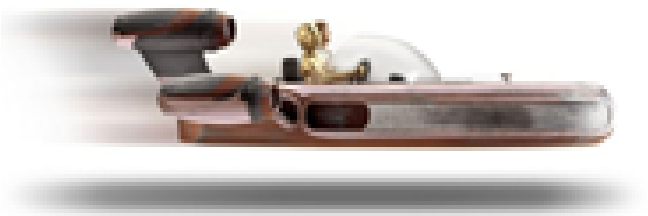


# When Robots Drive

## Will it truly be the end of death and delays on our roads?

Michael L. Sena

February 2016

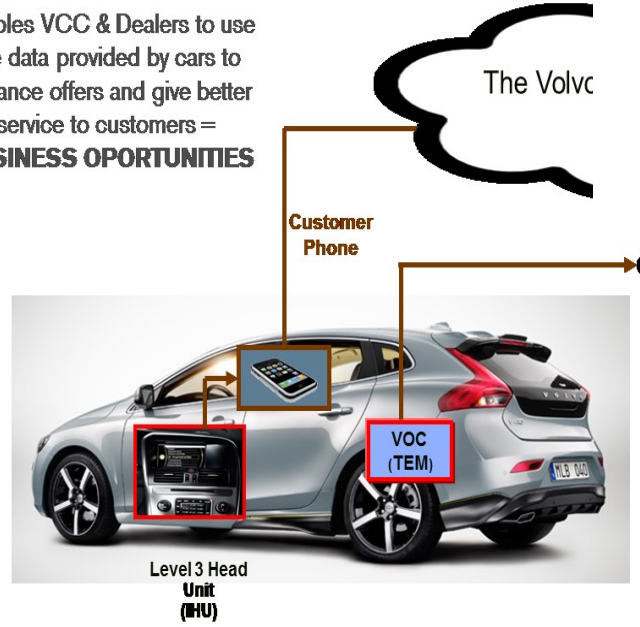
# Beating Traffic

*Time to Get Unstuck*

YOU CAN BEAT THE TRAFFIC CONGESTION PROBLEM. Take back the week or two of time you lose each year being stuck in traffic, and spend that time on something much more useful and productive. This book is intended to get you off the traffic treadmill.

**Michael L. Sena**


Enables VCC & Dealers to use the data provided by cars to enhance offers and give better service to customers = **BUSINESS OPORTUNITIES**




The data will be brought in from Wireless Car to internal VCC central databases. This data is today not available for analysis and dealers.

14 November 2016
Volume 4, Issue 2

# The Dispatcher

*Special interest features covered in each issue:*

- Autonomous and self-driving cars
- Map data and navigation
- Data privacy
- Third party automotive services
- Regulations and Standardisation

*In This Issue:*



*If we really believe that robots make better drivers than humans, why not just let them drive our cars rather than making cars into robots?*

*Trusty robot C-3PO drives Master Luke in the Speeder*

*Telematics Industry Insights by Michael L. Sena*

## Report from Dispatch Central

BMW, AUDI AND MERCEDES-BENZ compete fiercely in all markets for top dog position in the volume luxury segment. In 2015, they had a combined sales of 6 million vehicles, with BMW in the number one spot with 2.3 million, MB in second with 1.9 million and Audi in third with 1.8 million. They are the undisputed leaders of this high-margin segment. Lexus had global sales of 652,000.

It wasn't always this way. In the 1960s, BMW was producing Chevy Corvair look-alikes. In the 80s, Audi had a near-death experience when U.S. owners accused its automatics transmission cars of unintentionally accelerating when the ignition was turned on. In 1998, MB parent, Daimler, in a "What were they thinking?" moment paired the brand with Chrysler. It took nine years for everyone to come to their senses.

During the past few years, slowly, quietly and resolutely the three competitors have forged a partnership. Although they compete, they are pulling in the same direction in a number of important areas, including with HERE and 5GAA. They have shown that they have the financial resources, the will and the capabilities to take on the task of leading the automotive industry into the next generation of mobility.

