



Monday, February 24, 2020
Washington, DC

Welcome to New Members

Dara Wheeler, Caltrans

Ken Moshi, Transport Canada

General Agenda

MONDAY

8:30 – 12:00	Stantec white paper discussion
1:00 – 2:00	Reports envisioning the future
2:00 – 5:30	BCG future scenarios discussion

TUESDAY

8:30 – 11:00	Recaps with Stantec and BCG
11:00 – 12:00	Forum business and next steps



Topical White Papers for the TRB Forum on Preparing for Automated Vehicles and Shared Mobility

February 24, 2020



Project Goals



**Clearinghouse for
Research Completed
Under a Particular
Topic Area**

**Summary of Research
Completed to Date**

**Identification of
Barriers
in Research**

**Roadmap for
Additional Research**

Meet the Team

Principle Investigator



Kelley Coyner

Stantec Mobility Innovation
Lead

**Principal Research
Manager**



Greg Rodriguez

Stantec Mobility Policy Principal

Senior Researcher



Rod Schebesch

Stantec Transportation Sector
Leader

Researcher



Nick McCulloch

Stantec Mobility Policy Analyst

Senior Researcher



Jason Bittner

ARA Principal Transportation
Policy & Planning Analyst

Topic List – 9 Papers

Models for Data Sharing and Governance

Safety Scenarios and Engagement during Transition to Highly Automated Vehicles

Infrastructure Enablers for Automated Vehicles and Shared Mobility

Maximizing Positive Social Impacts of Automated Vehicle Deployment and Shared Mobility

Prioritizing Equity, Accessibility and Inclusion Around the Deployment of Automated Vehicles

Potential Impacts of Highly Automated Vehicles and Shared Mobility on Traveler Behavior and Freight Movement

Impacts of Automated Vehicles and Shared Mobility on Transit and Partnership Opportunities

Implications for Transportation Planning and Modeling

Impacts and Opportunities Around Land Use and Automated Vehicles and Shared Mobility

Schedule

Monday

9:00-9:10: Overview of project and goals (Kelley Coyner)

9:10-10:10: Two 30 min “lightning” panels (Greg Rodriguez)

- Future of Privacy Forum, AARP, APTA
- Eno, Brookings, NGA

10:10-10:15: Explanation of Break-out Discussions (Kelley Coyner or Greg Rodriguez)

10:15-10:25: Break

10:30-11:00: Break-out Discussions

11:35-11:55: Reconvene for break-out session wrap-up (Kelley Coyner and Greg Rodriguez)

Tuesday:

8:45-9:45: Analysis of workshop results and confirmation of next steps (Kelley Coyner or Greg Rodriguez)

Safety and Infrastructure Facilitators: Kelley Coyner and Jason Bittner	Land Use and Planning Facilitator: Ray Derr	Transit and Shared Mobility Facilitator: Katherine Kortum	Data Collection and Sharing / Equity and Accessibility Facilitators: Greg Rodriguez and Nick McCulloch
Keck 100 (main) Ongoing Zoom	Keck 101 866-528-2256; code 334 3255	Keck 102 866-528-2256;code 439 4245	Keck 103 866-528-2256; code 334 1894
Kevin Dopart Ken Moshi David Yang Ed Bradley Sandra Larson Cathy McGhee Faisal Saleem Steven Shladover Jeff Lindley Dara Wheeler Bernard Soriano Jane Lappin Steven Dellenback	Paul Ajegba Bob Hazlett Chandra Bhat David Anderson Thomas Byron Prachi Vakharia	Timothy Papandreou Carol Schweiger Ellen Partridge Reema Griffith Art Guzzetti Roger Huff Barry Einsig Adam Cohen	Jim Mahugh Patricia Hendren Katie Turnbull Cynthia Jones Anne Marie Lewis Eric Thorn Annie Chang King Gee Scott Schmidt

Break-out Discussions (Suggested Assignments)
Reconvene in Main Room by 11:40

Future Outlooks for AV & Connected Systems



Richard Mudge

Principal
Compass Transportation & Technology



Alain L. Kornhauser

Professor, Operations Research & Financial Engineer
Princeton University



Presented at



February 24, 2020

Today... Lots of Confusion

Caused by Terminology/Semantics...

- ‘Connected’; ‘Autonomous’, ‘Automated’, ‘5 SAE Levels’...
- We call them **SmartDrivingCars** (Trucks or buses)
- Kinds: 3 Very Different
 - Classified by their **Business Case**, Not Technology
- Partitioned: 2 Very Different Classes:
 - **Do-it-Yourself Mobility** & **Done-for-You Mobility**

Today... Lots of Confusion

Caused by Terminology/Semantics...

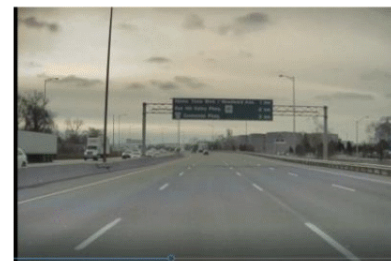
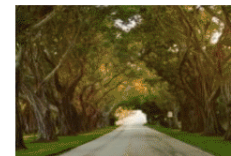
- **Do-it-Yourself Mobility**

- ‘Safe-Driving Cars... (Trucks or Buses)’

- Don’t Crash, Stay in their lane and keep us from mis-behaving
 - Always on **Automated Emergency Braking, Lane Centering & and Speed Limiting**
 - **Delivers: Safety**
 - Insurance **Can/Should Promote Wide-spread Adoption & Enhancement** w/o Government Mandate



AEB Failures



Approaching Nikola Tesla Blvd
Tesla's AutoPilot Brakes

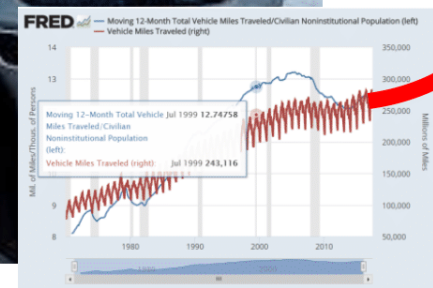
SmartDrivingCars

• Do-it-Yourself Mobility

– “Safe-Driving”

– “Self-Driving”

- Adult-Supervised Automated Driving **some of the time** on **some road**,
 - Driver’s choice in “certified” areas at “certified” times!!



VMT (Vehicle Miles Travelled) goes through the roof!

SmartDrivingCars

- **Do-it-Yourself Mobility**

- “Safe-Driving”
- “Self-Driving”

- **Done for You Mobility**

- “Driverless”
 - No Steering Wheel or Pedals
 - Automated Driving On **All the Time**:
 - In “certified” areas at “certified” times!!
 - “Operational Design Domain (ODD)”

Major Focus of...Driverless Cars

- Depends on Ownership Model
 - 1. Privately owned..



