Insights in Motion

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Public Sector, Transportation and Public Safety Lead

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Insights to a City

•Movement is fundamental to the economy and existence of cities, regions and nations. It is linked to economic activity, day to day lives of citizens, jobs, retail, recreation and other activities of the population.

•A city is largely defined by its transportation infrastructure in terms of its ability to support the economic activity as well as social activity and its ability for sustainable growth.

•Transportation also needs to reflect the city's vision of growth.

•Knowing and understanding aggregate movement patterns of the population is an extremely critical step in designing, implementing, improving and maintaining a transportation infrastructure that allows the city's vision of growth.

•In the past cities have struggled to plan and operate optimally due to lack of rich insights about population movement.

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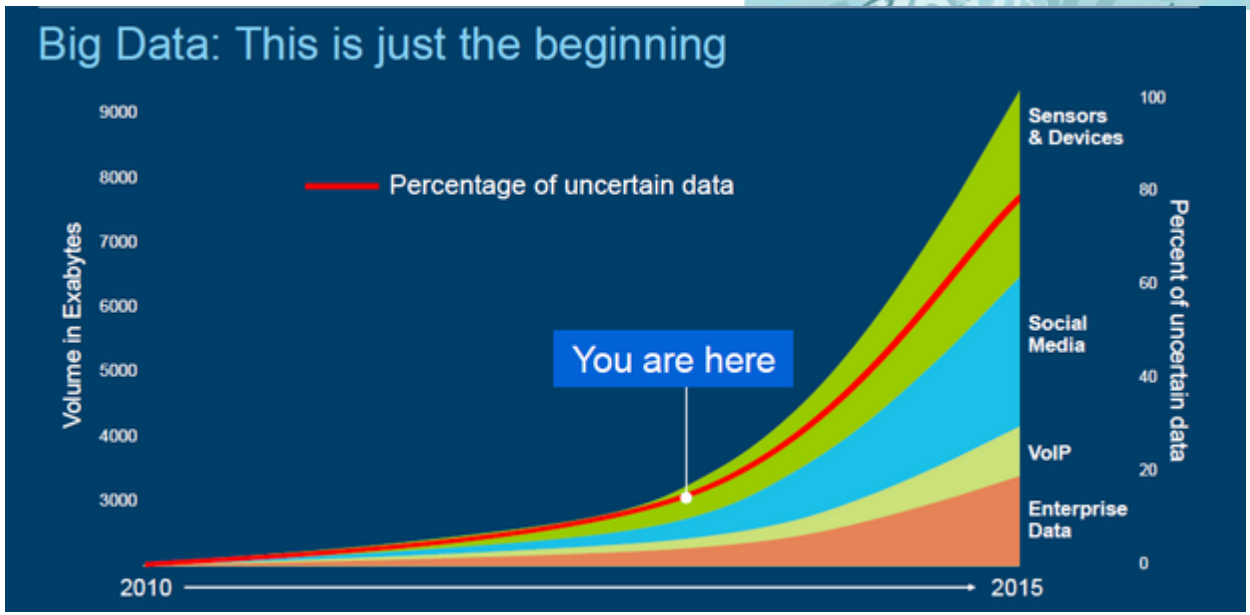
Data Mining: Uncovering hidden patterns in data

- We are drowning in data, but starving for information!
- Data is growing exponentially:
  - Devices
  - Sensors
  - Enterprise
  - Unstructured
  - Social



- Rapid growth of data: from terabytes to exabytes is driving the need for automated analysis of massive volumes of data

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What is Insights in Motion

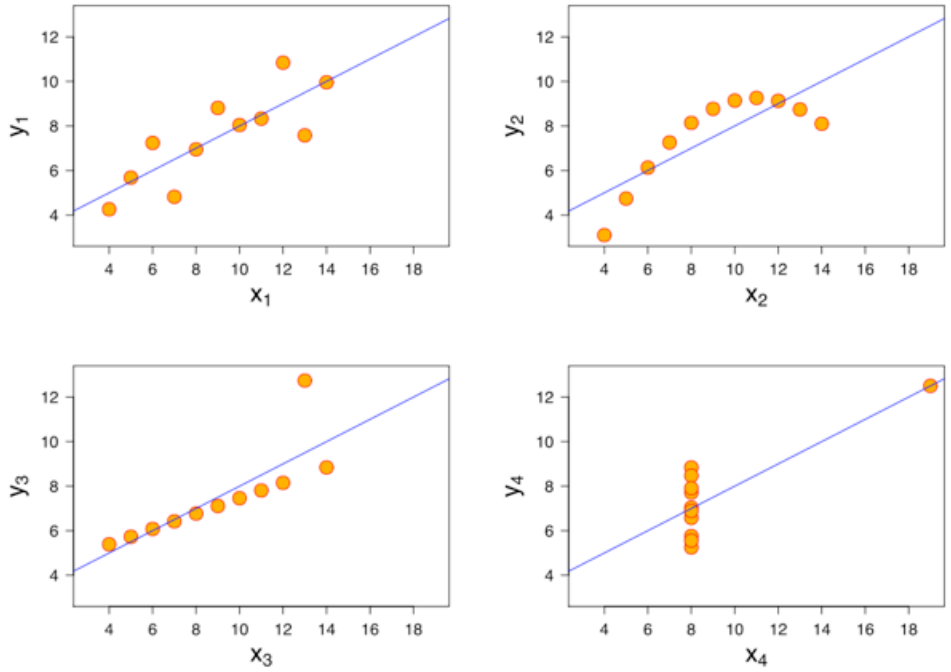
Data to Information

Through use of advanced analytics, you can leverage existing data to create information in the form of visualization, predictive capability to provide enablement of optimal outcomes in transportation, urban planning, economic development, sustainable growth and citizen satisfaction

