

Assessing the Stability of Company Strategies over Time

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U.S. Department of Transportation
Office of the Secretary of Transportation

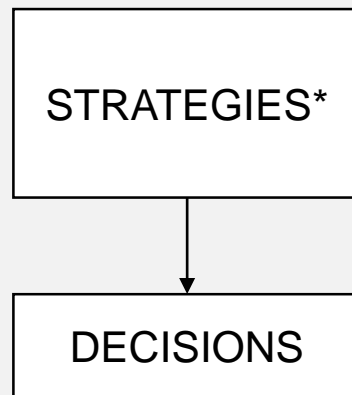
Bureau of Transportation Statistics



ABMs from a Freight Agent Perspective

Background and Objectives

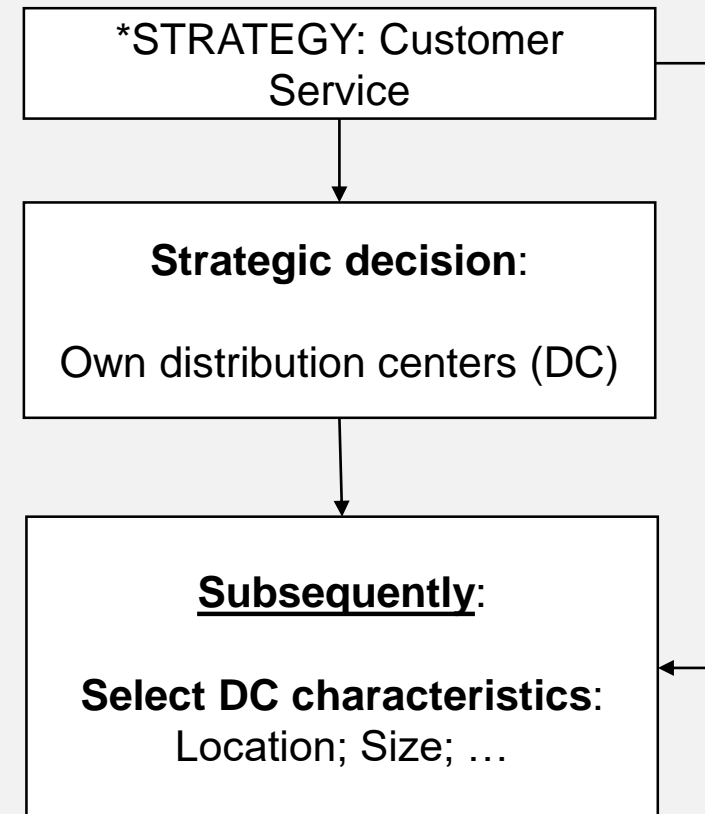
State of practice:



*and other variables

But some downstream decisions occur later → Need strategic alignment:

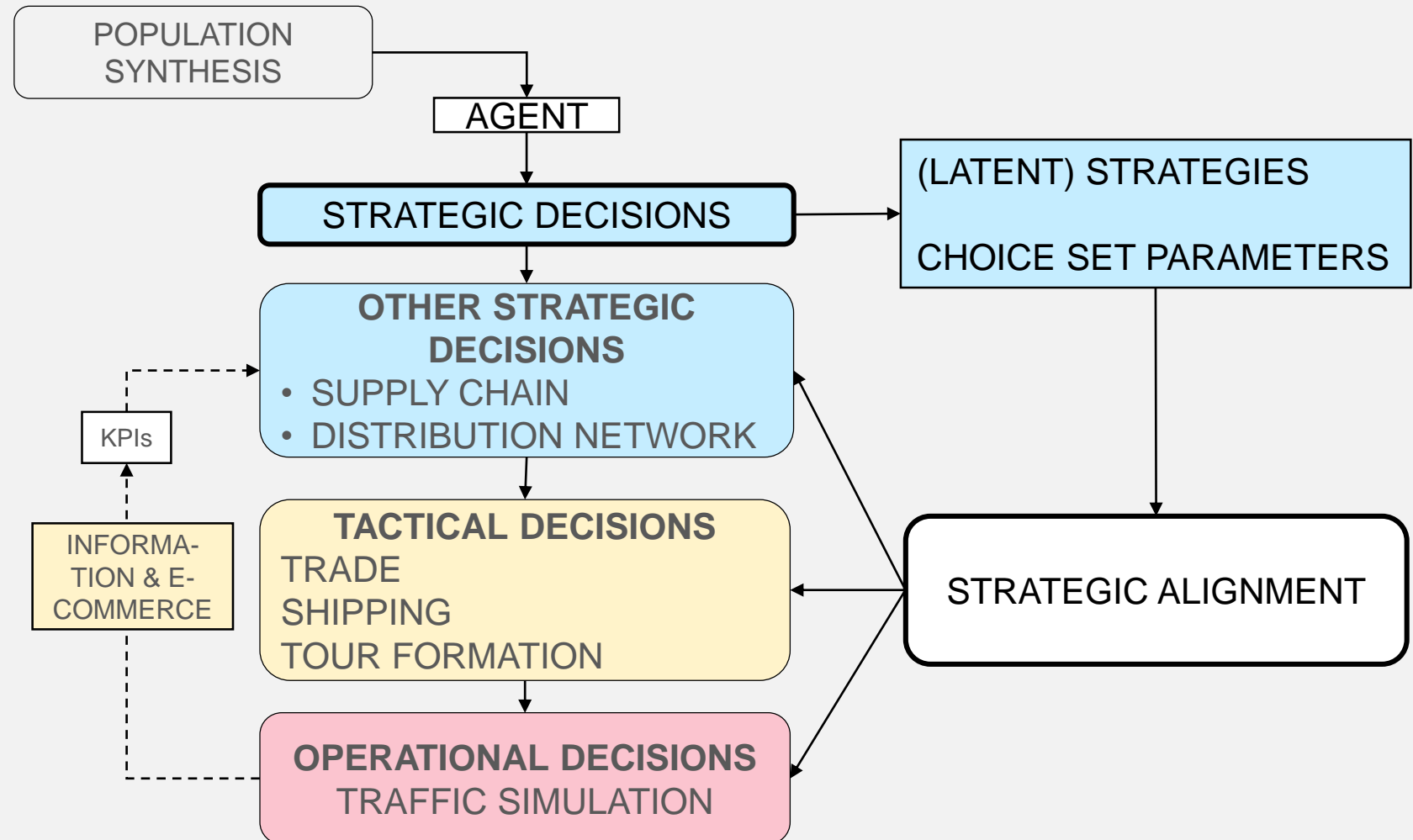
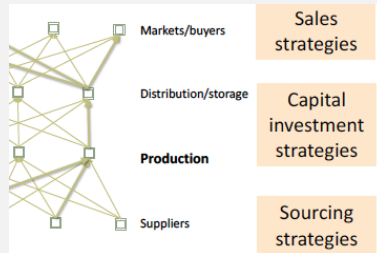
Example