Entitled Elitists' Toy

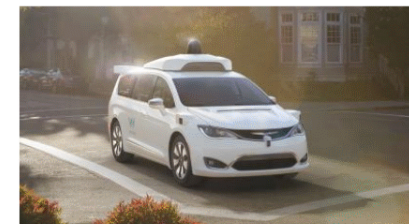
Major Focus of...Driverless Cars



- **Depends on Ownership Model**
 - 1. Privately owned..
 - 2. Fleet owned/managed
- **Affordable High-quality “Mobility Machines” for All**



Entitled Elitists Toy



RECENT NEWS (1)

- Real-world benefits of “Safe” and “Self Driving” vehicles
 - IIHS/HLDI shows tangible benefits from “Safe” car technology
 - 19 examples of positive impacts – see handout
 - Highway fatalities declining (slowly)
 - National Safety Council estimates 2 percent drop in 2019
- Waymo moves forward – slowly
 - Shared ride service in Chandler / Tempe Arizona
 - Partners: Lyft, UPS, Walmart, etc.
 - No word on 82,000 vehicles “ordered” from Jaguar and Chrysler
- Trucks
 - Several firms plan intercity deployments without safety drivers in 2020/21
 - Local freight delivery tests
- Safety record improving
 - Need more data – IIHS/HLDI
 - Risk that public turns off sensors in reaction to too many “beeps”
 - New owners need training

RECENT NEWS (2)

- Tesla insurance package
 - California to start
 - 20 percent savings?
 - Strategic implications for OEMs and insurance industry
- Company mergers
 - Despite slow deployment, large investments continue
 - Ford-VW; Waymo-Renault/Nissan; GM/Cruise – Honda; Aurora – Fiat/Chrysler -Hyundai
- Uber and Lyft IPOs
 - More reality versus hype
 - Are AVs the only way out?
- Federal and state regulations
 - No effort to pick winners / losers
 - Some state differences – Arizona versus California
 - Federal legislation stalled

RECENT NEWS (3)

- Local opposition to TNCs
 - NYC and Chicago stand out
 - Higher fees, limit number of drivers ..
 - Is this a sign for future local control of AVs? Concern for job loss?
- Mobility impaired population remains an opportunity for early deployment
 - Physical and economic
- Cruise “Origin” shuttle – 2022 deployment?
 - Vehicle designed for no driver (ZOOX next?)
 - What are implications for low-speed shuttle market?
- NHTSA exemption for Nuro (local freight delivery)
 - Steering wheel not required

TRIGGER POINTS

- Trigger points – Eleven listed in Society of Actuary report. Option to scenarios?
 - Policy – Institutional and Regulatory Change
 - Largely stalled – not necessarily bad
 - Technology
 - Sensor costs are dropping (increased competition)
 - Lower costs mean increased installation in new cars
 - Will cars be cheap enough for private ownership?
 - AEBs still unpredictable
 - Vehicles and Vehicle Use (market penetration)
 - Growth in Safe and Self-Driving Categories (not just Tesla)
 - Commercial vehicle growth
 - Local started; Intercity next
 - Ride sharing
 - Now more than national transit bus market
 - Ride sharing (Uber Pool etc.) limited
 - Scalability requires AVs

SOURCES

- Based on reports prepared for the Society of Actuaries
- An Update on the Outlook for Automated Vehicle Systems, (October 2019)
<https://www.soa.org/globalassets/assets/files/resources/research-report/2019/automated-vehicle-update.pdf>
- Market Framework and Outlook for Automated vehicle Systems, (November, 2018)
<https://www.soa.org/globalassets/assets/files/resources/research-report/2018/market-framework-automated-vehicle.pdf>
- Also, see Smart Driving Car newsletter
<https://smartdrivingcar.com/newsletter/>

SCENARIOS (1)

- How can state, local, federal plans make sense of AV and SM changes?
- No standard model.
- Scenarios one option
- FHWA draft **Practitioner Guidance** (not yet published)
- Developed a series of draft scenarios and a general guide for how public agencies might use scenarios
- Each Scenario traces several important factors
 - Technologic Developments
 - Customer Preferences
 - Socio-Economic Factors
 - Government Actions

SCENARIOS (2)

- 2035 Draft Scenarios – meant to stimulate reaction by state and local planners
- Baseline – minimal plausible change (not zero change)
 - Includes TSMO, safety technology, and mobility services
 - Level 2 vehicles are 30-40 percent of market
 - Level 3 and 4 not yet commercial
 - TNCs account for 5-10 % of market – 20 % in some places
- Enhanced Driving Experience
 - Managed Automated Lanes
 - 50-60 % of vehicles have some automation
 - 20% are level 3 or 4
 - 75% of vehicles have V2X
 - 75% of freight with Level 3 or 4 vehicles
 - Government manages AV Lanes (??)
 - Ultimate Traveler – built on connected vehicle technology
 - 85 % of vehicles with V2X (DSR and 5G)
 - Platooning common for freight
 - TNCs account for 5-10 % of market – 20 % in some places

SCENARIOS (3)

- Driver Becomes Mobility Consumer
 - Niche Services Dominate
 - Level 4 limited by costs and technical problems to niche markets
 - Campuses, office parks, last-mile services, CBD, etc.,
 - 40% of vehicles with V2X
 - Competing Fleets (with level 4 vehicles for most trips)
 - 70% of fleets have some AV – 30 % Level 4
 - EV grows fast – all TNCs are EV
 - All freight are CAVs – freight costs drop significantly
 - Integrated Automated Mobility
 - 70% of fleets have some AV – 30 % Level 4
 - In urban areas 85 % of CAV miles in TNCs
 - Concerted effort to coordinate all modes,
 - Support a multi-modal life styles

SUMMARY

- Reality has caught up with hype/romance of popular press
 - Has “reverse hype” arrived?
- Deployment will continue, but on a market-by-market, city-by-city, community by community basis.
 - Good weather, geo-fenced, etc
- But technology now deployed in most new cars
- Safety will improve incrementally with market penetration of safe driving cars and trucks
- National Safety Council: estimates motor vehicle deaths to have dropped 2 percent in 2019
- Growing local regulations for shared mobility – contrast with federal and state regulations
- V2V and V2I continue to migrate away from public-sector focus
- Fleet ownership still likely to dominate deployment of Driverless
 - Will private ownership be banned?
- Cybersecurity remains a concern
- Deployment will likely stimulate increased PMT and VMT (without efforts to encourage shared rides)



Interactive Scenario Development Workshop

Presentation Materials

FEBRUARY 24, 2020



Agenda today

➤ Introduction and process overview	14:00 – 14:30
Trends and shocks	14:30 – 15:10
Scenarios development I: Build matrix	15:10 – 16:10
Coffee break	16:10 – 16:20
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Wrap-up and next steps	17:20 – 17:30

Your BCG team today



Rich Davey
Partner & AD

- Leads BCG's State and Local sector in North America
- 15 years of C-suite transportation and infrastructure experience
- Former Secretary and CEO for the Massachusetts Department of Transportation



Alan Iny
Partner & Director

- BCG's Global Leader for Creativity and Scenarios
- Co-author of *Thinking in New Boxes: A New Paradigm for Business Creativity*
- Co-wrote BCG's perspective on practical creativity, and *Rethinking Scenarios*



Augustin K. Wegscheider
Partner

- Leads Center for Mobility Innovation in North America
- Led Engagement with WEF on Future of Urban & Autonomous Mobility
- Formerly with Audi of America

Plan for today:

We will develop rough cuts
at 3-5 plausible but
divergent future states or
scenarios

We will then refine these
with you in the months
ahead and explore
strategic implications of
the final scenarios at the
July meeting



For discussion: Overall Project focus



In Scope

- **Opportunities:** New modes, AV, EV, mobility platforms, ...
- **Customers:** Consumers, fleets, cities, ...
- **Geographies:** US primarily; consider EU and China dynamics
- **Timeframe:** Focus on 2030 / next ten years

Deliverables

- 3-5 divergent future states by 2025
- View of strategic implications by scenario, and potential action items across scenarios, to help members become better prepared for an uncertain future



What is a top
regret of CEOs

... and former
CEOs?

