

# Why BIG DATA for the Smart City?

9 SEP 2014

**Gunso Kim**

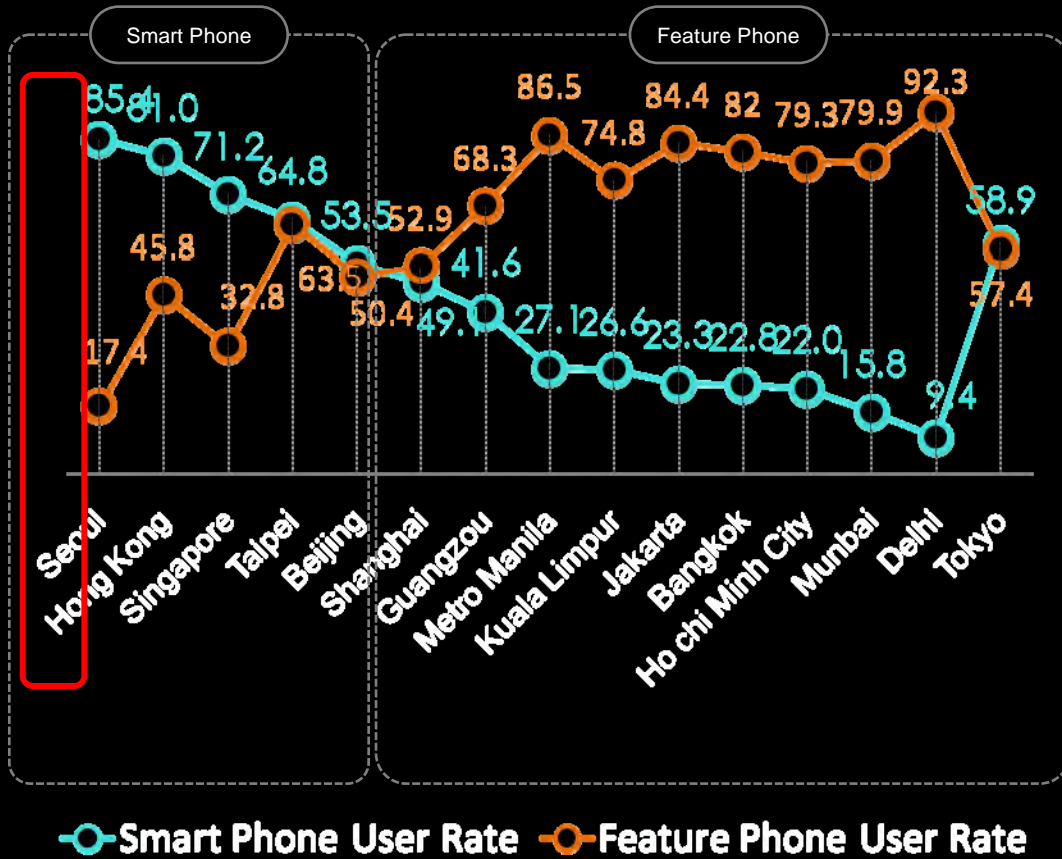
*Assistant Mayor, CIO of Seoul  
Secretary General of WeGO*

## BigData **Cases** and Plans

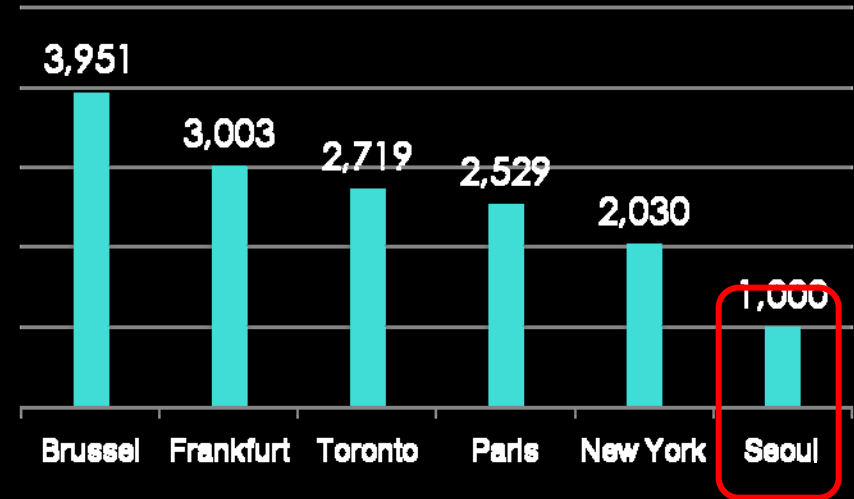
- Late Night Bus
- Taxi Matchmaking
- Reduction of Car Accidents
- Road Surface Monitoring
- City Festivals Analysis
- Mobility Service For the Disabled
- Energy Management Service



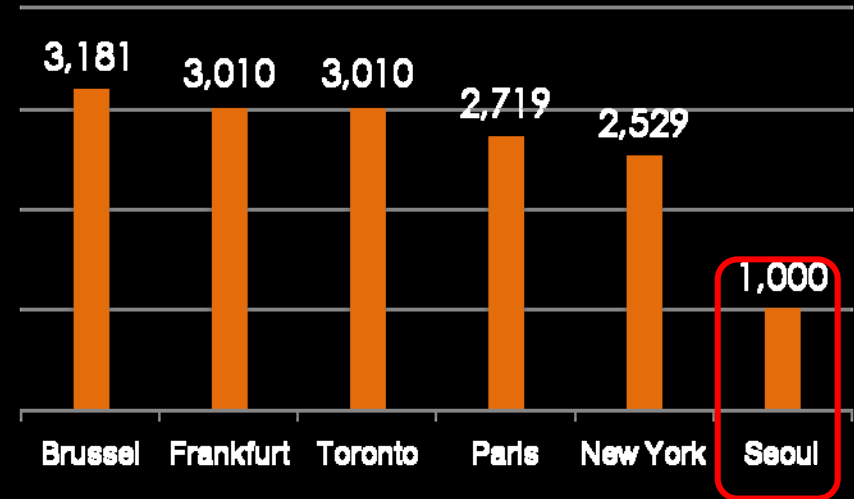
## A City with Top Use of Smart Phones



## A City with Affordable Transport



BUS



SUBWAY

# 3 Big Data Cases

- Late Night Bus
- Taxi Matchmaking
- Reduction of Car Accidents



# Case 1

From a **Blue Bird** to a **Night Owl**:

Establishment of Seoul's **Late-night Bus Routes**

No public transportation  
01:00 AM ~ 05:00 AM



Subway Bus

Taxi

*"Buses don't run by the time  
I get off work. I don't have  
a car.*

*So, I hope there will be  
buses  
available late at night..!!"*

*@gu\*\*\*\**





How could  
we set the  
optimal bus  
route?

?

?

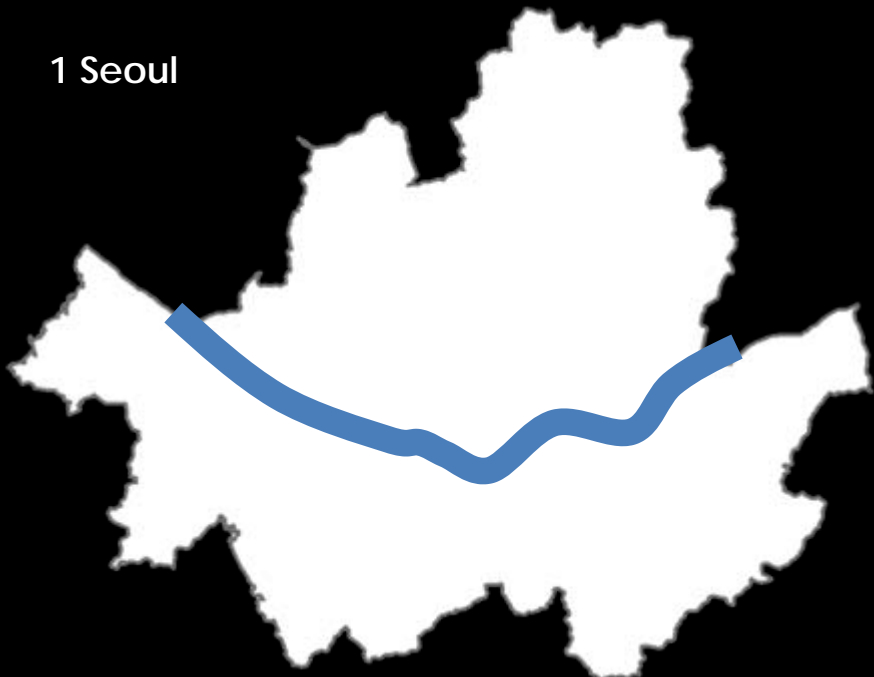
?



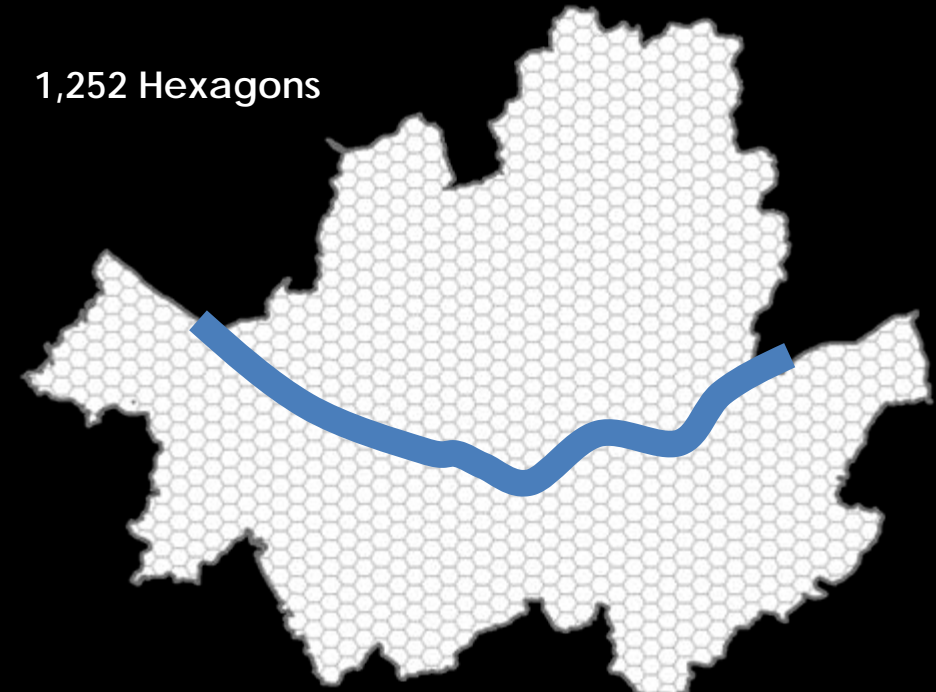
trying to find the **Answer** from the Citizens