CRISTAL: Strategic Alignment in ABMs

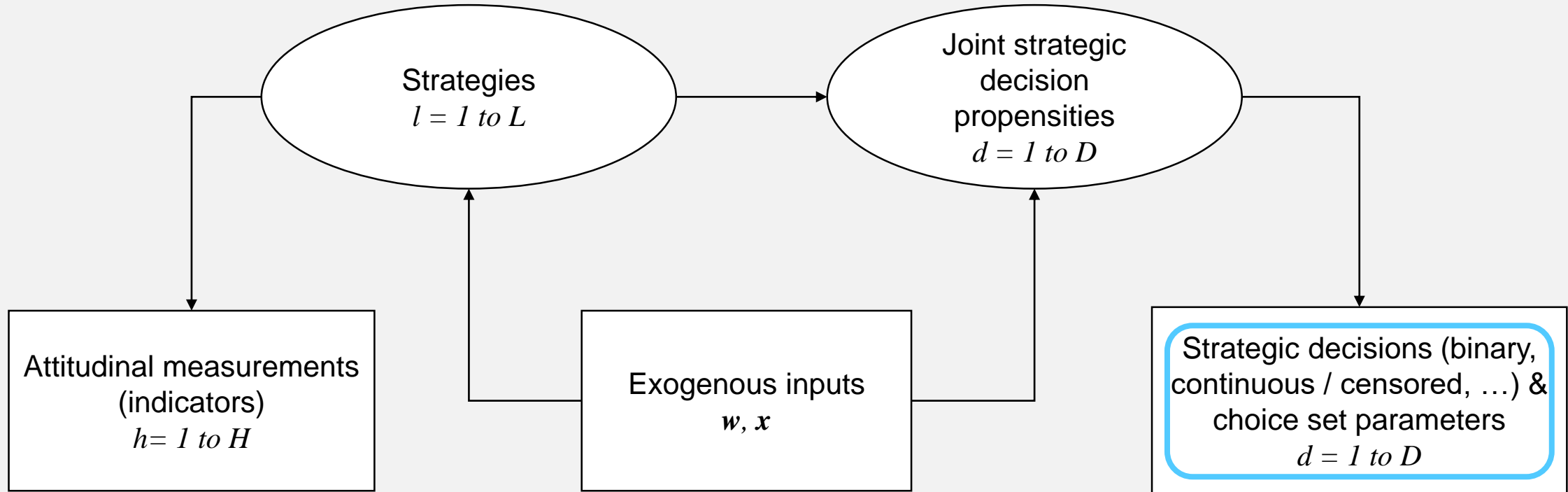
CRISTAL

Collaborative
Informed
Strategic
Trade
Agents
with
Logistics



SURTLV* Model to Operationalize Strategic Alignment

*Seemingly Unrelated Regression with Tobit and Latent Variables



LEGEND

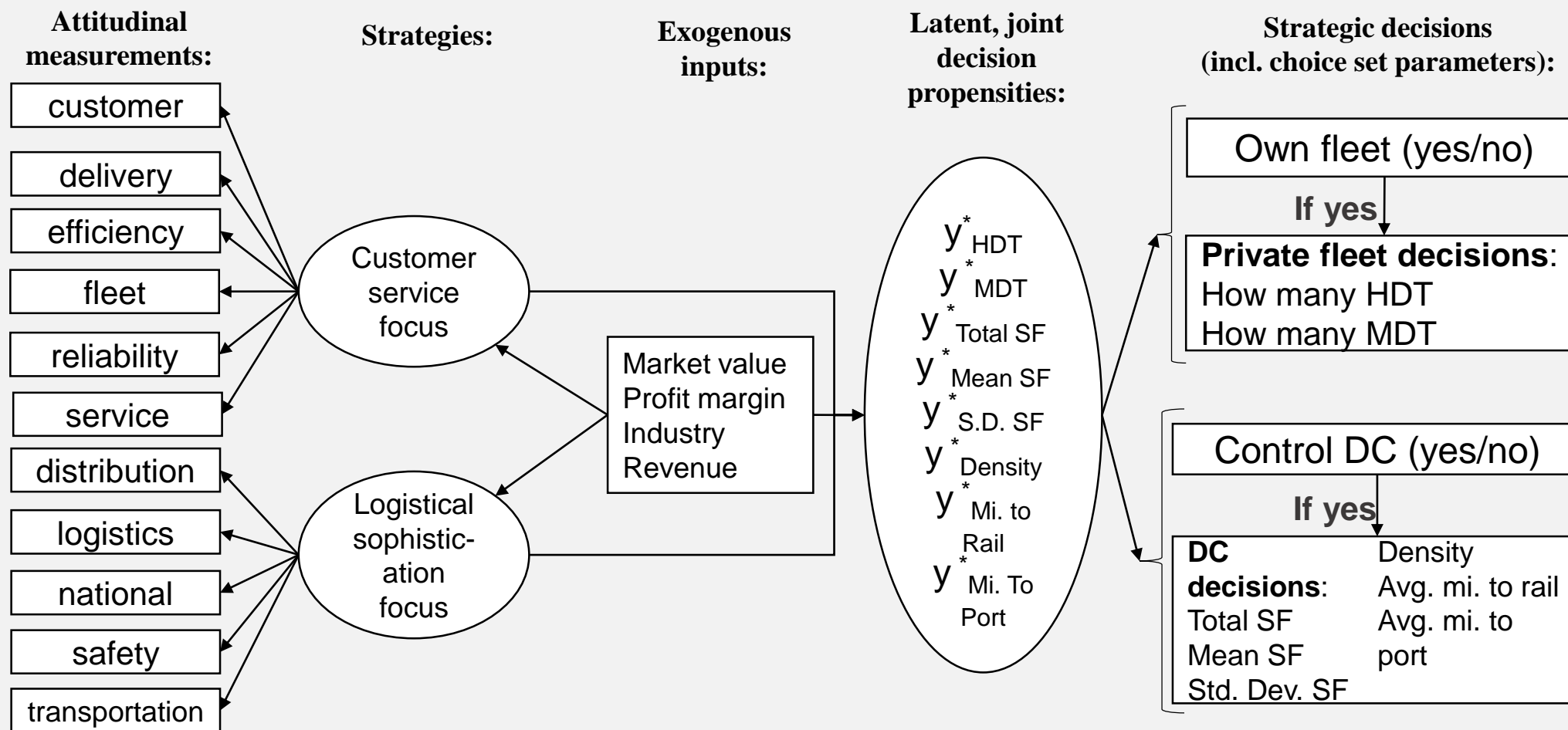
Latent

Observable

Strategic Alignment

HDT (MDT): heavy- (medium-) duty trucks
DC: distribution center

Applying the SURTLV model:

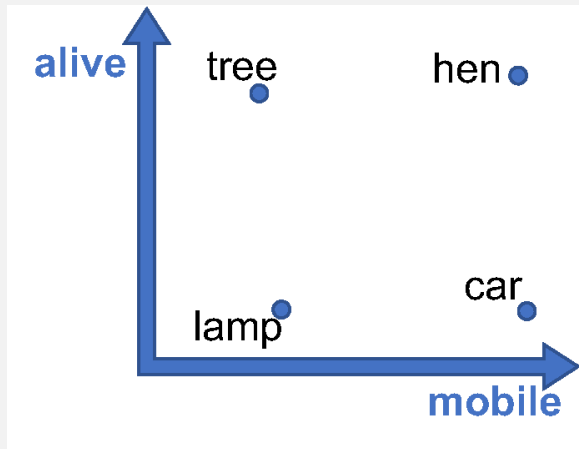


Natural Language as a Source of Strategy Data

- Strategy data sources
 - Surveys (challenges: burdensome, expensive, pre-determined questions,...)
 - Natural language text sources
- Freight examples: company reports and letters to shareholders
- Annual reports describe the collective views of company executives and actions of the company
- US Securities and Exchange Commission (SEC) requirement: publicly owned US companies file an annual 10-K report
- Fortune 500 companies in freight-intensive sectors

