The Road Ahead:
Evolving Auto Business Models and Autonomous Trucking

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Overview

1 Background
2 Technology
3 Risks
4 Implementation
5 Conclusions/Questions

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Background

Key Milestones

Global

April 2016
- Truck convoys used autonomous tech to "platoon" across Europe
- Backed by the EU
- Included Daimler, Volvo, Scania, and others
- Longest route was more than 1,200 miles

Intrastate

October 2016
- World's first autonomous truck delivery in CO
- Truck was retrofit with autonomous vehicle (AV) tech from Otto
- 120 mile route from Fort Collins to Colorado Springs

Interstate

February 2018
- First autonomous cross-country truck route
- Truck was equipped with AV tech from Embark
- 2,400 miles from Los Angeles to Jacksonville with minimal human intervention

Source: The Verge / Wired / TheDrive

What was carried on the first autonomous delivery?

What was carried on the first autonomous delivery?

50,000 Cans of Budweiser!

"I used to believe we'd see this stuff in 15 to 20 years, that it would get out slowly"

After witnessing the Otto delivery…

"I drank the Kool-Aid. Is the technology ready? Mostly, yes. It's mostly financial, institutional challenges we face. But I'm moving my 15 to 20 year forecast up to maybe five."

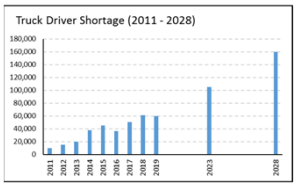
-Dan Murray, VP of the American Transportation Research Institute

Photo: Wired

Source: Wired / TruckNews.com

Trucking Industry Today

- Trucks move **71.4% of all freight** tonnage in the U.S.
- Freight volumes have continued to rise since the Great Recession
- **Median driver age is 47** in trucking industry, compared to 42 for all industries
- Shortage of drivers for last 15 years
  - ✓ 2018: **60,800 drivers short**
  - ✓ 2028: projected **shortage of 160,000**
- Shortage is amplified by the struggle to find qualified drivers
- Causes of Shortage
  - ✓ Driver Demographics – Age
  - ✓ Lifestyle – Extended Periods Away
  - ✓ Job Alternatives



Source: American Trucking Associations / BLS

Technology

SAE Levels of Automation

Examples

Level 0: No Automation
- My 2014 Ford Focus

Level 1: Driver Assistance
- 2018 Honda Civic, 2018 Toyota RAV4

Level 2: Partial Automation
- Tesla Model S, Mercedes-Benz CLA Class

Level 3: Conditional Automation
- Concept Audi A8, Concept Google

Level 4: High Automation
- Otto retrofit kit

Level 5: Full Automation
- Doesn't exist, probably won't for awhile

Photo: Vox

Types of Technology Utilized

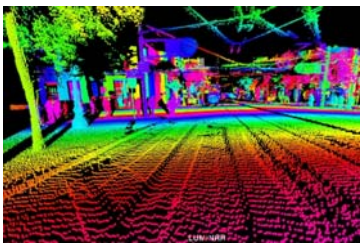
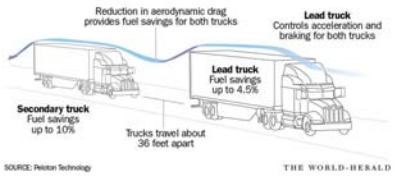


Photo: Motor Trend

- Radar
- LiDAR
  - ✓ Light Detection and Ranging
  - ✓ Uses infrared laser light to calculate distances, "upgraded Radar"
- High-precision cameras
  - ✓ Most accurate, but requires advanced software to identify objects
- Short-range communication
  - ✓ Wireless transmitters to communicate with nearby vehicles
- GPS
- Software
  - ✓ Processes the signals from the above devices and translates them into actions for the vehicle

Platooning



- Maintain distance via wireless communication, radar, and GPS
- Primarily performs "straight-line" adjustments
- Alert driver is still needed, especially for direction changing maneuvers
- 5-10% reduction in fuel cost, can be more or less depending on length

Platooning

Pros
- Fuel savings
- Less roadway congestion
- Reduced accidents

Cons
- Multiple truck accidents
- Prevent other vehicles from changing lanes
- Wireless communications could be compromised

Photo: The Verge

Retrofit / After-Market Sensors

Photo: Business Insider

Otto's Retrofit Kit includes:

- 3 LiDAR units
- Radar
- High-precision camera(s)
- Power steering
- Braking system
- GPS / Mapping data
- Custom computer