*1964 Chevrolet Corvair*

*1964 BMW 1800*

## Autonomous Driving News

HUMAN ERROR IS THE CAUSE of 95% of all vehicle-related accidents; robots are not humans; therefore, cars driven by robots will not have accidents caused by human error. According to Merriam-Webster, a robot is "a real or imaginary machine that is controlled by a computer and is often made to look like a human or animal." Even if you believe that robots will not make errors of their own—which I do not—at least those 38% misjudgment errors (lane keeping, static vehicle, preceding car) could be eliminated. We are left with 11% of the 95% caused by unexpected behavior, which is the really difficult nut to crack. That is where human judgment, or lack thereof, determines the vehicle's occupants' fate.

So, let us assume that at some point in the future, all the tests have been made the public have been prepared to accept their new role as passengers. What then? A billion non-robotic cars will be running around the streets of the world and a few million new robotic-controlled cars will be doing their best to avoid them. I, for one, do not believe that is a particularly good approach to the problem of reducing traffic-related fatalities.

Governments and the ve-

# When Robots Drive

- Why are we even thinking about turning over the wheel to a robot or android?
- Will robots ever be able to replace *Homo Sapiens* as a driver in all circumstances?
- What will we *Homo Sapiens* gain and what will we lose?

# Nomenclature

## *Robot*

A machine capable of carrying out a complex series of actions automatically, especially one programmable by a computer.

The term was coined in K. Čapek's play R.U.R. Rossum's Universal Robots (1920).



## *Android*

A mobile robot usually with a human form
<*sci-fi androids*>

Late Greek *androeidēs* manlike (as in person, not necessarily male)

First Known Use: circa 1736

Alicia Vikander as Eva in *Ex Machina*

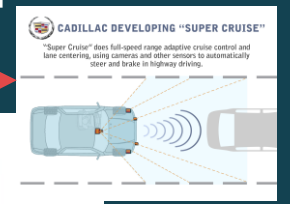
# Nomenclature

***Table 1 - Summary of levels of driving automation***

SAE's levels of driving automation are descriptive and informative, rather than normative, and technical rather than legal. Elements indicate minimum rather than maximum capabilities for each level. In this table, "system" refers to the driving automation system or Automated Driving System (ADS), as appropriate.

| Level | Name | Narrative definition | DDT | | DDT fallback | ODD |
|---|---|---|---|---|---|---|
| | | | *Sustained lateral and longitudinal vehicle motion control* | *OEDR* | | |
| ***Driver* performs part or all of the *DDT*** | | | | | | |
| 0 | **No Driving Automation** | The performance by the *driver* of the entire *DDT*, even when enhanced by *active safety systems*. | *Driver* | *Driver* | *Driver* | n/a |
| 1 | **Driver Assistance** | The *sustained* and *ODD*-specific execution by a *driving automation system* of either the *lateral* or the *longitudinal vehicle motion control* subtask of the DDT (but not both simultaneously) with the expectation that the *driver* performs the remainder of the *DDT*. | *Driver* and *System* | *Driver* | *Driver* | Limited |
| 2 | **Partial Driving Automation** | The *sustained* and *ODD*-specific execution by a *driving automation system* of both the *lateral* and *longitudinal vehicle motion control* subtasks of the *DDT* with the expectation that the *driver* completes the *OEDR* subtask and *supervises* the *driving automation system*. | ***System*** | *Driver* | *Driver* | Limited |
| ***ADS* ("*System*") performs the entire *DDT* (while engaged)** | | | *System* | ***System*** | *Fallback-ready user (becomes the driver during fallback)* | Limited |
| 3 | **Conditional Driving Automation** | The *sustained* and *ODD*-specific performance by an *ADS* of the entire DDT with the expectation that the *DDT fallback-ready user* is *receptive* to *ADS*-issued *requests to intervene*, as well as to *DDT performance-relevant system failures* in other *vehicle* systems, and will respond appropriately. | | | | |
| 4 | **High Driving Automation** | The *sustained* and *ODD*-specific performance by an *ADS* of the entire *DDT* and *DDT fallback* without any expectation that a *user* will respond to a *request to intervene*. | *System* | *System* | ***System*** | Limited |
| 5 | **Full Driving Automation** | The *sustained* and unconditional (i.e., not *ODD*-specific) performance by an *ADS* of the entire *DDT* and *DDT fallback* without any expectation that a *user* will respond to a *request to intervene*. | *System* | *System* | *System* | **Unlimited** |