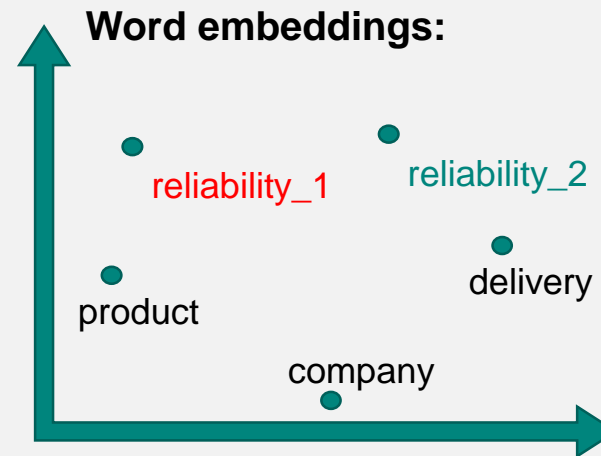
W2VPCA: Generating Strategy Measurements from Natural Language

**Background:
Words as Vectors**



Hypothesis:

Company goals → strategies →
report content → word use



**Company 1 strategy:
focus on product
development**

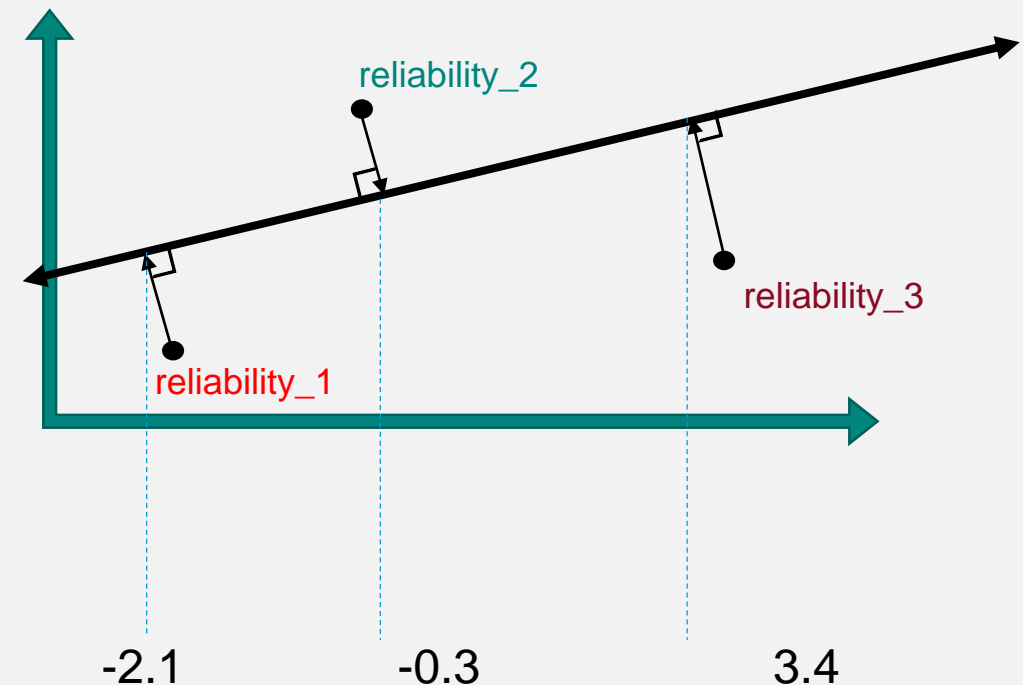
**Company 2 strategy:
focus on delivery**

W2VPCA: The Algorithm

1. Select keywords to serve as strategy measurements
2. Tag each keyword to be company-specific
3. Apply word2vec (Mikolov et al., 2013)
4. Apply Principal Components Analysis (Pearson, 1901)
5. Measure differences on principal component

Claim:

W2VPCA output = strategy measurements:

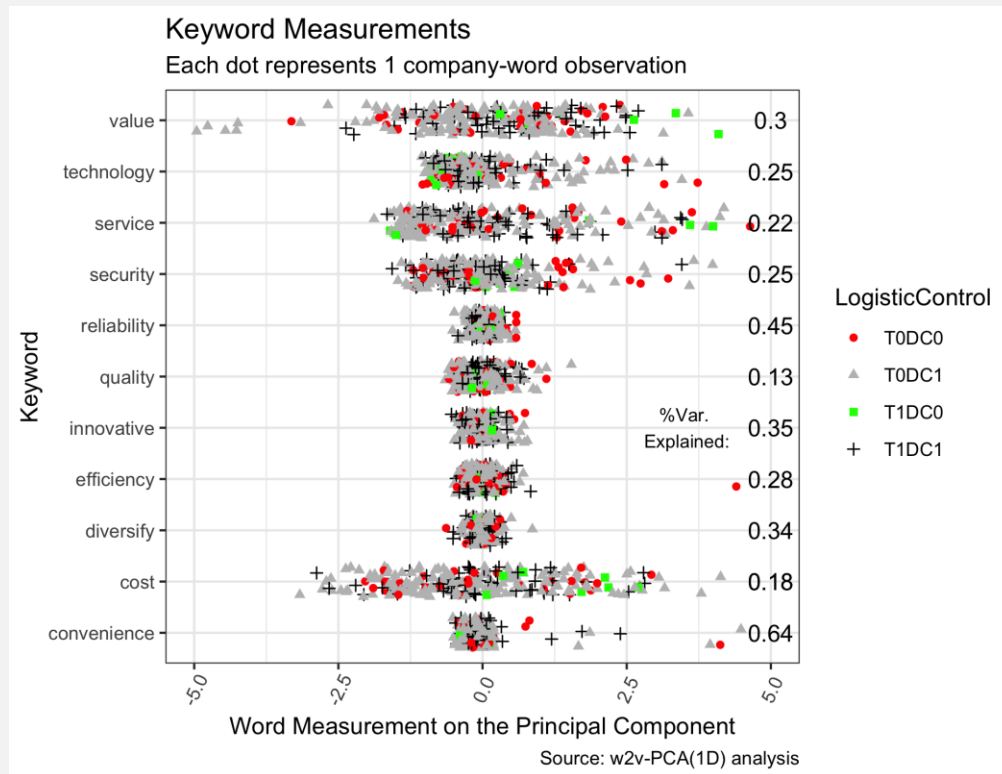


W2VPCA Results

250 US Fortune 500 companies in freight-intensive sectors

- Text data: SEC 10-K reports from 2017
- Distribution center data: CoStar real estate data
- Fleet data: FleetSeek magazine

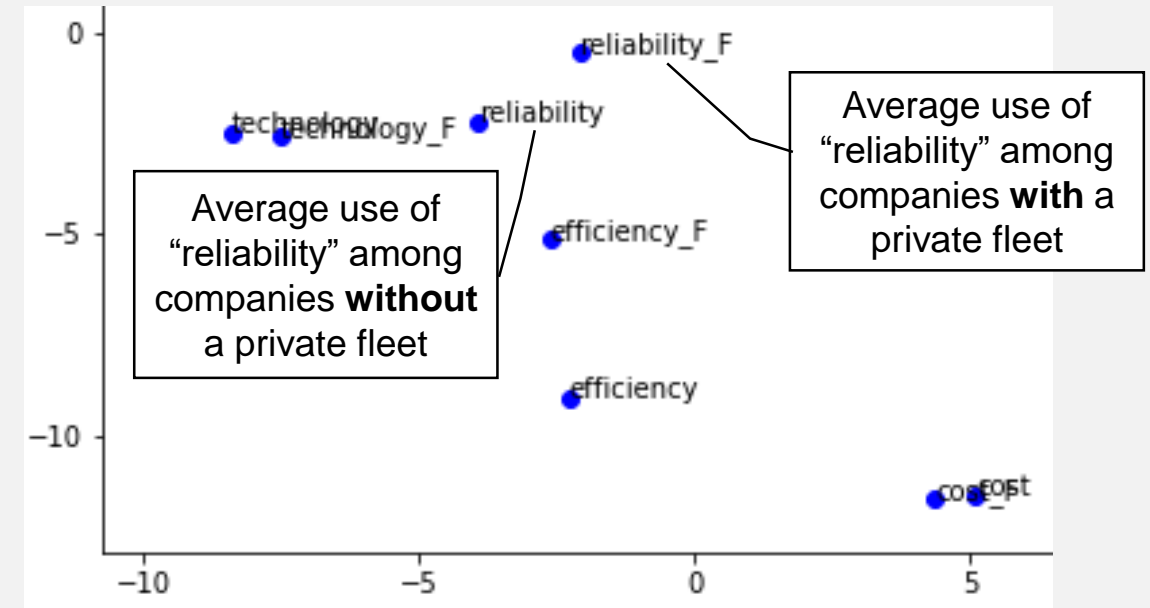
Measurements for 11 Keywords (250 companies)



T0=no private fleet (vs. 1)

Bureau of Transportation Statistics DC0=does not own/lease DC (vs. 1)

Measurements for 4 Keywords (Two Groups of Companies) – Projected from 100-space to 2-space using the 1st two PCs



“_F”=“has private fleet”

Application 1: Confirmatory Factor Analysis (CFA)

Result: W2VPCA CFA Yields Good Fit; Bag-of-Words (BOW) CFA is rejected

Measurement source:

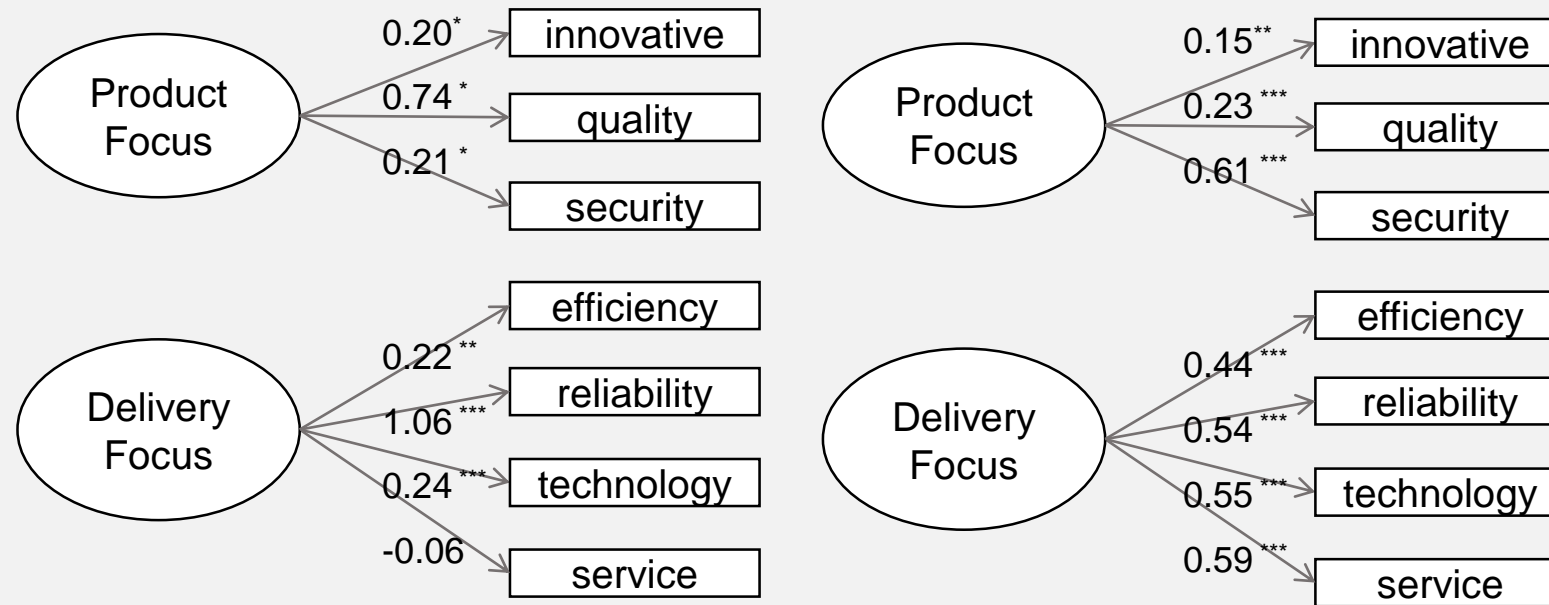
Comparative Fit Index (CFI)

