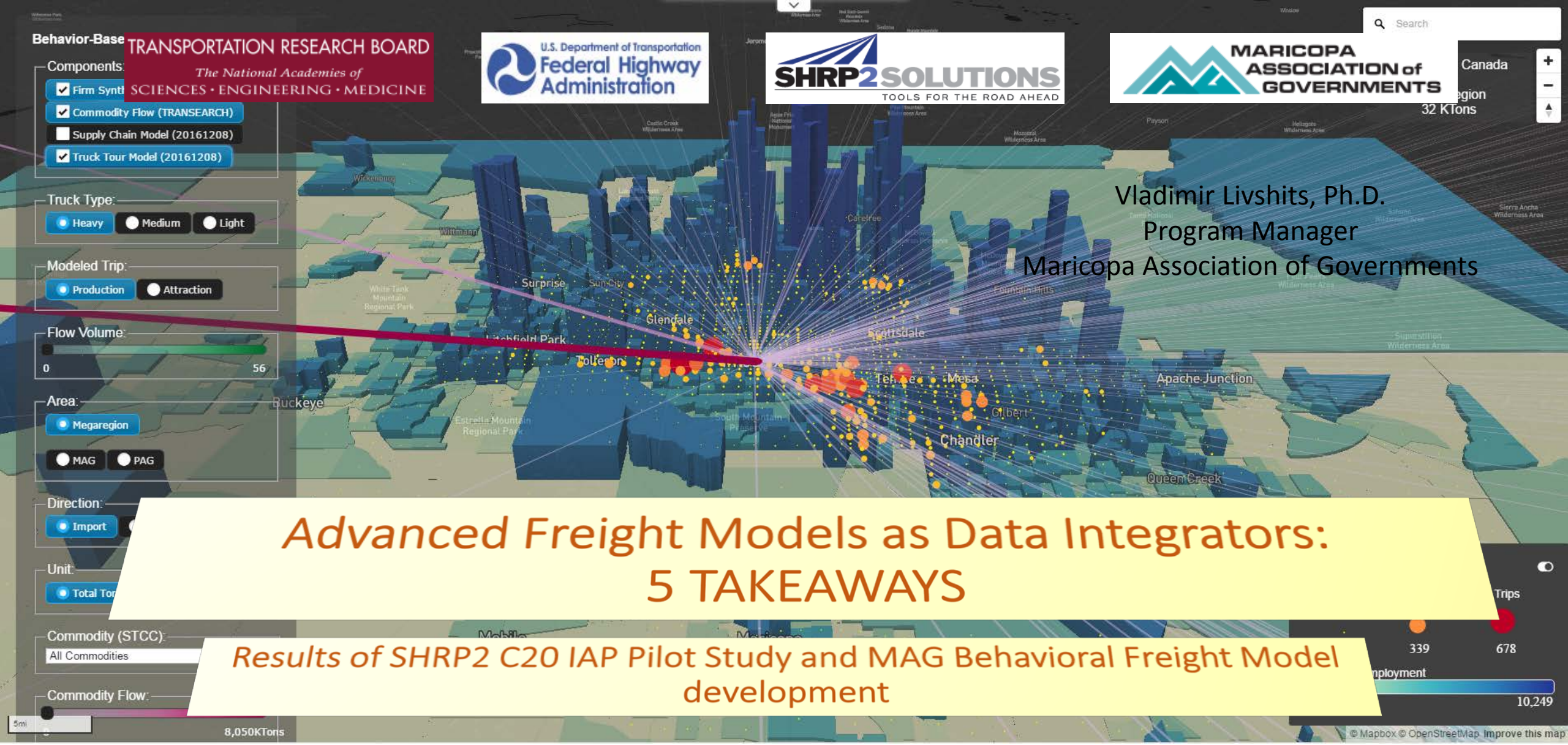


Advanced Freight Models as Data Integrators: 5 TAKEAWAYS

Results of SHRP2 C20 IAP Pilot Study and MAG Behavioral Freight Model development

Vladimir Livshits, Ph.D.
Program Manager
Maricopa Association of Governments

Project Contributors

Project Contributors -

Maricopa Association of Governments

Arizona Department of Transportation

American Transportation Research Institute, Inc.

Cambridge Systematics, Inc.

CDM Smith, Inc.

Federal Highway Administration

IHS Global Insight

InfoGroup

Pima Association of Governments

RS&H, Inc.

StreetLight Data, Inc.

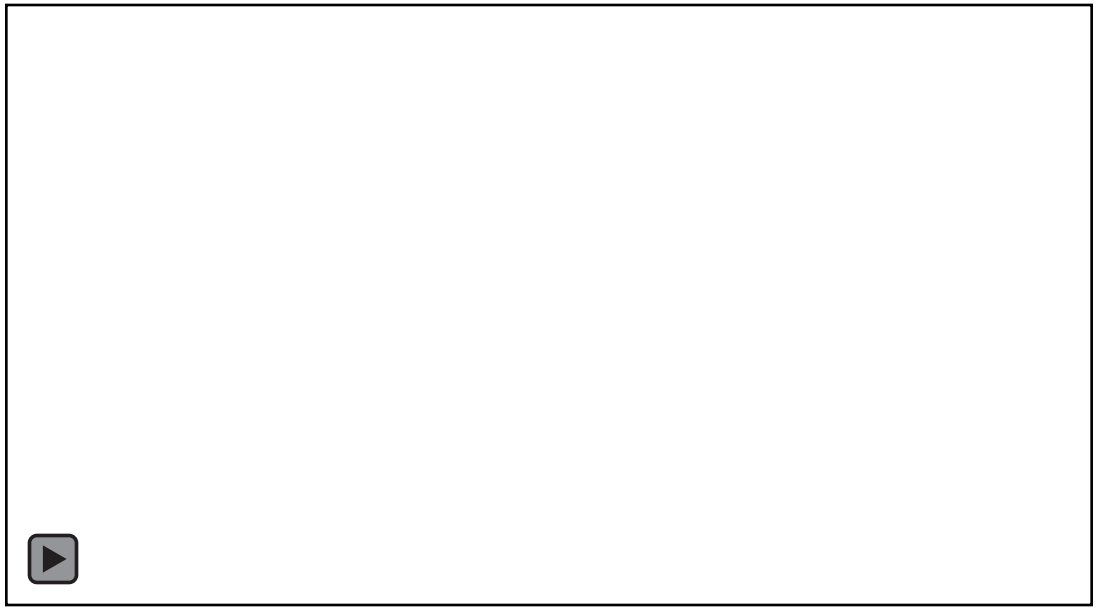
Walls and Associates, Inc.