- Levels of driving automation (SAE Standard J3016, SAE International September 2016 – Superseding J3016, SAI I 2014). Adopted in EU by C-ITS.
- ODD – Operational Design Domain - the critical definition of where (such as what roadway types, roadway speeds, etc.) and when (under what conditions, such as day/night, normal or work zone, etc.) an HAV is designed to operate.
- DDT – Dynamic Driving Task
- OEDR – Object and Event Detection Response
- ADS – Automated Driving System

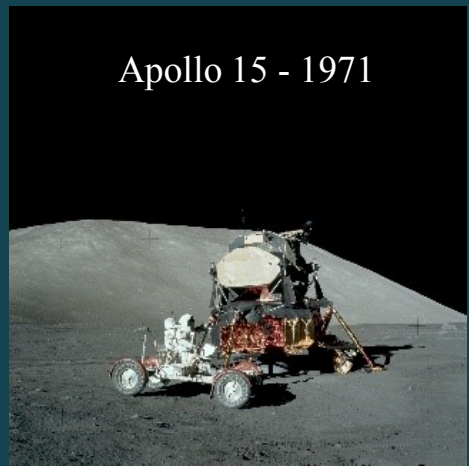




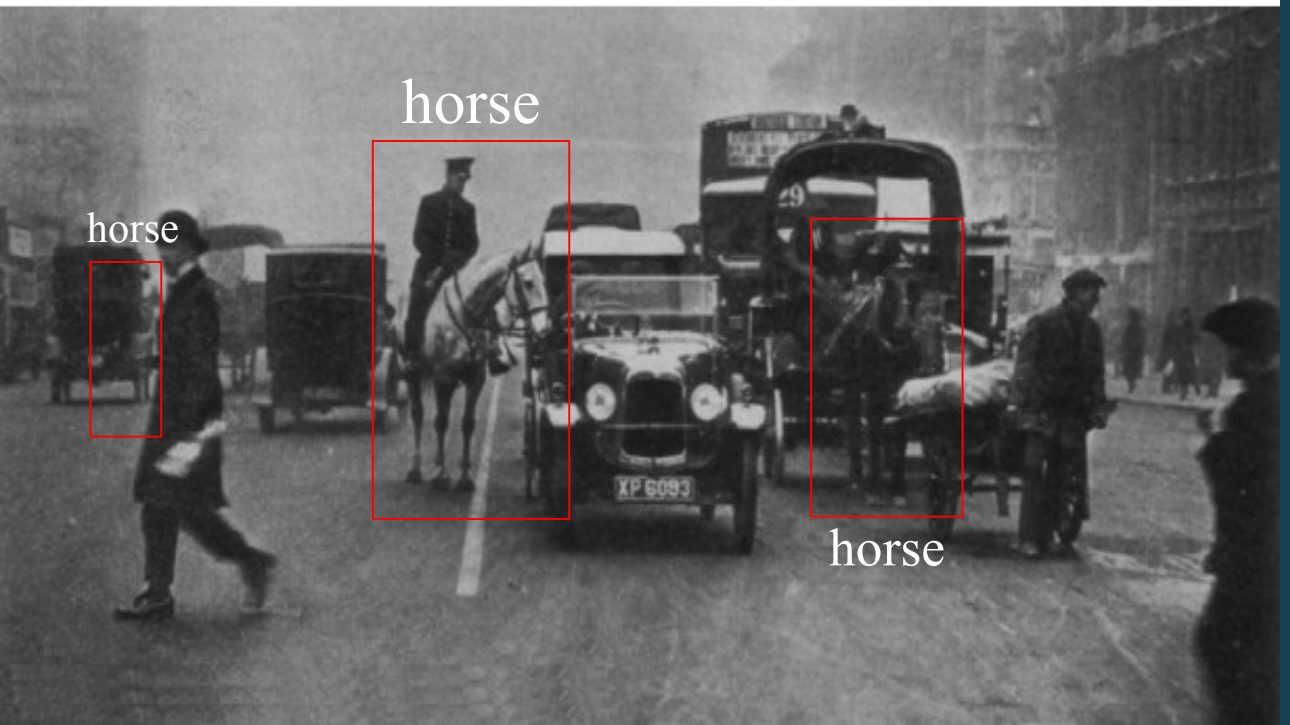
# *Point #1*

## Where we are today has a context; we should not forget that fact.

| Homo Sapiens evolves | We move out of Africa and populate the planet | We begin to farm the land | We build cities and roads | We invent the automobile | We learn how to fly | We drive on the moon |
|---|---|---|---|---|---|---|
| **200,000 years ago** | **70,000 years ago** | **12,000 years ago** | **5,000 - 2,000 years ago** | **120 years ago** | **104 years ago** | **46 years ago** |



