day is done, his daughter hops into a car that takes her to a music class. On the way, she gets a refresher of yesterday's class. After music class, when the car picks her up to drop her off to the library in the university, she chooses to play a game designed to teach her little concepts in physics.

At the library, she spends a couple of hours with her grandmother. Then her father joins them and they return home walking, after having dinner at the college canteen.





SCENARIO 2: SAN FRANCISCO

One decade after their introduction, AVs are used more in San Francisco than anywhere else in the world. Silicon Valley innovators have come up with service after service based on self-driving technology. Some do remarkably well, many go bust; but AVs of various sizes and shapes dominate the road, offering an unrivalled range of services.

They are popular with the tech crowd that also has the money to buy more and more property farther and farther away from the city for large houses, leading to unprecedented, unsustainable sprawl.



Anna Kristoff is an engineer with e-Bay and loves how effortless the commute has become in the last decade. She goes to work thrice a week and uses GoWork, a mobile workspace which comes with a cubicle where she can do her calls and work without disturbance from fellow passengers.

She uses a variety of options to return. Once a week she drops into BIGmart and uses their drop service, which has tons of storage to take her shopping home. Sometimes she uses the DinespaceM, where a meal that she orders is delivered during the commute. The car has a dining board on which she can eat comfortably. Occasionally, she uses the XGamer, where she shares a van with three random fellow gamers and they can play Battleship Orion, a multiplayer game.