Prepared with assistance from
Federal Highway Administration (FHWA)
SHRP2 C20 IAP Grant

http://www.azmag.gov

WHAT

Our goal was to develop a mega-regional multimodal behavioral freight model



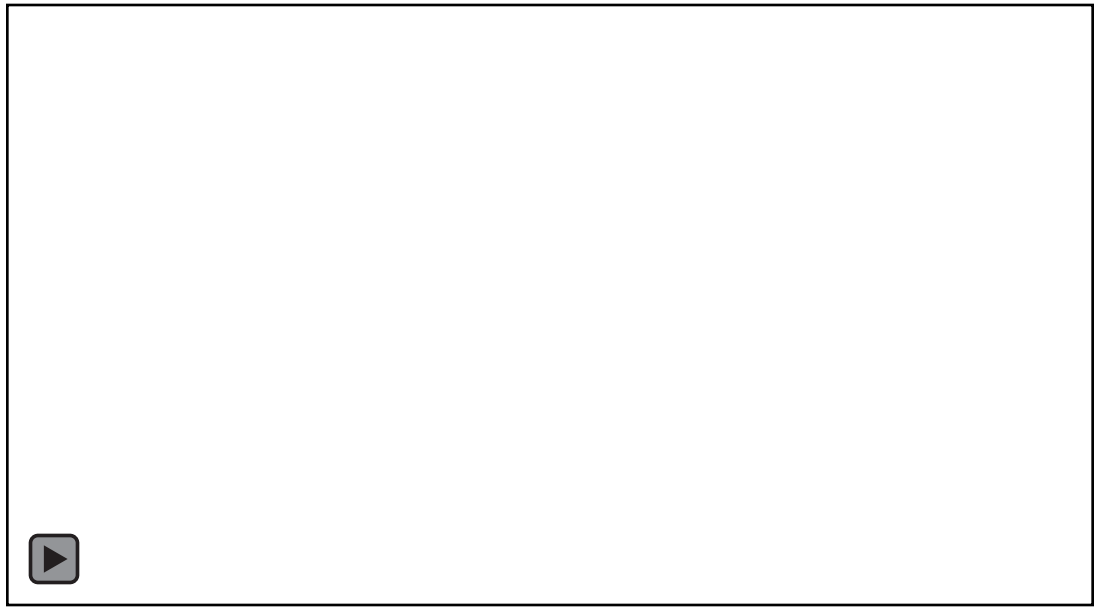


Table 3 shows the sub-models and data sources in a single table and details of each table in subsequent sections.

Table 3. Data Sources by Modeling Needs (See Table3_DataSourcesSnapshot.xlsx for a clear view)

Data Source	Model	Data Type	Spatial	Temporal	Mode	Commodity	Traffic Count	Data Use		
								Estimation	Calibration	Validation
Bureau of Economic Analysis (BEA) Input/Output Tables	Firm Synthesis	IO	National	Annual				✓	✓✗	✗
County Business Patterns (CBP)	Firm Synthesis	TS	County	Annual				✓	✓	✓
National Establishment Time-Series (NETS)	Firm Synthesis	TS	County	Annual				✓	✓✗	✓
Longitudinal Business Dynamics (LBD)	Firm Synthesis	TS	State	Annual				✗	✗	✓
Annual Survey of Manufacturers (ASM)	Firm Synthesis	TS	State	Annual				✗	✗	✓
Business Dynamics Statistics	Firm Synthesis	TS	MSA	Annual				✗	✓	✓
Business Employment Dynamics	Firm Synthesis	TS	County	Quarterly				✓	✓	✓
Commodity Flow Survey (CFS)	Supply Chain	TrS	CSA or MSA	Every 5 years	Truck, Rail, Air, Water, Pipeline, Other	SCTG commodities		✗	✓	✓
Freight Analysis Framework (FAF)	Supply Chain	TrS	CSA or MSA	Every 5 years	Truck, Rail, Air, Water, Pipeline, Other	SCTG commodities		✓	✓	✓
Transearch	Supply Chain	TrS	County/TAZ available on demand	Annual	Truck, Rail, Air, Water, Pipeline, Other	STCC commodities		✓	✓	✓
Surface Transportation Board (STB) Carload Waybill Sample	Supply Chain	TrS	BEA	Annual	Rail	STCC commodities		✗	✓	✓
Air Carrier Statistics	Supply Chain	TrS	Airport	Monthly	Air	None		✗	✓	✓
North American Transborder Freight Database	Supply Chain	TrS	State and Port of Entry/Exit	Monthly	Truck, Rail, Air, Water, Pipeline, Other	SITC	Yes	✗	✓	✓
PIERS	Supply Chain	TrS	Port	Annual	Water	HS		✓	✓	✓
National Highway Planning Network (NHPN)	Transportation Chain	TC, Net	State	Unknown			Yes	✓	✓	✓
National Performance Management Research Dataset (NPMRDS)	Truck Touring	TC, Net	Traffic Message Channel	Every 5 minutes	Trucks	Unknown		✓	✓	✓
ATRI	Truck Touring	TC, Net	Truck Lat/Long	Second	Trucks	Unknown		✓	✓	✓
MAG Roadway Network	Transportation Chain	TC, Net								
Vehicle Inventory and Use Survey (VIUS)	Transportation Chain	WD	State	Every 5 years	Freight Trucks and Commercial Vehicles	None		✗	✓	✓
ORNL Rail Network	Transportation Chain	TC, Net	Unknown	Unknown	Rail			✓	✓	✓✗
VTRIS	Transportation Chain	WD	Weight Station	Unknown	Freight Trucks and Commercial Vehicles	None		✗	✓	✓
Establishment Surveys	TrS, SS	Establishment	Establishment	Varies by Sponsor						

✓ - Applies ✓✗ - May apply ✗ - Does not apply

System Analysis Program: **2015 Behavior Based Freight Model Development**

Table 2. Data Sources by Data Type (See Table2-DataSourcexType.xlsx for a clear view)

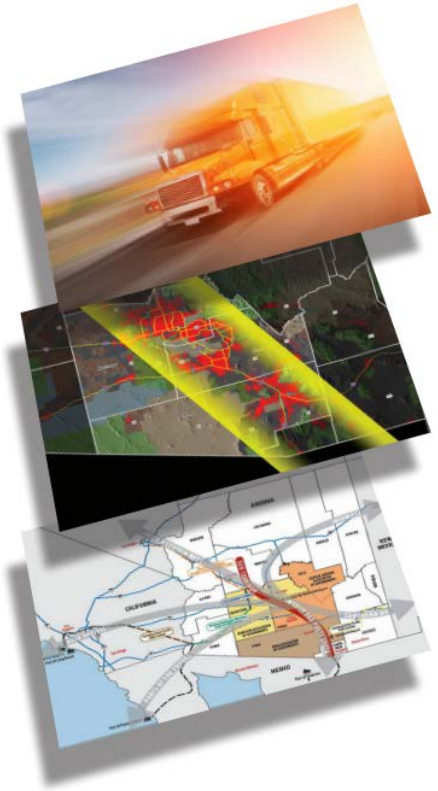
Data Source	Data Type										Spatial (Smallest Geography)	Temporal
	Trade Statistics	National Account Data	Transportation Statistics	Shipper surveys	Stated preference surveys	Consignment Bills and RFID data	Traffic Count data	Weight Data	Network data with cost functions	Terminal data		
Bureau of Economic Analysis (BEA) Input/Output Tables		✓			Project Specific						National	Annual
County Business Patterns (CBP)	✓										County	Annual
National Establishment Time-Series (NETS)	✓										County	Annual
Longitudinal Business Dynamics (LBD)	✓										State	Annual
Annual Survey of Manufacturers (ASM)	✓										State	Annual
Business Dynamics Statistics	✓										MSA	Annual
Business Employment Dynamics	✓										County	Quarterly
Commodity Flow Survey (CFS)			✓	✓							CSA or MSA	Every 5 years
Freight Analysis Framework (FAF)			✓								CSA or MSA	Every 5 years
Transearch			✓								County/TAZ available on demand	Annual
Surface Transportation Board (STB) Carload Waybill Sample			✓								BEA	Annual
Air Carrier Statistics			✓								Airport	Monthly
North American Transborder Freight Database			✓								State and Port of Entry/Exit	Monthly
PIERS			✓			✓				✓	Port	Annual
National Highway Planning Network (NHPN)							✓		✓		State	Unknown
National Performance Management Research Dataset (NPMRDS)							✓		✓		Traffic Message Channel	Every 5 minutes
ATRI							✓		✓		Truck Lat/Long	Second
MAG Roadway Network							✓		✓		Unknown	Unknown
Vehicle Inventory and Use Survey (VIUS)								✓			State	Every 5 years
ORNL Rail Network									✓		Unknown	Unknown
VTRIS								✓			Weight Station	Unknown
Establishment Surveys			✓	✓							Establishment	Varies by Sponsor

