

# Historical Milestones Enabling Driverless Vehicles

A Survey of Historical Innovation Milestones Driving Next-Generation Transportation and their Accelerating Pace of Occurrence

Linear Scale

Log Scale



News



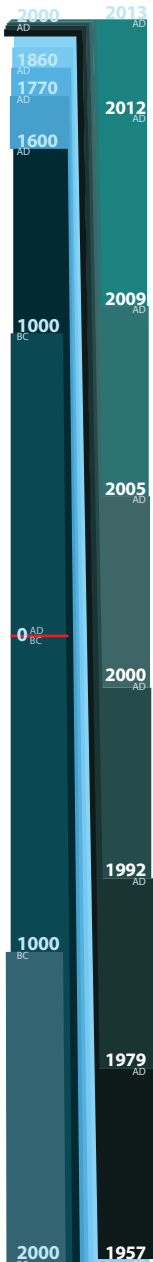
Mobility



Technology



Society



Log Scale

AIM

e<sup>+</sup> log-based timescale

Autonomy Innovation Metric

2013 29.0

2012 9.0

2009 8.5

2005 6.5

2000 3.6

1992 3.6

1979 1.8

1957 1.8

Digital Era

**News**

- 2000: 70m iPads Sold, 3rd Gen iPads Introduced
- 2000: Google Driverless Car Licensed in Nevada
- 2000: Apple CEO Steve Jobs Dies
- 2000: zipcar Initial Public Offering
- 2000: SPRIDE Getaround, RelayRides, mint Venture Capital Investment in Peer-to-Peer Car-Sharing
- 2000: 500m iPhone Apps D/d, 10k iPhone Apps Created, 10m iPhones Sold, 10b iTunes Songs D/d, 150m iPods Sold
- 2000: >2b Computers!
- 2000: zimride
- 2000: 5b iTunes Songs D/d, 65m iPods Sold
- 2000: i,ROBOT
- 2000: >1b Computers!
- 2000: MINORITY REPORT
- 2000: >200m Internet Users
- 2000: OnStar
- 2000: 4m Internet Users
- 1992: DEMOLITION MAN, TOTAL RECALL, Batman, KNIGHT RIDER, Macintosh
- 1992: MADD
- 1992: Apple, Microsoft, EXON, intel, HYUNDAI
- 1992: Star Wars, R2-D2, Love Bug, 2001: A Space Odyssey
- 1992: CAT Catalytic Converter
- 1992: Turbocharger