Anscombe's Quartet

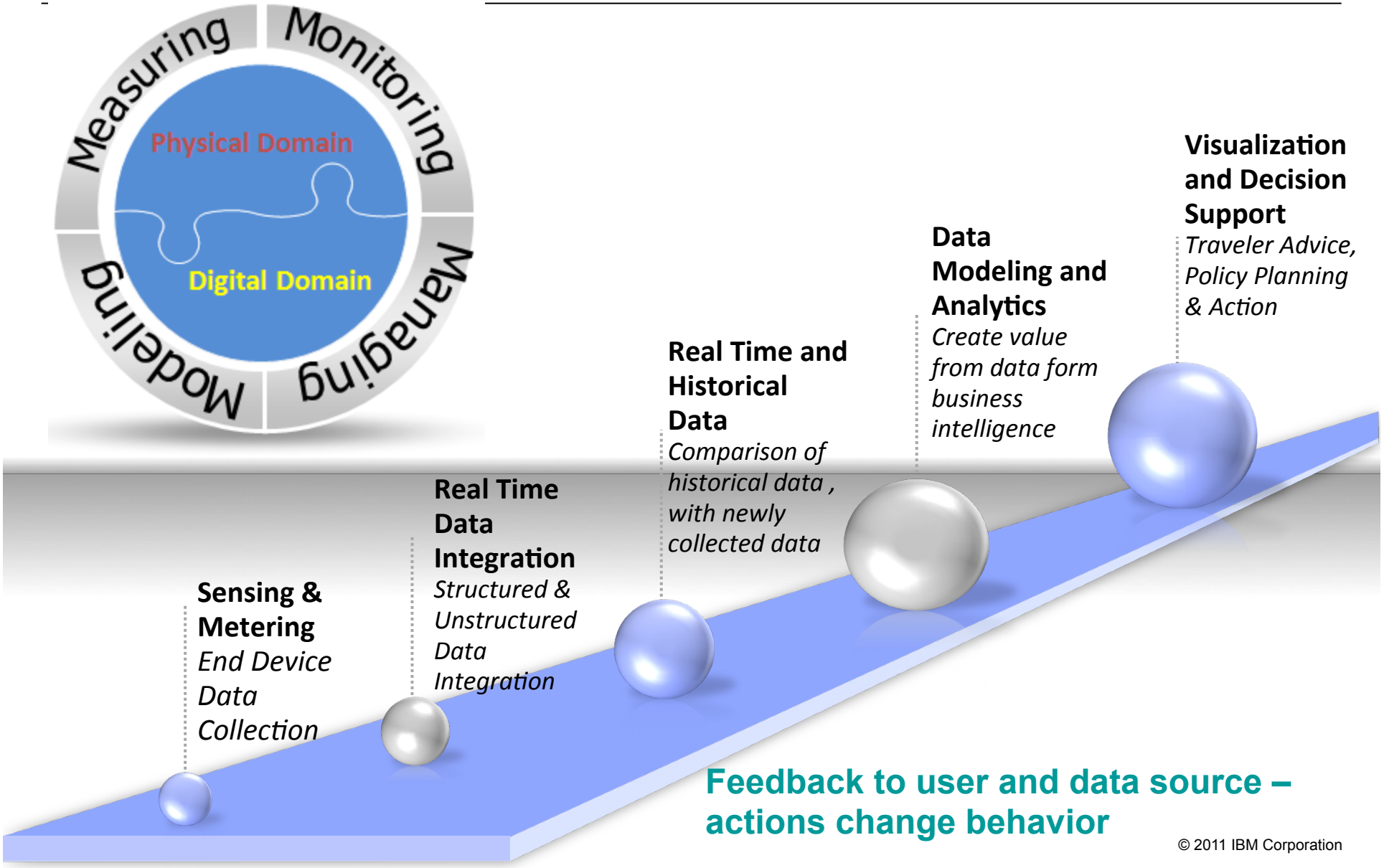
I		II		III		IV	
x	y	x	y	x	y	x	y
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56
7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89

Visualization makes data accessible.



ation

*The intersection of the '**physical**' with the '**digital**' provides the ability to accelerate benefits of Smarter Transportation*



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Insights, reports and statistics considered by various city agencies.

Insights can be generated in near real-time, on an hourly, daily, weekly and monthly basis

- ✓ Individual and Group Mobility Model
- ✓ Location and movement pattern (space, time)
- ✓ Meaningful location detection
- ✓ Meaningful location classification
- ✓ Trip purpose
- ✓ Estimated Duration of stay
- ✓ Estimated Duration of travel
- ✓ Mode of travel
- ✓ Calling patterns

- ✓Detecting tourist patterns
- ✓Detecting student patterns
- ✓Estimated demographic profile of user of phone
- ✓Anomalies in regular patterns
- ✓Supply Demand Gap Analysis
- ✓Bus Route Optimization Small and Medium Cities
- ✓Feeder Route Optimization for Multimodal Transit
- ✓Freight Modeling – future functionality

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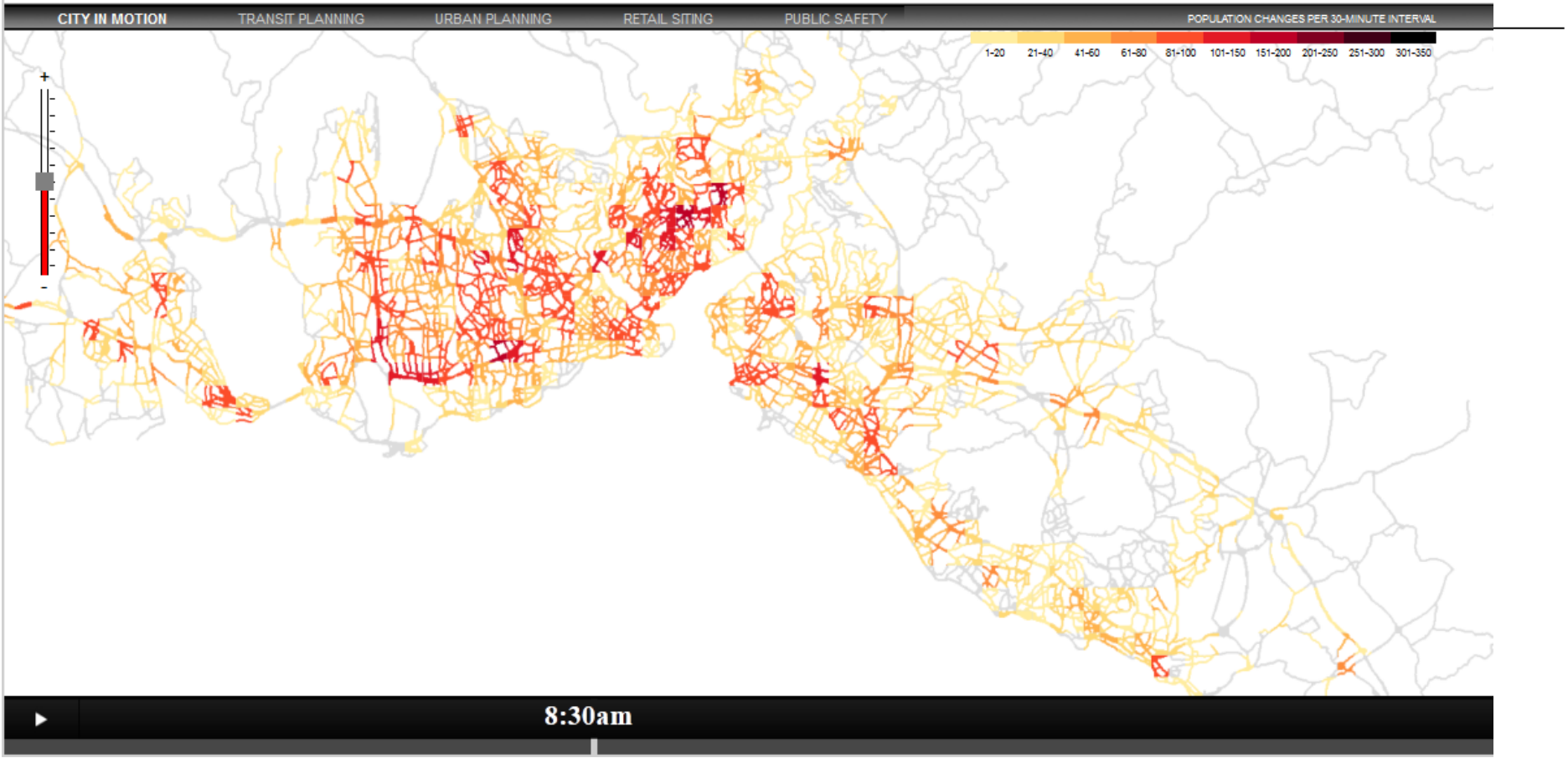
What is Insights in Motion



City and Regional Views of the movement and patterns of people over time

- Classify trips based on various parameters
  - Work, Shopping, Schools, Freight and Tourist Travels
- Show Origins and Destinations
- Location and Demographics
- Movement Patterns and Anomalies

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It is extremely expensive to instrument cities to measure this movement.