✓ - Applies

Traffic Message Channel (TMC) is the basic spatial unit (roadway segment) used to report the traffic flow data and at which NPMRDS data is available. TMC is a specific application of the FM Radio Data System (RDS) used for broadcasting real-time traffic and weather information. A 9 digit TMC ID is used to define a unique segment and direction of roadway in North America. For interstates and principal arterials TMCs are coded as two way but for lower functional class roads directionality is not always considered. The length of the roadway segment is variable. In urban areas, TMCs can be as short as a few hundred feet while in rural areas TMCs can be several miles long.

Strategic Highway Research Program 2 (SHRP2)
Freight Demand Modeling and Data Improvement (C20)
Implementation Assistance Program (IAP)

SHRP2



Mega-Regional Multi-Modal Agent-Based Behavioral Freight Model

MAG Next Generation Freight Demand Model

Final Report

Prepared with assistance from
Federal Highway Administration (FHWA)
SHRP2 C20 IAP Grant

U.S. Department of Transportation
Federal Highway Administration

Feburary 10, 2017 Update

MARICOPA ASSOCIATION of GOVERNMENTS ADOT PAG Pima Association of Governments

Maricopa Association of Governments (MAG) System Analysis Program
2015 Behavior Based Freight Model Development

Review of Freight Data Sources for the Development of a Behavior-Based Freight Model

