CAMBRIDGE SYSTEMATICS

Think Forward

Incorporating Values and Perceptions into Travel Forecasting

presented to

Innovations in Travel Modeling
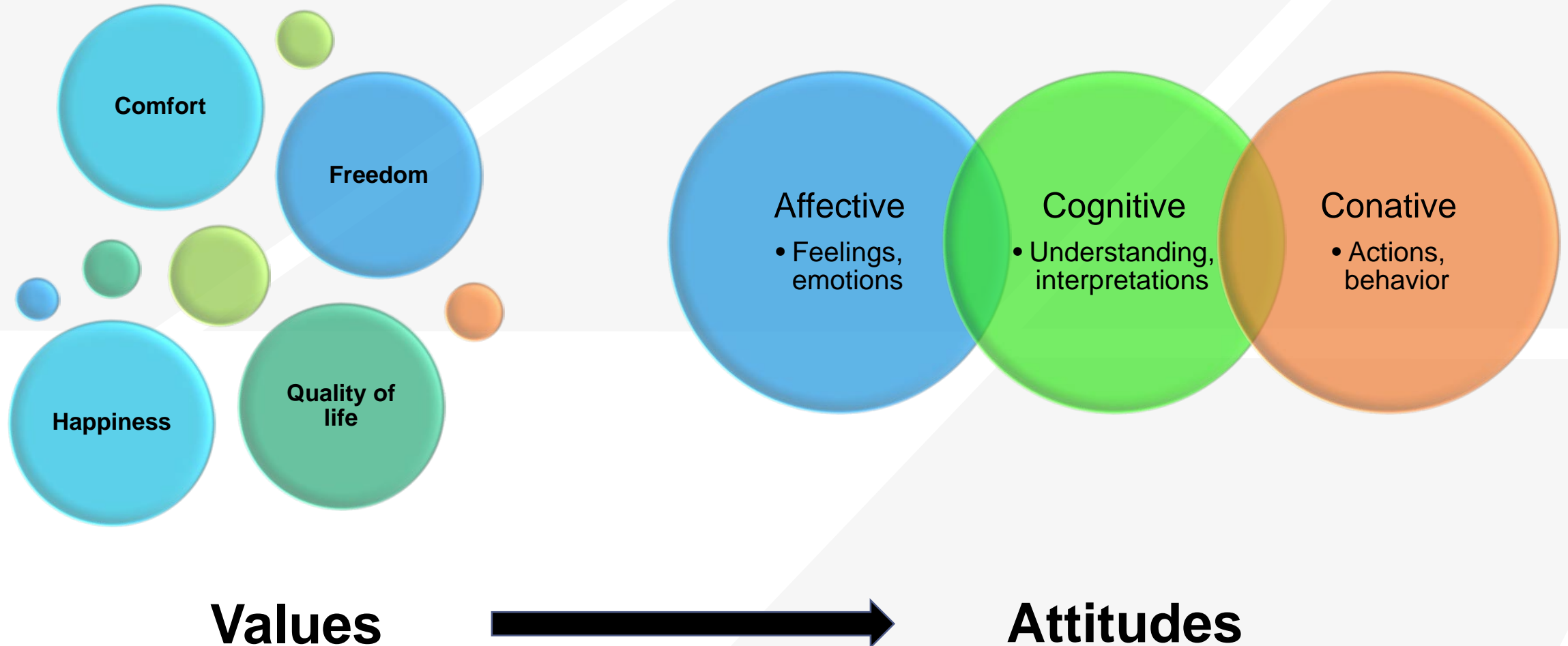
presented by

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Values shape Attitudes

Comfort

Freedom

Happiness

Quality of life

Affective
• Feelings, emotions

Cognitive
• Understanding, interpretations

Conative
• Actions, behavior

Values → **Attitudes**

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Attitudinal Statements

Scale from 1 to 9:

- Use of **transit** can help improve the environment. — 8
- I wouldn't mind **walking** a few minutes to get to my destination. — 8
- If my travel option is **delayed**, I want to know the cause and length of the delay. — 7.5
- I need to have the flexibility to make many trips during the day if necessary. — 6.5
- I would change my form of travel, if it would save me some time. — 6.5
- I use the most convenient form of transportation regardless of cost. — 6.5
- I avoid making certain trips at certain times because it is too stressful to make the trip. — 6.5
- I need to make trips to a wide variety of locations each week. — 6.5
- I would be willing to pay more when I travel, if it would help the environment. — 6
- I would switch to a different form of transportation, if it would help the environment. — 6
- I need to make trips according to a fixed schedule. — 6
- I don't mind taking a longer trip, if I could make productive use of my time when I travel. — 6

Scale from 1 to 10 (lower section):

- I am usually in a hurry when I make a trip.
- I always take the fastest route to my destination, even if I have a cheaper alternative.
- I don't like to drive but it is usually the fastest way to get where I need to go.
- Having a stress-free trip is more important than reaching my destination quickly.
- People who drive alone should pay more to help improve traffic congestion situation.
- I wouldn't mind the traffic congestion, if it was predictable from day-to-day.
- I don't mind delays as long as I am comfortable.
- I don't know how to reach my destination using public transportation.
- I prefer to make trips **alone** because I like time to myself. — 4
- I would use another form of transportation, if I could **afford** it. — 3.5
- I am usually **anxious and unsettled** when traveling. — 3

Categories: Environment, Walking, Reliability

Travel alone → Affordability → Anxiety

Confirmatory Factor Analysis

Latent Factors
(from factor analysis)

Explanatory variables
(for mode choice analyses)

Decision variables
(for policy purposes)

Traveler Attitudes

Need for Flexibility

Sensitivity to Personal Travel Experience
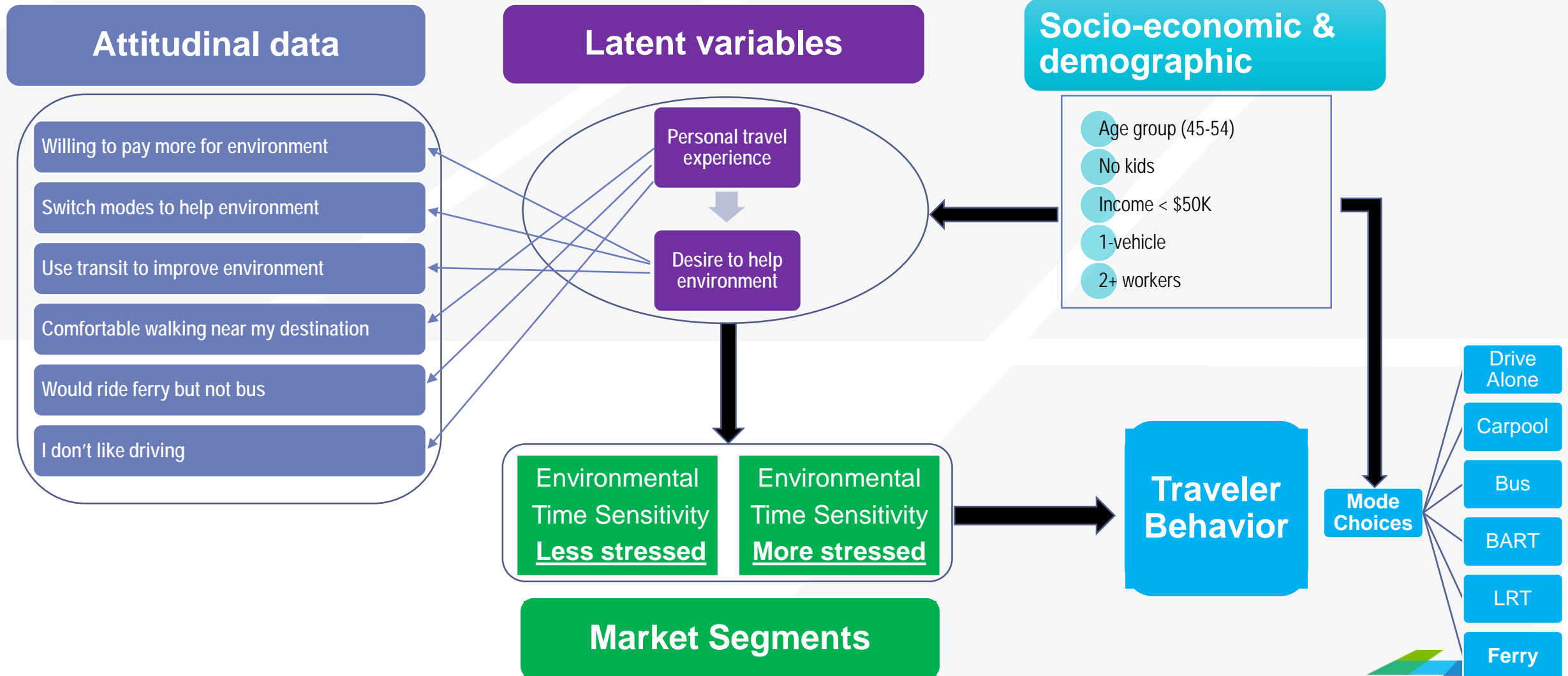
Desire to Help the Environment