Thinking they knew
what **the** future
would look like

Understanding change
and seeing the future
early requires a
wide-angle lens rather
than a telescope

Recent headlines illustrate macro changes organizations could face



US and China draw closer to final trade agreement



US-China trade war escalates

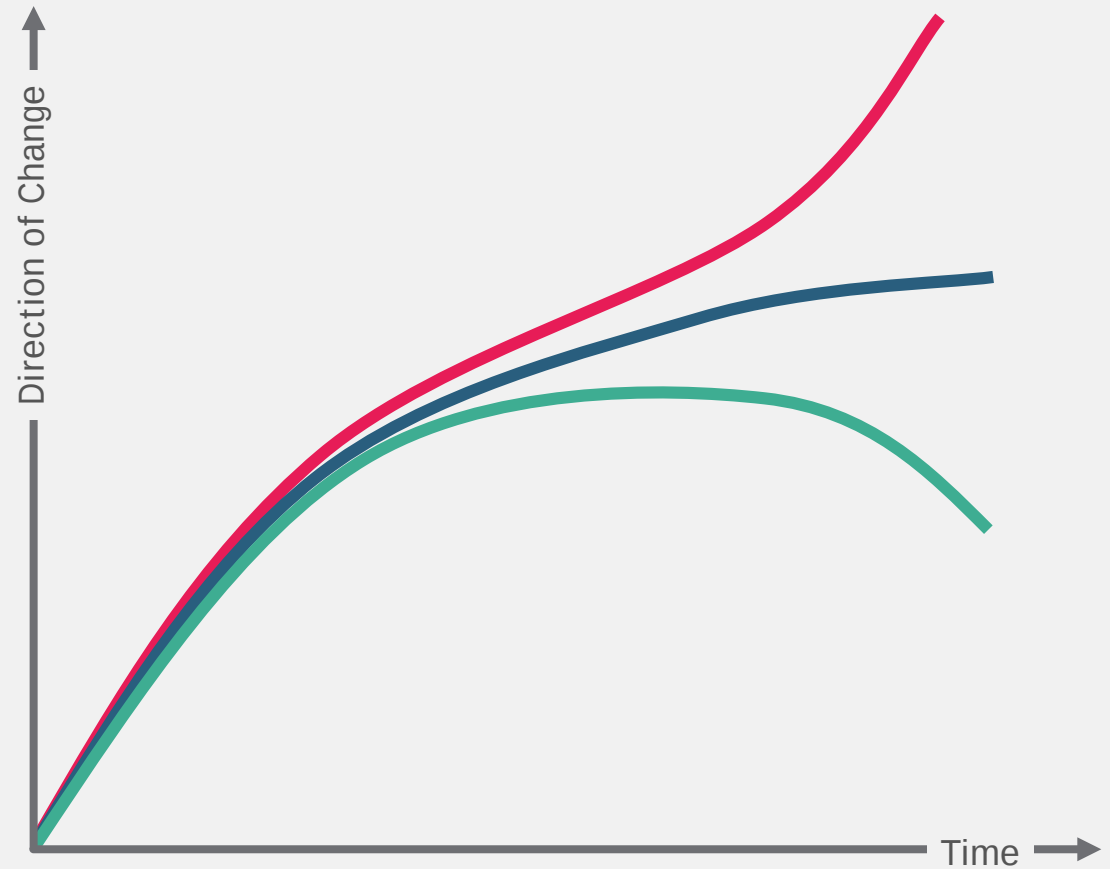
The US has more than doubled tariffs on \$200bn worth of Chinese products

10 May 2019

🕒 12 minutes

World

Forecasts are
not enough ...





We are not good at judging the prospects of uncertainties, and what's worse, we are overconfident in our judgments

“ There's no chance that the iPhone is going to get any significant market share. No chance

- Steve Ballmer,
CEO of Microsoft (2007)



We are not good at judging the prospects of uncertainties, and what's worse, we are overconfident in our judgments (II)

“ "No woman in my time will be prime minister or foreign secretary - not the top jobs. Anyway, I wouldn't want to be prime minister; you have to give yourself 100 percent."

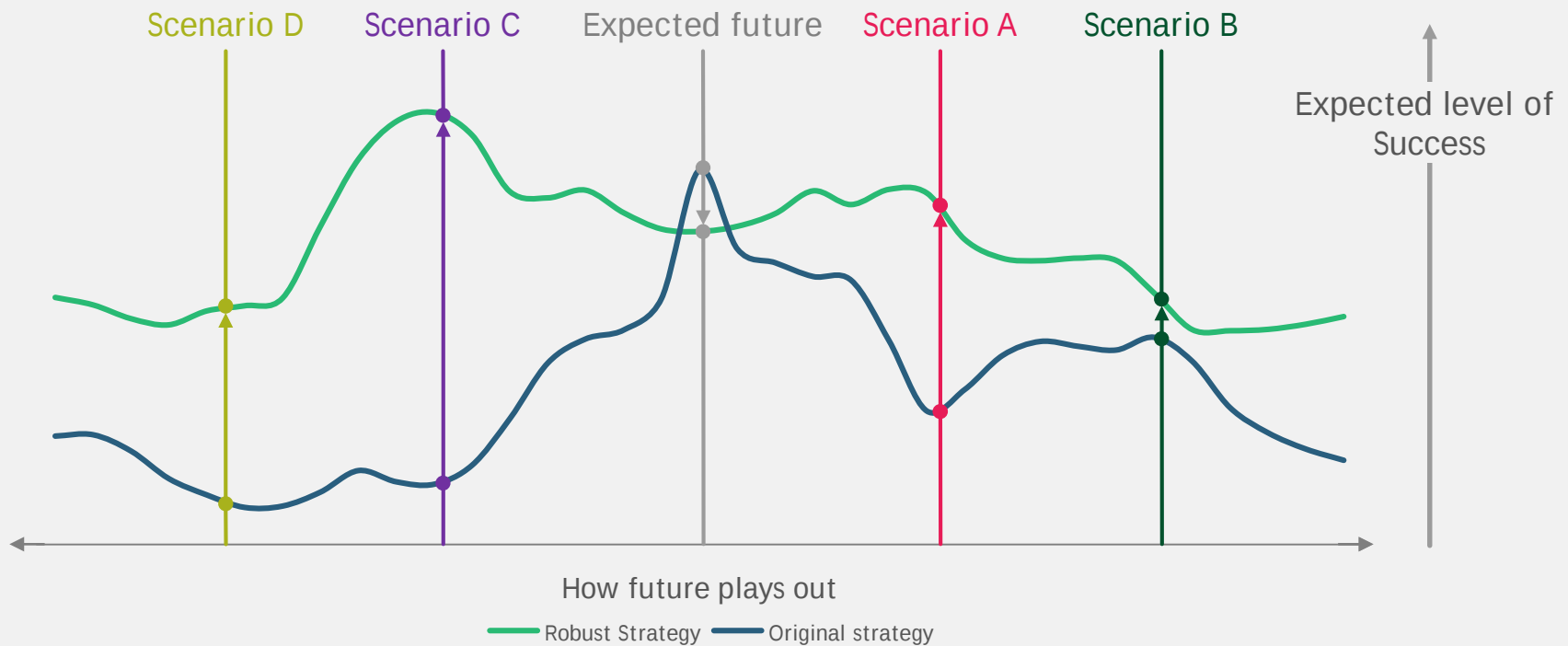
- Margaret Thatcher, UK Prime Minister 1979-1990 (1969)