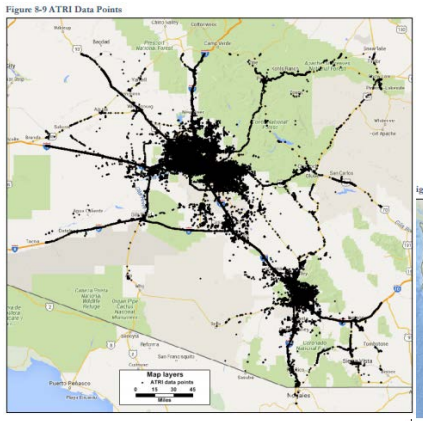
April 15, 2015

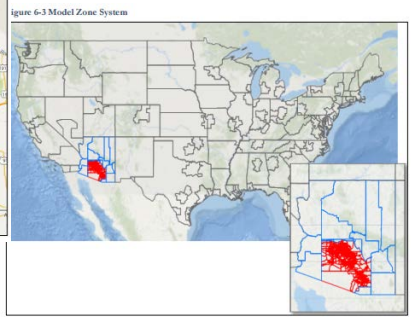
Prepared By

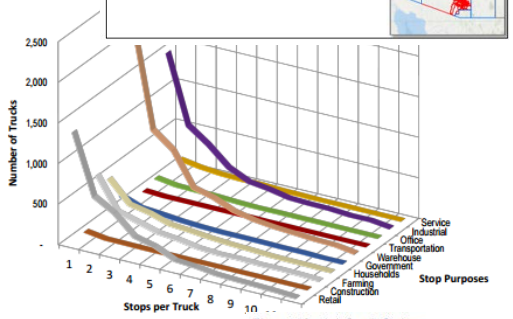
CDM Smith

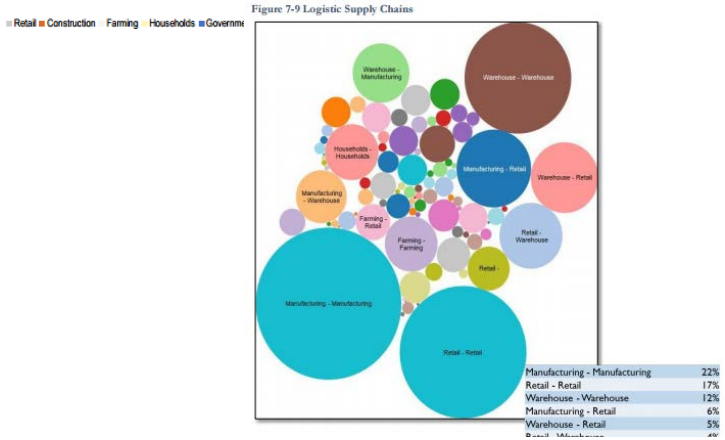
WHY

Beyond Proof of Concept

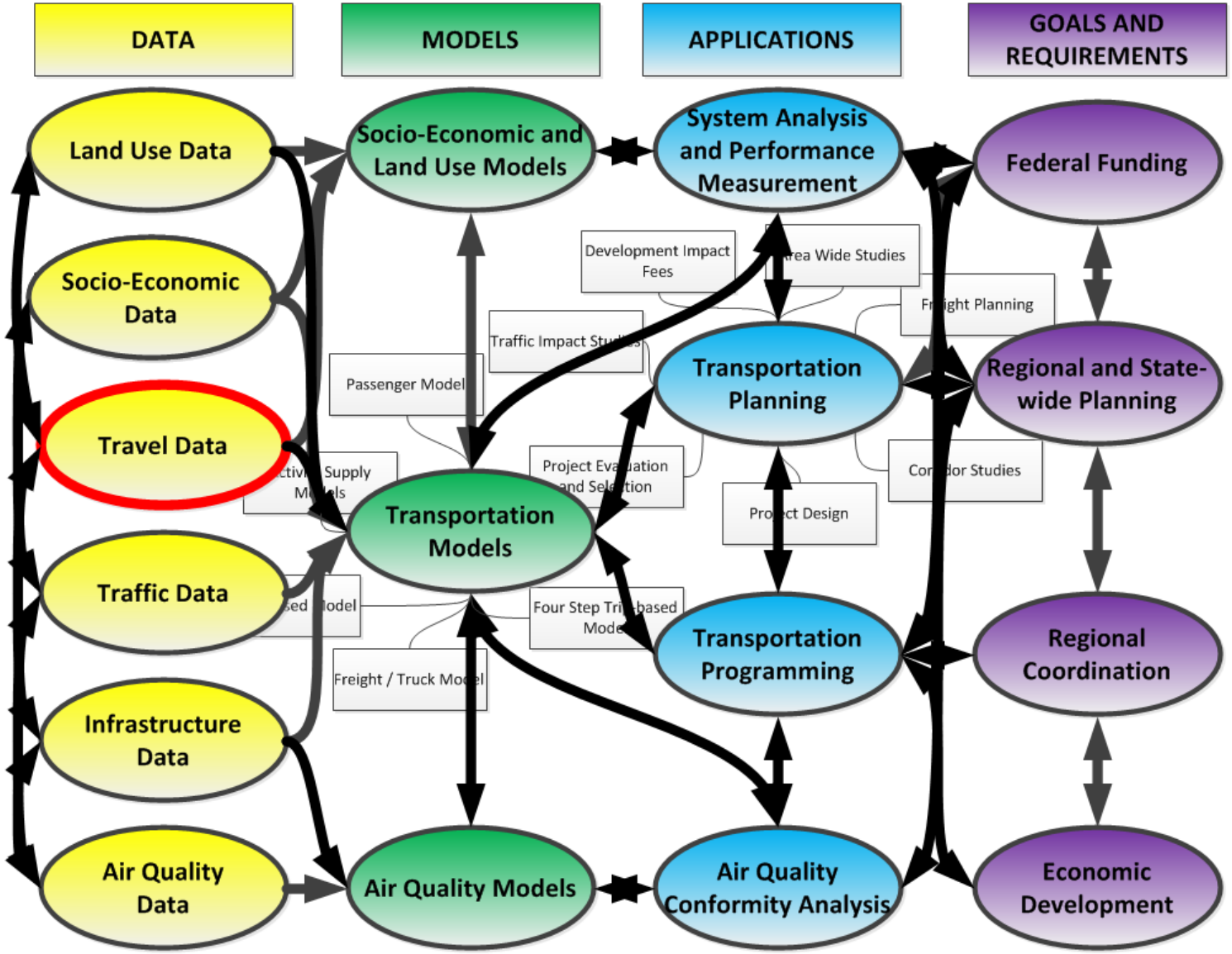








- Operational Calibrated and Validated Model – can be applied for projects
- Mega-regional Travel Demand Forecast - covers all major freight corridors in the state
- Multimodal Freight Demand Model – include freight mode choice
- Behavioral Model – simulates behavior of economic agents
- Agent-Based Model – explicitly models firms, firm evolution and interactions
- Visualization Interface for facilitated decision making, quality control and data analysis


DATA
MODELS
APPLICATIONS
GOALS AND REQUIREMENTS
Land Use Data
Socio-Economic Data
Travel Data
Traffic Data
Infrastructure Data
Air Quality Data
Socio-Economic and Land Use Models
Transportation Models
Air Quality Models
System Analysis and Performance Measurement
Transportation Planning
Transportation Programming
Air Quality Conformity Analysis
Development Impact Fees
Area Wide Studies
Traffic Impact Studies
Passenger Model
Project Evaluation and Selection
Project Design
Four Step Trip-based Model
Freight / Truck Model
Federal Funding
Regional and State-wide Planning
Regional Coordination
Economic Development

Home About Solutions Resources What's New Implementation Assistance SHRP2 Education Connection FAQ

Round

5 Round

4 Round

3 Round

1&2 Round

Precast Concrete Pavement (R05)

View Recipients

Pavement Renewal Solutions (R23)

View Recipients

Freight Demand Modeling and Data Improvement (C20)

View Recipients

State	Activity	Type	Contact
Arizona	Implementation Assistance Program – The Maricopa Association of Governments will develop a multi-modal freight model to better replicate the economic behaviors of establishments, shippers, and carriers by modeling travel and tour formations in Arizona's Sun Corridor mega-region.	Proof of Concept	Vladimir Livshits Maricopa Association of Governments (MAG) vlivshits@azmag.gov

Participation Levels

When open to applications, implementation assistance is available at three participation levels:

Proof of Concept Pilot

Opportunity to help evaluate the readiness of a particular product.

Lead Adopter Incentive

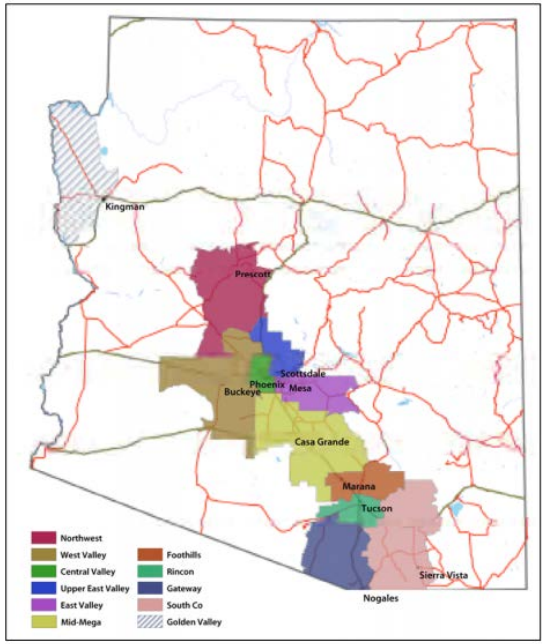
Available to help offset costs associated with product implementation and risk mitigation.

User Incentive

Available to accomplish a variety of implementation activities. Examples include conducting internal assessments, executing system process changes, and organizing peer exchanges.

MAG, ADOT and PAG submitted successful joint proposal emphasizing development of a megaregional model that will be able to answer freight demand questions for the Sun Corridor Megaregion

Figure 6-2 Sun Corridor Megaregion[25]