Apply to any truck built after 2013

Estimated Price: $30-100k

Source: Wired

Retrofit / After-Market Sensors

Pros

- Utilize current fleet
- Less frequent stops
- Driver is able to multi-task
- Maybe attract more drivers

Cons

- Risk of software failure
- Not enough real-world testing yet
- May end up costing more than initially anticipated

Photo: Wired

Originally Manufactured

Pros

- Theoretically more reliable
- Less frequent stops
- Driver is able to multi-task or even be removed from cab
- Possibility for electric

Photos: AutoBlog / Forbes

Cons

- Risk of software failure
- Mostly conceptual / Limited on-road testing
- Could be very costly

Players in the Autonomous Truck Realm

Risks

Major Risks in Trucking

1. Vehicle Accidents
2. Theft
3. Work-Related Injury

Major Risks in Trucking

1. Vehicle Accidents
2. Theft
3. Work-Related Injury
4. Cyberattacks

Vehicle Accidents

- Driver error causes about 90% of accidents
- About 4,102 people died in large truck accidents in 2017
  - ✓ 68% were passenger vehicles occupants
  - ✓ 17% were large truck occupants
- Driver fatigue is a main contributor
  - ✓ Federal hours-of-service regulations allow 11 hours
  - ✓ Surveys indicate many drivers violate this
- Loaded trucks go 20-40% farther than cars when braking

Source: Insurance Institute for Highway Safety

Vehicle Accidents w/ Autonomous Trucks

- Driver error causes about 90% of accidents +Reduced but not eliminated
- About 4,102 people died in large truck accidents in 2017 +Less accidents?
  - ✓ 68% were passenger vehicles occupants
  - ✓ 17% were large truck occupants +Driver may not be in cab or in a safer position
- Driver fatigue is a main contributor +Driver could rest in cab
  - ✓ Federal hours-of-service regulations allow 11 hours
  - ✓ Surveys indicate many drivers violate this
- Loaded trucks go 20-40% farther than cars when braking +Quicker response

-Cyberattacks on moving vehicles causing accidents, Terrorism

Source: Insurance Institute for Highway Safety

Theft

Picture: XtraLease

Theft

- FBI estimates that $15-$30 billion of cargo is stolen every year
  - ✓ Average shipment value stolen is around $200,000
- Most theft occurs within the first 4 hours of a route
- Areas around certain cities and highways are particularly vulnerable
- Many instances of theft committed by drivers

Source: XtraLease / XL Catlin

Theft w/ Autonomous Trucks

- FBI estimates that $15-$30 billion of cargo is stolen every year
  - ✓ Average shipment value stolen is around $200,000
- Most theft occurs within the first 4 hours of a route +Guarantee a 4+ hour start
- Areas around certain cities and highways are particularly vulnerable +Easier to continue driving through high risk areas
- Many instances of theft committed by drivers +Driverless segments

-Ransomware attacks

-"Digital piracy"

Source: XtraLease / XL Catlin

Work-Related Injury

- Injury from vehicle accidents
- Repetitive motion injury
  - ✓ Long hours spent in the same position
- Lifting/Overexertion injuries when loading and unloading cargo
  - ✓ Improper lifting form, fatigue, and rushing are all contributors

Work-Related Injury w/ Autonomous Trucks

- Injury from vehicle accidents +Less frequent, less severe
- Repetitive motion injury
  - ✓ Long hours spent in the same position +Driverless for long highway segments
    +Possibly able to move around?
- Lifting/Overexertion injuries when loading and unloading cargo
  - ✓ Improper lifting form, fatigue, and rushing are all contributors +Driver could rest
    +More likely to be on time

Cyberattacks

- No documented incidents involving a truck
  - ✓ However, autonomous trucks have not been available for public testing


Source: Wired / Green Car Reports

Insuring Autonomous Trucks

- Some manufacturers have announced that they will accept responsibility for accidents due to malfunction
  - So far seem to be self-insuring this risk due to lack of coverage options
- One insurer has explicitly said that it is willing to write policies for autonomous trucks (AXA XL)
  - Including liability, error and omissions, cyber, and business interruption
- Changes in underwriting and pricing strategies
  - Shift from focus on driver to focus on technology and maintenance
- Changes in policy language
- Speculative Liability Structures
  - Status Quo & Subrogation / Product Liability First / Others