BOW

0.849

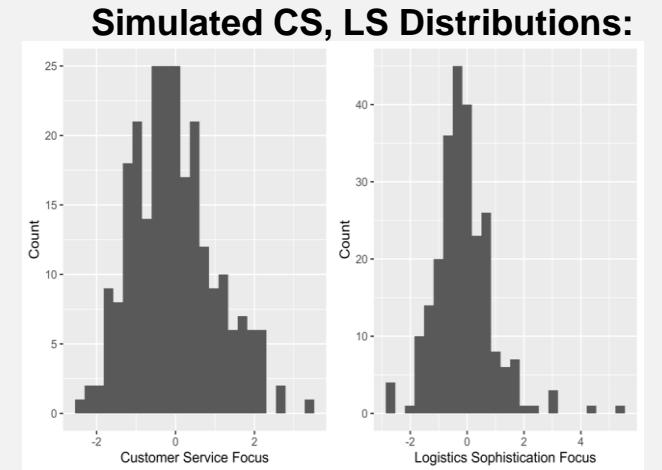
W2VPCA

0.917



Application 2: SURTLV Model Using W2VPCA Measurements

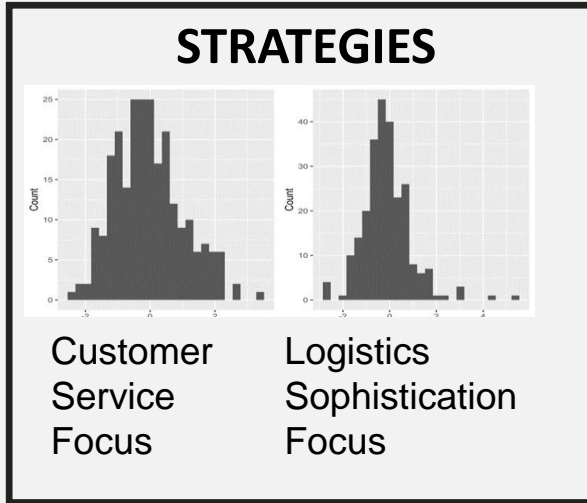
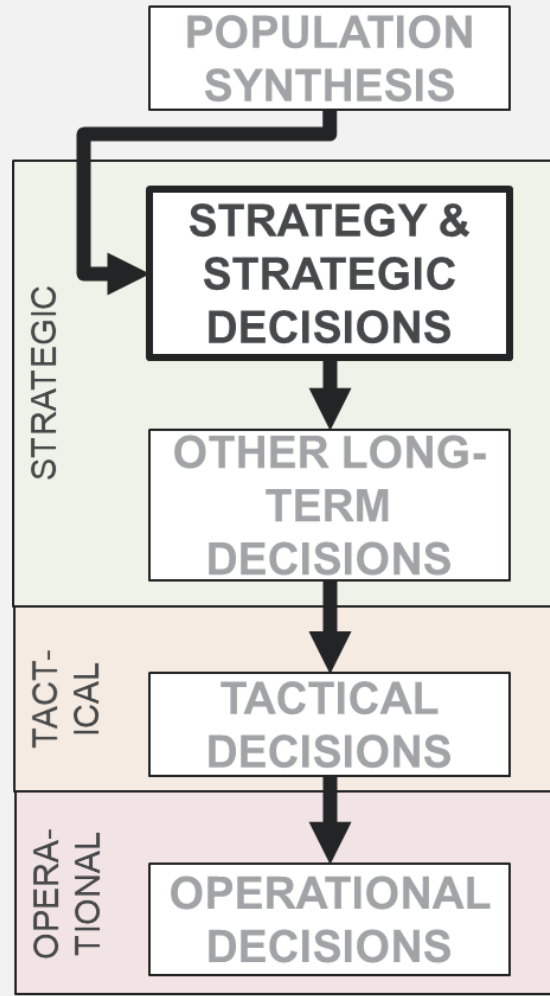
| Measurement variable h : | z^* : Customer service (CS) focus | | | Measurement variable h : | z^* : Logistical sophistication (LS) focus | | |
|----------------------------|-------------------------------------|-----------|--|----------------------------|--|-----------|--|
| | Est. (s.d.) | t -stat | | | Est. (s.d.) | t -stat | |
| customer | 0.77 (0.08) | 9.50 | | distribution | 0.74 (0.09) | 8.29 | |
| delivery | 0.18 (0.07) | 2.64 | | logistics | 0.19 (0.07) | 2.74 | |
| efficiency | 0.09 (0.07) | 1.31 | | national | 0.05 (0.07) | 0.75 | |
| fleet | 0.04 (0.07) | 0.65 | | safety | 0.16 (0.07) | 2.17 | |
| reliability | 0.07 (0.07) | 1.02 | | transportation | 0.35 (0.07) | 4.66 | |
| service | 1.06 (0.09) | 11.99 | | | | | |



| Strategic decision d : | Tot. SF | | | Mean SF | | |
|--------------------------------------|-----------------------|-------------|-----------|--------------|-----------|--|
| | Variable (x, z^*) | Est. (s.e.) | t -stat | Est. (s.e.) | t -stat | |
| Intercept | -4.03 (0.97) | -4.14 | | -0.54 (0.72) | -0.75 | |
| Food/Petro./Gases | -0.15 (0.28) | -0.55 | | -0.64 (0.21) | -3.07 | |
| Retail/Wholesale | 0.49 (0.21) | 2.32 | | 0.07 (0.16) | 0.46 | |
| Revenue | 5.08 (1.01) | 5.04 | | 1.85 (0.75) | 2.48 | |
| Customer service (CS) focus | -0.12 (0.11) | -1.14 | | -0.17 (0.08) | -2.10 | |
| Logistical sophistication (LS) focus | -0.38 (0.12) | -3.14 | | -0.26 (0.09) | -2.96 | |

→ CS, LS influence distribution center decisions (total area; avg. size; ...)

Strategic Alignment Demo



STRATEGIC ASSET DECISIONS

Fleet size and mix
 Number of Medium-Duty Trucks
 Number of Heavy-Duty Trucks

Distribution Center (DC) preferences:
 Total Area (Square Feet, SF)
 Mean Area
 Variance in Area
 Proximity to Water Port
 Proximity to Intermodal Yard

Align downstream decisions
Example: Create DC Location Choice Set using Strategy Model.
 Preferred DC Area: 650+/-150 SF & Preferred Miles to Intermodal (IMX) Truck-Rail Yard: <15 mi.