It cost Istanbul $2M to survey 1% of their population over 1 year. This system replaces such surveys while penetrating 30-40% of the population

Toronto spent 3 years and $3M surveying less than 5% of population

There exist sources of instrumentation of population movement that if leveraged judiciously with sensitivity to individual privacy and security can transform the ways in which cities can understand their movement needs and manage their transportation infrastructure most efficiently.

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Insights in Motion – Understanding Movement and Optimizing Services

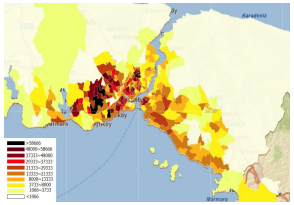
Information Sources

Network Data

Smart Fare Card Data

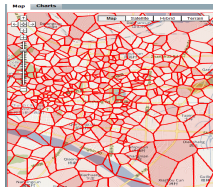
Transit System & GIS Data

Census & Demographics Data

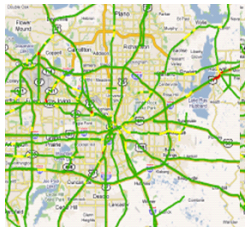


Analytics & Models

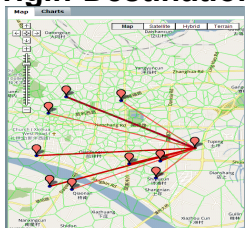
Time of Day Density Maps



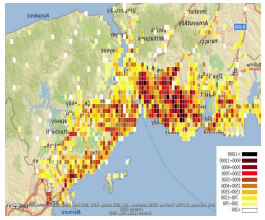
Traffic Flow



Origin-Destination

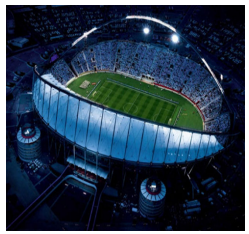
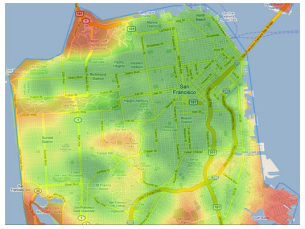


Deep Analysis

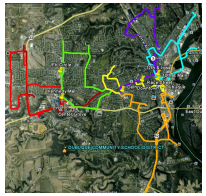


Business Services

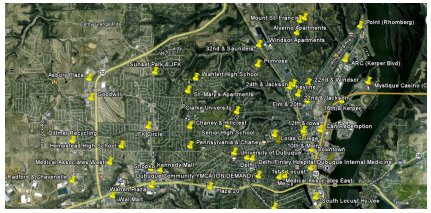
Planning Large Scale Events, Emergency Response

Transit Planning



Optimize Service Locations



Location-based Services, Traffic Alerts, Promotions

Benefits

- Reduce Congestion
- Reduce Journey Time
- Reduce Carbon footprint
- Reduce Emergency Response Time
- Reduce Operating Expenses
- Improve Access of Services
- Improve Revenue

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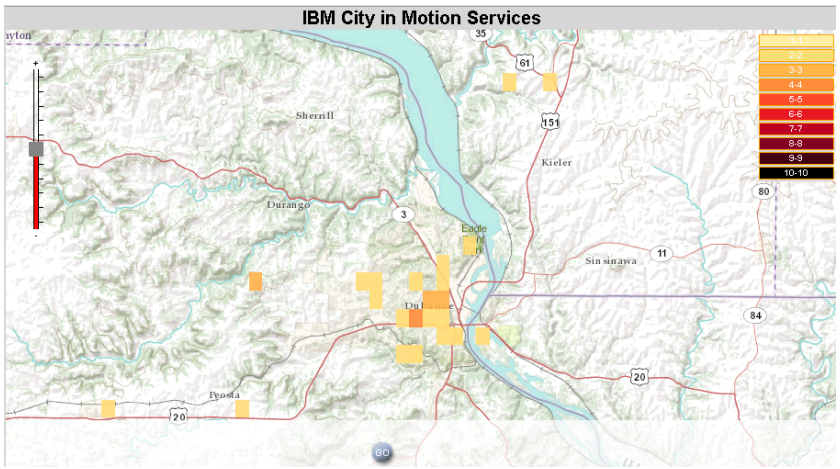
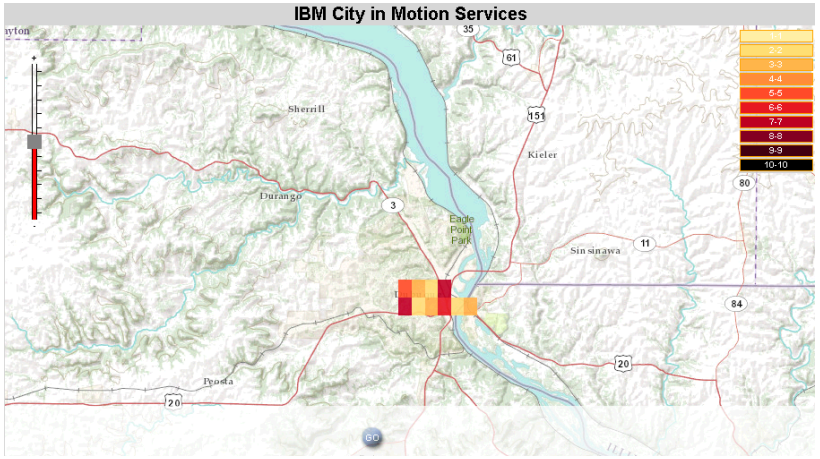
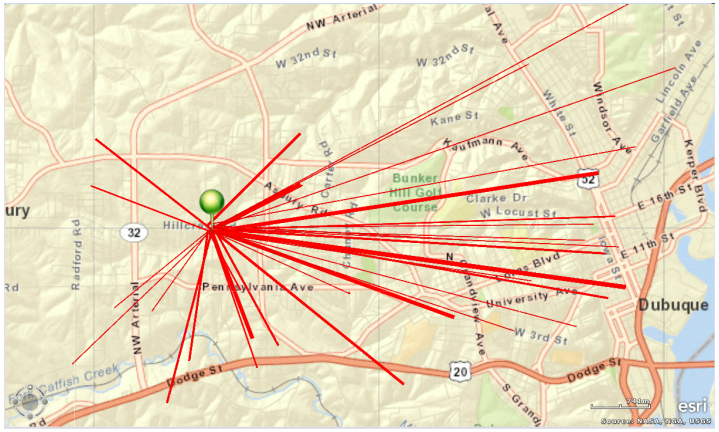
Time of Day Origin Destination Models