Need for Time Savings

Insensitivity to Transport Costs

Sensitivity to Stress

Factor/Variable	Variable Statements	Coefficient	Std Error	t-value
Factor One	Desire to help the environment			
PAYENVIR	I would be willing to pay more when I travel if it would help the environment.	1.000		
MODENVIR	I would switch to a different form of transportation if it would help the environment.	0.949	0.028	33.447
TRNENVIR	Use of transit can help improve the environment.	0.376	0.018	20.887
Factor Two	Need for timesavings			
CHANGMOD	I would change my form of travel if it would save me some time.	1.000		
HURRY	I am usually in a hurry when I make a trip.	0.911	0.023	39.283
FASTEST	I always take the fastest route to my destination even if I have a cheaper alternative.	0.760	0.024	32.044
NOSTRESS	Having a stress-free trip is more important than reaching my destination quickly.	-0.680	0.030	-22.978
CROWDSOK	I'll put up with crowds if it means I'll get to my destination quickly.	0.657	0.020	32.082
COMFORT	I don't mind delays as long as I am comfortable.	-0.511	0.021	-23.848
DLDRIVE	I don't like to drive, but it is usually the fastest way to get where I need to go.	0.418	0.025	16.791
Factor Three	Need for flexibility			
VARIETY	I need to make trips to a wide variety of locations each week.	1.000		
NEEDFLEX	I need to have the flexibility to make many trips during the day if necessary.	0.841	0.031	27.555
REGULAR	Generally, I make the same types of trips at the same times of the day.	-0.489	0.023	-21.654

Deriving Market Segments

Attitudinal data

- Willing to pay more for environment
- Switch modes to help environment
- Use transit to improve environment
- Comfortable walking near my destination
- Would ride ferry but not bus
- I don't like driving

Latent variables

Personal travel experience

↓

Desire to help environment

Socio-economic & demographic

- Age group (45-54)
- No kids
- Income < $50K
- 1-vehicle
- 2+ workers

Environmental Time Sensitivity **Less stressed** | Environmental Time Sensitivity **More stressed**