800K SF

700K SF

600K SF

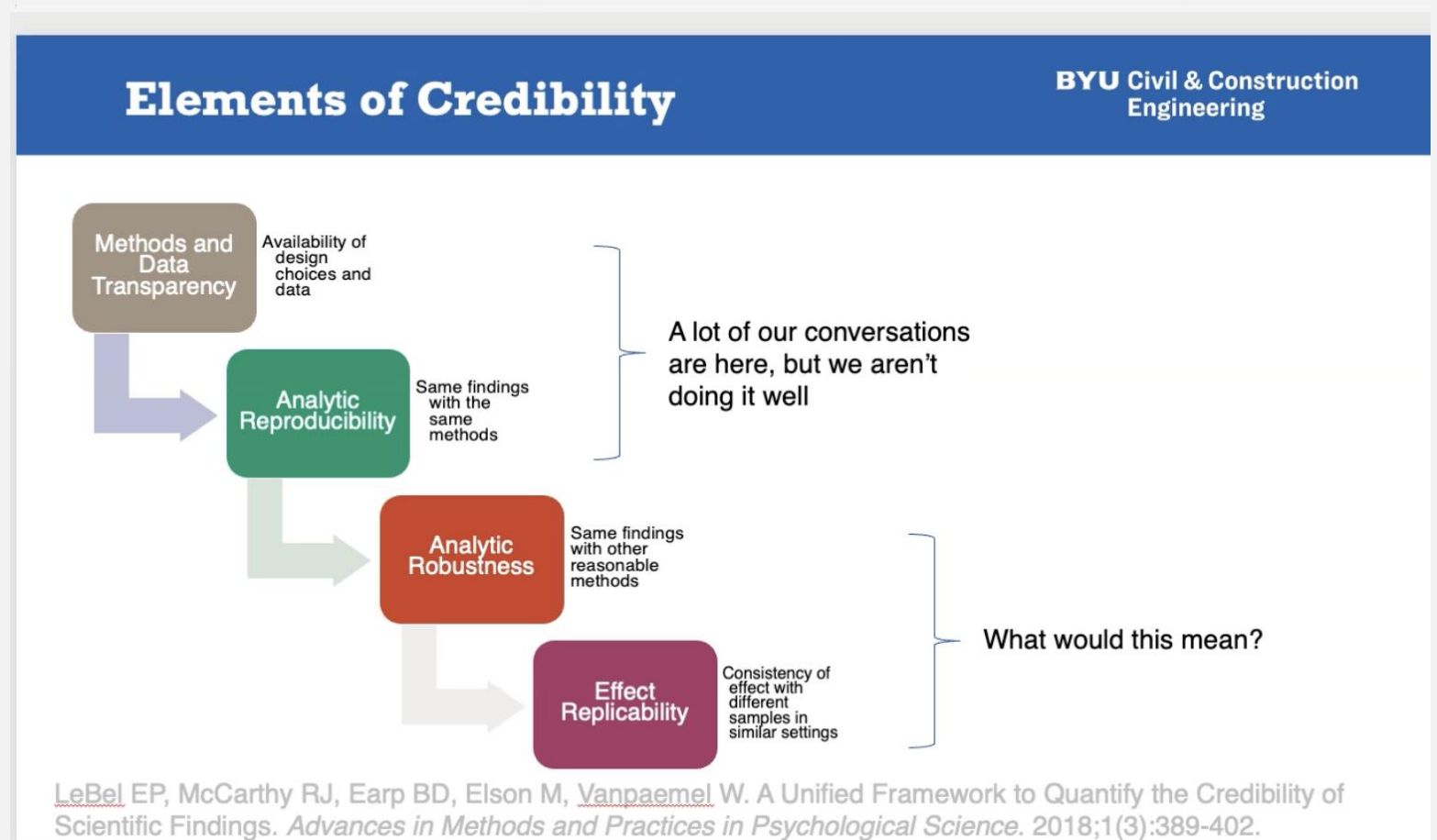
IMX truck-rail yard
 Candidate location



Elements of Credibility

Reflections

Please reflect on the graphic below on the Elements of Credibility for scientific findings, particularly in regard to your own ABM research as well as to ABM research as a whole. Are we achieving these elements? If so, how? If not, how could we? How important is it for us to do so? If you are giving a presentation, please use a few of your podium minutes to share these reflections.





Thoughts for Future Research: Stability of Strategies over Time

Evaluating Strategies over Time

Research question: Are company strategies stable over time?

Hypotheses:

- Permanent strategies: temporally stable; importance may wax or wane
- Short/medium-duration strategies: firms will adapt (or abandon) other strategies over time
- Strategy magnitude and mix will vary in response to environmental factors (geopolitics, tariffs, climate disasters, ...), macroeconomic conditions, measurable success of the firm, and other factors

Research Design

Design

- Retrospective analysis of company strategies and decisions ~last 25 years
- Repeat the work described above for select companies
- Gather supplemental data (esp. on environmental factors)

Second research question

What quantities are comparable across time?

- Measurements
- Strategies

Potential test: Apply SURTLV or other model → the estimated parameters represent the impacts of strategy on observable strategic decisions → are the parameter values similar in years when environmental conditions are similar?



Thank you!

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Acknowledgement

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(1) Introducing CRISTAL: A model of collaborative, informed, strategic trade agents with logistics; Stinson and Mohammadian (2024); (2) W2VPCA: A Machine Learning Method for Measuring Attitudes With Natural Language; (3) A Method to Integrate Strategic Alignment in Freight Transportation Behavioral Models.