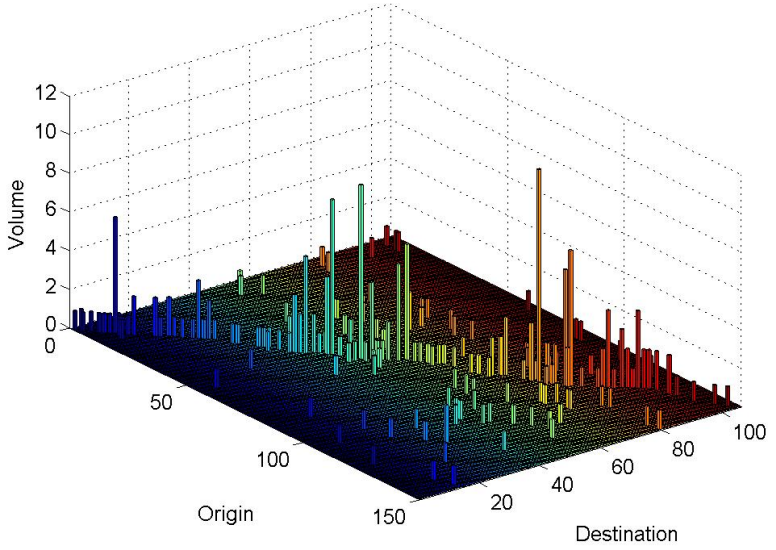


Origins to Top Destination





RFID



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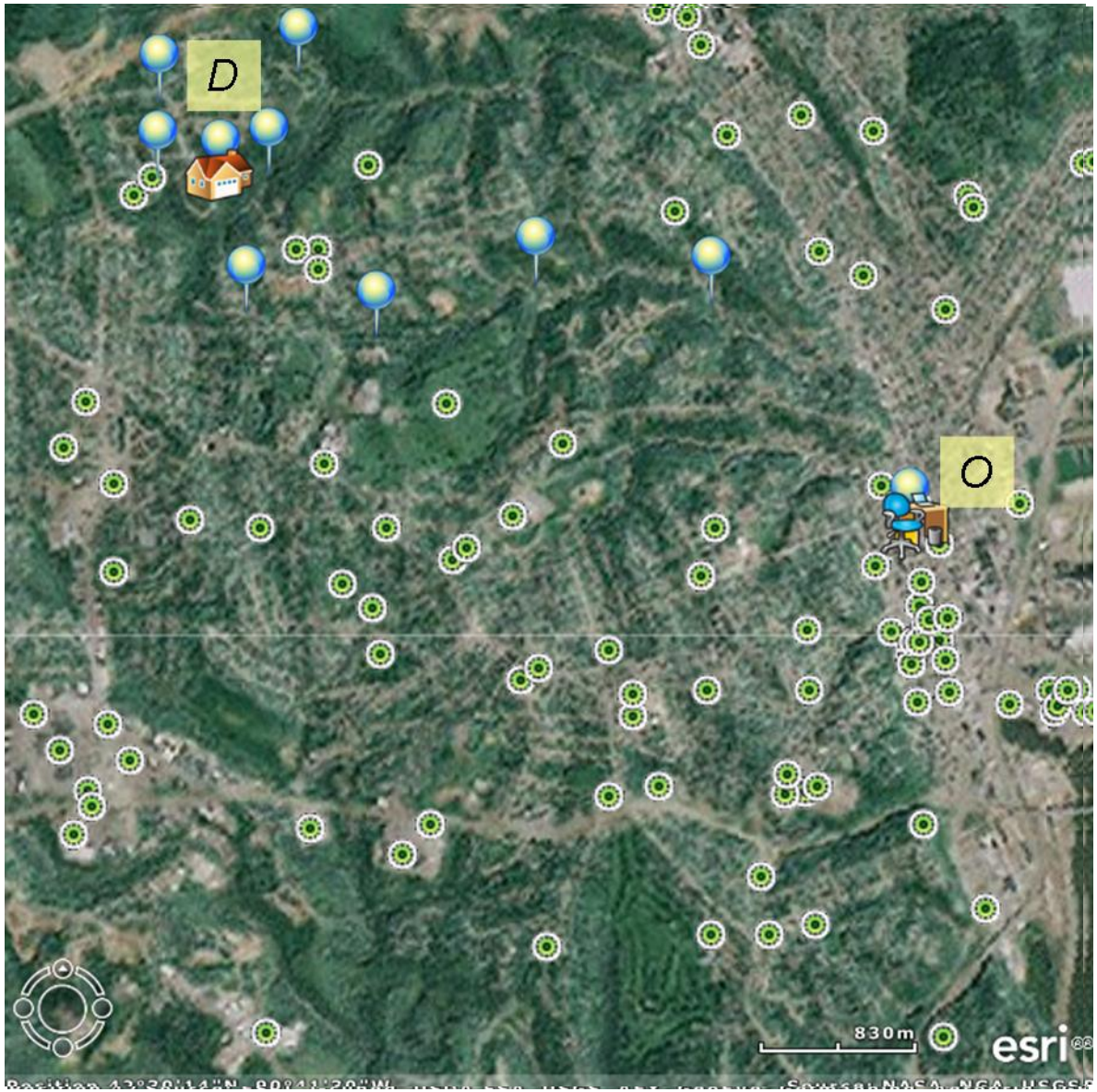
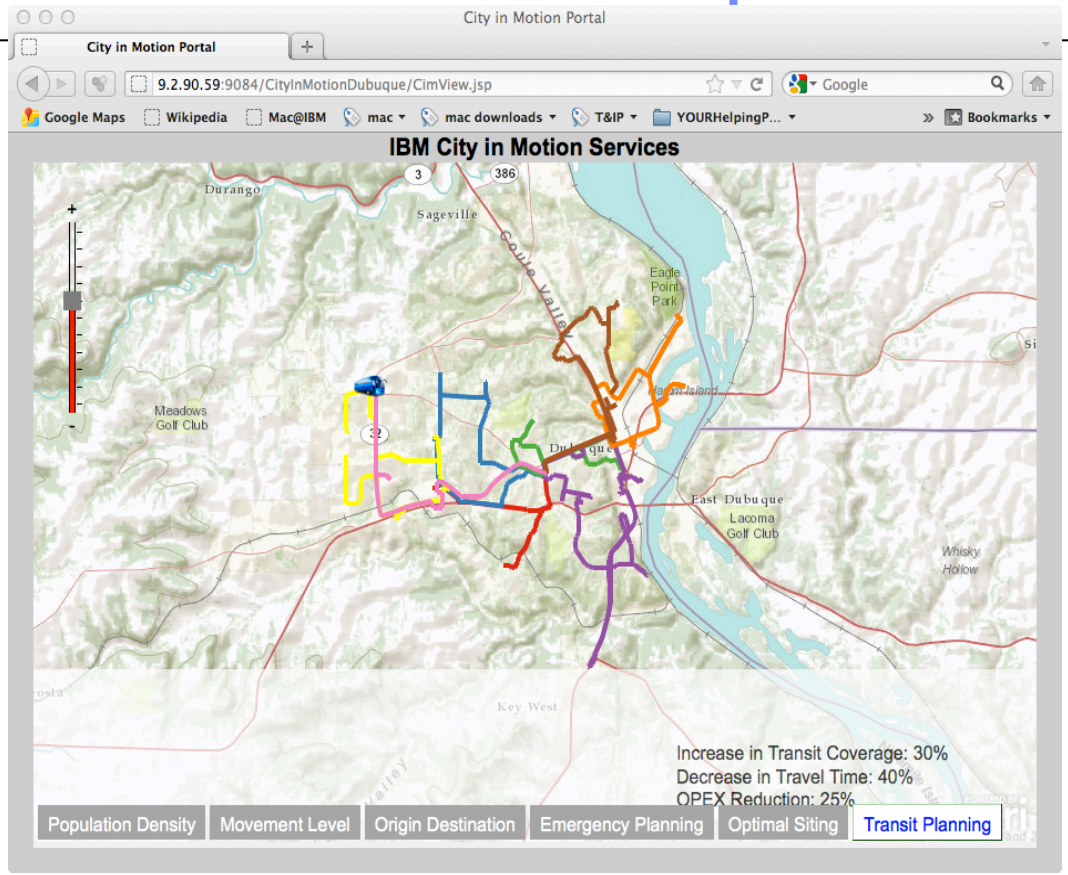
Trip Analytics: Trip Purpose Identification