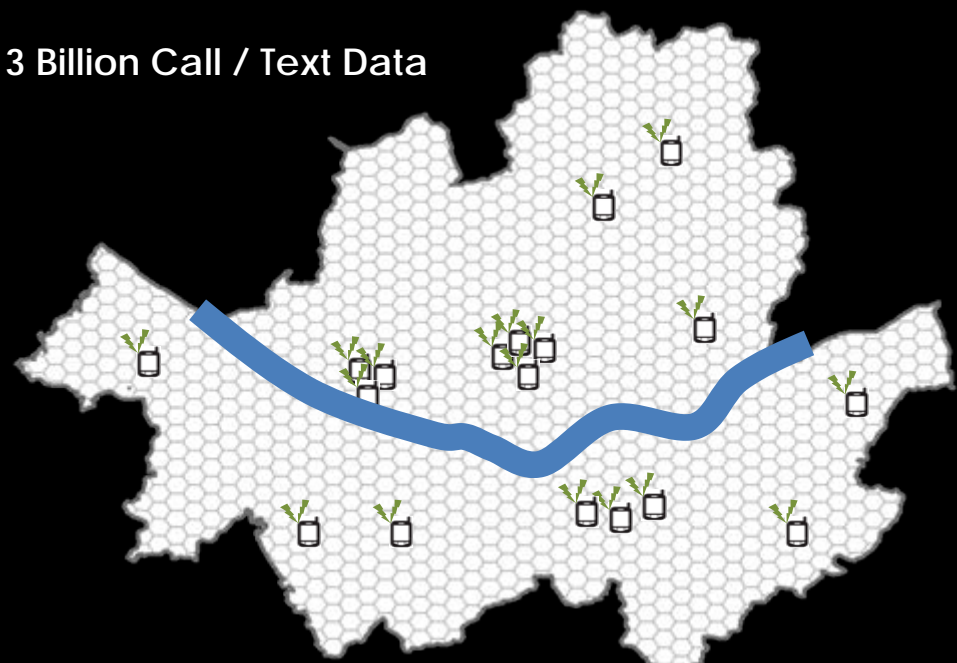
1 Seoul



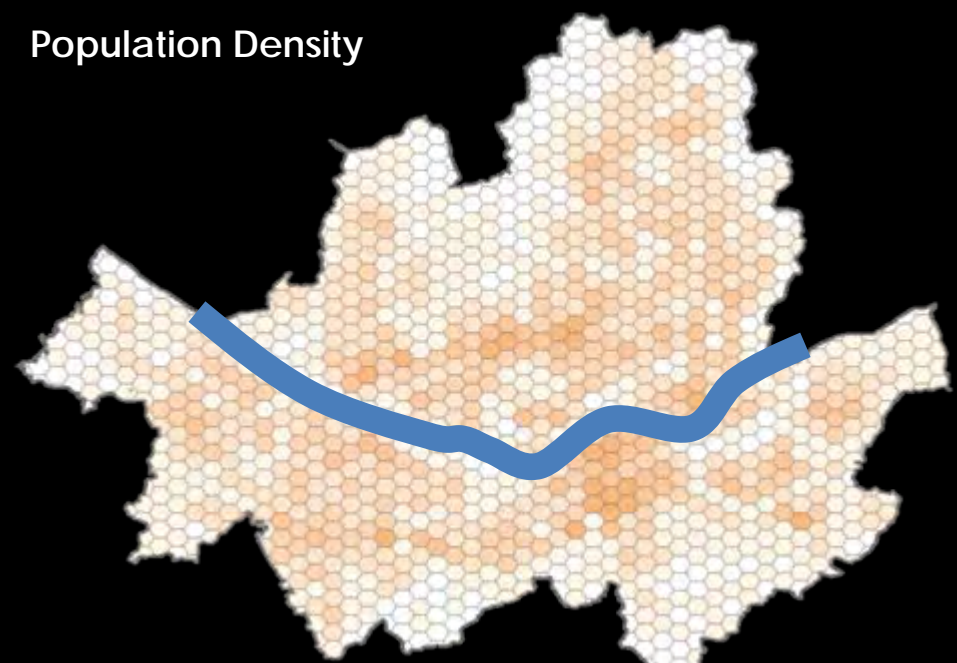
1,252 Hexagons



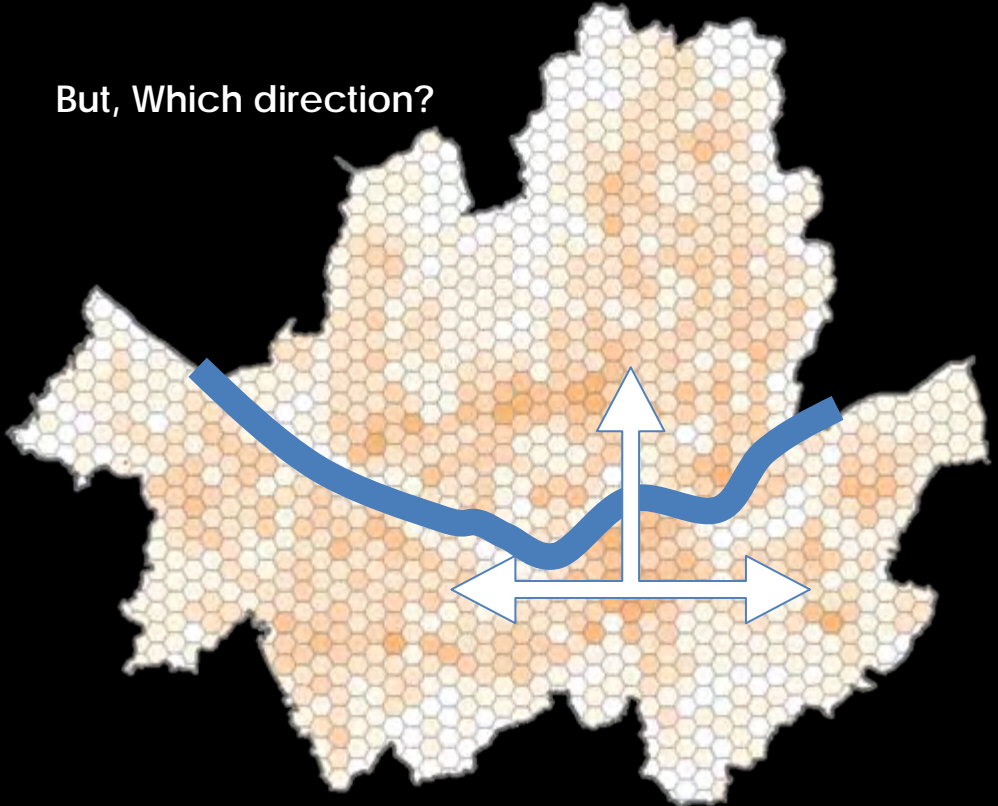
3 Billion Call / Text Data



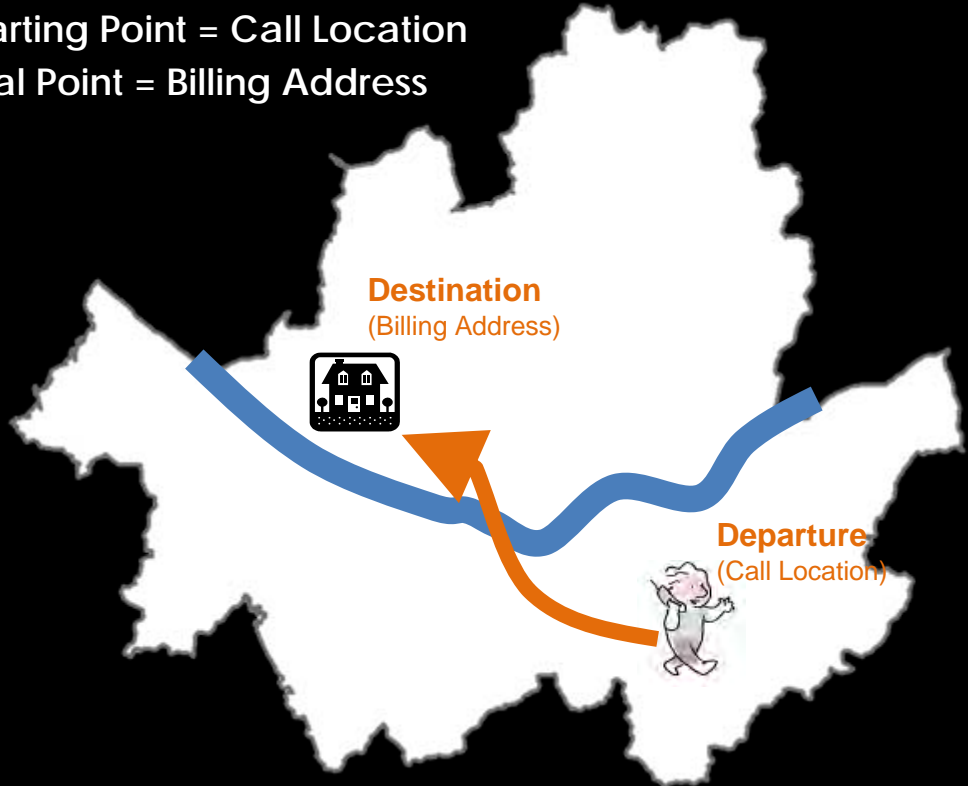
Population Density



But, Which direction?

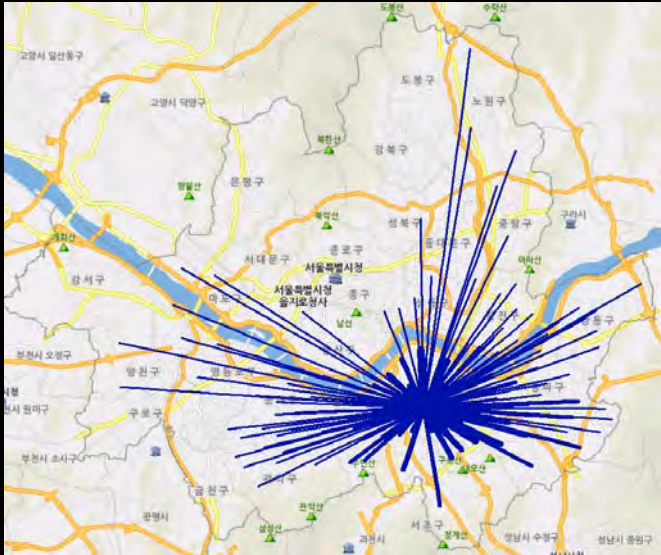


Departing Point = Call Location  
Arrival Point = Billing Address

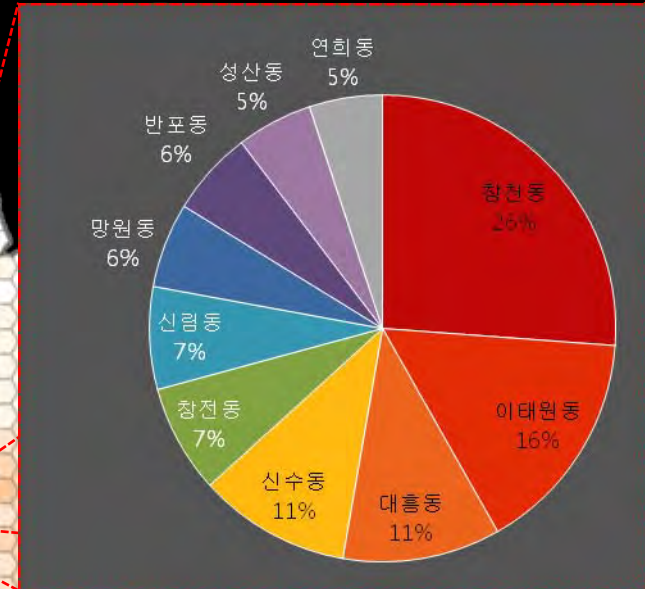




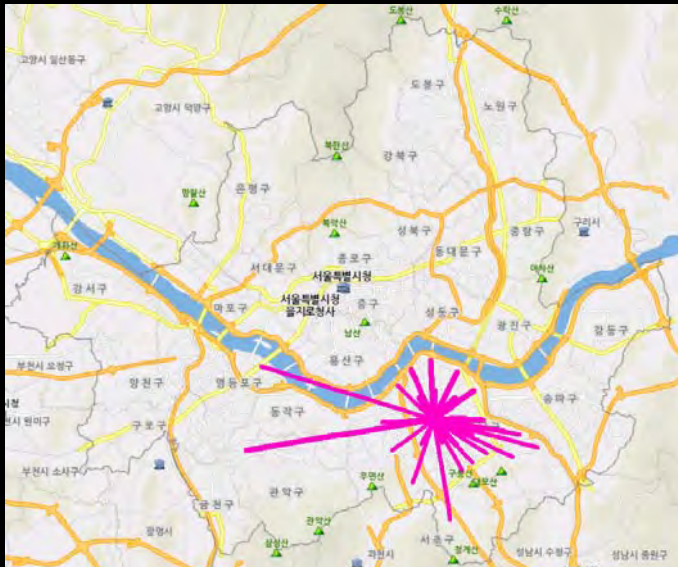
## From Where?



