Future of Mobility in the Age of Industry 4.0
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Urban Mobility in the age of Exponentialism: transforming mobility core from transport mode to solutions model
Context

**Green Mobility**
Accelerating the Adoption of Electric Vehicles in particular and promoting green transport in general.

**Connected and Autonomous Vehicles**
Will they Deliver Road Safety and how will they impact on jobs and mobility in general?

**Drone Technology**
Balancing the Regulatory Imperatives with Economic Opportunities and a promise of over 40,000 jobs.

**Shared Mobility and Mobility-as-a-Services**
Is this our hope for inclusive and affordable mobility for all?
The Revolutions

1\textsuperscript{st} Industrial Revolution (1760 to c. 1840) – the humble Steam

2\textsuperscript{nd} industrial revolution (between 1870 and 1914) – Centralised electricity; telephone and television, Internal combustion Engine

The Age of Synergy- the inventions and innovations were engineering & science-based
The Revolutions

3rd Industrial Revolution:

• Digital Revolution - mechanical and analogue electronic technology to digital electronics 1950s to 1970s

• adoption and proliferation of digital computers and digital record keeping

Industry 4.0:

• Industrial internet of things technology trend.
What is the common thread from 1st to 3rd Revolutions?
Technology development

Modern socio-economic system from the 1\textsuperscript{st} to 3\textsuperscript{rd} Industrial Revolutions have been based on 3 foundations –

1. Energy,
2. Communication and
3. Transport
6Ds of Disruptive Technologies

1. “Digitalization”
2. “Deception” –
3. “Disruption” –
4. “Demonetization” –
5. “Dematerialization” –
6. “Democratization” –

Source: Peter H. Diamandis and scientist Steve Kotler - Abundance - getAbstract © 2015
Revolution Foretold - Exponential Technology

1. **Moore’s Law** - In 1965, Intel’s founder, Gordon Moore, predicted that **processing power of computer chip / microprocessors** effectively doubles every **18 months becoming more powerful, accessible and cheaper.**

2. **Metcalfe’s Law** - Networking pioneer” Robert Metcalfe 1983, states that the **value of a network** will increase with the **square of the number** of its participants & that networks become more valuable the more people use them.

Where are we? – The Automobile?

• Fully autonomous self-driving car was in Paris in November 1994 held the finale of a European wide car manufacturers collaborative program to develop ADAS and autonomous systems.

• 1997 US hosted its 1st demonstration of autonomous platooning cars, Buick LeSabres operating on a closed-off lane of a freeway outside San Diego.

• 2004 US DARPA hosted its first driverless car competition - the possibility of self-driving cars ever becoming a reality looked bleak.

• 15 teams qualified for the final race after just three hours into the 10-hour competition, only four cars remained operational.

• Carnegie Mellon, Intel, Boeing and others were behind the Red Team’s racing vehicle called the “Sandstorm.”

• Although the vehicle did not finish the 150 mile course, it did travel the furthest distance at 7.4 miles.
• Next Grand Challenge in 2005, five teams’ vehicles successfully finished the 132 miles course.

• Since then, tech companies and automobile companies alike have been chasing the dream of bringing self-driving cars to market, and they have made a lot of progress.

• Stanford’s vehicle dubbed “Stanley” took first place in the 2005 Grand Challenge, finishing the 132 mile race in six hours and 54 minutes.

• Stanford’s racing team worked alongside Volkswagen Electronics Research Laboratory to create the vehicle, which featured five LIDAR lasers, a video camera, and a GPS system.

• In 2007, Carnegie Mellon worked with General Motors and Caterpillar to take first place.
• Google launched its self-driving car project in 2009 and the technology became a little more seamless.

• December, 2015, Google unveiled its first prototype of a car designed from the ground up as a fully autonomous vehicle.
After Driverless Cars, Singapore To Test Self-Driving Buses All aboard!

NTU and the Land Transport Authority of Singapore are collaborating on transport research projects into autonomous vehicles and rail network enhancement.

Disruption in the personal transportation industry

As time passes, transportation models are both building on one another and rapidly iterating.