Start Time	End Time	Purpose
7:27	7:39	HBW
8:35	8:47	NHBO
9:30	9:55	NHBW
10:56	11:15	NHBO
11:23	11:31	NHBW
12:22	12:33	NHBO
12:53	13:09	HBW
14:00	14:04	NHBO
14:29	14:48	NHBW
19:28	19:47	NHBO

Optimization of Bus Routes For Dubuque Iowa



City of Dubuque with an optimal bus route network design

Optimal routes have been shown to:

- **Reduce OPEX cost up to 40%**
- **Reduce unmet demand by 37%**
- **Decrease avg. travel time from 37 minute average to 10-22 minute average**
- **Encourage transit use**

Constraints include Fleet size, Max transfers, Duration, Bus Loads …..etc

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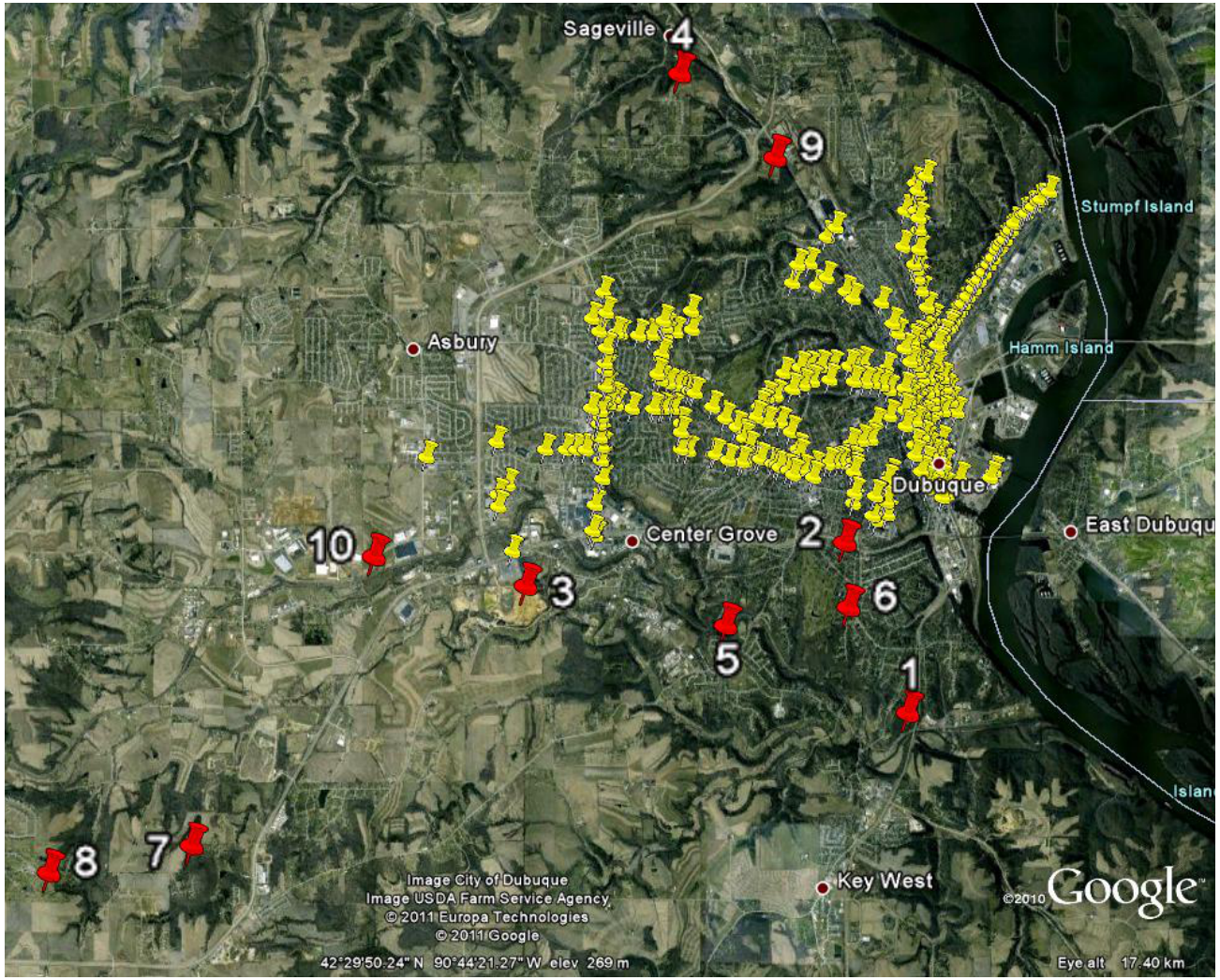
Optimal Bus Stop Location Design



- Stops are added by considering the greatest potential demand for transit and accessibility at origin and destination
- Some stops are added to far places in which demand to the area already served by existing stops is potentially large

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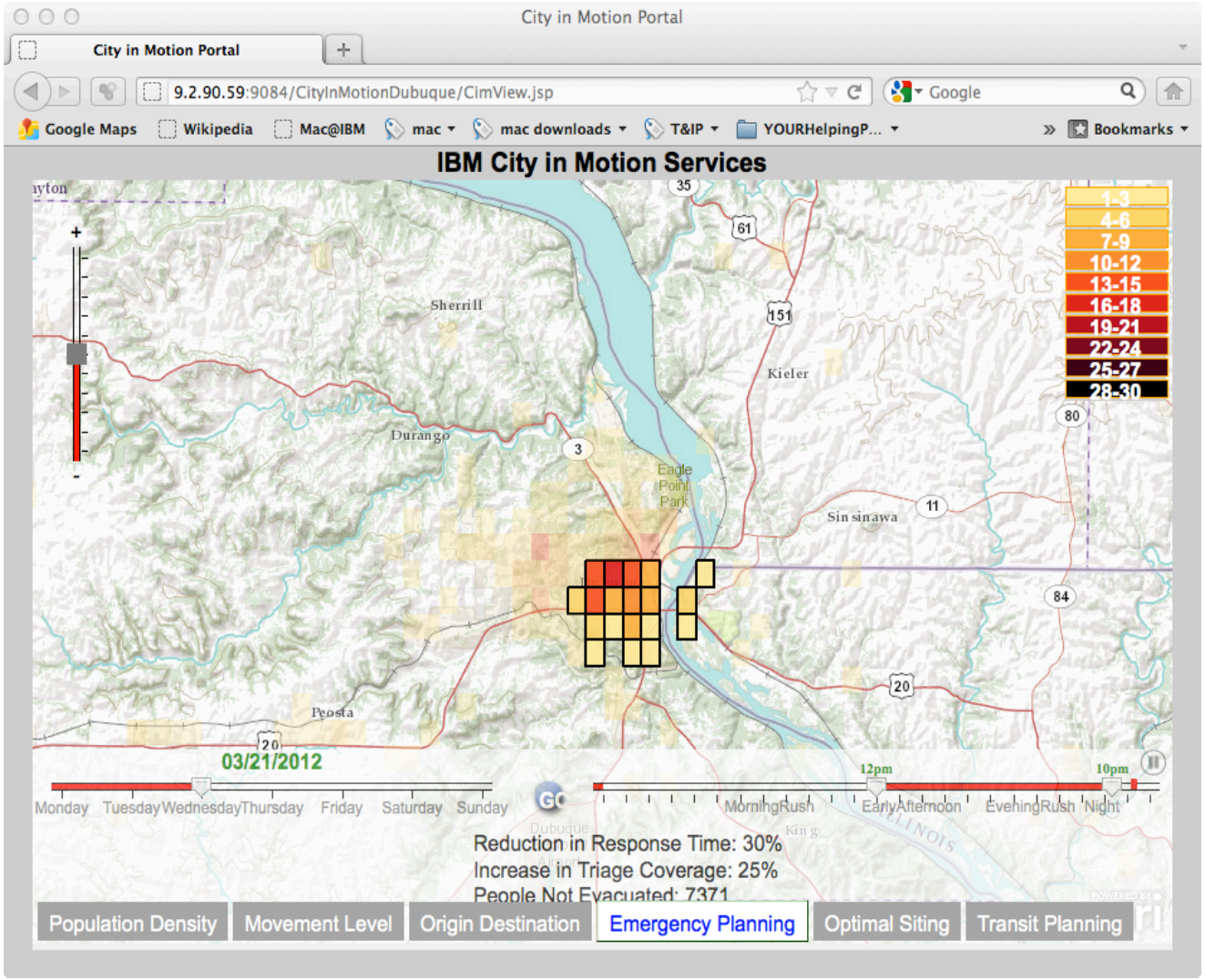
City in Motion: Emergency Planning