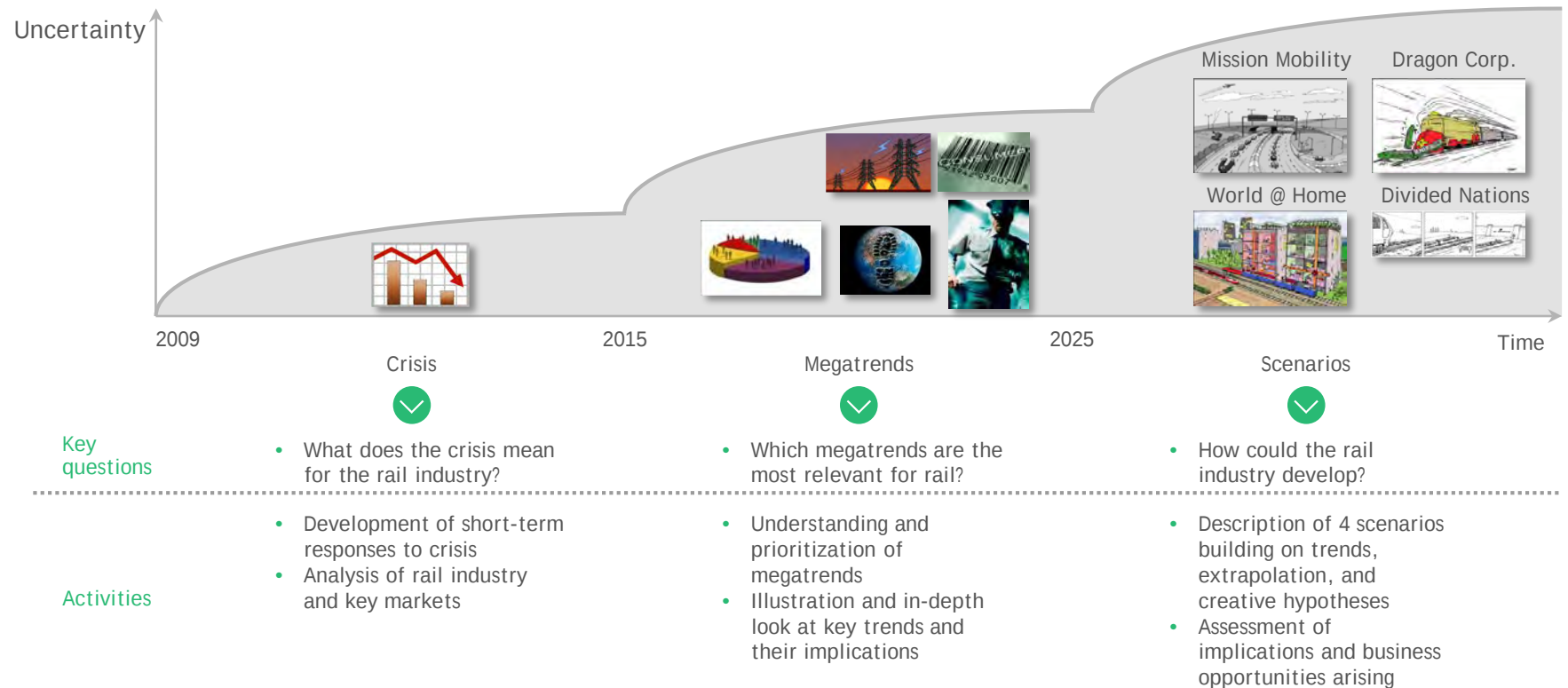
Often our corporate strategy only performs well in expected future; scenarios can help develop a more resilient strategy



Regardless of approach taken to scenario development, there is a clear path to any scenarios effort

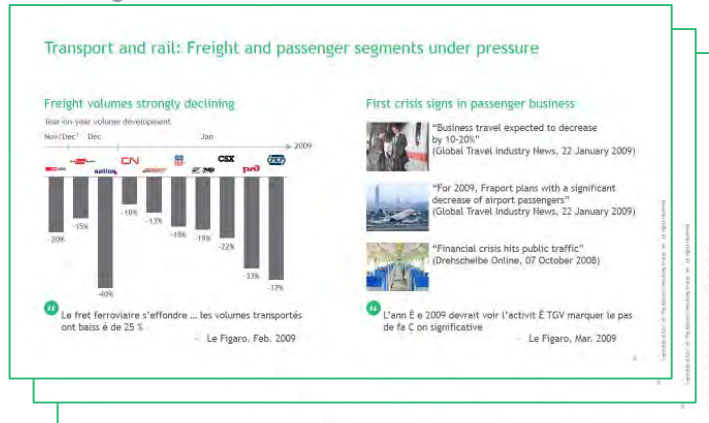


Approach example: UNIFE moved from challenges to visions of possible futures



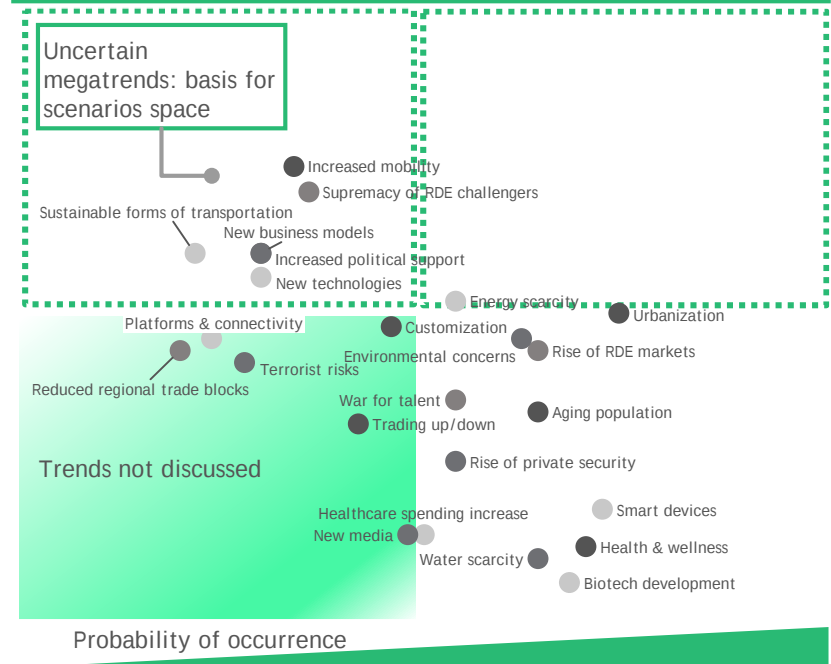
Preparatory work to assess a range of megatrends and understand the world UNIFE is facing

First, a wide range of trends was explored—one example is in this slide ...



... we then classified each trend based on their likelihood and impact, with the high-impact low-likelihood ones forming the basis for the scenarios

Impact on rail



We then built upon trend analysis to develop variables



Variable 1: Writing a tender for a rail project in 2025

Topics for discussion:

- Customers profiles (govt, private)
- Scope of offering/product/techno
- Contract types (BOT, turnkey ...)
- Price and financing options
- Regulation/standard
- Competition
- Process/organization



Variable 2: Arriving at Penn Station Monday morning in 2025

Topics for discussion:

- Intermodal cooperation
- Technological innovations
- Urbanization
- Demography (population aging/growing)



Variable 3: Shipping bananas from Harare to Barcelona in 2025

Topics for discussion:

- Interoperability
- Intermodal competition
- Ecological awareness
- Geopolitics



Variable 4: Cover of The Economist Christmas issue 2025

Topics for discussion:

- Ecological awareness
- Urbanization
- Demography
- Shortage of engineering capacities
- Resource scarcity
- Geopolitics

Creativity led to plausible-but-stretched hypotheses for each variable...

Example from Variable 1: Writing a tender in 2025

- *Click & Buy*: Manufacturers offer standard trains for sale through catalogs, with a limited set of options. Clients buy them directly online, without tenders and bids.
- *Complete mobility solution*: Train manufacturers offer a full-service solution, including products and maintenance but also operation and infrastructure. They manage interfaces and links with other forms of transport, manage all risks, and remove responsibility from their clients.
- *BIG elephant*: A mega-tender is conducted every ten years, covering the entire continent – winner takes all.
- *Iron Curtain*: A nationalist approach to tenders means local companies are prioritized, with engineering and manufacturing substantially local. Towns and regions get their share of local value-add, and contracts are in local languages.

...which were then combined into a matrix

Variables

	Hypotheses			
Writing a tender for a rail project in 2025	Click & Buy	BIG elephant	Complete Mobility Solution	Iron Curtain
Arriving at Penn Station Monday morning in 2025	Easy rider	Prison	City Peak	Phantom
Shipping bananas from Harare to Barcelona in 2025	Fair African Banana Boom	Fast Bananas	Electric Bananas	Local Food
Cover of The Economist Christmas issue in 2025	Virtual Christmas Dinner	Platinum Age	Beijing 1, New York 0	Last survivor

An alternative way of thinking about the matrix



Back to UNIFE's matrix...