**Mobility**

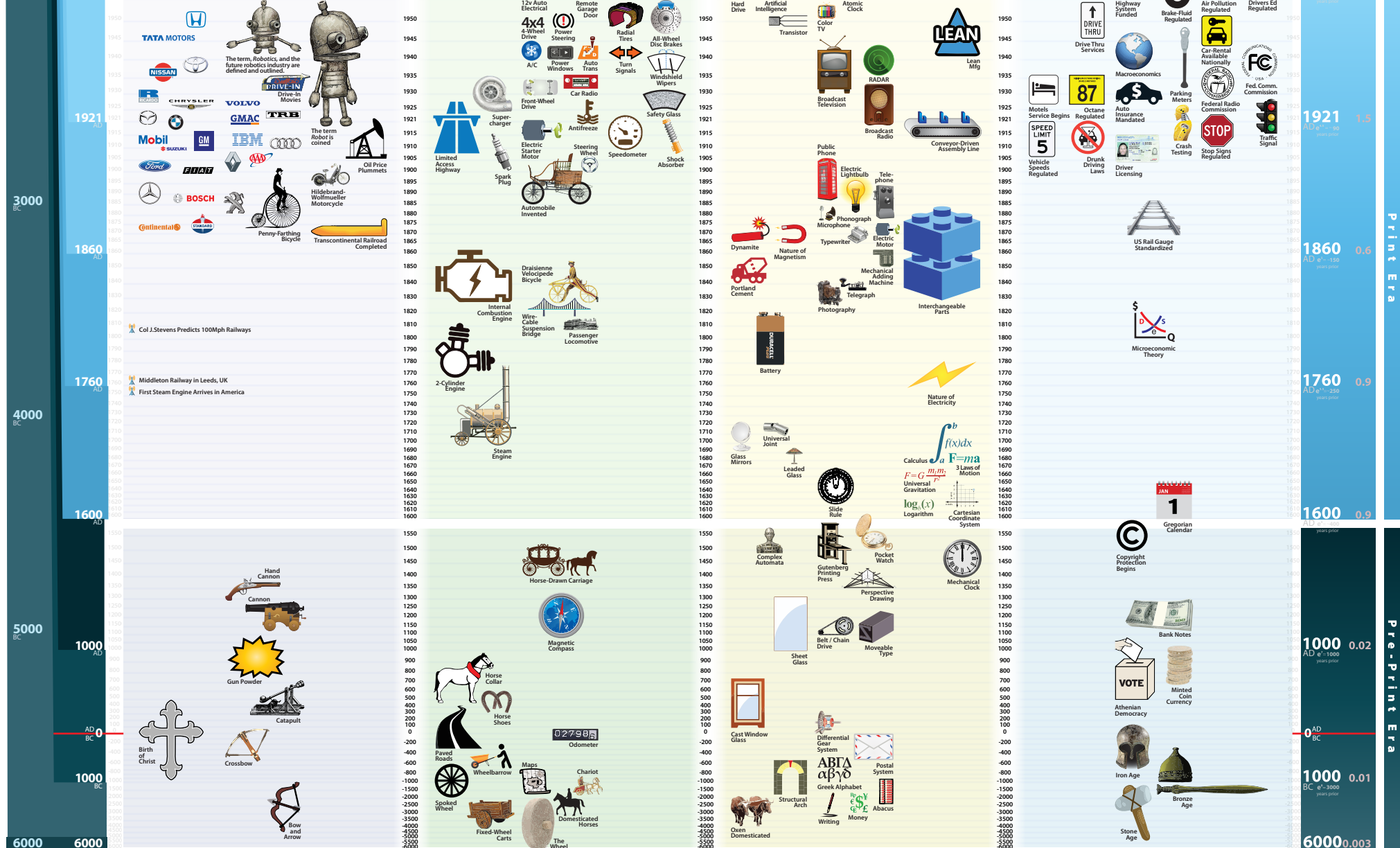
- Efficiency: Trexa Enercube EV Chassis
- Accessibility & Convenience: P2P Rental Support, AR+ Augmented Reality Car Windows, GM EN-V
- Safety: Pedestrian Detection, Automatic Braking, GM PUMA, Tesla EV Roadster, Automatic Parking, SEGWAY Lane Keep Assist
- 2000: GM Hy-wire AUTONOMY
- 2000: zipcar
- 2000: Night Vision, AI Seatbelts, Lane Departure Warning, Push-Button Ignition, Hybrid Electric, Curtain Airbags, Adaptive Cruise Control, Daytime Headlamps, Electronic Stability Control, Side Airbags
- 2000: Natural Gas Powered, Zero Emission, Remote Assist, GPS Vehicle Navigation
- 2000: CVT Introduced
- 2000: Traction Control, 68mph, Heads-Up Display, Seatbelt Tensioner, Keyless Entry, Remote Keyless Entry, Ignition Interlock, ABS, Airbags, Side-Impact Guard Beam, Head Restraints, Side-Impact Brakes
- 2000: CAT Catalytic Converter
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**Technology**