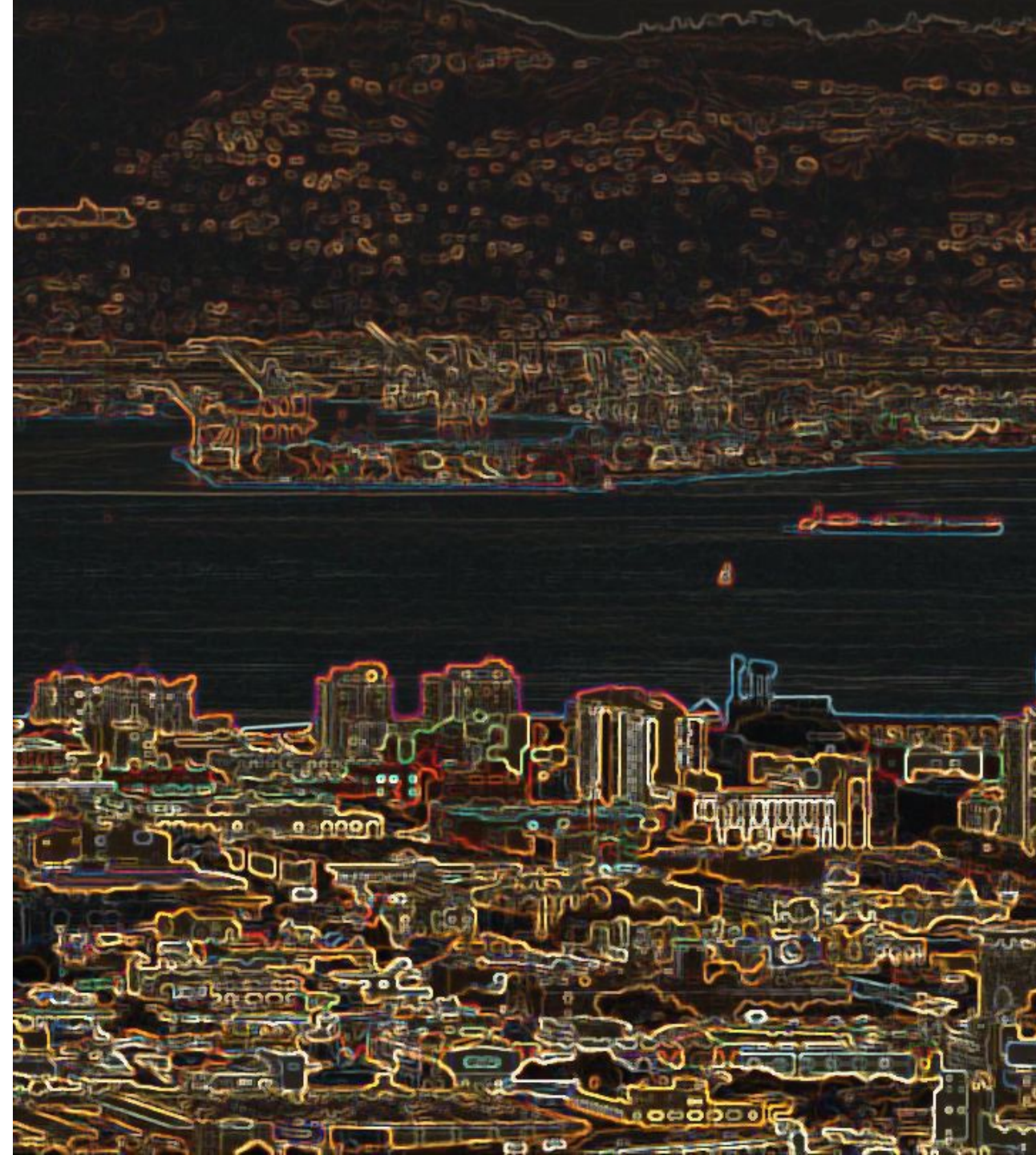


Walks in the city are now passé. The large number of cars in the Bay area has made it completely unwalkable.

With sky rocketing real estate prices in the city and a hundred miles around (a 3 hour commute is normal), her house—like many others—is well over 200 miles outside the city.

The large number of cars plying the roads all the time gives San Francisco the new epithet MobileCity, where everything seems to be moving. Only the rich can afford fixed spaces and services. The middle class exists in a completely shifting world. Tourists are amazed at the range of mobile services.

Her parents can't stand it, they never visit her here.