- Displays zones of interest with number of people in each zone at any given time.
- Can be used to assist with evacuation, security issues, large event planning.

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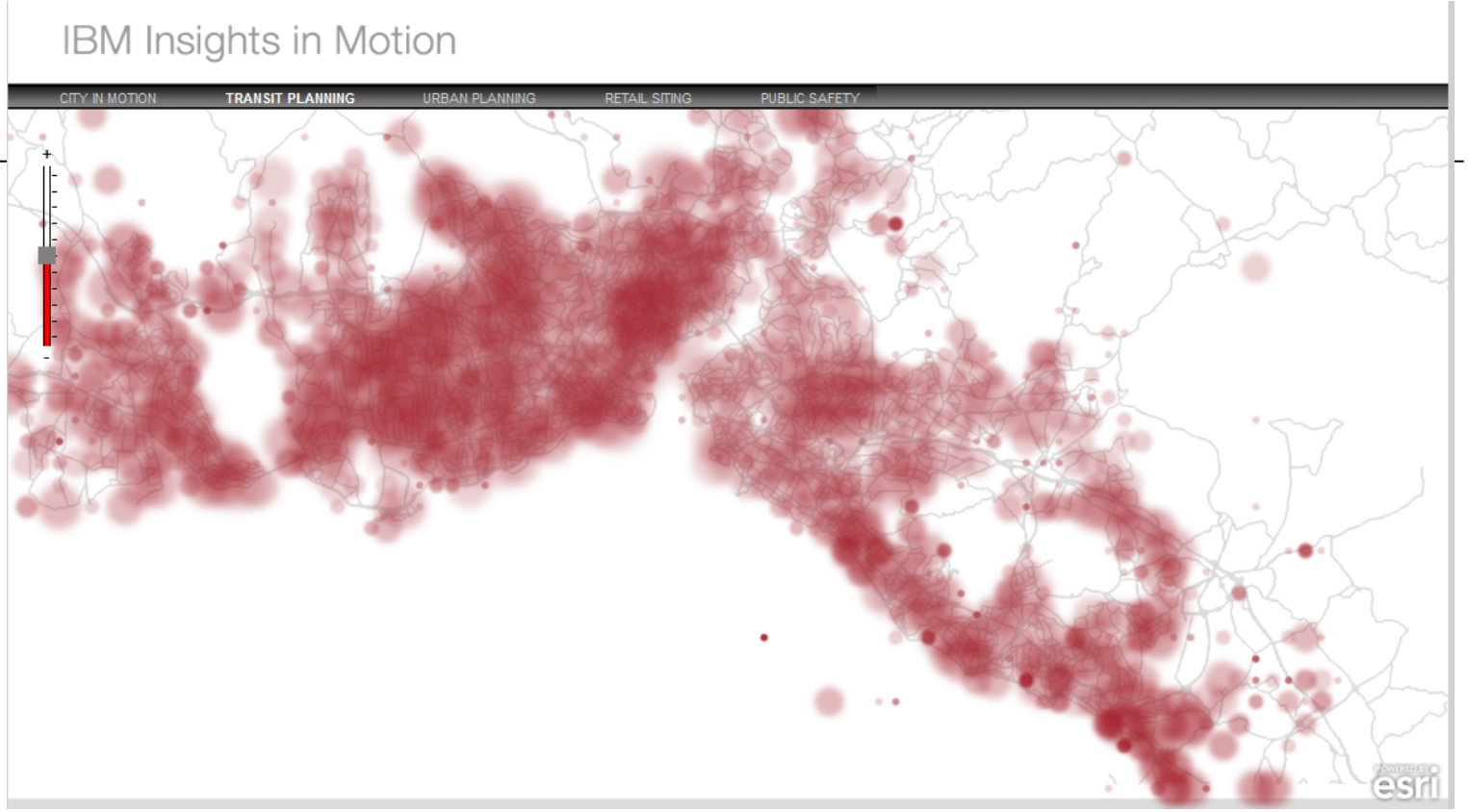
Istanbul



Gap analysis between the supply side (existing transit infrastructure) and demand models.

Compares the existing supply with the existing demand to help visualize and understand the gap between the two. The ability to visualize and analyze such gaps can again be critical to transportation and urban planning as well as emergency planning.

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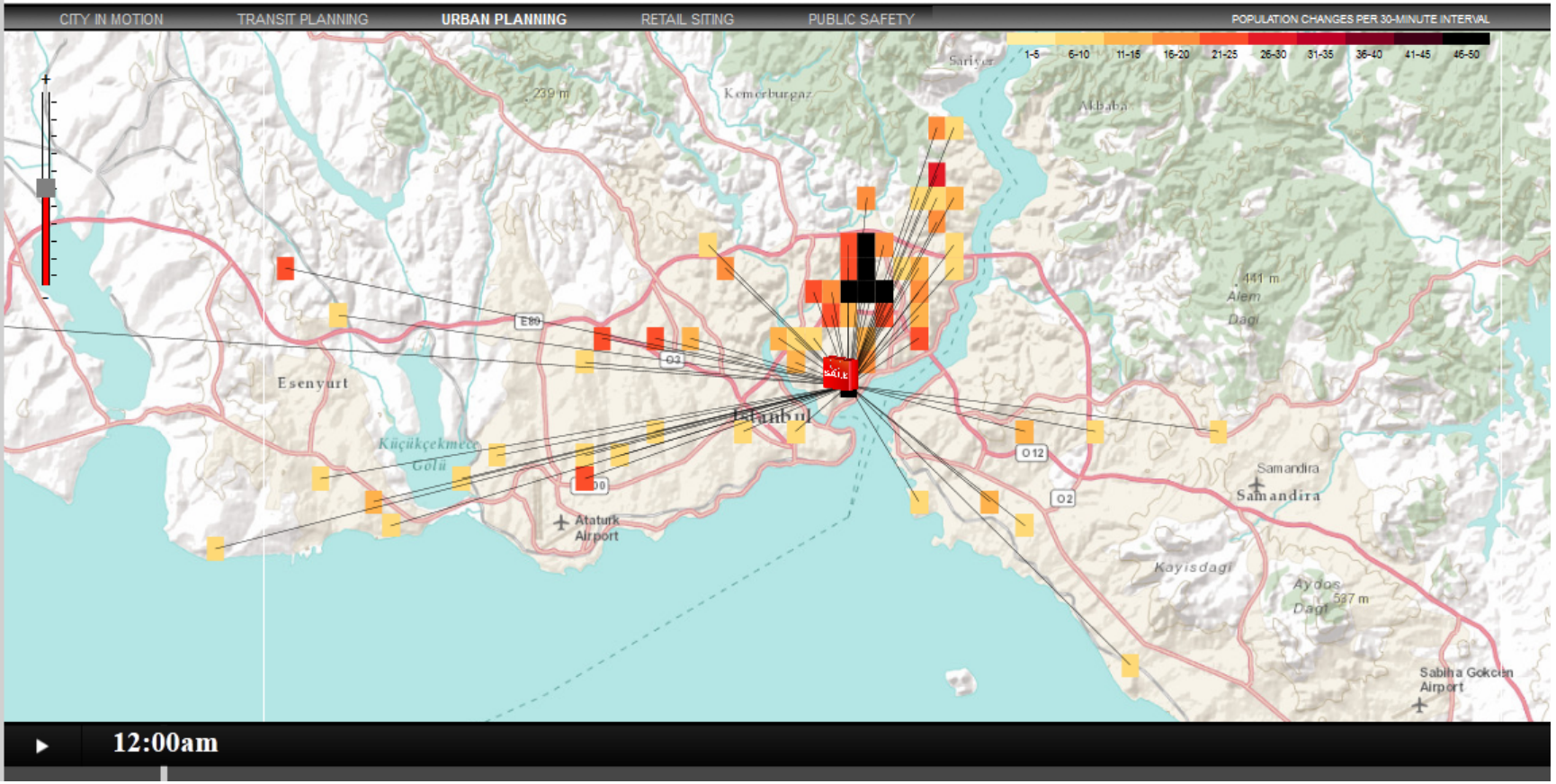
Results – Origin Destination