## Direction Data

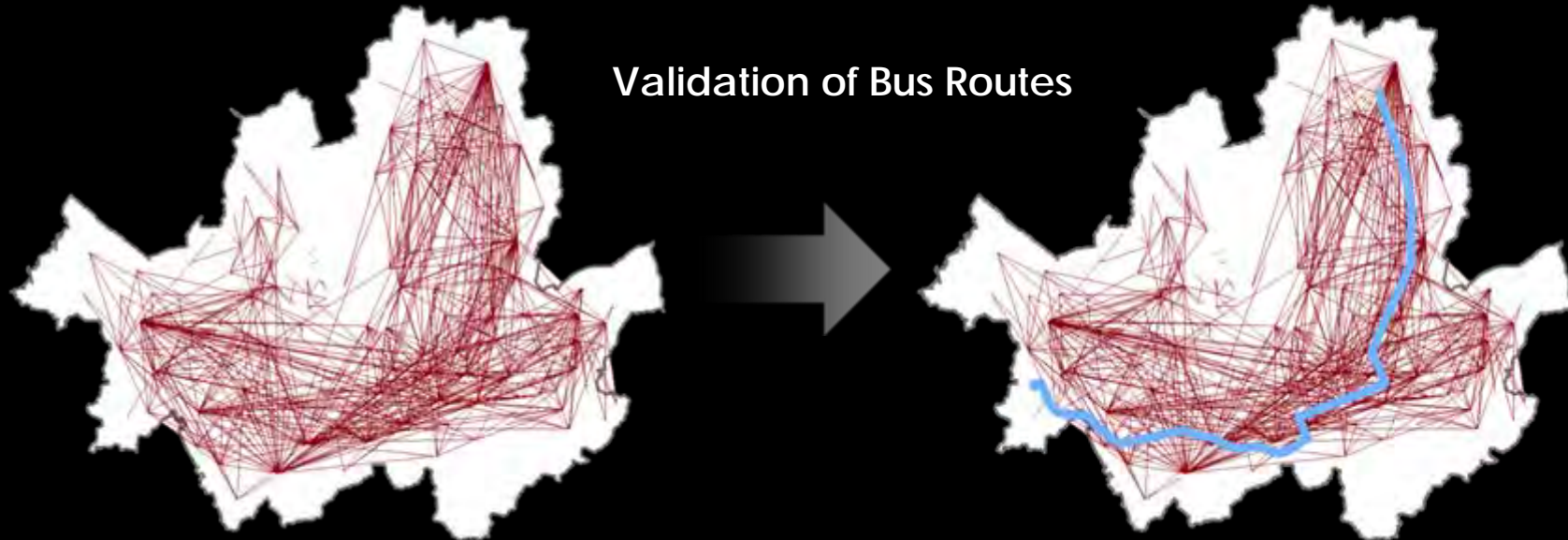
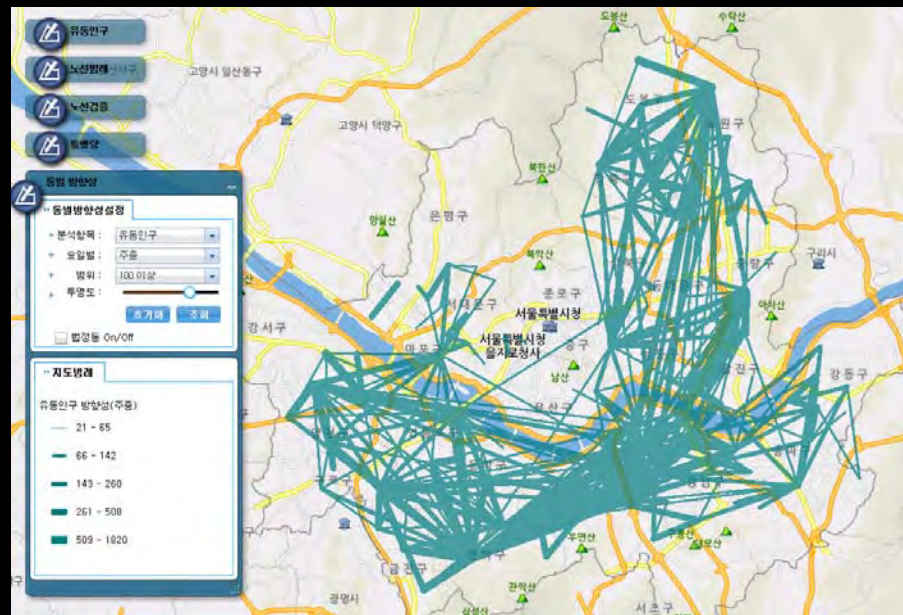


## To Where?

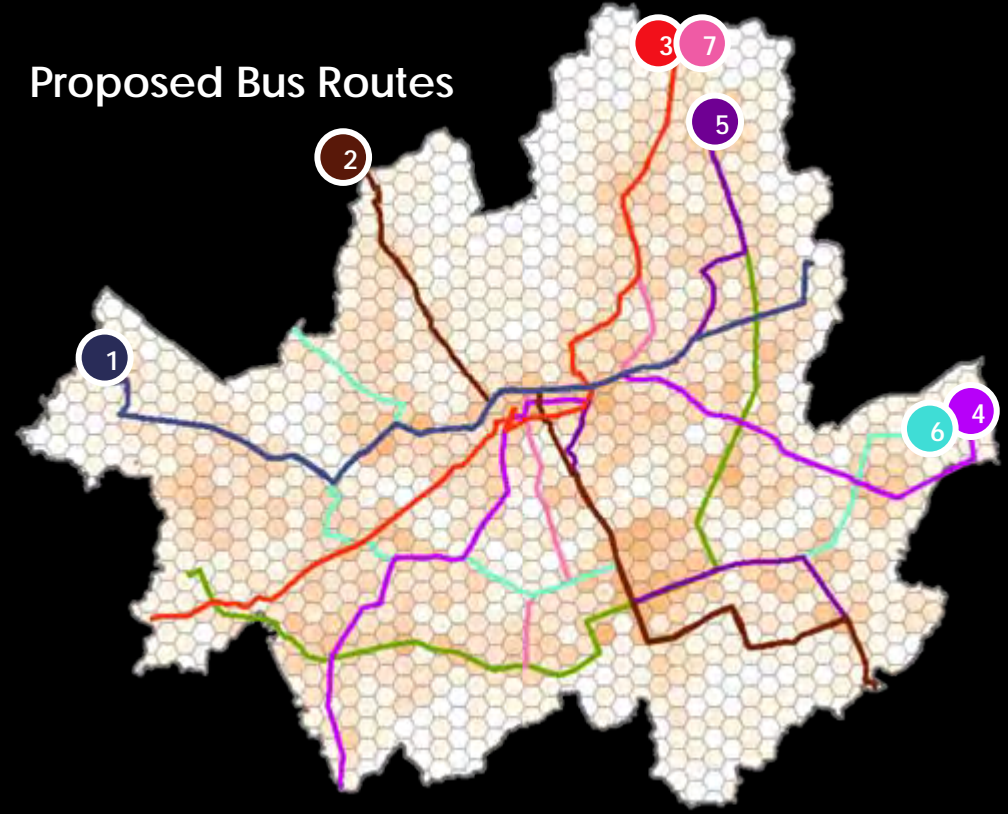




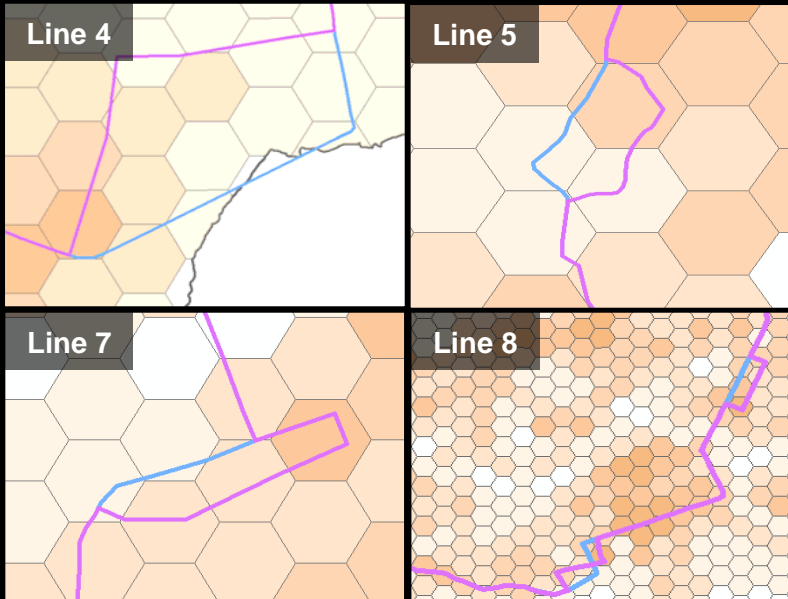
# Directed Graphs



# Proposed Bus Routes

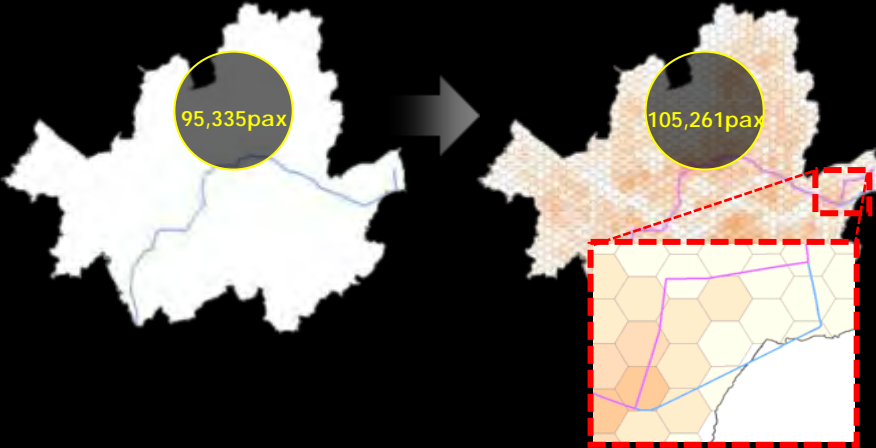


# Simulating Bus Routes



Line 4 :

Number of Users Increased by 10%



Line 5 :

Number of Users Increased by 8.5%



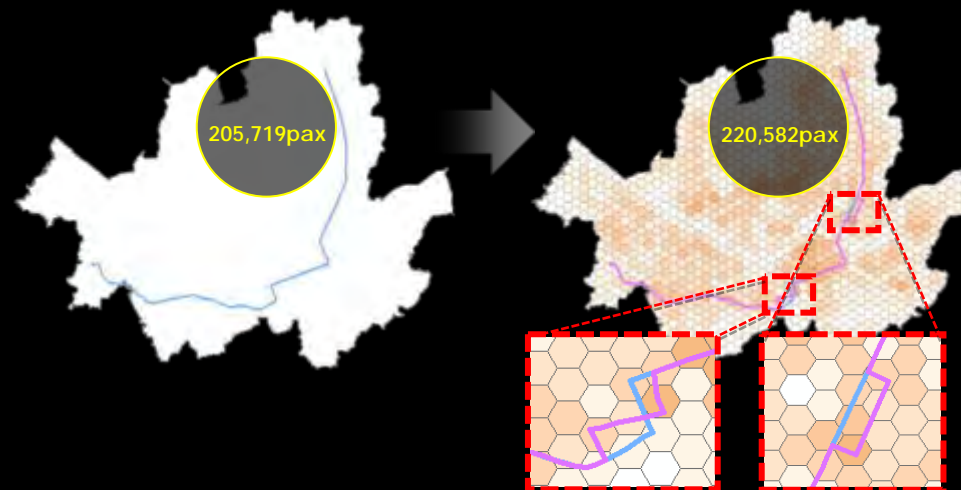
Line 7 :