Market Segments

Traveler Behavior

Mode Choices

- Drive Alone
- Carpool
- Bus
- BART
- LRT
- **Ferry**

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Innovations

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Attitudes towards CAVs
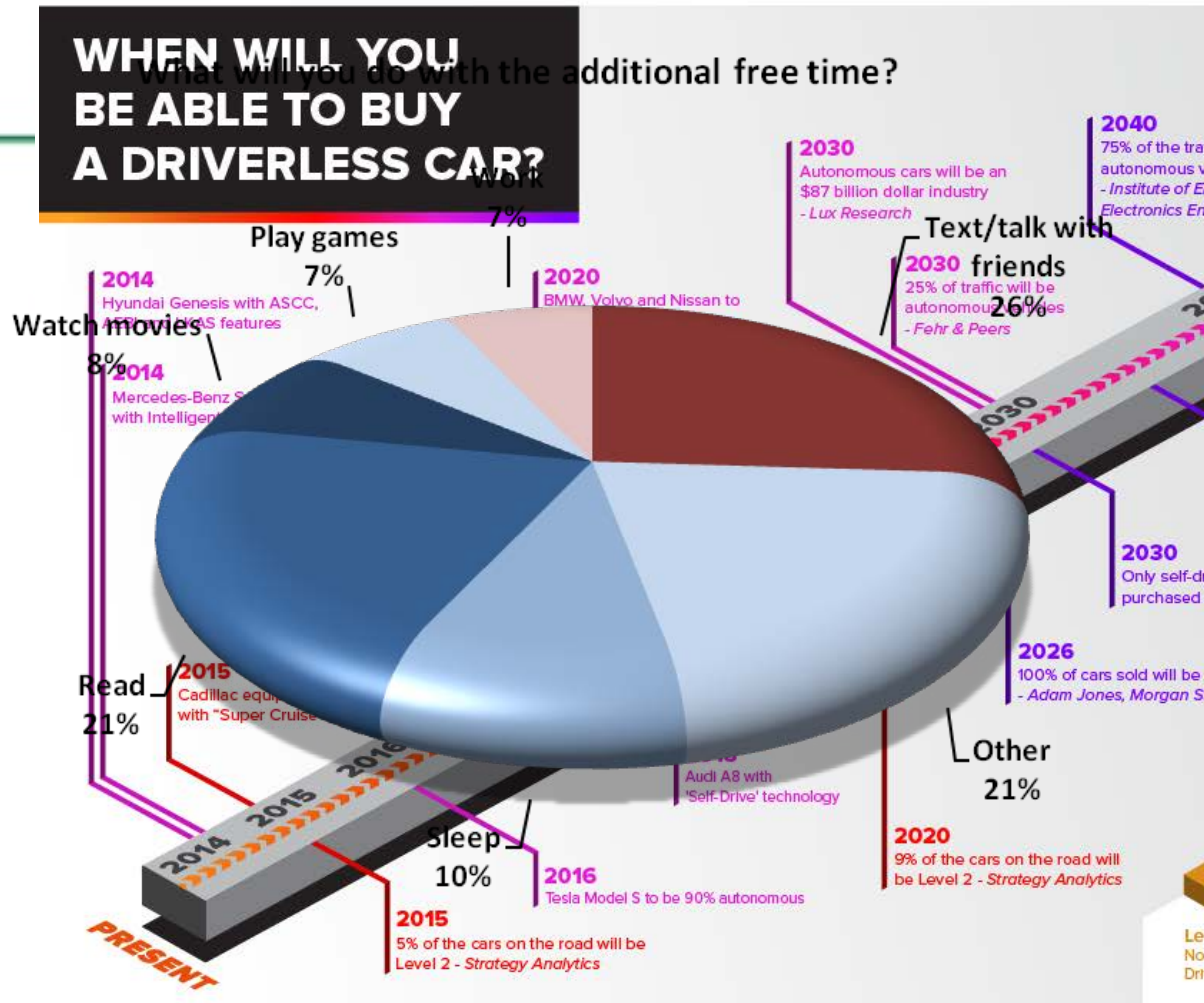
Attribute	Response
Willingness to ride	58%
Willingness to let kids ride	35%
Willingness to share	38%
Willingness to buy	44%
Willingness to pay	50%
Cost of AV features	$4,000 to $10,000
Adoption rates	12% (2025), 25% (2035), 50% (2050)
Arrival of CAVs	2019-2025
Top 3 reasons to adopt	Insurance, safety, time savings
Major concerns	Safety, cybersecurity, technology
Market segments	Millennials, transit riders, ride hailers

WHEN WILL YOU BE ABLE TO BUY A DRIVERLESS CAR?