Variables

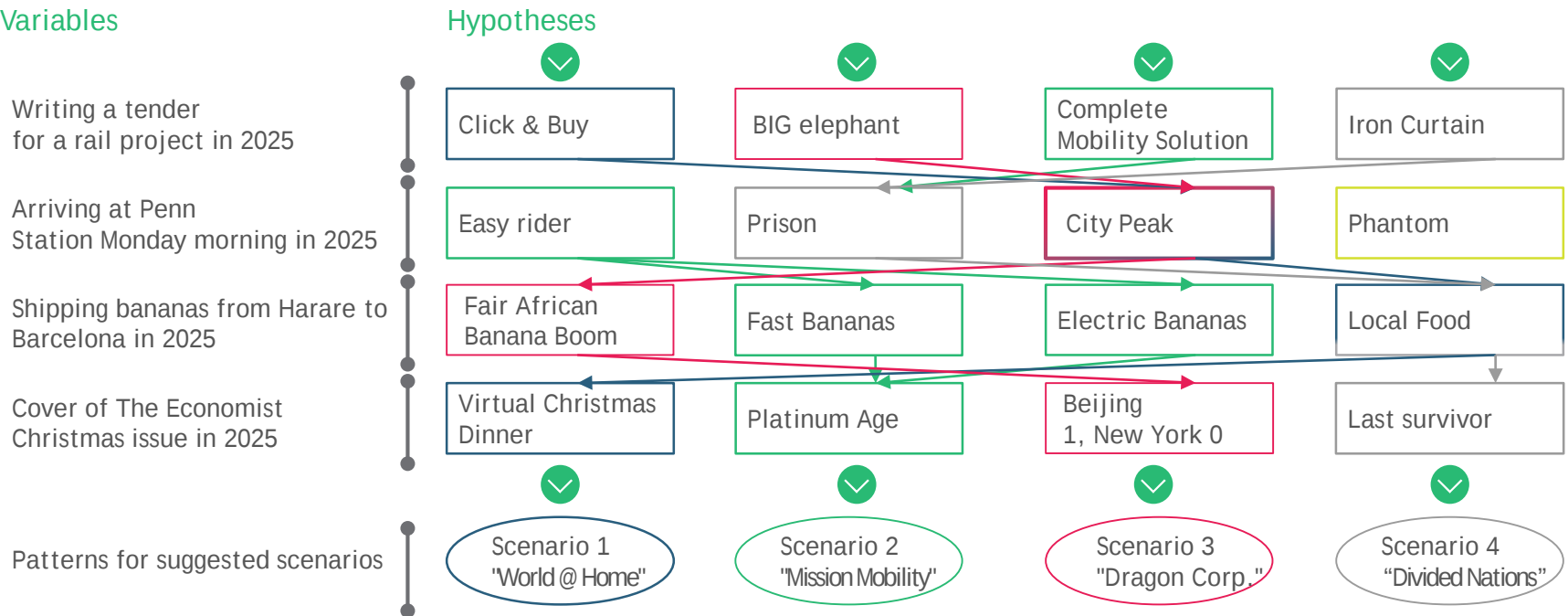
Hypotheses

	✓	✓	✓	✓
Writing a tender for a rail project in 2025	Click & Buy	BIG elephant	Complete Mobility Solution	Iron Curtain
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Permutations of the hypotheses in the matrix led to four scenarios

Variables



Four scenarios for 2025

Imagine ...

Increasing virtual interactions and communities,
less people mobility and more local focus

Clean-technology and energy revolution in transport
Increasing demand for integrated mobility services

China dominates the world economically, politically
and industrially – Chinese players leading in rail

Trade blocks explode, drop in global trade
Rise of protectionism and nationalism

... Four scenarios



World@Home



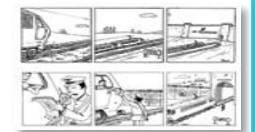
Mission Mobility



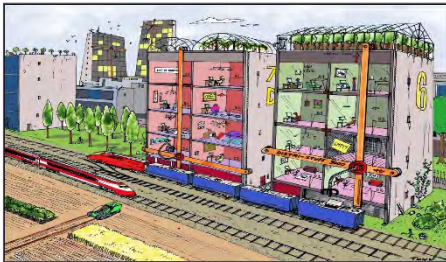
Dragon Corp.



Divided Nations



Example: The results for scenario 1 — World@home

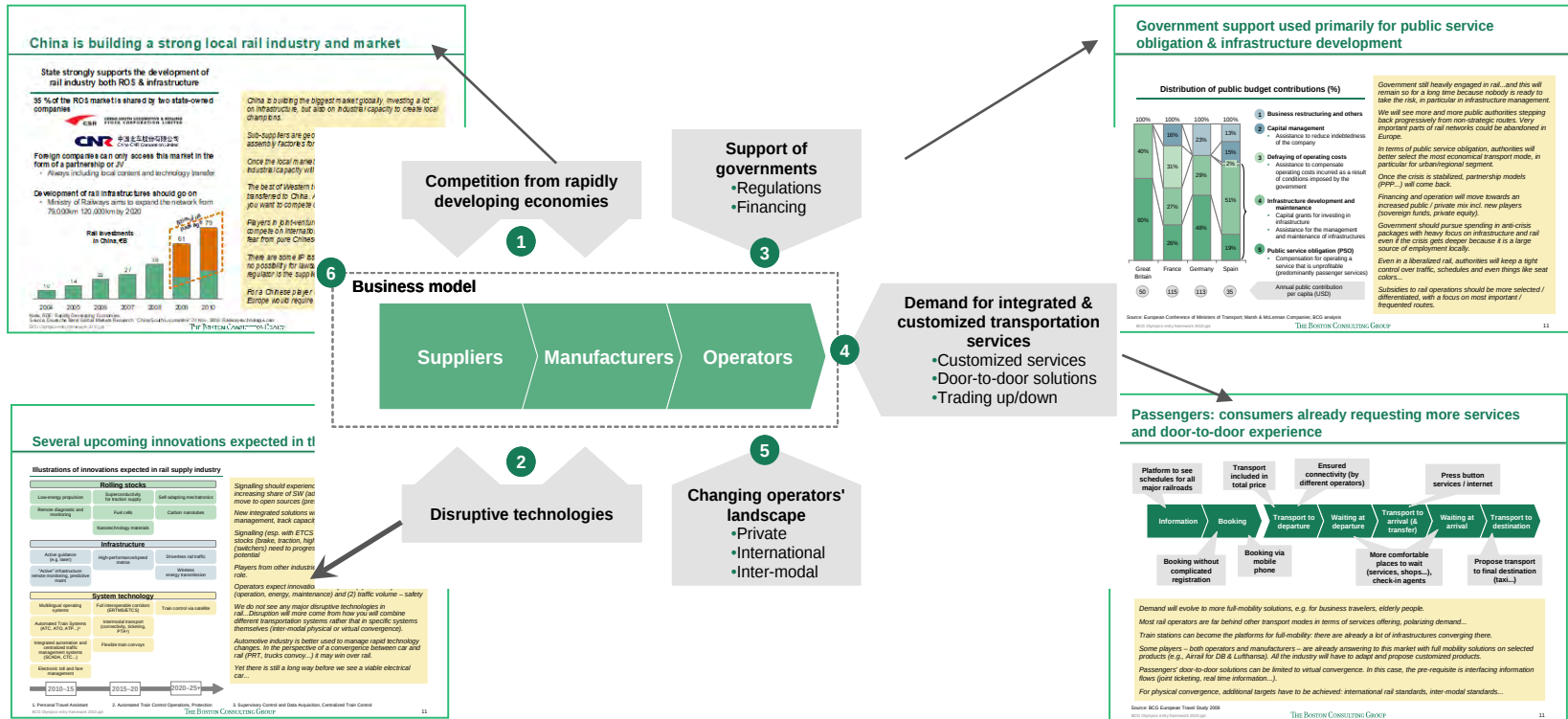


- Communication technologies boomed after the crisis to improve cost efficiency and environmental-friendliness
- Virtual worlds become the backbone of the society: virtual communities develop, meet and live via the web
- High degree of urbanization increases contrast between city centers and rural areas used for agriculture
- Higher sensitivity to environmental concerns and nutrition quality: increasing demand for local products
- People mobility is secondary, only goods are moving