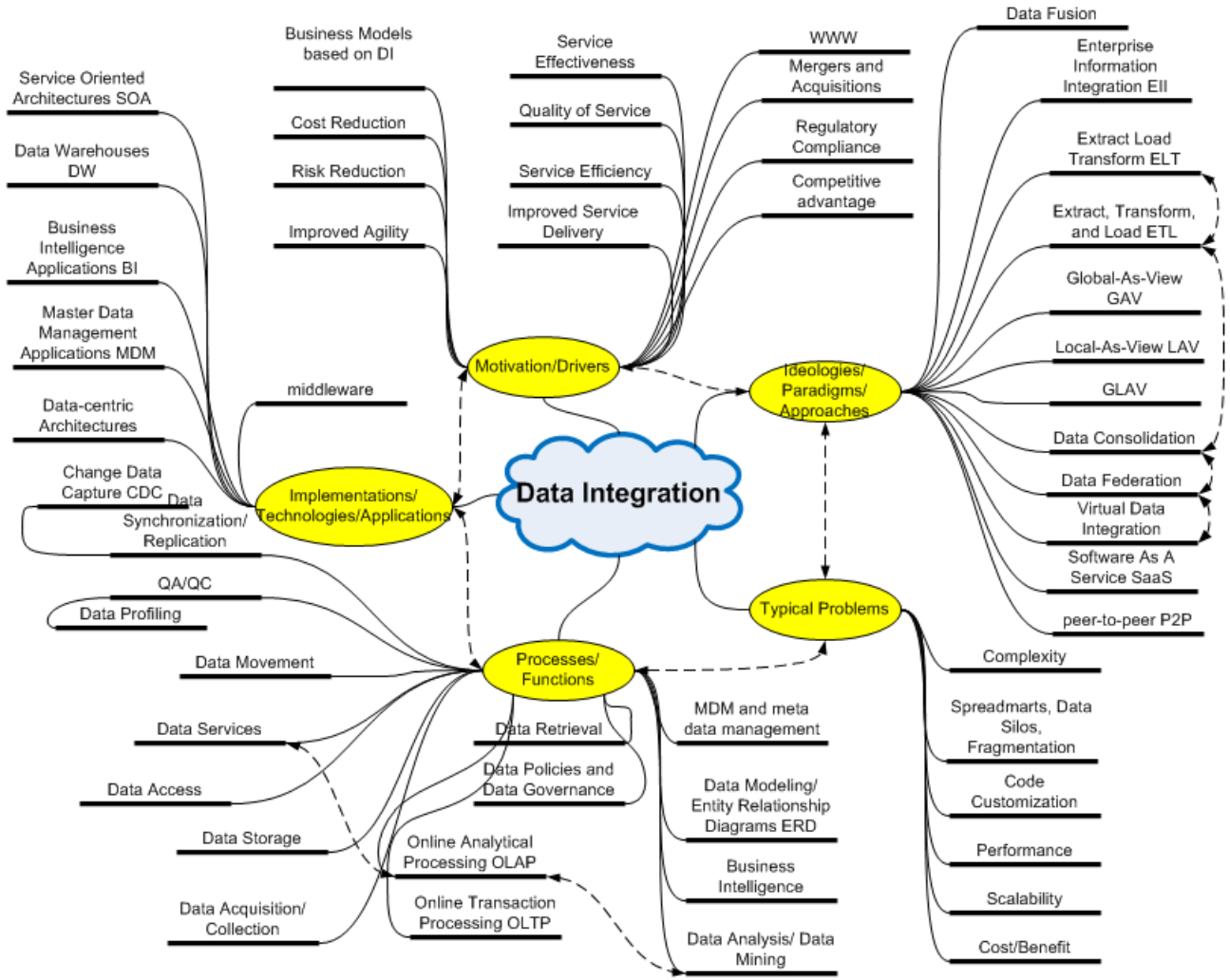
TAKEAWAYS

1. Freight data integration problems are often unstructured problems

1. Freight data integration problems are often unstructured problems

- No “step by step” instructions for data integration.
- Visibly incompatible, incomplete, disparate data with no clear path for integration.
- Data (especially “Big Data”) availability, suitability, quality, limitations, collection, distribution methods, business models, prices and sources are either not known, or not known a priori, or changing on an ongoing basis, or all of the above.
- Purposes of data integration can change as data is being integrated.

Data Integration Problems are often Unstructured Problems: Mind Map of Issues



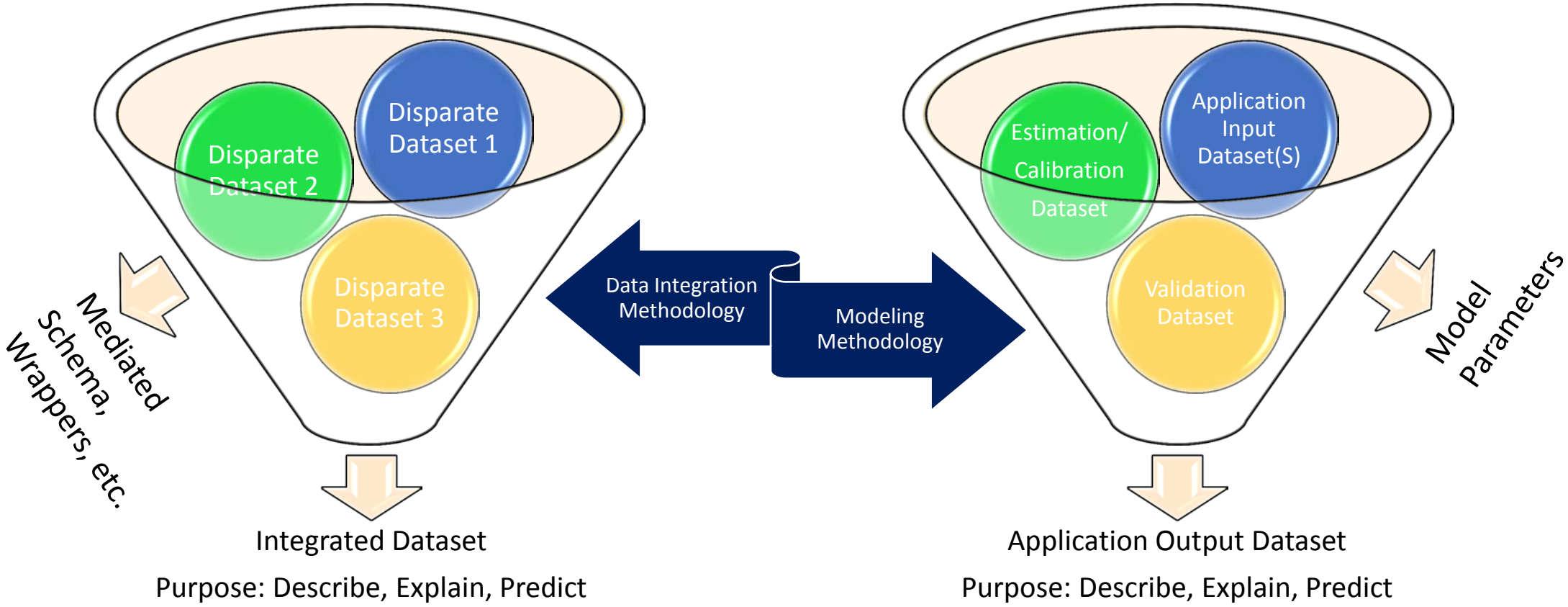
Setting the Stage for Understanding Urban Data Integration. Vladimir Livshits, Ph.D. Maricopa Association of Governments. January 22, 2012 TRB 91st Annual Meeting. Event W188.

TAKEAWAYS

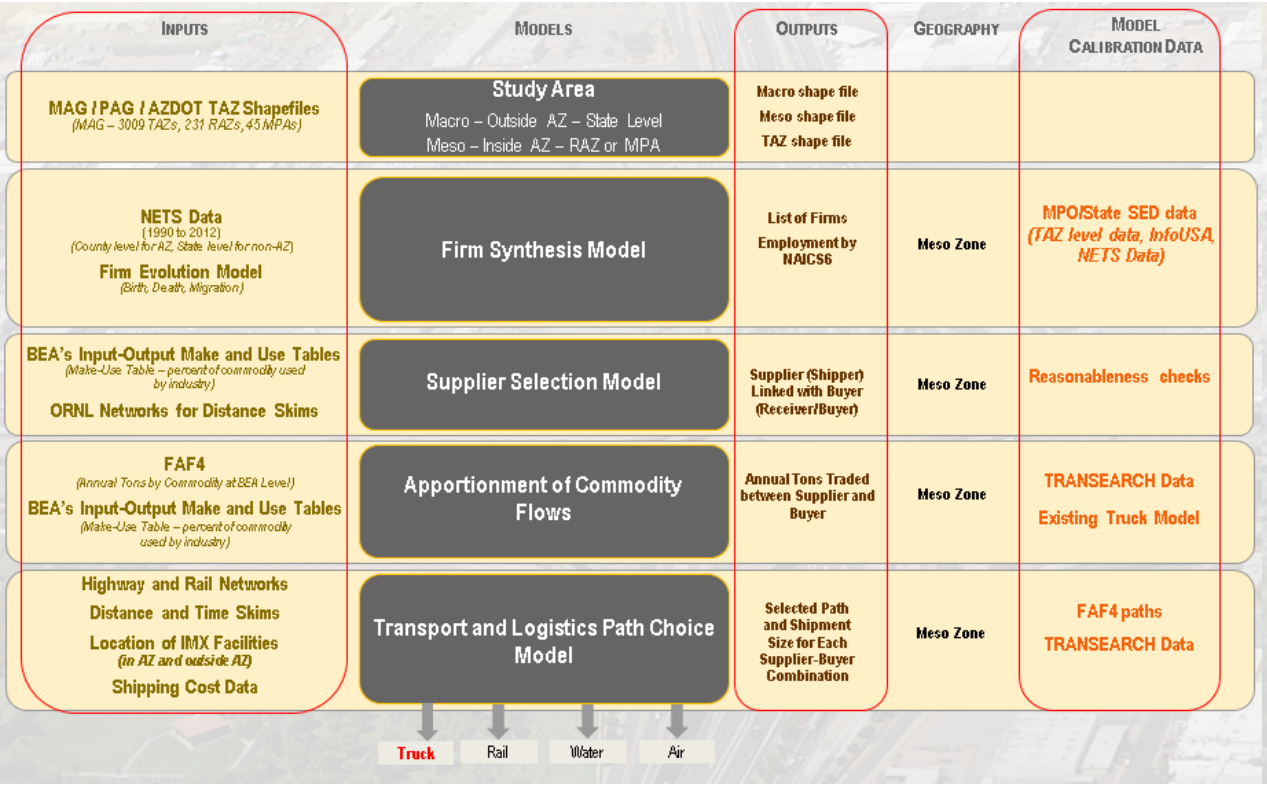
1. Freight data integration problems are often unstructured problems
2. Models are natural data integrators: they bring structure into data integration problems