What will you do with the additional free time?

Work 7%
Play games 7%
Watch movies 8%
Text/talk with friends 26%
Read 21%
Other 21%
Sleep 10%

2014 — Hyundai Genesis with ASCC, ADAS features
2014 — Mercedes-Benz S with Intelligent
2015 — Cadillac equipped with "Super Cruise"
2015 — 5% of the cars on the road will be Level 2 - Strategy Analytics
2016 — Tesla Model S to be 90% autonomous
2020 — BMW, Volvo and Nissan to
2020 — 9% of the cars on the road will be Level 2 - Strategy Analytics
Audi A8 with 'Self-Drive' technology
2026 — 100% of cars sold will be a - Adam Jones, Morgan Sto
2030 — Autonomous cars will be an $87 billion dollar industry - Lux Research
2030 — 25% of traffic will be autonomous vehicles - Fehr & Peers
2030 — Only self-dri purchased in
2040 — 75% of the traff autonomous ve - Institute of Ele Electronics Eng

PRESENT

Sources: Mercedes-Benz, GM News, Strategy Analytics, Automotive News, Nissan News, Navigant Research, Volvo News, Fehr & Peers, Lux Research, IHS

mojomotors

Customer feedback in a Mobility-as-a-Service (MaaS) future

Natural Language Processing
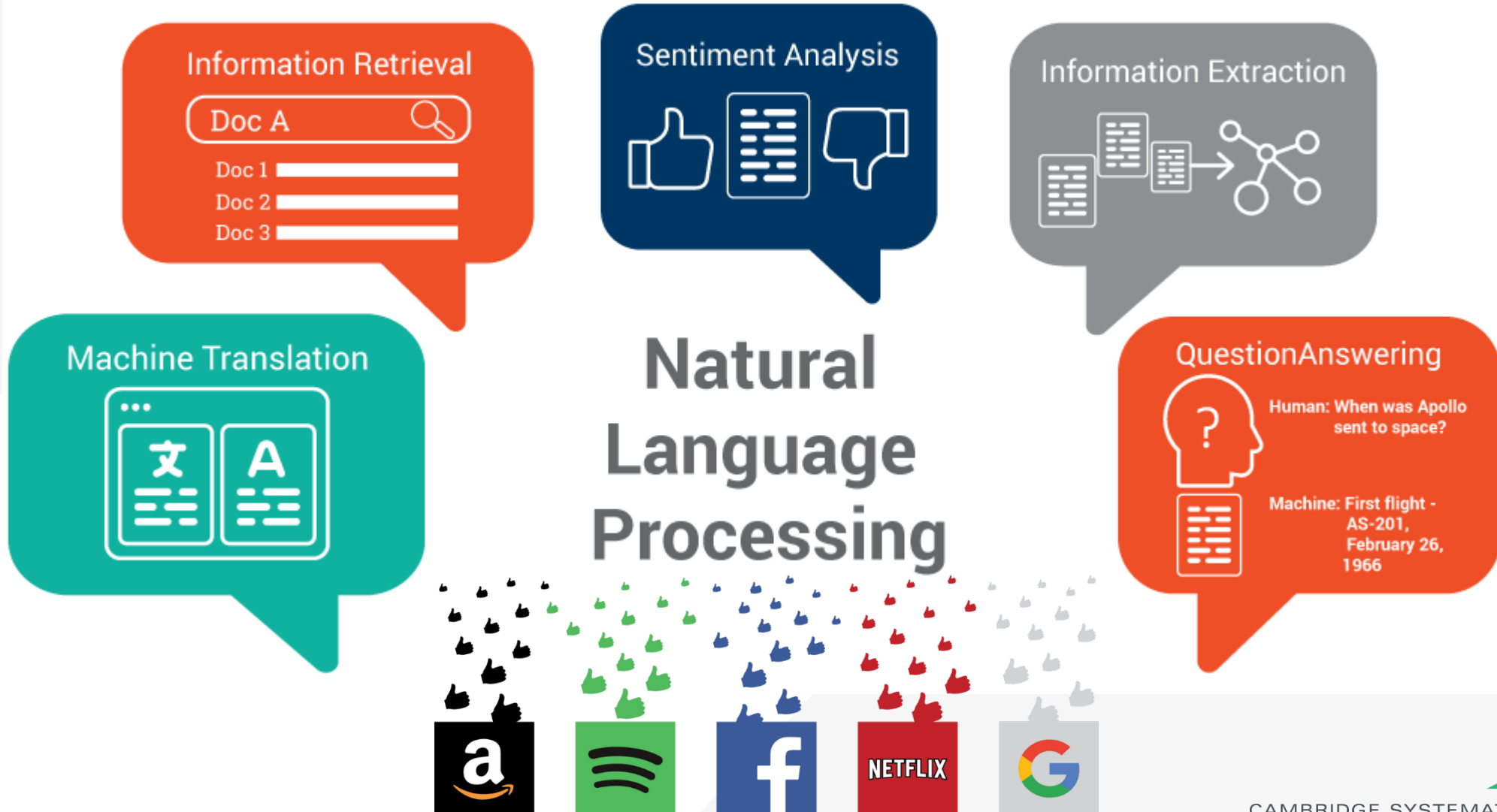
Sentiment Analysis