*The **private automobile** was widely hailed as an environmental savior. In the span of two decades after it was introduced, motor cars eradicated a major urban planning nightmare that had strained governments to the breaking point, vexed the media, tormented the citizenry, and brought society to the brink of despair: mountains of **horse manure** and seas of **horse urine** and **dead horse carcasses** on the streets.*



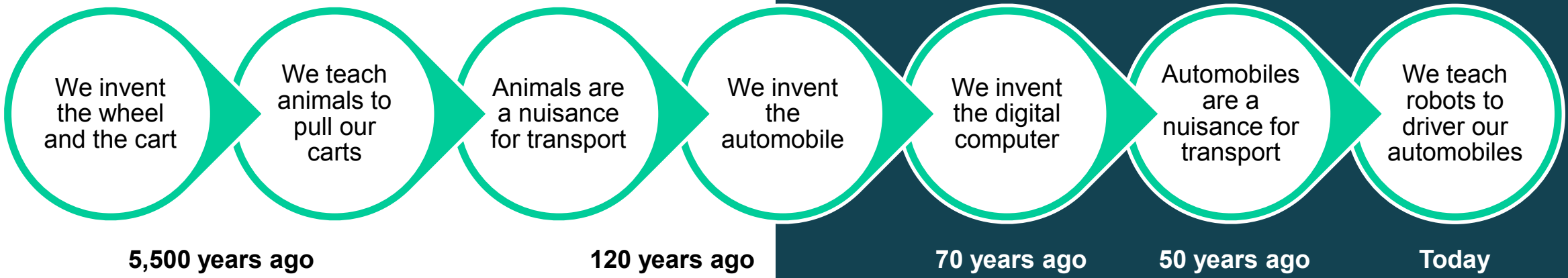

# Framing the Problem of Motorized Vehicles in 2017

- Personal transport is a more convenient and comfortable way to travel compared to the alternatives.
- The more successful we are, the more personal transport we desire.
- The more personal transport we have, the more land space we need to move.
- Land space costs money, so we need to spend more on land space for moving.
- Before we can add the space, too many personal transports make the space we have so congested that we feel it is a nuisance to move.
- Then there is all the care that the personal transports need to keep moving. Sometimes they stop in the most inconvenient places.
- …and lastly, sometimes—all too often—the personal transports crashed and people are killed or injured.