Source: XL Catlin / King & Spalding

Implementation

Benefits of Implementation

- Improved driver experience
  - ✓ Multi-tasking
  - ✓ Shorter routes
- Increased efficiency / Reduced costs
  - ✓ Less down time, fuel efficiency, longer routes
  - ✓ Cost savings of 15-20% per autonomous trip (Strategy& study)
- Decreased liability leading to insurance savings
  - ✓ Thought to be key for wide-scale implementation
- Corporate responsibility
  - ✓ Contributing to safer roadways
  - ✓ Reducing carbon emissions

Source: Wired / Strategy& / FleetOwner

Roadblocks to Implementation

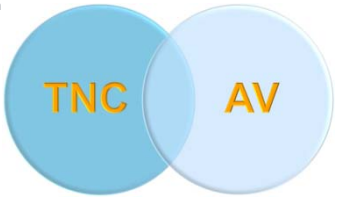
Photo: Wired

- Consistent law changes across states
  - ✓ Liability laws don't allow injured individuals to sue manufacturer
  - ✓ Following too closely is a moving violation – Platooning
  - ✓ Hours of Service will need to be amended
- Poor infrastructure
  - ✓ Inconsistent lines and signage can make maneuvering difficult
  - ✓ Add connected vehicle technology
- Cost to purchase and maintain technology
  - ✓ Upgrades in cyber protection will be needed
- Public Perception
- Weather

Source: Business Insider / TruckNews.com / Trucks.com

Implementation: Transportation Network Company (TNC) vs. AV Trucking

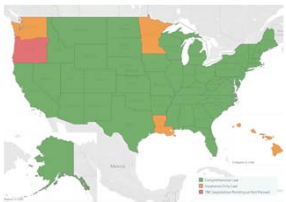
- The birth of and need for TNC regulation
- What causes states to pass laws?
- How do states differ in regulating?
  - ✓ Insurance vs. Operational laws
  - ✓ Restrictive vs. Laissez-faire
- Who were the early adopters?
  - ✓ Overlap between AV and TNC
- How long did it take states to adopt?



Current TNC Legislation

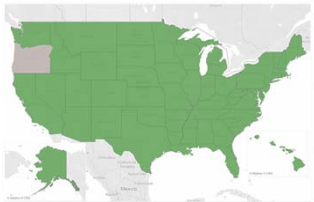
Note: GIF below not compatible with PDF. Displaying 2018 map.

States with TNC Legislation



Legend: Green – Comprehensive Law
Orange – Insurance Only Law
Red – TNC Legislation Pending or Not Passed

Timeline of TNC Adoption (2014-2018)



Legend: Green – Legislation Passed
Yellow – Legislation in Progress
Gray – No Legislation

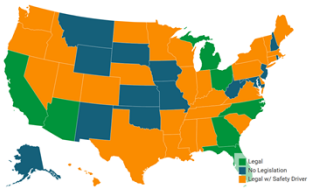
Source: PCI Infographics: Uber Technologies

Current AV Legislation

States that Authorize Vehicle Platooning

Legend: Red – No exemptions for platooning vehicles
Yellow – Some authorization w/ restrictions
Green – Full authorization of platooning

States with Autonomous Vehicle Legislation



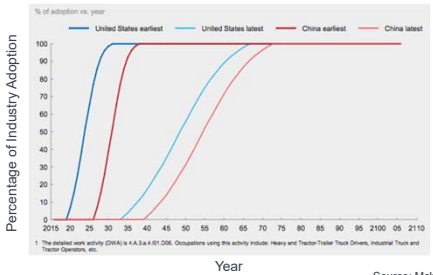
Legend: Green – Legal
Orange – Legal w/ Safety Driver
Blue – No Legislation

Photos: CEI / Lifewire

Insurance Complications

- Assignment of risk
  - ✓ Is the manufacturer liable? If so, which manufacturer (sensors, software, truck)?
  - ✓ Determining percentage of driver error?
  - ✓ Was the vehicle properly maintained leading up to the accident?
- Lack of data
- Lack of available coverage
- Structure of Liability
  - ✓ Status Quo & Subrogation
  - ✓ Product Liability First

Projected Adoption



Source: McKinsey

Conclusions

Conclusions

- Autonomous truck technology – tested, not yet proven
- Reduces the exposure to many trucking risks, but introduces cyber risk
- Could lead to some major benefits: greater efficiency, less liability
- Roadblocks, such as public policy and infrastructure, may hold back implementation
- Insurance response is still up in the air, but will likely be a key piece
- Opportunities exist to influence future insurance structures
- Keep this on your radar, wide-scale implementation is closer than it seems

Questions

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Thank you

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