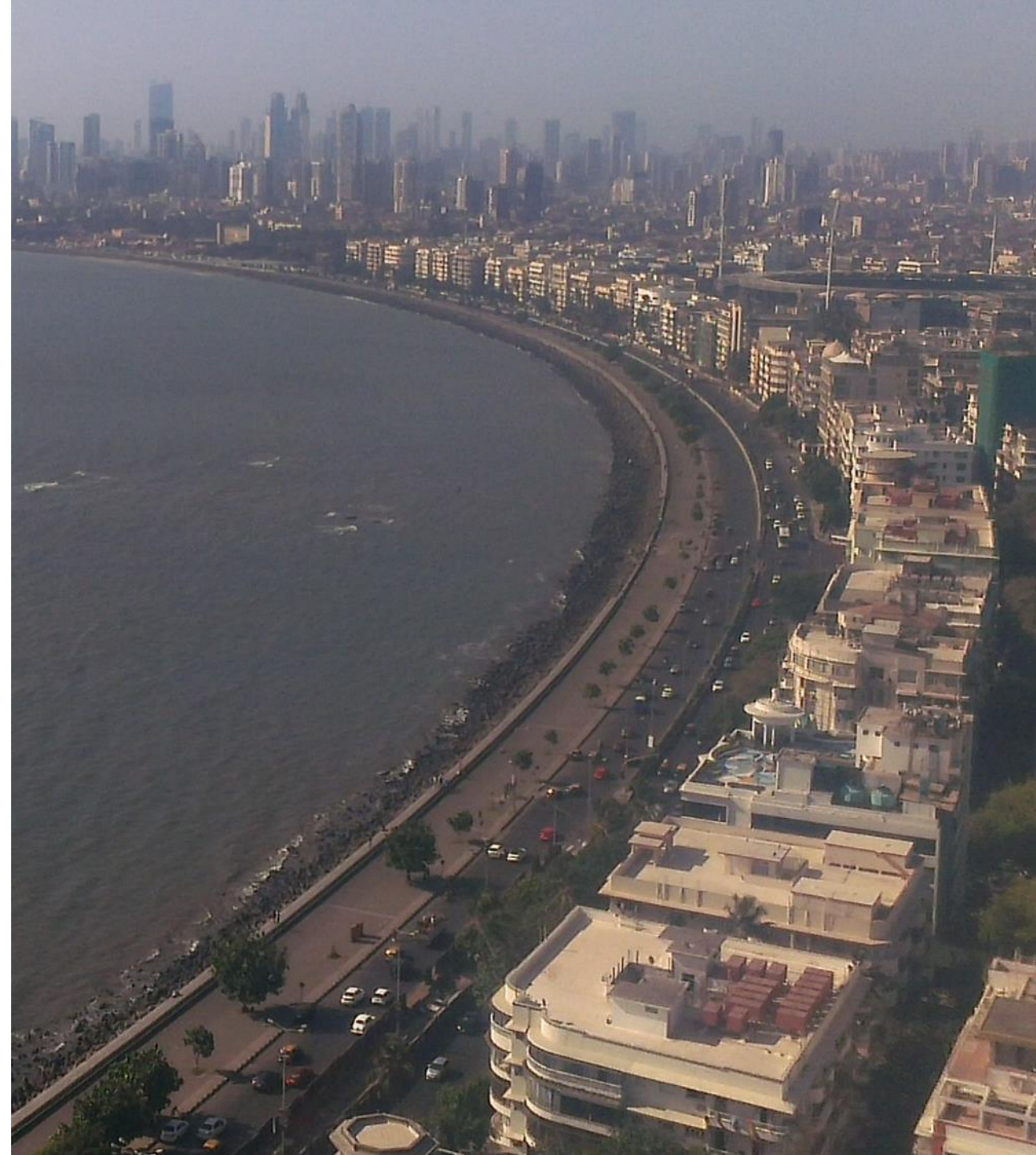
SCENARIO 3: MUMBAI

Self-driving cars have taken over about 90% of the transport sector in developed nations. There are proposals to abolish human driving in several Western European countries. AVs have a significant presence in developing countries too.

The city administration of Mumbai is emulating Singapore in limiting personally owned vehicles to just 10% of the population. There has been substantial investment in large public transit.

AVs serve as feeders to the metro and trains.

Mumbai's shortage of space for housing and business makes AVs a fertile bed for enterprise.





The Dabbawalas of Bombay were known for their reliable and affordable delivery services for over 130 years. In 2015, following a tie-up with e-Kart, a leading logistics provider, their numbers grew rapidly.

When AVs became commonly available in 2025, e-Kart invested in a fleet to change their logistics model entirely. The role of people was limited to the first and last parts only. i.e. Pick up packages from the doorstep and put them in the vehicles OR pick them up from vehicles on the road and deliver to the doorstep.





But when drone technology got reliable enough in 2030, the entire ground staff was laid off. Leading to riots and strikes. These were soon put down, and life went on more automated than before.

This came along with similar layoffs in the logistics sector across the world. The Drone+AV combo also revolutionized sectors like Agriculture and Manufacturing, leading to large scale unemployment throughout the world.



In the midst of all the excitement about AVs,

Don't forget the basics

AVs come with a tendency towards centralization and monopoly.

Several safeguards need to be put in place to ensure this doesn't happen and the benefits of a great traffic system are not undermined.



For starters, the technology will have to be Open Source.



Multiple modes of ownership will need to exist in order to prevent monopolies

State

Non-Mobility Corporates

Locality

Mobility Service Provider

Given how fundamental transport is to the functioning of a city, measures must be taken to prevent a handful of companies from getting too much control of the system. While Mobility companies can own and innovate with about 50% of the transport, ownership of the other half will have to be distributed at several levels.

The state needs to own the large pieces of infrastructure. Large non-mobility companies can own their own fleets, which can be lent out to other users including Mobility providers.

Each locality will need to retain a skeletal fleet of its own that they can fall back on in the event of a breakdown of service.





CITY PLANNING WITH AVs

Walkability: A city is only as livable as it is walkable.

Design for Car Optional rather than Pro-Car or Anti-Car.

Keep the focus on creating environments for humans rather than moving cars.

Beware of Induced Demand: Avoid sprawl which could be created by the ease of transport.

This could easily undercut most of the benefits that could accrue from the new system.





TRANSPORT AS SYSTEM

AVs cannot replace mass rapid transit. Planners need to keep in mind that an ideal system uses an optimal combination of mass transit and shared AVs to deliver a seamless commute experience.

It is just as important to safeguard the public aspect of the transport system and not allow the growth of private transport in changed circumstances.





KEEP EXPERIMENTING

We also need experiments through models, art projects, research, games, etc. to explore possibilities of the city and continuously rethink it, reinvent it.

The experimentation needn't be limited to transport, but also the organization of work, urban planning, leisure, everything that goes to make urban experience.

It is this experimenting and exploration that will throw up ideas and innovations that matter most.



Sources:

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Institute for the Future, The Future of Cities, Information and Inclusion

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