# *So here we are…in 2017*

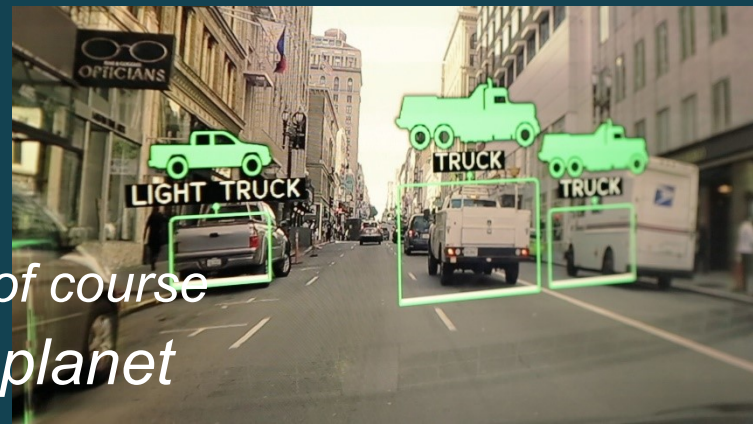
# *Point #2*

## As long as we are evolving, we will find problems to solve.




*"Sapiens do not become satisfied by leading a peaceful and prosperous existence. Rather, we become satisfied when reality matches our expectations. The bad news is that as conditions improve, expectations balloon."*
*Yuval Noah Harari, Homo Deus: A Brief History of Tomorrow*

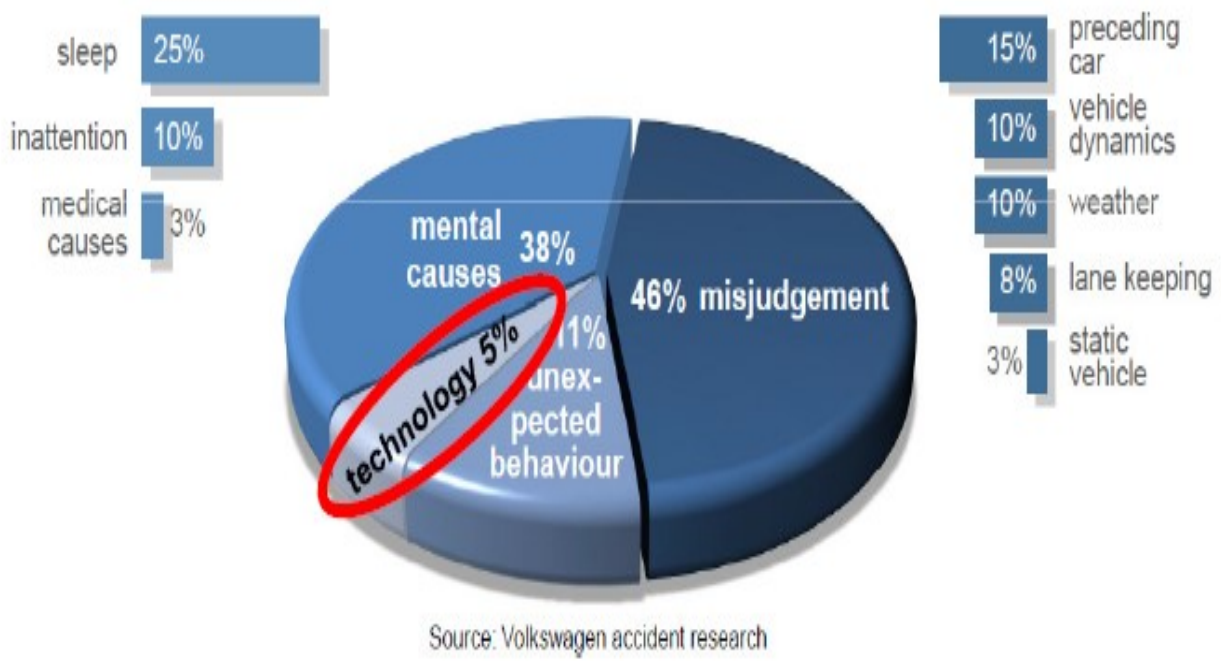
*Save lives*
*Save time*
*Save the planet*
*…and save money, of course*
*Move to another planet*



# Traffic Accidents
# Why do they happen

## *Mechanical*

*Vehicle technology: 5%*




## *Non-mechanical*

*Driver related: 85%*

*Weather: 10%*

*<u>Deductive Reasoning</u>*

*Human error is responsible for 85% of vehicle accidents;*

*Robots are not humans; therefore,*

*If robots drive vehicles there will be 85% fewer accidents. Right?*

*…If only we could find a way of controlling the weather, we could eliminate another 10%. Get on that Elon.*