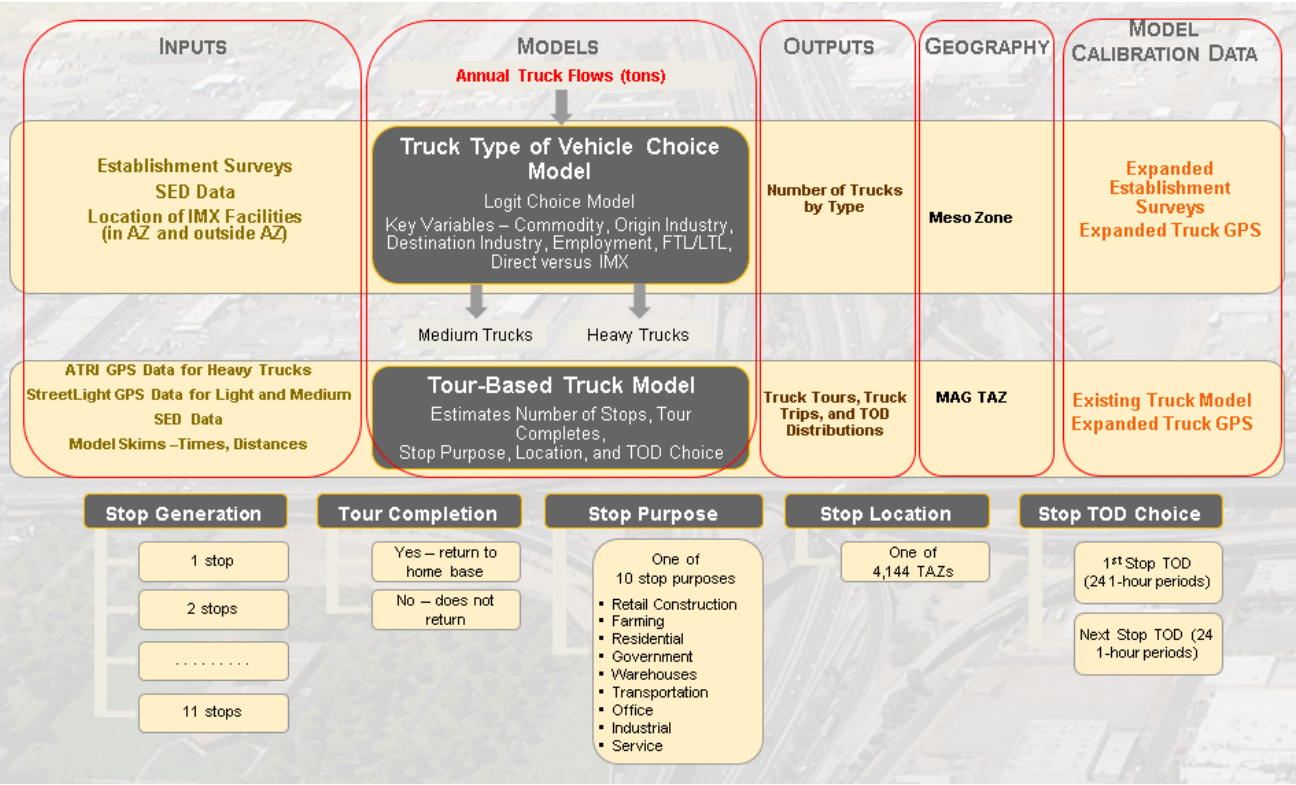
2. Models are natural data integrators

…*and data integration tools are, essentially, models*



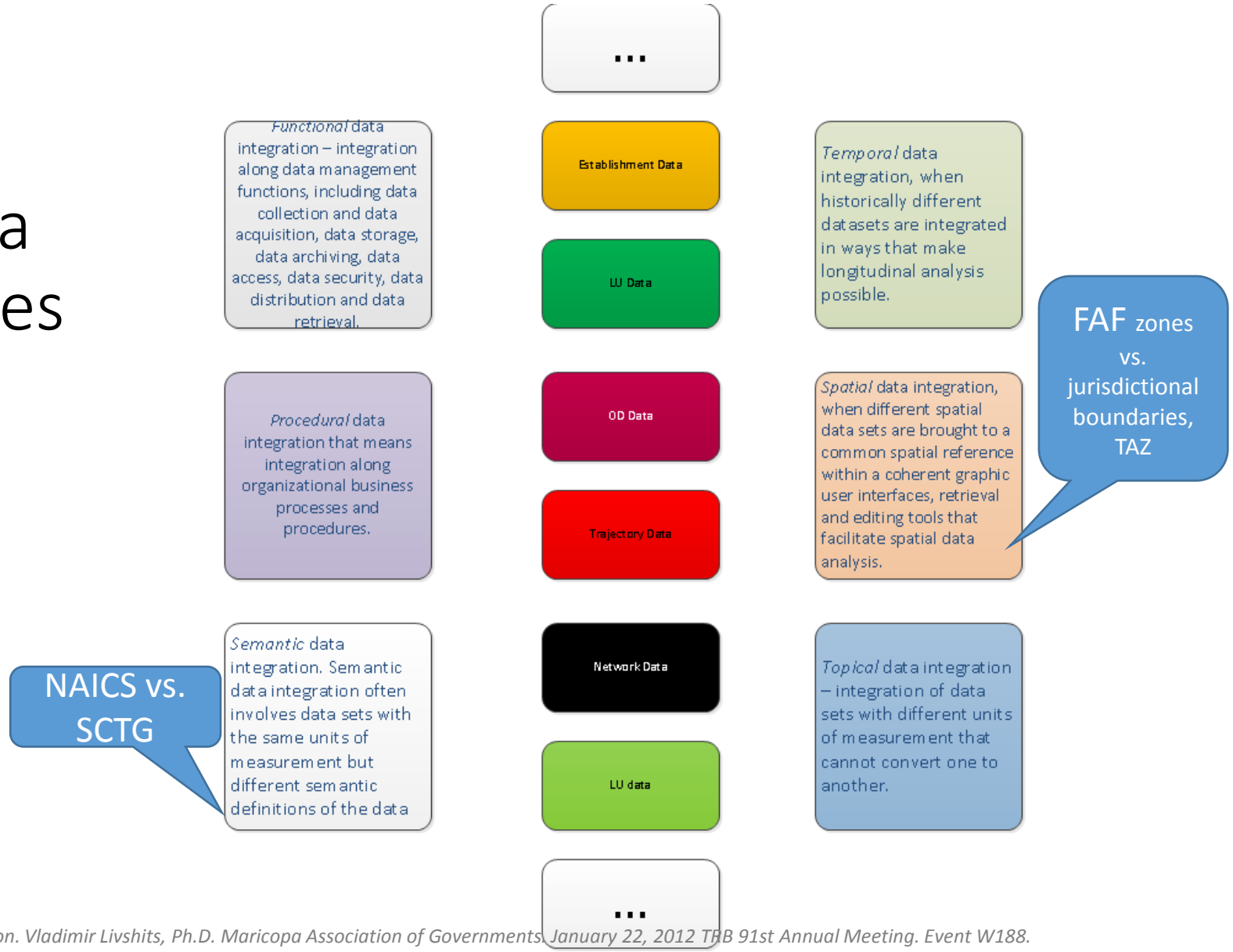
Models Transform Unstructured Problems into Structured Problems.