Number of Users Increased by 5%



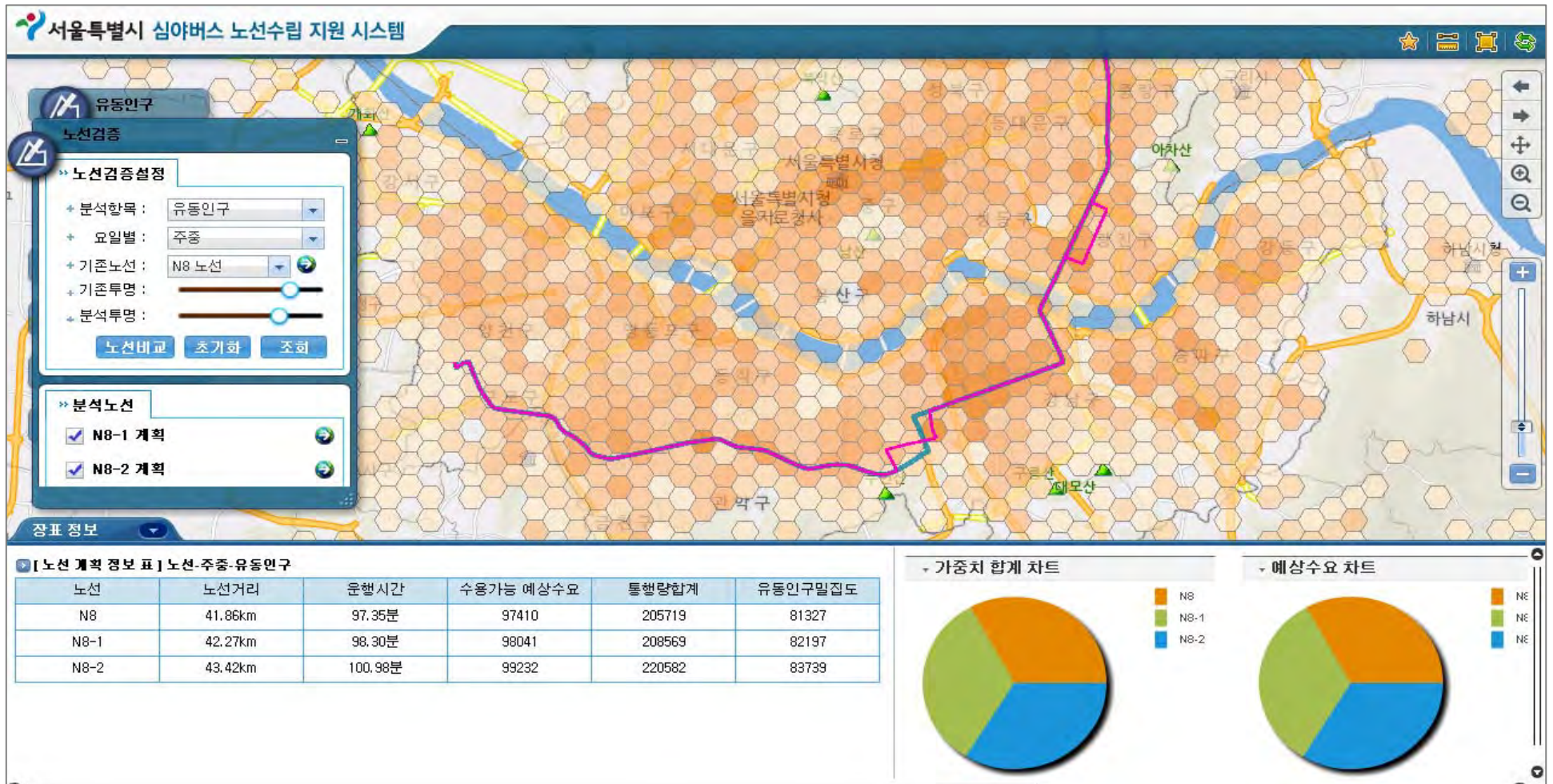
Line 8 :

Number of Users Increased by 7%





# Support System for Late night Bus Route Design

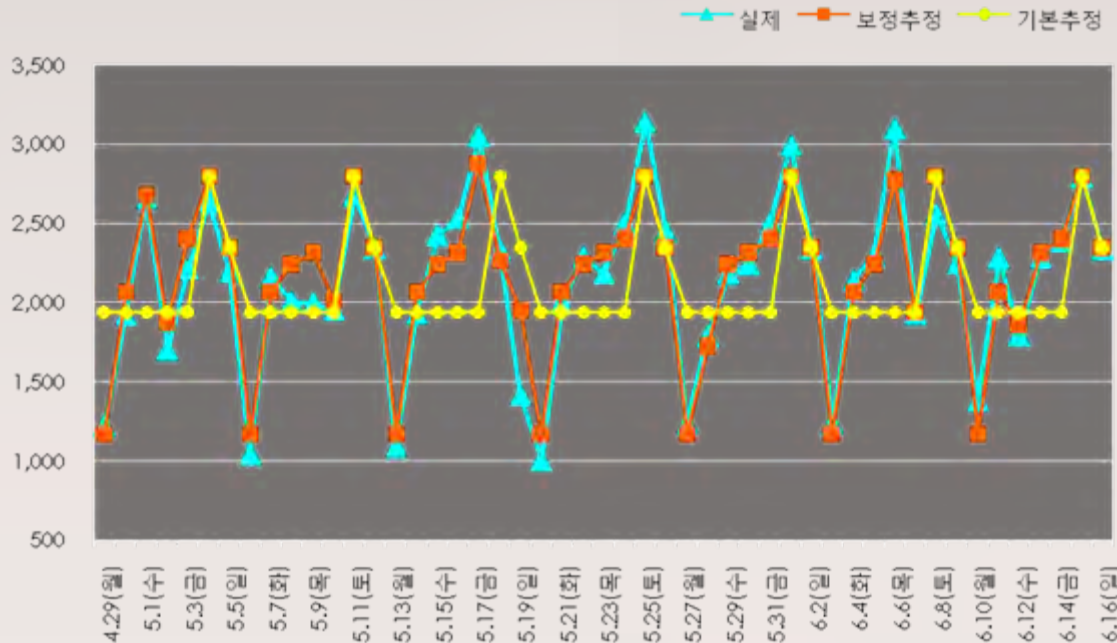


| 100 days | # of bus | distance | interval | # of users | average | Acc users |
|----------|----------|----------|----------|------------|---------|-----------|
| N10      | 3        | 33.7km   | 40~45    | 318        | 106     | 31,756    |
| N13      | 6        | 74.5km   | 40~45    | 914        | 152     | 91,381    |
| N16      | 6        | 76.1km   | 40~45    | 899        | 150     | 89,940    |
| N26      | 6        | 69.6km   | 35~40    | 1,108      | 185     | 110,799   |
| N30      | 3        | 73.4km   | 45~50    | 468        | 156     | 46,845    |
| N37      | 6        | 69.0km   | 35~40    | 954        | 159     | 95,432    |
| N40      | 3        | 40.0km   | 40~45    | 138        | 69      | 13,767    |
| N61      | 6        | 90.0km   | 45~50    | 969        | 161     | 96,891    |
| N62      | 6        | 72.3km   | 40       | 529        | 88      | 52,941    |
| Total    |          |          |          | 6,298      | 143     | 629,752   |

629,752 Users  
for 100 days



### Operation Data ≙ Simulation Results



### Increasing/Decreasing Factors

| Condition              | Percentage change |
|------------------------|-------------------|
| Precipitation > 5.0 ml | -17%              |
| The Day before Holiday | 0%                |
| Holiday                | 20%               |
| The Day after Holiday  | -19%              |



# About 42% Citizens are Living Near the Bus Stops of Post-midnight Buses



|                    | No. of Census Output Area | Population   |
|--------------------|---------------------------|--------------|
| Seoul              | 16,471                    | 9,512,346    |
| Within 500m radius | 6,907                     | 3,980,391    |
| <b>Ratio</b>       | <b>41.9%</b>              | <b>41.8%</b> |

Sourced from 2010 GIS Population Database by Census Output Area, National Statistical Office



# Case 2

## Matchmaking Taxis and Passengers

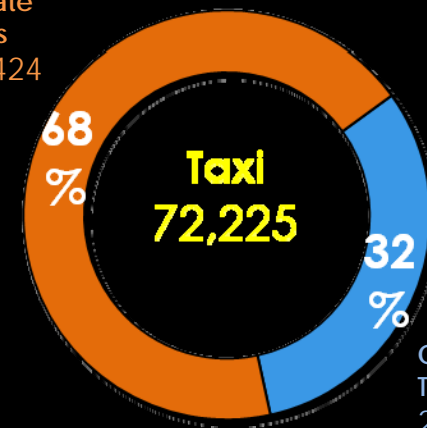
### Taxi DTG (Digital Tachometer Gauge)

X,Y coordinate, height, date, heading, speed, status  
(10 secs or 1 min)



Subsidy 160M USD / year

Private  
Taxis  
49,424



Corporate  
Taxis  
22,801

According to Seoul's 120 Dasan Call Center, **25.5%** Of the citizens' complaints are on transportation!

Among them, **73.5%** are related to taxis!