Stuff we should be able to fix

# Traffic Congestion
# Why does it happen

## *Recurring*

*Also known as 'rush hour traffic', occurs when the volume of traffic exceeds the road capacity.*

*Many factors feed into recurring congestion including economic and population growth, synchronized work and school schedules, the shift of population to lower density areas of the city, inefficient transit systems, and the relocation of businesses from downtown areas to out-lying areas (sprawl).*

## *Non-recurring*

*Unexpected occurrences due to accidents, construction or emergencies:*

- *Roadway debris*
- *Crashes*
- *Disabled vehicles*
- *Roadway construction*
- *Law enforcement activities*
- *Inclement weather*
- *Heavy merging traffic*
- *Unplanned special events*

# *Point #3*

So what do driverless vehicles have to do with eliminating vehicular accidents and traffic congestion?

**DARPA** – Defense Advanced Research Projects Agency

Blame it on the (U.S.) military. The defense industry is pushing for robotic vehicles to keep military personnel from being killed in battle.

If you want to do something, you can find all kinds of reasons to justify it.


DARPA Challenge One and Two

13-12 years ago

DARPA Urban Challenge

10 years ago

Google hires winners

If Google can do it, we can too

# Why driverless vehicles seem to be inevitable

*Save Lives: Forces are working for zero traffic deaths. 85% of accidents caused by human error. We have reached the limit with passive safety; the next step is to take over the driving.*

*Save Time: People want to use social media all the time, don't they, even when they have to be in their cars?*

*Congestion costs private and commercial motorists plenty.*

*Save the Planet: If cars don't crash, they can be much lighter, saving fuel and reducing emissions*

*(Besides the fact that the military and automotive suppliers want to build them)*

## *Impact of Traffic Congestion on Trucking Industry*

*According to research by the American Transportation Research Institute (ATRI), congestion added over $49.6 billion in operational costs to the U.S. trucking industry in 2014.*

*Delays from congestion totaled more than 728 million hours of lost productivity, which equates to 264,500 commercial truck drivers sitting idle for a working year.*

# Can robots really make a difference with delays?

## *Major causes of traffic congestion*

- *Highways are operating at certain times at over demand with under capacity*
- *Accidents cause road blockage*
- *Traffic signals are out of sync*
- *Road work and work-related lane closures*
- *Weather-related problems*
- *Too many trucks on the road*
- *Double parking*
- *Lane reductions*
- *Too many pedestrians crossing not permitting cars to turn*
- *Overdevelopment in areas where the mass transit system is already overcrowded and the road system is inadequate*

## *How robots driving our cars could help to solve these problems*

- *Reduce safe distance between vehicles with convoying increasing capacity*
- ***Connected**, driverless cars have fewer accidents*
- *Real-time feedback from vehicles spots malfunctions quickly*
- *Real-time sensor feedback provides immediate local weather conditions.*
- *Autonomous vehicle technology enables platooning and convoying allowing trucks to be more tightly spaced but still allowing for cars to exit highways.*

# Can robots really make a difference with deaths?

## *Major causes of accidents*

- *Falling asleep at the wheel*
- *Not keeping your eyes on the road ahead*
- *Taking medicines or drugs that affect driving*
- *Following too closely the car ahead*
- *Changing lane at the wrong time*
- *Over- or understeering*
- *Disobeying rules of the road*
- *Parking in a dangerous location*
- *Driving in dangerous weather conditions*
- *<u>The vehicle experiences a sudden mechanical problem that causes the driver to lose control and crash</u>*