Key implications for rail

Consumers	• Virtual communities use internet instead of transport systems • Moving is secondary but door-to-door delivery expected • Strong "green awareness", rely on local food and resources
Authorities	• Decreased government support: rail not key to gain votes • Alternatives rail financing from logistics and agriculture sectors • Only financially viable routes survive
Operators	• Passenger: small market, specialists in premium segment • Freight: very high speed, urban and underground services • Large intermodal players vs. flexible last-mile specialists
Suppliers	• Overall market drop accelerates supplier consolidation • Chinese players prosper in large domestic market: gain scale effects and set new standards • Standardization is key, trains are commodities sold on internet
Technologies	• Integrated communication systems with high share of software • Automated systems in all rail segments • R&D focus on freight: speed, efficiency, cost, environmental
Business models	• Super effective supply chain • Economies of scale and scope drive consolidations • Information, interface and intermodal management essential

Application of scenarios involved deep-dives into specific implications for stakeholders, and individual companies used them too



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Trends and shocks exercise

Plan for this section

- 1 Discuss list of trends
- 2 Add to / remove trends from initial list as needed
- 3 Vote on relative impact and preparedness
- 4 Explore potential shocks; add as needed

Megatrends: 29 for initial discussion



Economy



Urbanization



Rise of rapidly dev. economies (RDE)



On-demand economy



Increase in income gap



War for talent



Sustained impact of labor unions



Rising national and personal debt



Tech



IoT and smart devices



Rise in alternative energy sources



New materials/substitutes



Biotech (gene engineering etc.)



Rise of Blockchain



Rise of AI/Automation



Customers



Convenience/Time Compression



Aging and shifts in population



Seamless user experience



Shifting needs of next billion consumers



New approaches to retail (virtual etc.)



Mobility-specific



Rise of new modes and shared mobility



Move towards autonomous driving



Multimodal platforms



Electrification of powertrain



Greater role of cities in mobility landscape



Evolution of profit pools and value chain



Transition from ownership to fleets



Regulations and environment



Climate change and natural disasters



Cybersecurity risks



International trade policy volatility



Rise in city regulations



Trends and shocks exercise

Voting instructions

Vote on impact & preparedness

- 1 Five **green** "votes" on the trends with the **greatest impact**
- 2 Five **blue** "votes" on the trends for which we are **least prepared**

Example vote

"Greatest impact"

Place "vote" sticker on 5 different trends

Rise of rapidly dev. economies (RDE)

"Least prepared"

Place "vote" sticker on 5 different trends

Shocks: 9 for initial discussion

- **US-China trade war intensifies**, resulting in protectionism policies, isolating US companies from China and ally markets around the world
- **Massive Antarctic ice shelf collapse** leads to extreme flooding, citizen protests and tightened carbon emissions regulation
- **Cyber security breaches escalate**, targeting infrastructure and spreading to corporate targets
- **A massive global economic slowdown**, triggered by a domino-like series of bank failures, pushes GDP back decades in a matter of weeks
- **Extreme weather events and crop diseases** disrupt the global food supply chain, triggering a major food crisis
- **BEV uptake significantly lower than expected** due to sustained high component & raw material prices
- **AV technology** (L4, L5) doesn't advance as expected and not deployed at scale by 2035
- **Catastrophic event** (incl. loss of lives) severely dampens consumer acceptance of AV technology across use cases
- **Investor support for EBIT negative ventures**, e.g., Uber, Lyft, dries up resulting in pressure to sell / reorg.

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Build matrix

Breakout:

1. Break into five groups
2. Groups assigned to a trend category
3. Take 30 minutes to ideate ~4 hypotheses for the trend category
4. Present to the group for 5 minutes
5. Group discussion to refine hypotheses



Economy

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Tech

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Customers

--	--	--	--



Mobility-specific

--	--	--	--



Regulations and environment

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Output from our first breakout session



Economy

Stupid empire economy

Uber rich core / poor masses

Redistribution B(illionaires)

Redistribution G(overnment)

Future forward economy



Tech

Tech nirvana

Human puppets

Energy too cheap to meter

AI is the enemy



Customers

All online transactions

No paradigms

The Matrix

Forever young



Mobility-specific

Tech takes over

Third dimension

System failure

Forced sharing

Everything local



Regulations and environment

Gas mask for all

Global EU

World on fire / Cities under water

Oliver Twist

The Great Depression 2.0

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Build scenarios

Entire group exercise
(60 minutes)

Determine hypothesis combinations to
construct scenarios



Economy



Tech



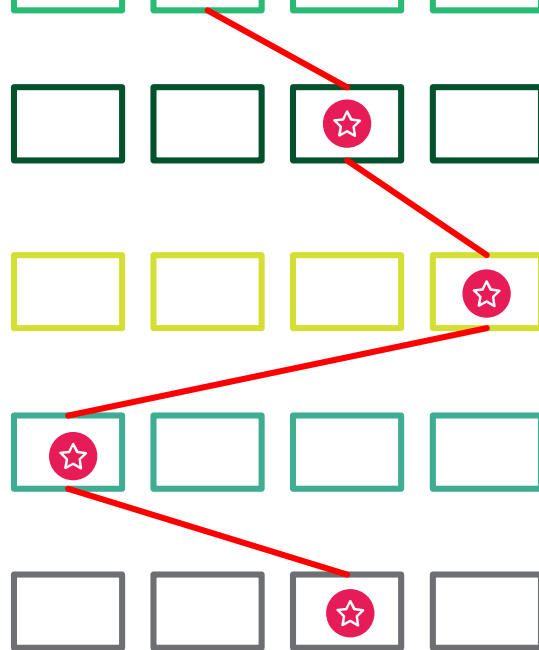
Customers



Mobility-specific



Regulations and
environment



Criteria for a good scenario and a good set of scenarios



Criteria to refine each individual scenario

Each scenario must be

- Internally consistent—no inherent contradictions
- Clear and easy to explain
- Visual and evocative (“picture of the future”) with an evocative title
- A plausible evolution of relevant megatrends, current events or other inputs
- Surprising in some way, rather than continuation of the status quo
- A blend of challenges and success stories, not utopia or disaster, not black or white
- Useful, relevant for the strategic decisions to be considered



Criteria to finalize a full set of scenarios

The full set of scenarios must

- Cover all key topics across all 5 trend areas
- Cover the full range of priority megatrends and any other inputs selected
- Contain fundamentally different scenarios
- Be representative of as many alternative futures and opinions possible
- Not contain scenarios that are much more or less extreme than others (all scenarios should be roughly same level of plausibility)

Agenda today

Introduction and process overview	14:00 – 14:30
Trends and shocks	14:30 – 15:10
Scenarios development I: Build matrix	15:10 – 16:10
Coffee break	16:10 – 16:20
Scenarios development II: Build scenarios	16:20 – 17:20
> Wrap-up and next steps	17:20 – 17:30

"The best generals
are those who arrive
at the results of
planning without
being tied to plans"

Winston Churchill



Reflections on the day





bcg.com



Tuesday, February 25, 2020
Washington, DC



Topical White Papers for the TRB Forum on Preparing for Automated Vehicles and Shared Mobility – Workshop Recap