Courtesy Cambridge Systematics

For Each of the Data Integration Processes Model Provides Requirements and Common Structure



Setting the Stage for Understanding Urban Data Integration. Vladimir Livshits, Ph.D. Maricopa Association of Governments. January 22, 2012 TRB 91st Annual Meeting. Event W188.

TAKEAWAYS

1. Freight data integration problems are often unstructured problems
2. Models are natural data integrators: they bring structure into data integration problems
3. Big Data and new agent-based and microsimulation demand models qualitatively change needs and approaches for data integration

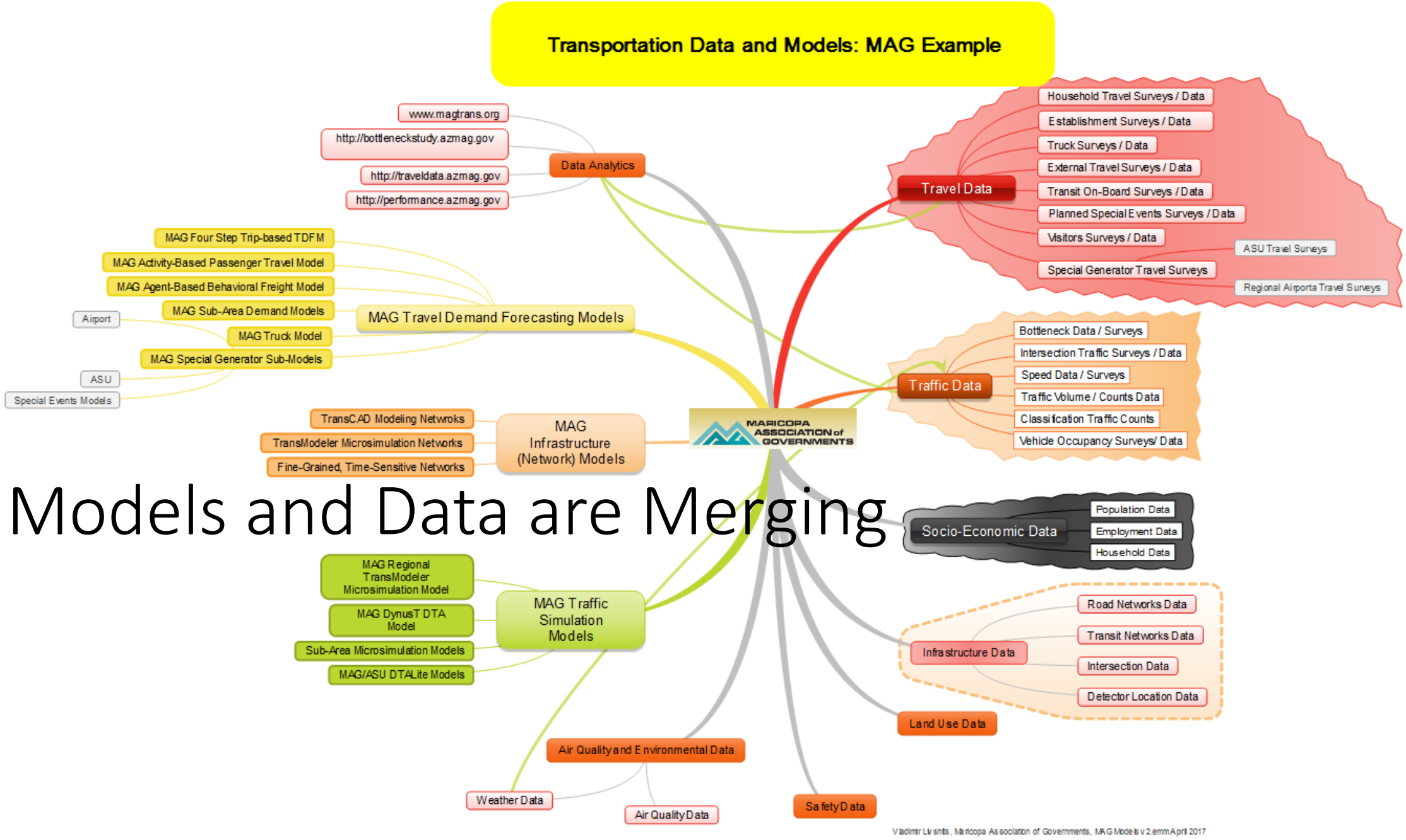
3. What's new now?

- Big Data adds new qualitatively different aspects to data integration
- Agent-based and microsimulation demand models provides qualitatively new base for data integration and resemble disaggregate estimation data sets in their outputs
- Multibillion fast growing data integration and access software market, including integration Platform as a Service, or iPaaS
- See "*Setting the Stage for Understanding Urban Data Integration. Vladimir Livshits, Ph.D. Maricopa Association of Governments. January 22, 2012 TRB 91st Annual Meeting. Event W188"* for more detailed discussion on issues and solution approaches