Driver-less ride sharing

Driver-less car

Single person pods

PickupPal

Zimride

Tickengo

Instacar

SideCar

Uber Hailo

Relay Rules Zipcar

Getaround

Rent

Share

Future frontiers

Own

Time

Own

Vehicle

Smartphone penetration

Mobile GPS sophistication and cost performance
We cannot grasp the full potential of The 4IR until we explore the interactions across technologies IoET.
The Future of Mobility

**Insider view**

The industry will **evolve naturally and incrementally** toward a future mobility system that **retains its roots** in what exists today.

The key players, major assets, and overall structure of the **current ecosystem can remain intact** while change progresses in an **orderly, linear fashion**.

The incumbent mindset appears **dually focused** on sustaining the current model while **testing change in small ways**.

**Disrupter view**

A **whole new age** is dawning featuring **fully autonomous** cars accessible on demand.

Before long, a **tipping point** will occur, after which the **momentum of change will become unstoppable**.

**New entrants**, notably Google, Uber, and Apple, **are catalysts** for transformation.

Unlike the stakeholders in today’s system, they **do not have vested stakes** to protect.

Source: Adapted from Deloitte analysis, based on publicly available information and company websites /DUP-1374_Future-of-mobility_vFINAL_4.15.16.pdf
It is about Smart Transportation ......

Urban Planning

System Design, Management & Operation

Outcomes & Impacts

Smart City Planning
- Integrated development & spatial planning
- Transportation & traffic strategy
- Environment & public safety

Technologies & Urban Infrastructure
- Automation
- Real-time information
- Advanced control methods

Urban Multimodal Systems for High-Density Megacities

Smart Sensing and Computing
- Stationary & mobile data
- Urban informatics & data analytics

Smart Travel Behavior
- Data driven (Short-term)
- Infrastructure (Medium-term)
- Technology driven (long-term)

Smart Performance
- Efficient
- Resilient and reliable
- Safe
- Green and sustainable
Smart Future Mobility is about ....

- Enabling technologies and urban infrastructure to enhance sustainability, accessibility, mobility, and wellbeing?
- How would autonomous vehicles modify fundamental traffic flow properties, and impact infrastructure design and urban form?
- How would electric vehicles interface with the smart grid in terms of energy distribution and storage?
The Issues to address now - Smart Sensing

- Does our South African Cities have sensing strategies for collecting stationary and mobile sources of multi-modal traffic data and how are these data integrated and interpreted?

- What are the computing strategies for centralized and distributed data transmission, processing, interfacing, analysis, sharing, dissemination, and storage, in the context of big data arena?

- Or we will be out-gunned like before?

Source: CloundT Project [http://clout-project.eu/](http://clout-project.eu/)
The Issues to address now - Smart Performance

- Better mobility and less congestion
- V2V and V2I technologies
- Real-time travel information
- Smart vehicles
- Uncertainties and disruptive conditions
- Autonomous self-driving vehicle
- Journey Time Indicator

- How to develop a cost-effective but highly resilient multi-modal transportation system in response to increasingly frequent and serious natural and manmade disruptions?

- How smart developments help to maintain safe, healthy, rapid, reliable, comfortable, convenient, affordable, equitable, and environmentally compatible mobility of mankind?
Mobility in the age of Exponentialism is not about discussion and planning in transport mode –

This is about developing a new business and collaborative platform of core mobility solutions
The 4IR - explore the interactions across technologies IoET.

- In 1981, 1 gigabyte of storage cost half a million dollars. Today, it's 25 million times cheaper at 2 cents per gigabyte.
- In 1971, Intel installed 1st computer chip, the Intel 4004. It had 2,300 transistors on at $1 each.
- Today Intel no longer tell it customers how many transistors are on their chips, but the recent Core i7 had 14.4 billion transistors at less than a millionth of a penny each.
  - This represents a 330 billion-fold increase in price performance in 45 years.
- A Smartphone today has more computational than all the governments on the planet had just 3 decades ago.
  - But that doesn't compare to what's coming next in quantum computing.
- Google recently unveiled Bristlecone. This new quantum computer chip has 72 qubits. By 300 qubits, it can perform more calculations than there are atoms in the known universe.
- With the Internet of Things and a proliferation of sensors, by 2020 we'll have 50 billion connected devices with a trillion sensors in the world. By 2030, we’ll see 500 billion connected devices with 100 trillion sensors.
  - Most of these will be about Mobility.
Disruptive Technologies S-Curve
THANK YOU

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