February 25, 2020



White Paper Goals



**Clearinghouse for
Research Completed
Under a Particular
Topic Area**

**Summary of Research
Completed to Date**

**Identification of
Barriers
in Research**

**Roadmap for
Additional Research**

Models for Data Sharing and Governance

- Data needs to be considered from multiple perspectives including: manufacturers, public agencies, and consumers
- Need to identify uses for data, value of data, and how to achieve true data sharing between public and private sector
- Stakeholders have overlapping interests around safety and mobility
- Need to consider new risks and liabilities that data sharing brings
- Identified research: FPF, SAE, USDOT

Safety Scenarios and Engagement during Transition to Highly Automated Vehicles

- New approaches to safety needed to support ongoing deployment
- Need to rethink driver education and mobility engagement and identify models to ensure user understanding of capabilities of technology
- Consider coordination with traffic and law enforcement, particularly: vehicle registration, licensing, right-of-way and curb management
- Identified Research: Issues in Autonomous Vehicle Testing and Deployment—CRS; NCHRP 20-102 program

Infrastructure Enablers for Automated Vehicles and Shared Mobility

- What are the tipping points where you have sufficient market penetration to justify infrastructure investments; how can these be accelerated?
 - Infrastructure's relationship to climate change should be examined
 - Outline critical elements of infrastructure, including safety, operations, and management – convergence with data sharing and analysis
 - Governance can drive demand and shape development
 - Identified Research: Advice on Automated and Zero Emissions Vehicles
- Infrastructure: Infrastructure Victoria, October 2018

Maximizing Positive Social Impacts of Automated Vehicle Deployment and Shared Mobility

- What are the impacts on the workforce and how can that workforce address ongoing human needs?
- What are collaborative approaches and policy levers to understand and mitigate negative impacts and enhance positive outcomes?
- Identified Research: Preparing the Workforce for Automated Vehicles - Truck Platooning State of the Industry 2018: American Center for Mobility; Will Self-Driving Cars Usher in a Transportation Utopia or Dystopia? Yale E360, January 2018

Prioritizing Equity, Accessibility and Inclusion Around the Deployment of Automated Vehicles

- Data provides opportunity to understand new uses cases for automated vehicles; make sure equity and data sharing a focus of pilot projects
- How issues like complete streets, building codes, universal design, and the ADA, relate to vehicle design, the built environment, and mobility
- What must be done to protect vulnerable users and their interests regarding facial recognition, safety, and shared mobility
- Identified Research: The Transition Toward Shared Automated Vehicles, Transportation Research Board, September 2019; Socioeconomic Impacts of Automated and Connected Vehicles: TRB Conference Proceedings 56, January 2019; Auto Alliance Accessibility Report

Potential Impacts of Highly Automated Vehicles and Shared Mobility on Traveler Behavior and Freight Movement

- What opportunities do AVs and shared mobility offer for the movement of people and goods, especially over long distances
- How can new forms of mobility and freight be managed across jurisdictions?
- What research exists on delivery automation, automated freight movement, and their relation to right of way, privacy, and congestion?
- Identified Research: Study by SAFE examining truck workforce

Impacts of Automated Vehicles and Shared Mobility on Transit and Partnership Opportunities

- How to utilize shared mobility for transit purposes, including first/last mile, or in rural settings.
- What are the obstacles and restraints on public-private partnerships? Are these partnerships sustainable? How can they be facilitated?
- Need to rethink transit from traditional forms and traditional providers
- Consider human behaviors and concerns beyond legal barriers, for example speed, number of stops, and variability
- Identified Research: Automated Transit Buses Research Program, Federal Transit Administration, January, 2018; STAR Program

Implications for Transportation Planning and Modeling

- There is a lack of mobility, safety, and pricing data for automated vehicles
- Decision makers are risk-averse and reluctant to support innovation without data
- There is a need to provide a realistic overview of opportunities and challenges. How do these perspectives change over time?
- Time frames for these decisions are not compatible with current knowledge and each other (ex: on land use, curb management, relocation decisions, new technologies)
- Identified Research: The Future of Autonomous Vehicles: Lessons from the Literature on Technology Adoption, California Department of Transportation, July 2018

Impacts and Opportunities Around Land Use and Automated Vehicles and Shared Mobility

- What role does the existing built environment play on adoption of these new technologies?
- How does the adoption of technologies affect land use?
- How do we put policies in place that bridge the gaps between land use and transportation?
- Key issues: housing affordability, development patterns which are indifferent to mobility, and curb pricing
- Identified Research: The Transforming Mobility Ecosystem: Enabling an Energy-Efficient Future; U.S. Department of Energy, January 2017

Schedule

- FEB. 24-25 —FORUM MEETING
- JULY 27-30 —AUVSI MEETING / PROJECT UPDATE
- AUG. 7 —PROVIDE DRAFT WHITE PAPERS TO STAFF / FORUM MEMBERS
- AUG. 21 —COMMENTS RECEIVED ON DRAFTS
- AUG. 31 —FINAL WHITE PAPERS DELIVERED
- FALL 2020/ WINTER 2021 —DELIVER PRESENTATIONS ON FINDINGS

See or think of additional research along the way?

Principle Investigator



Kelley Coyner

Stantec Mobility Innovation Lead

**Principal Research
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Stantec Mobility Policy Principal

Researcher



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Stantec Mobility Policy Analyst

Senior Researcher



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**ARA Principal Transportation
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Contact – greg.rodriguez@stantec.com

What did we do in 2019?

- Sponsor 2019 TRB AM Session
- Hold workshops on the cross-cutting topics identified in 2018
- Author e-circulars summarizing takeaways from each workshop
- Develop ongoing directory of information resources
- Collaborate with NCHRP 20-102 projects
- Coordinate with international partners, including in France and Australia

The Existential Questions

- What is the vision(s) for a “fully evolved” future?
- What are the potential impacts on government and private sector?
- What are the economic implications?
- What is the importance and role of connectivity?
- What are the potential impacts on our traditional research processes and programs?

Workshops and E-Circulars

Summaries of each of five “existential questions”

- 236: Preparing for Automated Vehicles and Shared Mobility
- 247: Importance and Role of Connectivity
- 252: Transition to Shared Vehicles
- 253: Impacts on Traditional Research Processes
- 258: Roles of Government and Private Sector
- 261: Economic Effects of AVs and Shared Mobility

Other Digital Resources

- Directory of information resources
 - Key resources directly addressing Forum mission
 - Direct links to more than 100 reports published, 2017 to date
 - Continuously updated
- E-community
 - Weekly postings of reports and information affecting Forum mission
- Website

CRP updates

Ray Derr, Project Manager

rderr@nas.edu

Transportation Research Board
National Cooperative Highway Research
Program

Impacts of CVs and AVs on State and Local Transp. Agencies [NCHRP 20-102]

- Summary of TRB Research at <http://bit.ly/2y8gEm4>
- Next selection meeting at Automated Vehicle Symposium, July 27-30, San Diego

<http://bit.ly/2y8gEm4>

Impacts of Connected Vehicles and Automated Vehicles on State and Local Transportation Agencies NCHRP Project 20-102 and Other Efforts

July 2019

The **National Cooperative Highway Research Program** (NCHRP) is funded by the state departments of transportation and managed by the Transportation Research Board, part of the National Academies of Sciences, Engineering and Medicine. **NCHRP Project 20-102** began in Dec. 2014 to tackle CV/AV issues and is being coordinated with the U.S. DOT, private sector, and other efforts. Contact Ray Derr (rderr@nas.edu) for more information.

Reports Available

Updating Regional Transportation Planning and Modeling Tools to Address Impacts of Connected and Automated Vehicles [NCHRP Report 896] addresses transportation supply, road capacity, and travel demand, with [Executive Summary](#) and [Presentation](#).