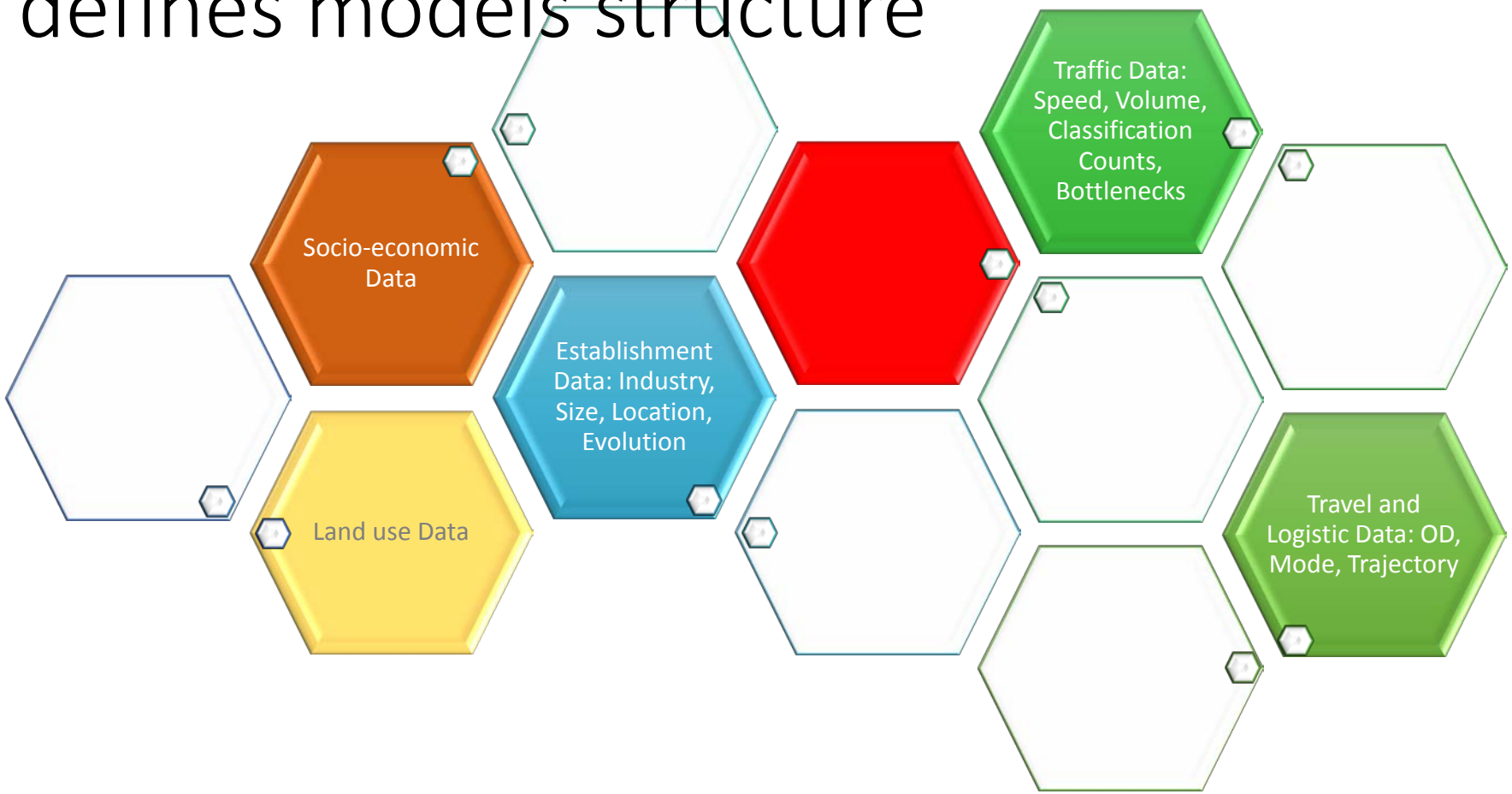
TAKEAWAYS

1. Freight data integration problems are often unstructured problems
2. Models are natural data integrators: they bring structure into data integration problems
3. Big Data and new agent-based and microsimulation demand models qualitatively change needs and approaches for data integration
4. Increased fidelity of models (agent-based, micro-simulation) leads to merging of models and data

4. Models and Data are Merging



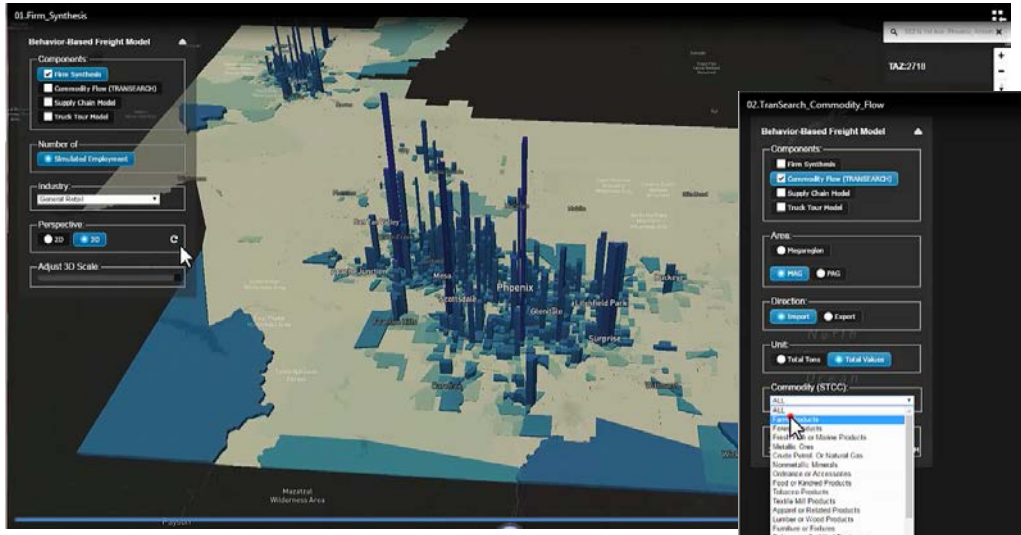
Models are application-specific tools for data integration, imputation, data fusion and data expansion
Data defines models structure



TAKEAWAYS

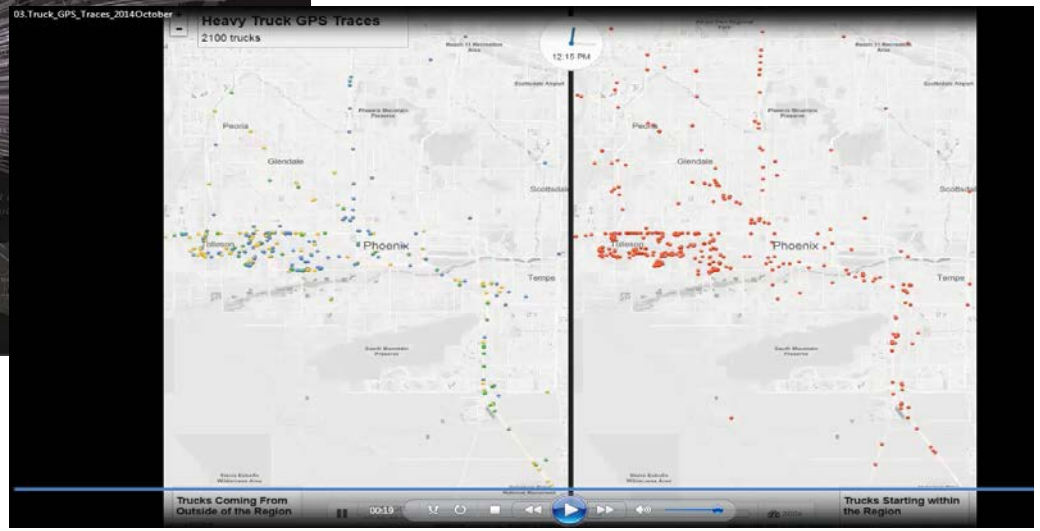
1. Freight data integration problems are often unstructured problems
2. Models are natural data integrators: they bring structure into data integration problems
3. Big Data and new agent-based and microsimulation demand models qualitatively change needs and approaches for data integration
4. Increased fidelity of models (agent-based, micro-simulation) leads to merging of models and data
5. Visualization and analytical tools are a necessity

5. Visualization and Powerful Analytics Become a Necessity



How this economic scenario will affect individual firms and employment?

What commodities are being shipped? From where to where?



What routes between an origin and a destination heavy trucks take?

Live demo

For more information…

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