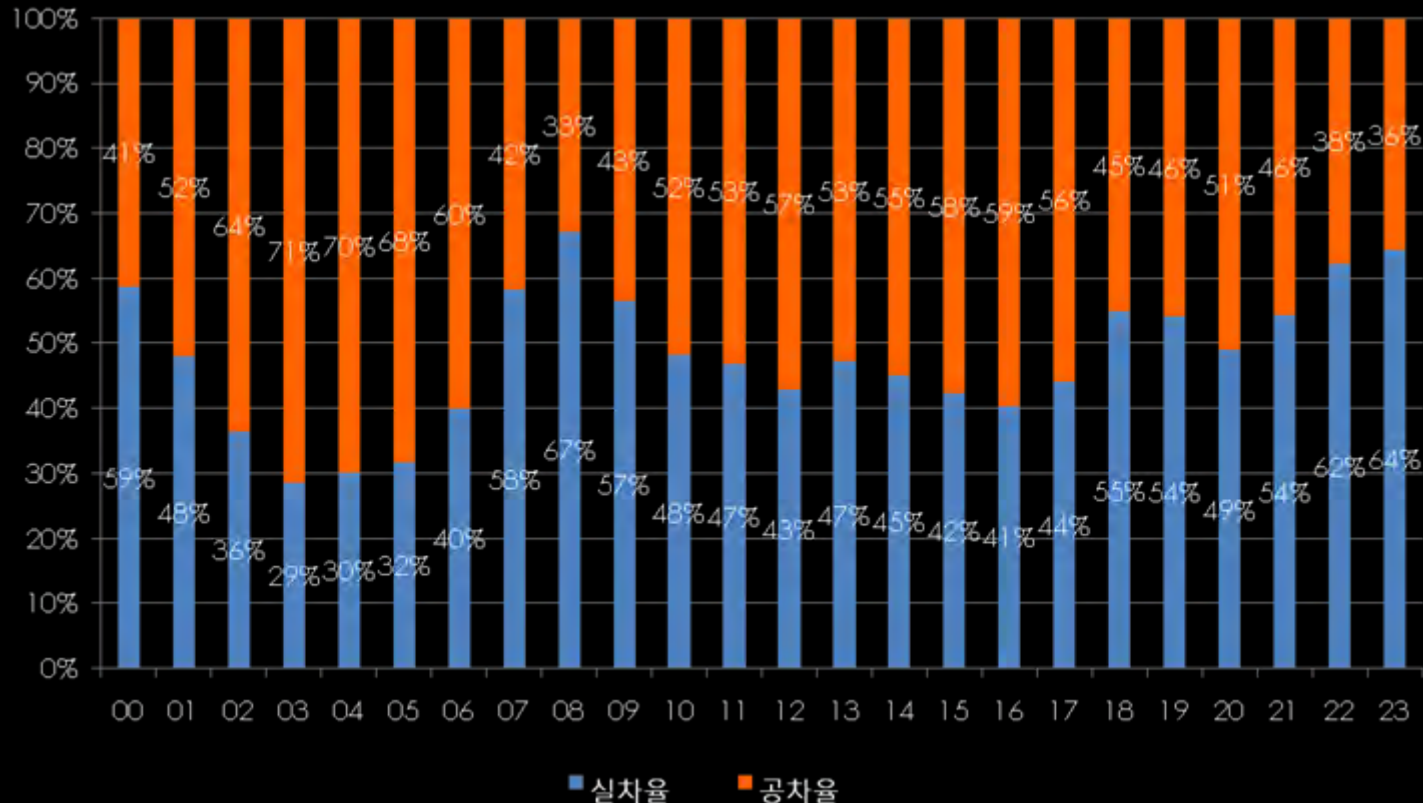
Refusal

Overcharging

Aggressive driving

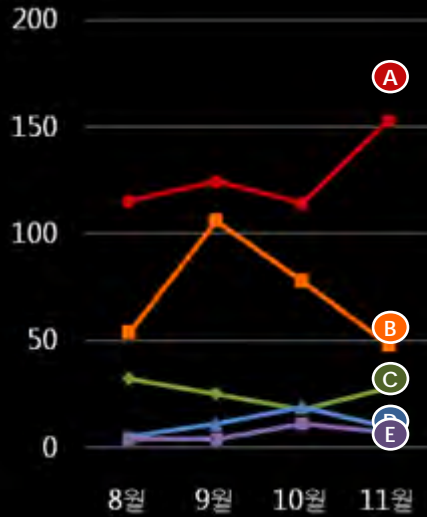
Unkindness

Empty/Occupied Transfer Rates by Time

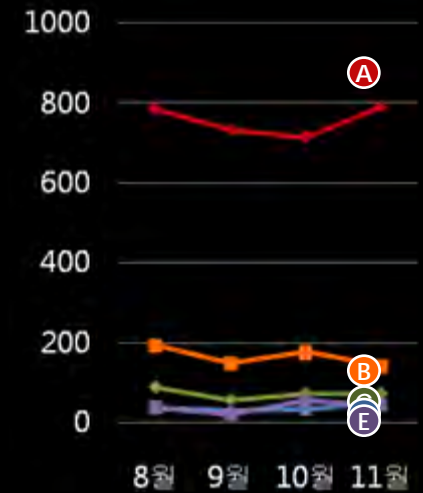
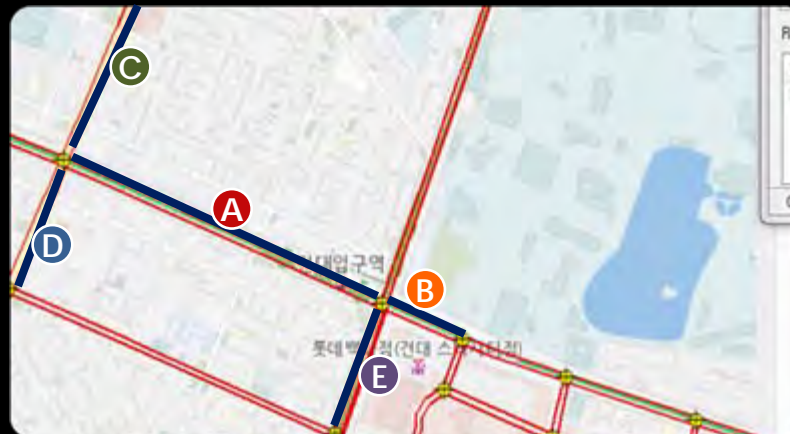


# Example of Taxi Data Pattern

Seoul City Hall

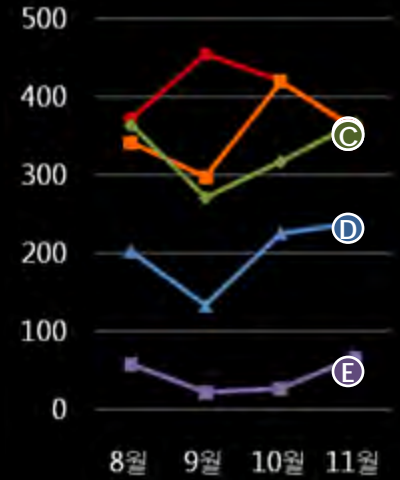
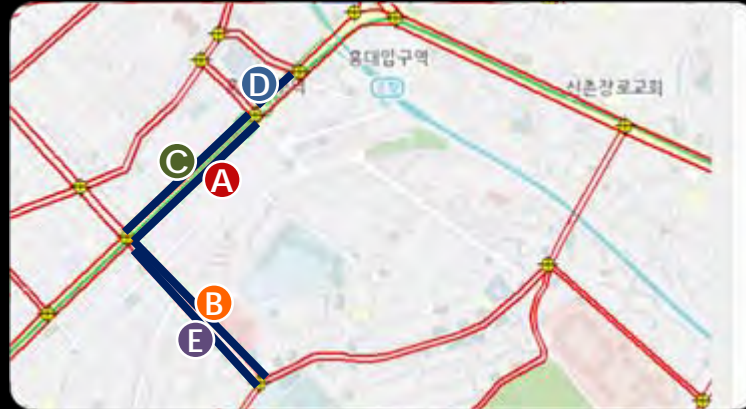


Konkuk University Subway Station

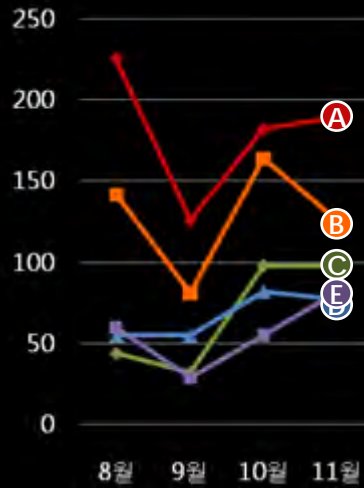
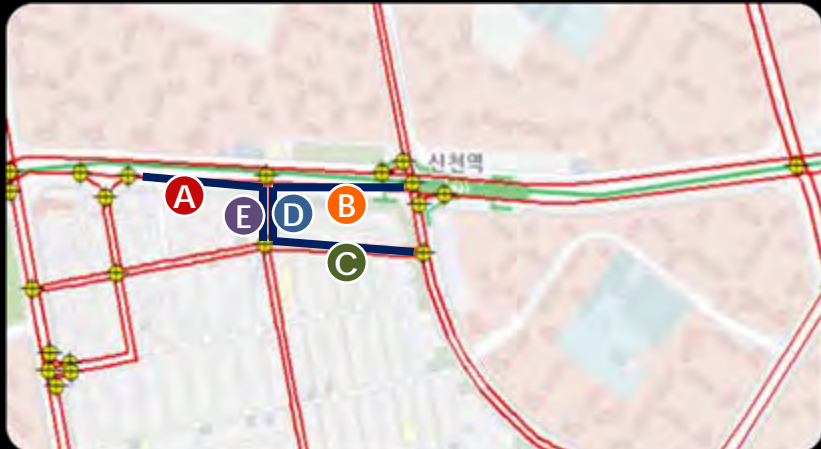




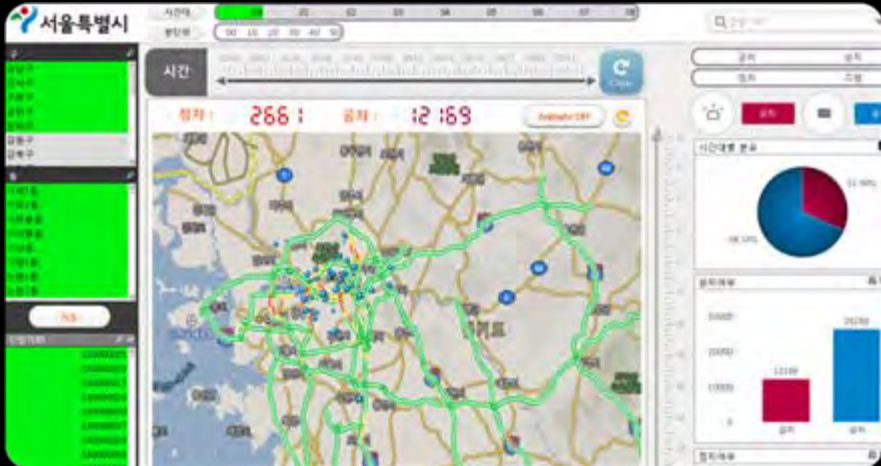
Hongik Univ. Subway Station



Sincheon Subway Station



# Prototype Analysis System of Taxi data (upto 3 Tbyte)



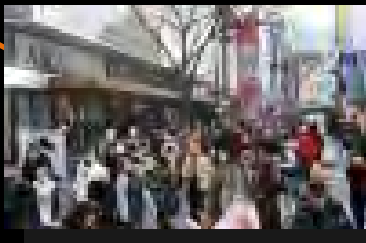
# Analysis of the Big Data



Information of Boarding and Departing Time, Location, and Traveling Course



Weather Information



Information on the Floating Population

Collection of Data

Analysis of Data



Driver

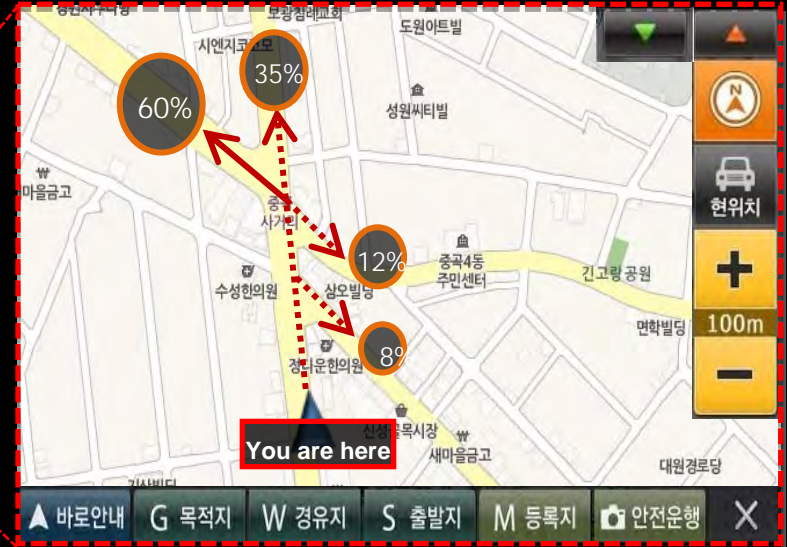


Passenger



# Taxi Drivers, "Where can I find passengers more likely?"

Effective Use of the Matchmaking Service!  
No problem for new drivers as well!



Passenger hiring data and destination information to taxi drivers

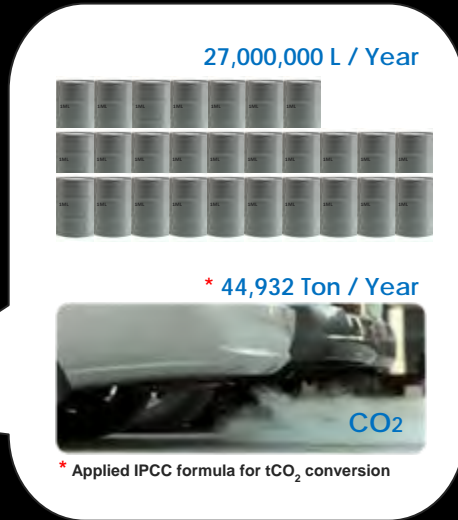
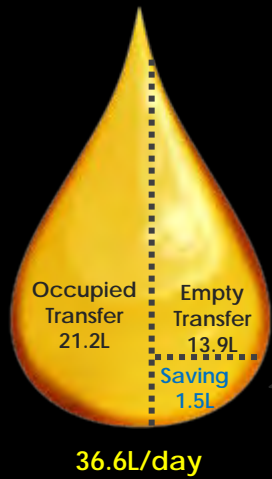
# Passengers, "Where can I find a cab?"

Nice place to grab a taxi!