## *How robots driving our cars could help to solve these problems*

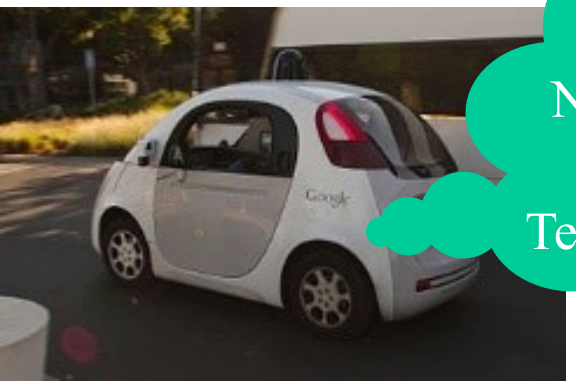
- *Robots can be programmed to maintain constant attention to the driving task, obey all rules of the road and never start a journey when weather conditions do not permit it. They don't fall asleep unless their batteries wear down and they don't take drugs or drink alcohol.*

The Three Laws of Robotics are a set of rules devised by the science fiction author Isaac Asimov

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

# Can robots really make a difference with saving time?

Today, around 2.4 billion people in the world spend an average of 20 minutes on line every day. That is 800 million hours. That same amount of time is spent driving cars each day: 800 million cars with an average driving time per day of one hour. ***Imagine*** if they could be on line instead of driving and still get to where the car would take them.



Yes, imagine, they say..mouth watering.

Nintendo Apple Baidu Google Microsoft Tencent Amazon Alibaba Facebook

*Volvo Cars – Drive Me – "In 2017 Volvo will recruit people living in Gothenburg, Sweden to take part in Drive Me, its research project on autonomous driving. It takes place on public roads and will involve local drivers integrating Volvo's autonomous driving technology into their daily lives. Volvo Cars has an ambition to validate its technology, enabling drivers to switch from a supervised mode to an unsupervised mode in the future….*

*…where it is safe to sit back, relax or work instead of keeping your eyes on the road."*

Are they up to the task right now? No, not today and not for some time to come. Why?

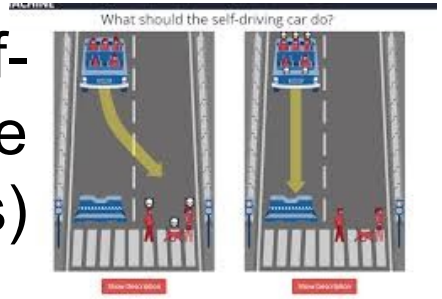
- *Technology needs more testing and development*
- *Better map data is needed – Driverless cars work somewhere; they need to work everywhere*
- *Laws are not ready – Countries and U.S. states have allowed testing; basic rules of the road need to be changed.*
- *Humans are not ready – They either trust too much or too little.*
- *Infrastructure is not ready – V2V, V2I and over-the-air updates need to work flawlessly. Today, they don't.*


Joshua Brown counted on Tesla's systems working flawlessly. They didn't.

He trusted too much.

# *Once you go there, it will be difficult to come back if things don't work out as expected*

- Economic – Driverless trucks, buses and taxis replace people.
- Social – ADAS in luxury vehicles are already protecting more wealthy people than poor people; driverless vehicles could add another layer of stratification.
- Political – Wealthy nations will have an advantage.
- Ethical - When self-driving cars kill, it's the code (and the coders) that will be put on trial.




*Self-driving trucks could save $67 billion annually in US. What would the 1.3 million truck drivers do when they lose their jobs? They earn a mean income of $42,000. That's $67 billion dollars in income – about 0.3% of the US GDP.*

*If trucks drive themselves, that's a lot of money saved. It's also a lot of money that won't be spent buying cars and houses and paying taxes.*

*There are already fewer jobs building vehicles because of all the automation that is used in factories. Who is pocketing all these savings?*

Humans are intelligent and conscious—in varying degrees. Robots have intelligence, but are not conscious.

But one day, robots will drive our cars. Count on it.