IBM Insights in Motion



Origins of all people visiting a specific destination zone in Istanbul. Understanding these movement patterns and origin destinations can be crucial to all kinds of urban, transportation and emergency planning.

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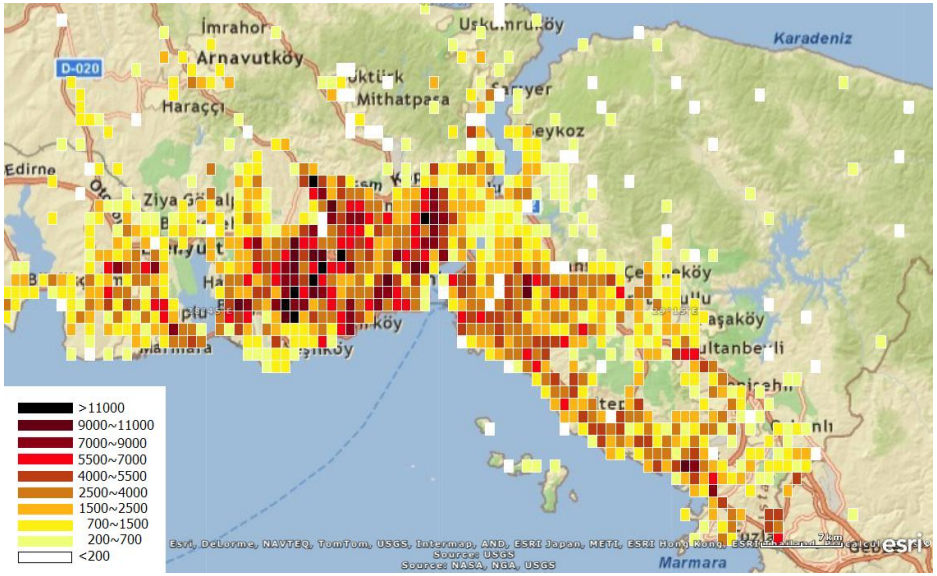
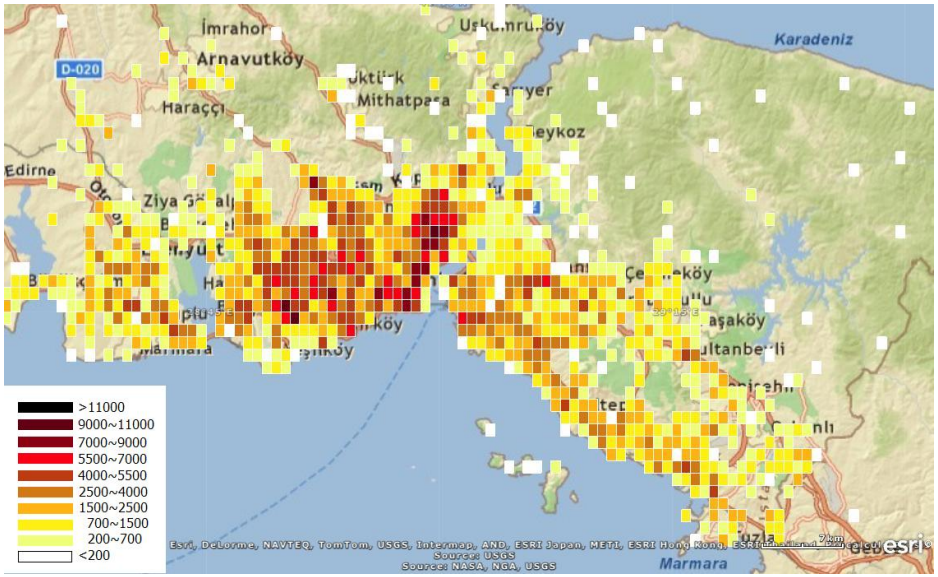
Trip Analytics: Identifying Meaningful Locations



Where People Live



Where People Work

Istanbul Movement Analysis with cell network data

- **4.7 million phones with 3B+ events/week**
- **Accurate detection of home, work & meaningful locations**

Data from roughly 2 million mobile phones
…..100 events captured per day per device
….200 million events per day
=1.4 billion events per week!!!

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Istanbul in Motion

Objectives

- Create people movement models with anonymous Telco data
  - Utilize anonymous mobile phone location information
  - Build demand side models
- Work to evaluate applications of models
  - Evaluate existing multimodal transit system use against overall demand
  - Explore opportunities to optimize multimodal transit coordination based on gaps
- **Deliverables**
  - Trip Frequency Tables
  - Trip Distribution Tables (Origin Destination Matrices)
  - Snapshots of zonal occupancy
  - Analysis of multimodal transit use against the backdrop of overall movement demand
  - Preliminary results on feeder routes for M4 line for all stations
- **Outcomes**
  - First rich, large scale movement model level understanding of how Istanbul moves
  - Used by Istanbul to plan feeder bus routes for all stations
  - It will be used by all Istanbul municipal agencies in planning beyond Istanbul.