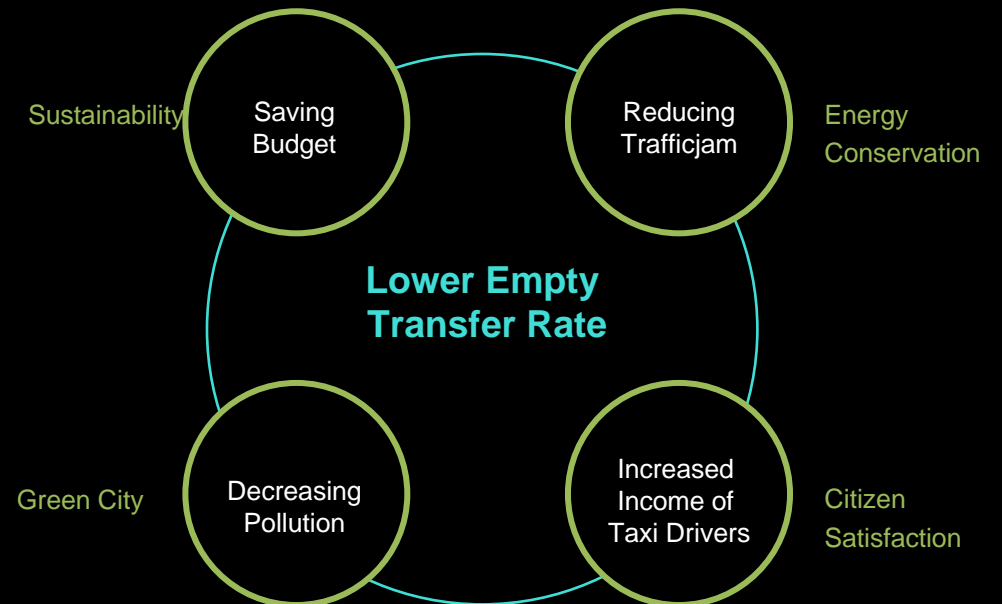


Empty taxi data and destination information to the citizens

# How Much Energy will be Saved if Empty Transfer Rate Decreased by 10%?



What would it be like, if there is 'matchmaking' between taxis and the passengers?





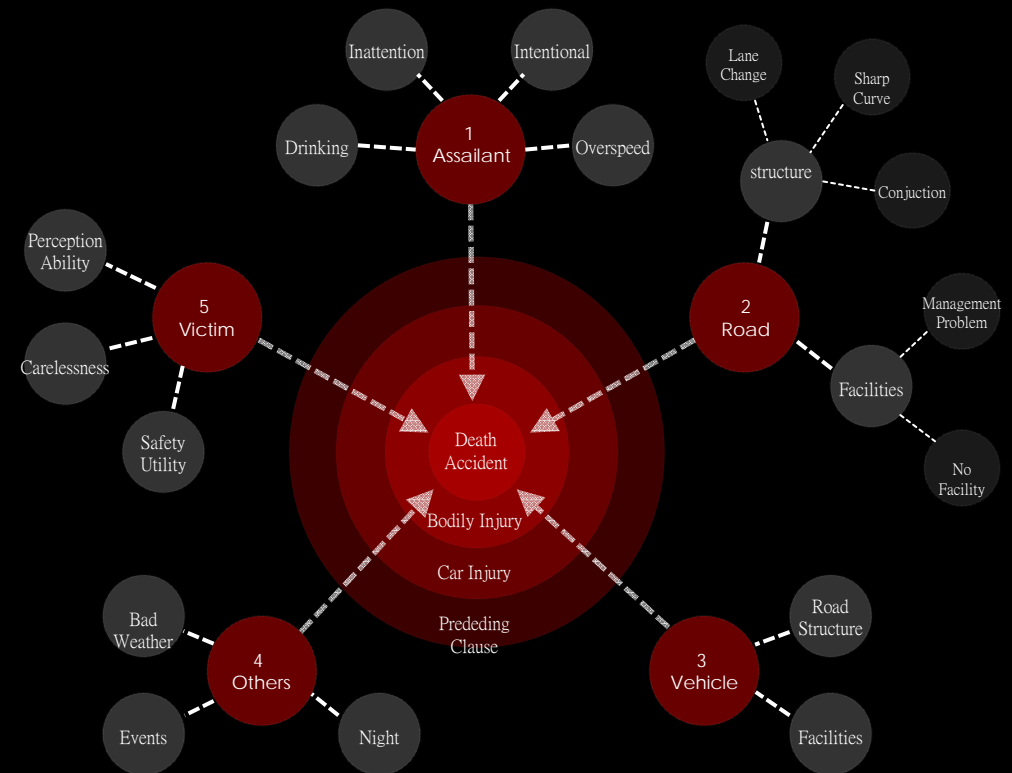
## Target Data for Analysis

- **Car Accident Records**  
from National Police Agency and Insurance Association
- **Drivers' Unexpected Behavior** (e.g. sudden stop)  
from Digital Tacho-Graph
- **Traffic Safety Facility**
- **Vehicle Speed on the Roads**
- **Standard Node Link**
- **Others** (floating population, nearby facilities, weather)

# Case 3

## Reduction of Car Accidents

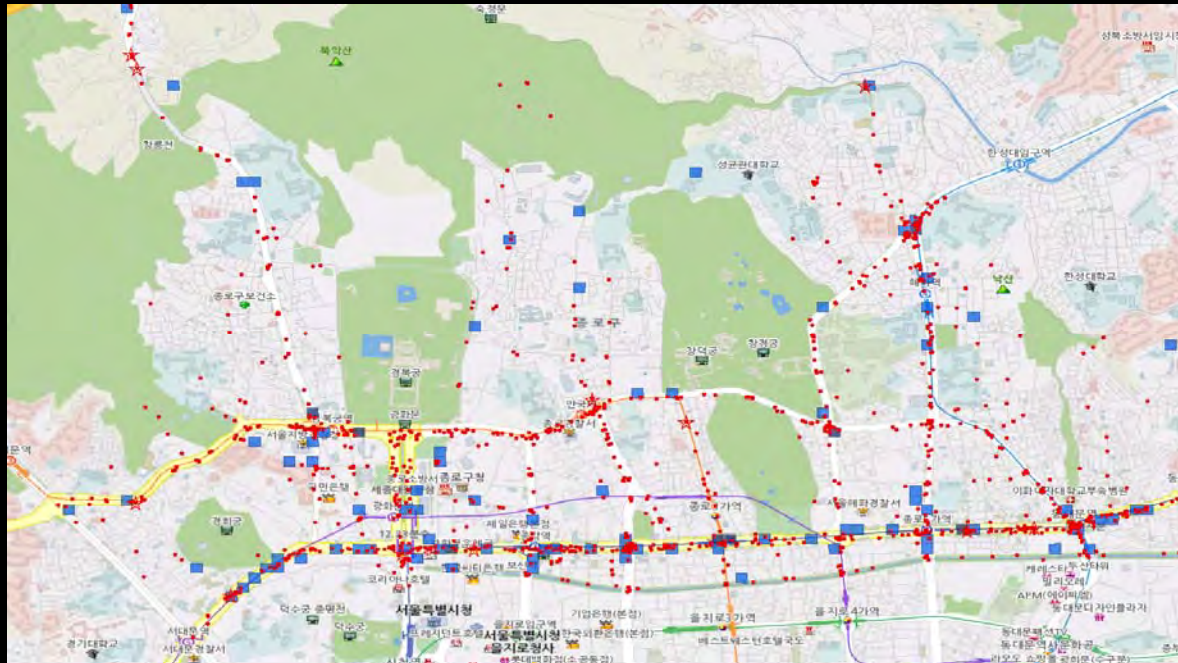
### Factors of Car Accidents



### Heinrich's Law (1:29:300)

**In a workplace, for every accident that causes a major injury, there are 29 accidents that cause minor injuries and 300 accidents that cause no injuries.**

# Sudden Stops on the Roads



# Car Accidents/Operation Information



# Reports of Car Accidents/Operation

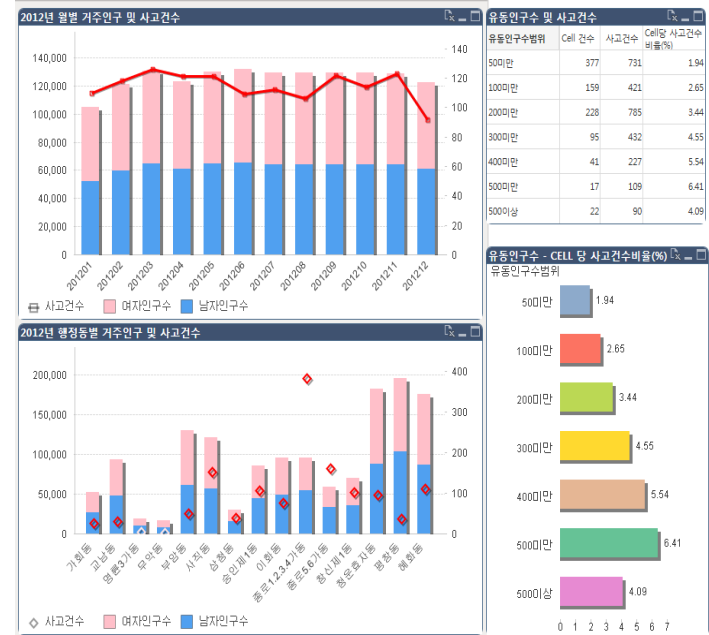


# Correlation Analysis

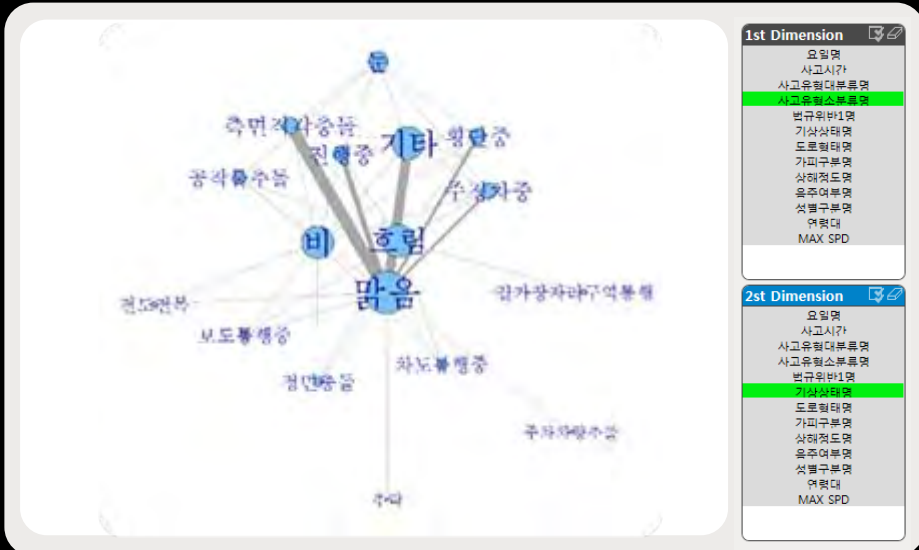
## Vehicle Speed



## Residing Population/Floating Population



## Car Accident Factors





# Insight will be applied to

## Policy Making for Transportation

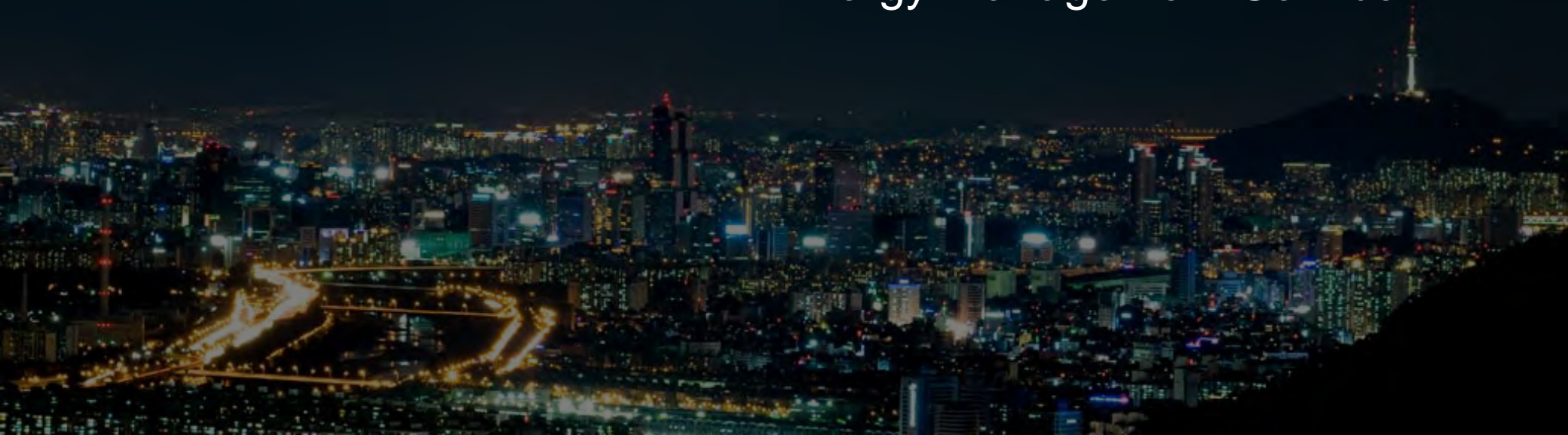


## Alerts on Drivers' GPS Navigation(TPO)



# 4 Big Data Plans

- Road Surface Monitoring
- City Festivals Analysis
- Mobility Service For the Disabled
- Energy Management Service