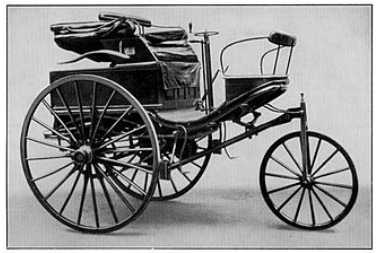
## *The Winners*

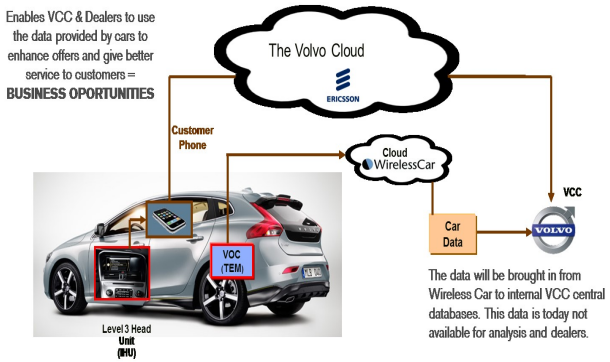
- *Taxi fleet operators*
- *Truck fleet operators*
- *Bus fleet operators*
- *Artificial intelligence software developers*
- *Sensor hardware and software developers*
- *Substitutes for the time we spent driving*

## *The Losers*

- *Taxi drivers*
- *Truck drivers*
- *Automotive insurance companies***
- *Car driving enthusiasts*
- *Car dealers and repair workshops*

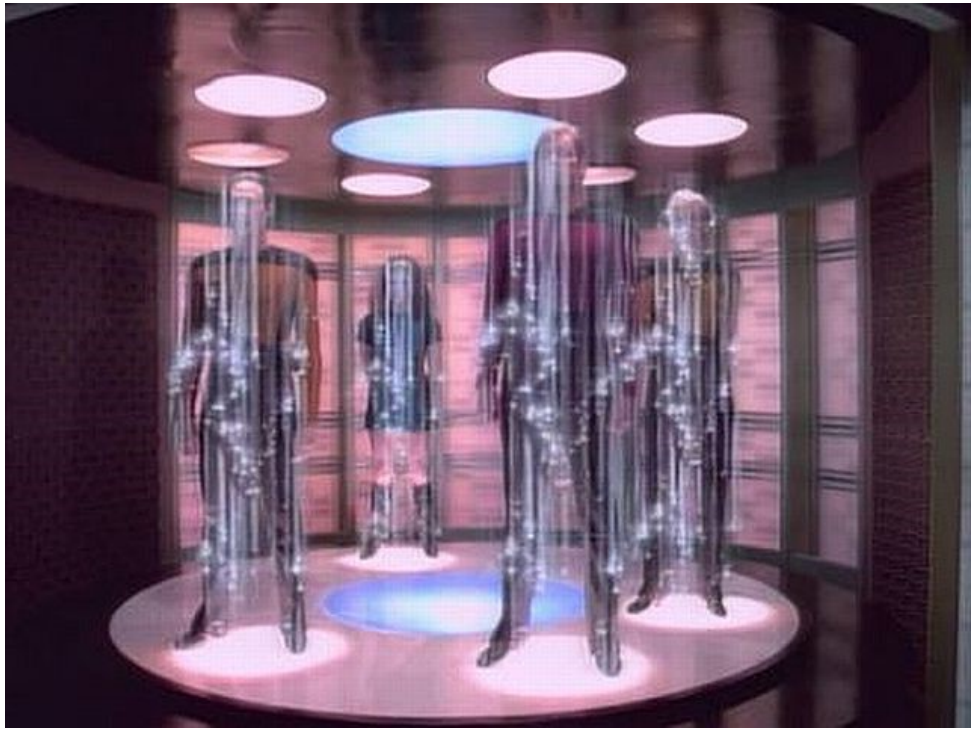

**The motor insurance business may shrink by 60% by 2040 due to driverless car technology, according to a KPMG study. (*The Economist* September 24th 2016)






Luke Skywalker's Landspeeder

# *Parting Point*



**"Beam me up, Scotty."**

When it is accomplished, we will go on to the next challenge. How about a Transporter?

**One day we**
**may not**
**need vehicles**
**at all.**

Questions?

# When Robots Drive

## Will it truly be the end of death and delays on our roads?

Michael L. Sena

February 2016