Process of computationally identifying and categorizing opinions expressed in a piece of text, especially in order to determine customer's attitude towards a particular topic, product, or service

Collaborative Filtering
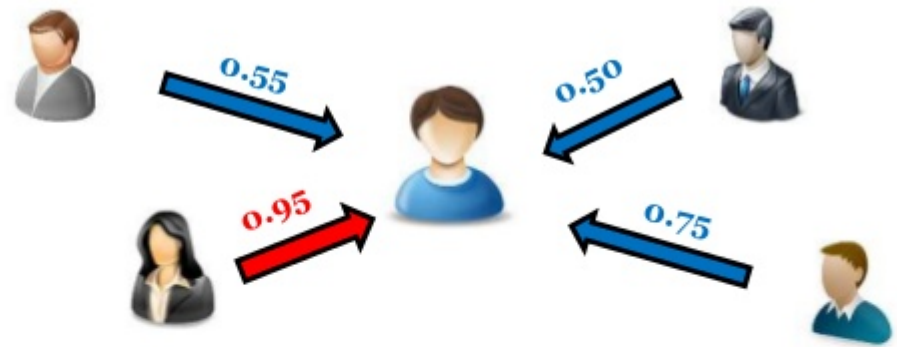
Challenges

Need for different forecasting frameworks

- **Avoid congestion**
- **Traveler feedback**
- Machine learning

Real-time
Within the hour

**'Near'
Real-time**
Same day
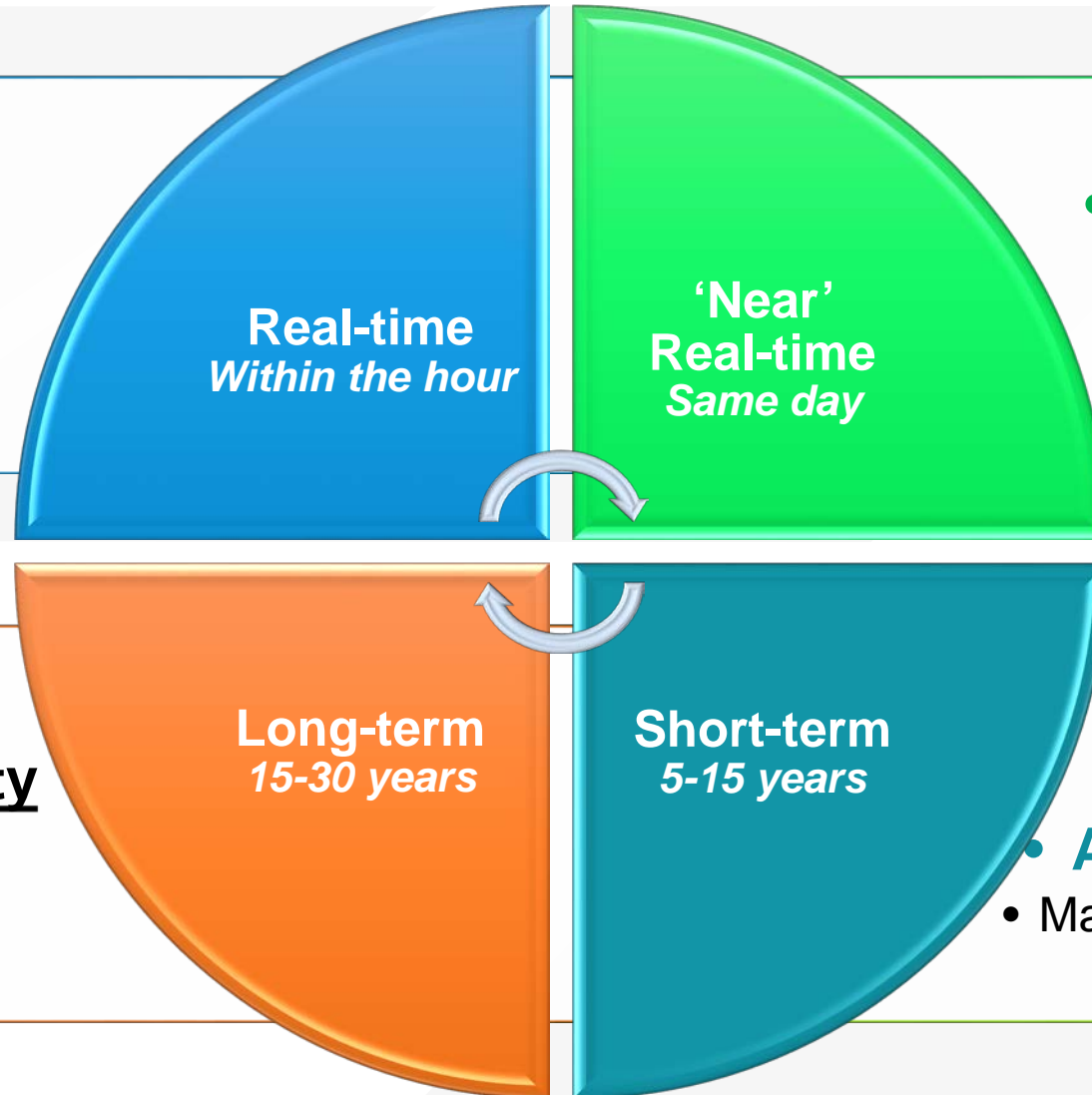
- **Plan trips using MaaS**
- **Traveler preferences**
  - Machine learning

Long-term
15-30 years

Short-term
5-15 years

- **LRTP, MTP, Conformity**
- **Travel surveys**
- Econometric methods

- **EIR, MIS, Corridors**
- **Attitudes towards modes**
  - Machine learning and econometric

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Collecting data on a 'regular' basis

Traditional methods

- Expensive and intrusive

Reliability: how accurate are people's responses?

- Perceptions vs behavior

MaaS Providers

- Build user profile reflecting travel behavior, preferences and demographics

Harnessing data from private sector

- Ride hailing, car sharing, cell phone trace data

Emotion detection from facial expressions using AI

- Measures consumer's engagement with brands based on reactions
- Alert driver when feeling drowsy (in self-driving cars)

(a) angry   (b) disappointed   (c) laughing   (d) surprised

Need to be "customer-centric"

CAVs
- Affects VMT
- Impacts LU patterns
- Changes congestion 'hotspots'

Traveler experience
- Values
- Perceptions

Sharing economy
- Affects transit
- Impacts vehicle availability
- Changes residential location

Drive alone · Carpool · Bus · Walk · Bike

Vanpool · Light rail · Heavy rail · Subway · Private bus

Ride hailing · Ride sharing · Car sharing · E-scooter sharing · Bike sharing