# Plan 1

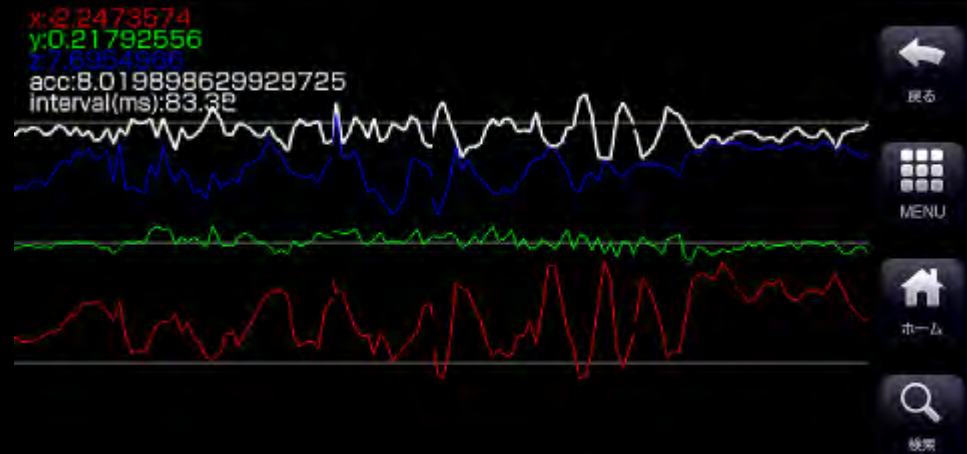
Crowdsourcing Based **Road Surface Monitoring Service**

Citizens at risk due to unsafe road conditions





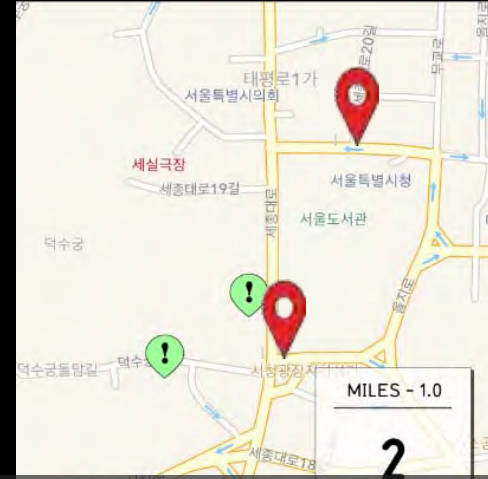
Thanks to smartphones,  
citizens have ways to monitor road  
conditions now.



# Analysis of the Big Data



Road Surface Monitor Data From Citizens (Crowdsourcing Data)



Citizen

**Road Surface Problem Alert Service via Apps**

Collection of Data

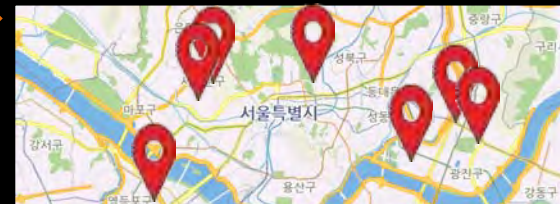
Analysis of Data



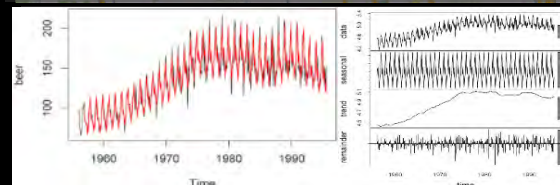
Known Road Obstacle Data



Daily Traffic Volume Data



**1) Real-time Road Surface Monitoring in Seoul**



**2) Road Deterioration Process Analysis**



Road Traffic Authority



# Plan 2

Big Data Based

Seoul City Festivals Analysis

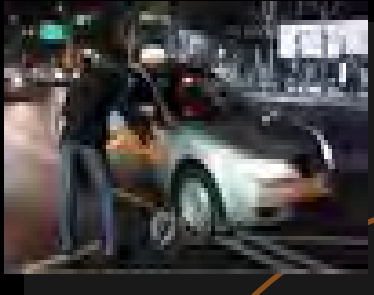
city festival visitors:

- Where do they come from?
- How can we manage city traffic and safety issue better?
- How do we measure the social and economic benefits of the city festivals?





# Transforming the Big Data into the Big Insights



Information of Boarding and Departing Time, Location, and Traveling Course



Credit Transaction Data

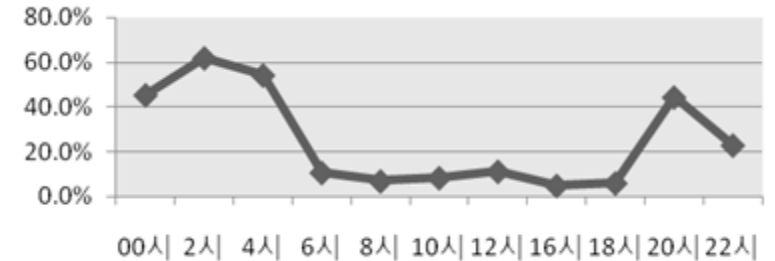


Floating Population Data

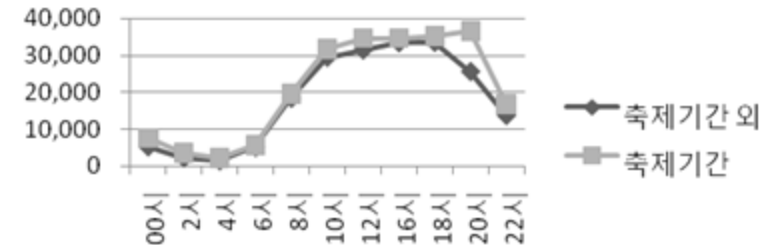
Collection of Data

Analysis of Data

## Hourly floating population change rate



## Hourly floating population comparison



## Most popular transportation and route analysis



# Policy Area where the Big Insights can be applied to:

## Traffic Management



## Public Safety



## Festival Contents Development



## Local Area Development



# Plan 3

## Improved Mobility Service For the Disabled

### Typical Daily Schedule of Visiting to Welfare Center



Call Taxi Service for the Disabled  
1 Hour of Waiting and 30-Minute-  
Ride to the Local District Office



Free Shuttle Bus at the Local District  
Office: 2 Hours of Waiting and 30-  
Minute-Ride to Welfare Center

Mr. Kim spent nearly 4  
hours to tend his business  
that would only take less  
than an hour for an  
ordinary person.



# Transforming The Big Data into the Big Time Saver

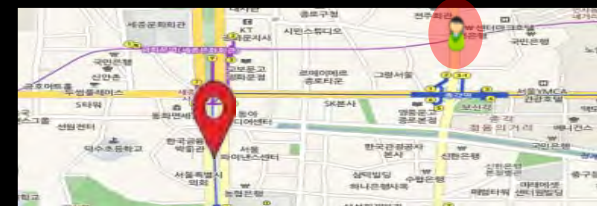


Call Taxi for the Disabled Operation Data

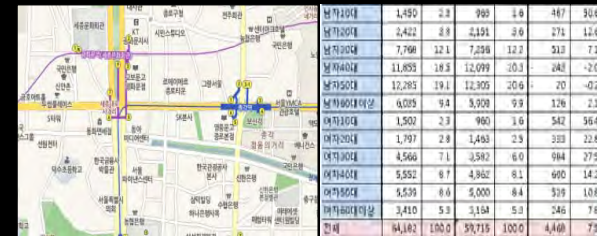


Welfare Card for the Disabled Usage Data

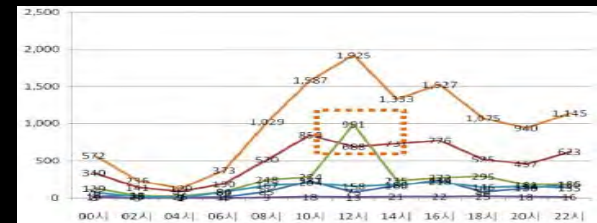
## Customer Mobility Pattern Analysis



## Vehicle Availability and Population Analysis



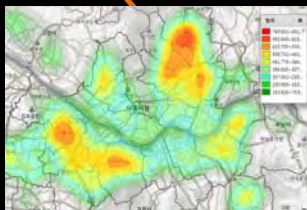
## Hourly Vehicle Routing and Turnaround Analysis



Call Center Service Request Data



Facility for the Disabled Data



Residence Population Data

Collection of Data

Analysis of Data



Traffic Volume Data

# The Big Data Analysis applied to:

## Vehicle Availability Management



## Vehicle Allocation Optimization



## Disabled Access Facility Location Plan and More...

# Plan 4

## Big Data Based Smart Seoul Energy Management Service

The Reduction of Electricity Consumption is the #1 priority policy for Seoul Metropolitan Government.

Can the Big Data improve overlooked area where the electricity consumption can be reduced further?





# Transforming The Big Data into the Big Energy Savings

Electricity Supply and Demand Data



Climate Data



Alternative Energy Use Data



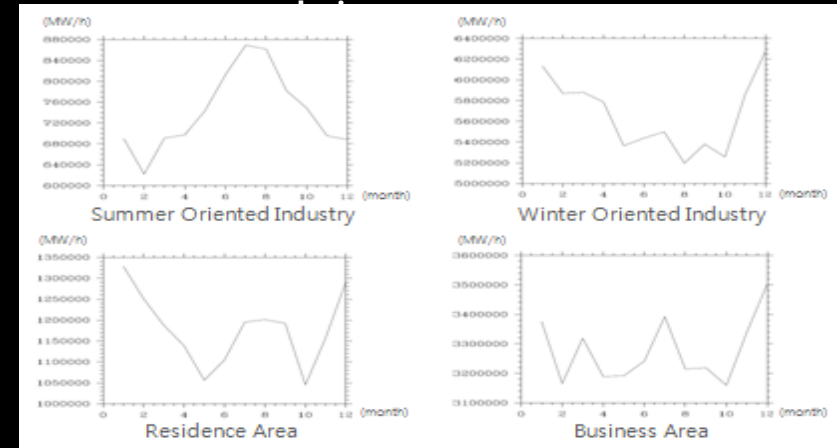
Collection of Data

Analysis of Data

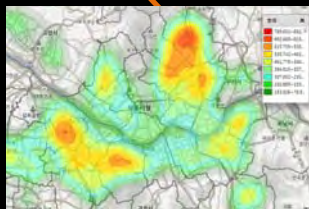
## Electricity consumption and climate correlation analysis



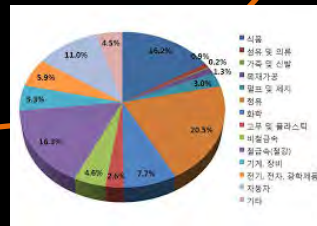
## Seasonal electricity consumption per residence/business cluster