- Supporting Innovations: Light-field Camera, KINECT, iPad, Retinal Implants, Bionic Contact Lens, AR+ Augmented Reality, iPhone, ROS.org Robot Operating System, Bendable Concrete, YouTube, Facebook, SIRIUS SATELLITE RADIO, iPod, creative commons, open source, openwifi 802.11b
- Communication & Automation: Google Glass, Google, 6σ Six Sigma Adoption, Java, MOSAIC Graphical Browser, GPS, Global Positioning System, World Wide Web, BSD License, BSD License, TCP/IP, Internet Protocol Suite Std.
- Open Standards: Nevada Licenses Robot Drivers, Nevada Legalizes Robot Drivers, AZ, CA, FL, HA & OK Debate Robot Drivers Licenses, AB-1871 California Passes Car-Sharing Law, Tire Pressure Sensors Regulated, DARPA Urban Challenge, DARPA Grand Challenge II, DARPA Grand Challenge I, DARPA Grand Challenge Funded & Announced, US DOD Funded Demos, NAHSC PATH Demo '97, Dual Airbags Regulated, National Seatbelt Mandate, High-Occupancy Toll Lanes, SRS Passive Restraints Regulated, 5 MPH Bumpers, E-Trans Open-Road Tolling, Rear Passenger Seatbelts Regulated, Side-Impact Protection Regulated, Child Seats Regulated, High-Occupancy Vehicle Lanes, FARS Fatality Analysis Reporting, National Transportation Safety Board, Head Restraints Mandated, FHWA Federal Highway Administration, U.S. Dept of Trans, Auto Emissions Regulated
- 2000: Google, NDIRECT, Smart Phone, iRobot, CISCO, Digital Camera, Personal Computer, Microprocessor, Relational Database, CPU, Robotics, Computer Vision, Touchtone, Integrated Circuit, Laser, Pocket Calculator, VCR, LED, Kalman Filter, AI
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**Society**

- 2000: NEVADA MI-L8, Nevada Licenses Robot Drivers, Nevada Legalizes Robot Drivers, AZ, CA, FL, HA & OK Debate Robot Drivers Licenses, AB-1871 California Passes Car-Sharing Law, Tire Pressure Sensors Regulated, DARPA Urban Challenge, DARPA Grand Challenge II, DARPA Grand Challenge I, DARPA Grand Challenge Funded & Announced, US DOD Funded Demos, NAHSC PATH Demo '97, Dual Airbags Regulated, National Seatbelt Mandate, High-Occupancy Toll Lanes, SRS Passive Restraints Regulated, 5 MPH Bumpers, E-Trans Open-Road Tolling, Rear Passenger Seatbelts Regulated, Side-Impact Protection Regulated, Child Seats Regulated, High-Occupancy Vehicle Lanes, FARS Fatality Analysis Reporting, National Transportation Safety Board, Head Restraints Mandated, FHWA Federal Highway Administration, U.S. Dept of Trans, Auto Emissions Regulated
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A partially modified log-scale (above & right) uses the logarithmic base  $e$ , also known as the natural log. The timeline along this scale, reveals a sweeping span with a broad perspective of historical innovation, all within a highly compact area.

All milestone events are mapped to the **Log Scale**, shown on the right-side of the left column, and on the far right side of the page. A reference **Linear Scale**, (far left) shows the full 8000 year timespan with conventional linear (even) spacing. This reference helps expose the long-term and accelerating pace of innovation.

- The earliest timeline period, or **pre-print era**, spans 7600 years (6000 BC to 1600 AD). This is ~**95%** of the total span, & yet yields merely **15%** of the milestones.
- The **print era** is the middle period, spanning 1600 AD -1956 AD. It begins after the **Gutenberg Press** & continues until the **Integrated Circuit** & Computer Modem are introduced. This period accounts for more than **one-third** of innovation milestones, yet requires less than **5%** of the 8000 year timespan to be developed.
- The current period is the **digital era**, which begins in 1956. ~**50%** of all innovation, across 8000 years, occurs in this short period. In total, these 56 most recent years comprise less than **1%** of the total 8000 year timeframe. People in the U.S. will live 33% longer than the time taken to manifest these milestones.