Dedicating Lanes for Priority or Exclusive Use by Connected and Automated Vehicles [NCHRP Report 891] evaluates opportunities, constraints and guiding principles for implementing dedicated lanes.

Implications of Connected and Automated Driving Systems [NCHRP Web-Only Document 253] helps states identify laws and regulations that may need to be changed. It includes six volumes: [Legal Landscape](#), [State Legal and Regulatory Audit](#), [Legal Modification Prioritization and Harmonization Analysis](#), [Autonomous Vehicle Action Plan](#), [Developing the Autonomous Vehicle Action Plan](#), and [Implementation Plan](#).

Advancing Automated and Connected Vehicles: Policy and Planning Actions for State and Local Transportation Agencies [NCHRP Report 845] presents potential societal outcomes of these technologies and 18 policy and planning strategies that could advance public interests. The [briefing document](#) provides a good introduction.

Impacts of Connected and Automated Vehicles on State and Local Transportation Agencies



Foreseeing the Impact of Transformational Tech. on Land Use and Transportation [NCHRP Report 924]

- Guidance for transportation investment and land use decisions on technologies that
 - Replace the need to travel
 - Facilitate travel
 - Increase flexibility in travel
 - Improve government services
 - Improve the delivery of transportation services
 - Improve the delivery of parking
 - Improve logistics



Credit: fastcodesign.com

Connected Roadway Classification System Development [NCHRP 20-24(112)]

- Report Available on Project Webpage
- Three Infrastructure Approaches
 - Talking to the Road
 - Seeing the Road
 - Simplifying the Road
- Four Classification Levels
 - In Need of Upgrade
 - Meets Best Practice
 - Meets Emerging Markets (1-5 years)
 - Meets Next Decade Market



Credit: nacto.org

Update AASHTO's CV/AV Research Roadmap [NCHRP 20-102(19)]

- Producing Four White Papers
 - Emergency Response and Public Safety Implications of Automated Driving Systems
 - Implications of Highly Automated Vehicles on Planning for Parking Infrastructure
 - Shared Automated Vehicles
 - Dedicated Short-Range Communications (DSRC) & Other Communications for Intelligent Transportation Systems
- First two are being revised, last two are under review
- Copies have been provided to Stantec

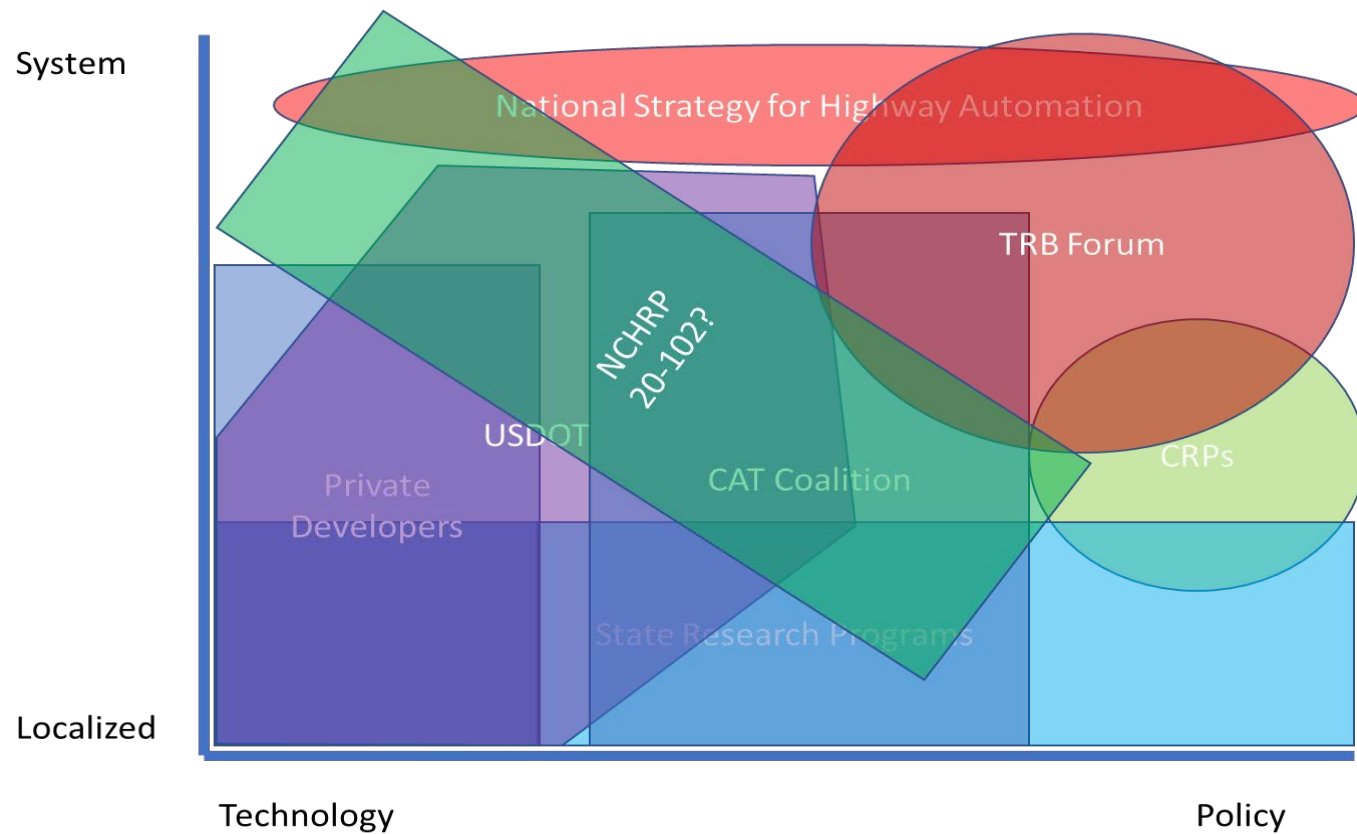


Credit: University of Iowa & Zipcar

Updated Research Roadmap for NCHRP 20-102 (NCHRP 20-102(19)B)— Jan 10, 2020 Meeting

	CAT Coalition	TRB Forum	Private Sector	US DOT	States/Local Agencies	TRB CRPs
What is underway						
Goals						
Audience						
Strengths						
Weaknesses						
Opportunities						
Threats						

- Summary coming soon outlining priorities for 20-102
- Catalog of recommended projects in April



State-of-the-Art Review of CAT Systems [NCHRP 20-124(128)]

Document and disseminate lessons learned from Cooperative Automated Transportation (CAT) system deployments that state and local DOT leadership can apply to decisions affecting their agency

Schedule

Jun 2019, Las Vegas

Oct 2019, ITS WC Singapore

Dec 2019, Arizona

Jan 2020, TRB Session 1647

Apr 2020, Florida

Jun 2020, Germany & Netherlands

Aug 2020, Ohio & Pennsylvania

Oct 2020, ITS WC, Los Angeles



Credit: Steve Kuciemba

Panel

Tracy Larkin-Thomason, NV

Carlos Bracerias, UT

Tom Byron, FL

Shanté Hastings, DE

Randy Iwasaki, Contra Costa Co.

Julie Lorenz, KS

Patrick McKenna, MO

Russell McMurray, GA

Roger Millar, WA

Jennifer Toth, Maricopa Co.

John Corbin, FHWA

Gummada Murthy, AASHTO

What is the Forum doing in 2020?

- Sponsor 2020 TRB AM Session (complete)
- February 24-25: Meet in Washington DC
- July 26-27: Meet in San Diego (with AVS)
 - Future scenarios workshop with BCG
- Late summer 2020: Stantec completes white papers
- Fall 2020: BCG and TRB staff provide final scenario planning report

Next Steps

- Stantec follow-up
- BCG follow-up
- Spring 2020 webinar: likely May, date TBD
- Summer 2020 meeting at AVS in San Diego
 - Sunday and Monday, July 26 and 27, 2020



trb.org/AVSMForum

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