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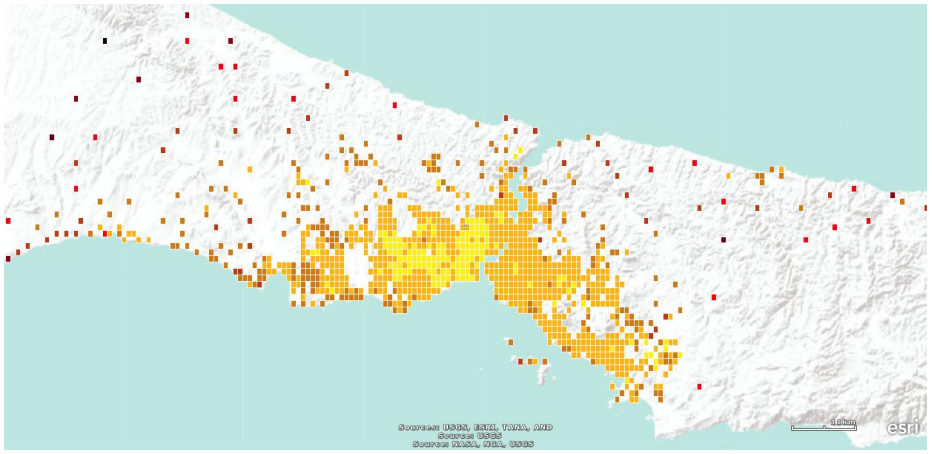
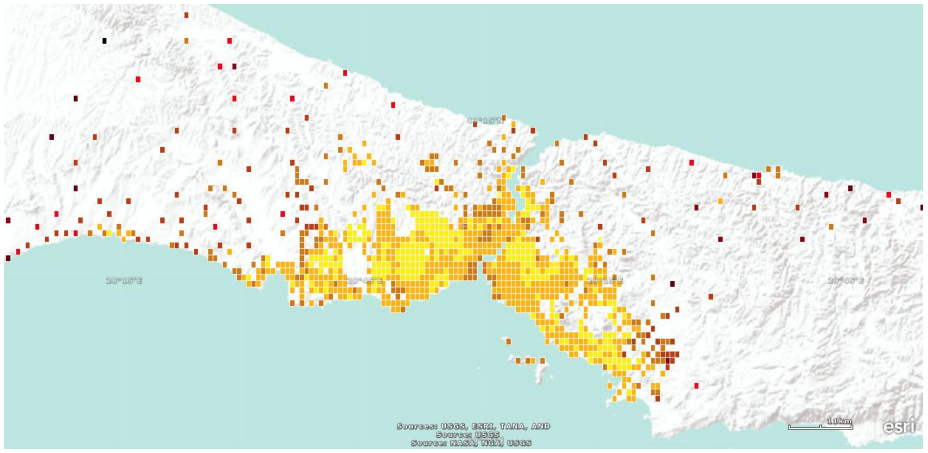
Trip Analytics: Understanding home-to-work commute patterns



How far people travel from home zones to work



How far people travel to come to work zones

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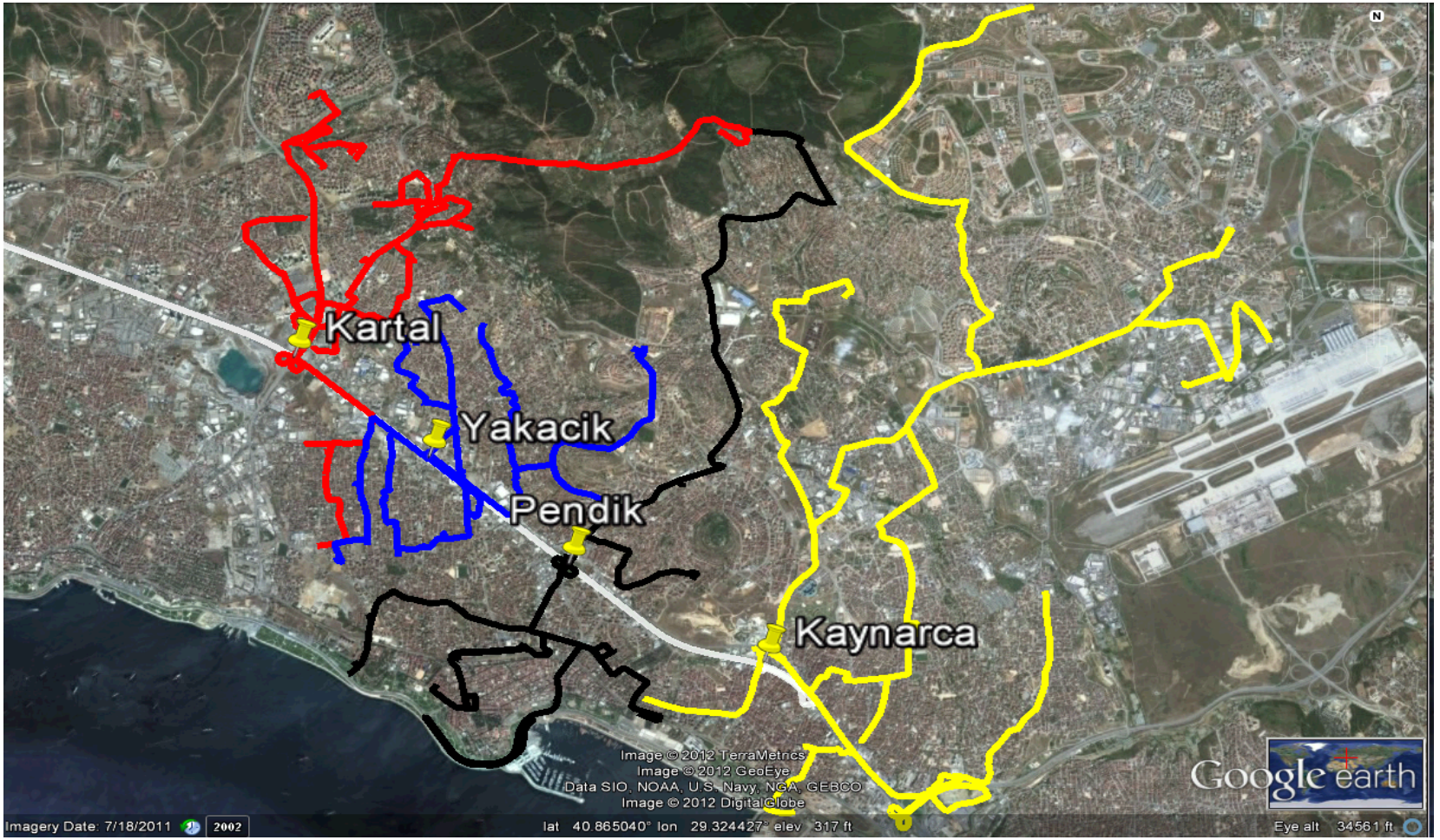
Preliminary Results – Optimal Feeder Bus Routes



University in Hungary planning for the City of Gyor depicting best placement of bus to match arterial and other major highway and rail stops.
This will allow a greater area of transit coverage while reducing resource usage.

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Benefits

- Allows better information to provide more accurate Planning, Scheduling and Forecasting
- Able to expand into other City and Regional areas such as Traffic Operations Centers
- Supports information to Optimize route planning for Multi-modal travel
- Maintain a higher State of Good Repair (SOGR) for infrastructure for highly used routes for the Citywide Enterprise Asset Management Systems.
- What-if scenarios are plausible for Emergency Planning and Large Events
- Rationalize and prioritize projects to provide the biggest impact
- Gap Planning, Policy Planning Scenarios, and Decision Support
- Test results before and after policy and/or infrastructure changes are made..

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Awards, Demos and References

- Cities in Motion
  - Dubuque, 2011
  - Istanbul, 2012
  - Gyor, Hungary 2013
- Awards and Demos
  - 2012 National Associations for Development Organization Innovation Award
  - 2013 International Association of Public Transportation (UITP) Award to ULASIM Istanbul at the Geneva meeting
  - 2012 IBM Investor Day Demo

    http://www.istanbul-ulasim.com.tr/hakk%C4%B1m%C4%B1zda/haberler/istanbul-ula%C5%9F%C4%B1m%E2%80%99a-uitp-d%C3%BCnya-kongresi%E2%80%99nde-%C3%B6d%C3%BCl.aspx
  - 2013 Mobile World Congress Demo

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