Electricity Consumption Data



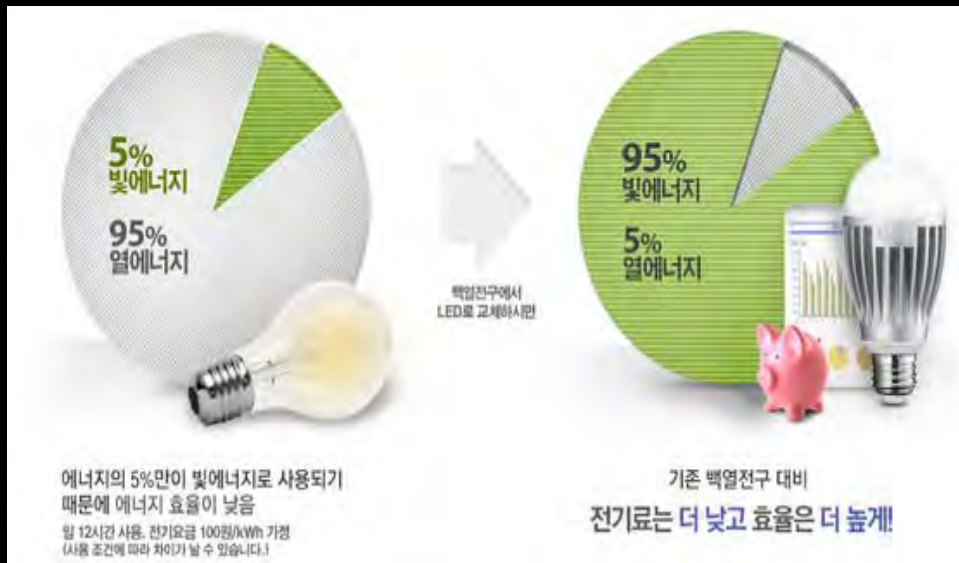
Residence Population Data



Industry / Business Data

# The Big Data Analysis applied to:

## Customized Electricity Saving Plan for Citizens



## Alternative Energy Campaign Policy



# Seoul's Big Data Vision





# Bar, Hong-ik Street, Seoul

20°C  Autumn

08:00 pm

Event: Dining Together

Total Calorie: 570 kcal



## Bottle

Material: ceramic  
Volume: 800ml  
Color: White  
Price : \$ 36.95

## Green Onion Pancake

Calorie: 430 kcal  
Price : \$ 11.82

## Rice Wine

Calorie: 140 kcal  
AVB: 6%  
Price : \$ 5.91

## Plate

Material: ceramic  
Size: 31.5 X 5.2 (cm)  
Color: Dark Brown  
Price : \$ 42.25

## Cup

Material: ceramic  
Volume: 380ml  
Color: White  
Price : \$ 12.34



# Gwanghwamun, Seoul

24°C ☁️ Summer / Rainy Season

04:43 pm

Event: Concert



**Man**  
Job: Student  
Age: 29

**Shirts**  
Brand: UNIQLO  
Price: \$ 60.00  
Color: Black

**Bag**  
Brand: PRADA  
Price: \$ 420.00  
Color: Black

**Pants**  
Brand: LEVIS  
Price: \$ 210.80  
Color: Blue

**Umbrella**  
Color: Crimson Red  
Price: \$ 11.82

**Shoes**  
Brand: FENDI  
Price: \$ 220  
Color: Black

**Woman**  
Job: Student  
Age: 23

**Bag**  
Brand: H&M  
Price: \$ 220.50  
Color: Baise

**Woman**  
Job: Student  
Age: 25

**Woman**  
Job: Housewife  
Age: 33

**Sidewalk**  
Material: Stone  
Size: 40 x 20 (cm)

**Umbrella**  
Color: Transparent  
Price: \$ 12.00

**Umbrella**  
Color : Brown & White dot  
Price : \$ 14.00

**Billboard**  
Material: LED  
Size: 60inch





# Hong-ik Street, Seoul

32°C ☀ Summer

09:00 am

Fine Dust:  $90\mu\text{g}/\text{m}^3$

Event: Graduation

Average Vehicle Speed: 12km/h



## Tree

Kind: Spindle tree  
Color: Green  
Age: 15 Years  
Height: 14.5m

## Full sized car

Brand: AUDI  
Color: Black  
Displacement: 3,993cc  
Price : \$ 153,565.80

## MID SIZE CAR

Brand: KIA  
Color: Black  
Displacement: 3,342cc  
Price: \$ 41,312.06

## SUV

Brand: Hyundai  
Color: Black  
Displacement: 2,476cc  
Price : \$ 29,550.83

## MID SIZE CAR

Brand: Hyundai  
Color: Black  
Displacement: 1,999cc  
Price: \$ 18,715.82



# Seoul

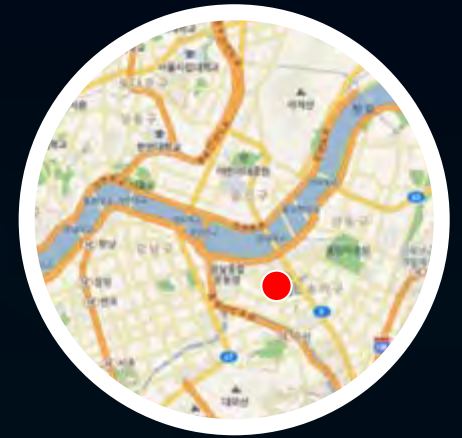
16°C  Autumn

09:40 pm

Fine Dust:  $73\mu\text{g}/\text{m}^3$

Event: Baseball Game

Average Vehicle Speed:  $46\text{km}/\text{h}$



N Seoul Tower  
Height: 236.7m / 777ft

## Yeongdong-Daero

Vehicle Speed: 20km/h  
Fine Dust:  $83\mu\text{g}/\text{m}^3$

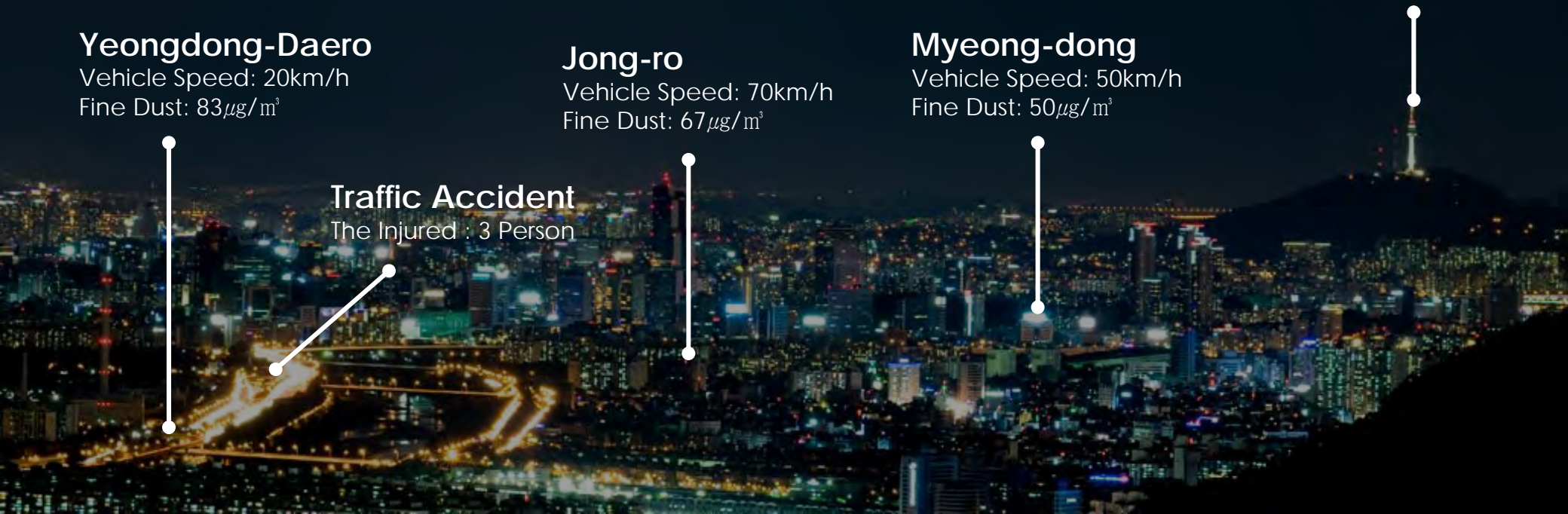
## Jong-ro

Vehicle Speed: 70km/h  
Fine Dust:  $67\mu\text{g}/\text{m}^3$

## Myeong-dong

Vehicle Speed: 50km/h  
Fine Dust:  $50\mu\text{g}/\text{m}^3$

Traffic Accident  
The Injured : 3 Person



# BIG DATA

Sidewalk  
Material: Stone  
Size: 40 x 20 (cm)

Sidewalk  
Material: Stone  
Size: 40 x 20 (cm)

Billboard  
Material: LED  
Size: 60inch



**Green Onion Pancake**  
Calorie: 430,000 cal  
Price : \$ 11.82

Traffic Accident  
The death toll: 3 Person

09:40 pm



**MID SIZE CAR**  
Brand: KIA  
Color: Black  
Displacement: 3,342cc  
Price: \$ 41,312.06

Traffic Accident  
The death toll: 3 Person

08:00 pm

Billboard  
Material: LED  
Size: 60inch

**Umbrella**  
Color: Transparent  
Price: \$ 12.00

**SUV**  
Brand: Hyundai  
Color: Black  
Displacement: 2,476cc  
Price : \$ 29,550.83

Billboard  
Material: LED  
Size: 60inch



Autumn

16°C

Traffic Accident

**Event**  
Baseball Game

**Raw Rice Wine**  
Calorie: 140,000 cal  
AVB: 6%  
Price : \$ 5.91

**SUV**  
Brand: Hyundai  
Color: Black  
Displacement: 2,476cc  
Price : \$ 29,550.83

20°C



**Man**  
Job: Student  
Age: 29

**Plate**  
Material: ceramic  
Size: 31.5 X 5.2 (cm)  
Color: Dark Brown  
Price : \$ 42.25

**Umbrella**  
Color: Crimson Red  
Price: \$ 11.82

**Full sized car**  
Brand: AUDI  
Color: Black  
Displacement: 3,993cc  
Price : \$ 153,565.80

**Umbrella**  
Color : Brown & White dot  
Price : \$ 14.00

**Cup**  
Material: ceramic  
Volume: 380ml  
Color: White  
Price : \$ 12.34

**N Seoul Tower**  
Height: 236.7m / 777ft



18°C



**Shirts**  
Brand: UNIQLO  
Price: \$ 220.00  
Color: Black



**Jong-ro**  
Vehicle Speed: 70km/h  
Fine Dust: 67µg/m³

**Bag**  
Brand: H&M  
Price: \$ 220.50  
Color: Baize



**Yeongdong-Daero**  
Vehicle Speed: 20km/h  
Fine Dust: 83µg/m³

**SUV**  
Brand: Hyundai  
Color: Black  
Displacement: 2,476cc  
Price : \$ 29,550.83

18°C



**Woman**  
Job: Student  
Age: 23



**Myeong-dong**  
Vehicle Speed: 50km/h  
Fine Dust: 50µg/m³

19°C

**Sidewalk**  
Material: Stone  
Size: 40 x 20 (cm)



**Bag**  
Brand: PRADA  
Price: \$ 420.00  
Color: Black



**Pants**  
Brand: LEVIS  
Price: \$ 210.80  
Color: Blue

**Shoes**  
Brand: FENDI  
Price: \$ 220  
Color: Black



**Woman**  
Job: Student  
Age: 25



**Woman**  
Job: Housewife  
Age: 33



**Event**  
Dining Together

**Traffic Accident**  
The death toll: 3 Person



# DATA CONNECTED

Sidewalk  
Material: Stone  
Size: 40 x 20 (cm)

Sidewalk  
Material: Stone  
Size: 40 x 20 (cm)

Billboard  
Material: LED  
Size: 60inch



**Green Onion Pancake**  
Calorie: 430,000 cal  
Price : \$ 11.82

09:40 pm

**MID SIZE CAR**  
Brand: KIA  
Color: Black  
Displacement: 3,342cc  
Price: \$ 41,312.06

**Tree**  
Kind: Spindle tree  
Color: Green  
Age: 15 Years  
Height: 14.5m

08:00 pm

**Bottle**  
Material: ceramic  
Volume: 800ml  
Color: White  
Price : \$ 36.95



**Event**  
Baseball Game

Autumn



**Rice Wine**  
Calorie: 140,000 cal  
AVB: 6%  
Price : \$ 5.91

**Umbrella**  
Color: Transparent  
Price : \$ 12.00

**SUV**  
Brand: Hyundai  
Color: Black  
Displacement: 2,476cc  
Price : \$ 29,550.83

**Billboard**  
Material: LED  
Size: 60inch

16°C

**Plate**  
Material: ceramic  
Size: 31.5 X 5.2 (cm)  
Color: Dark Brown  
Price : \$ 42.25

**Umbrella**  
Color: Crimson Red  
Price: \$ 11.82

**Full sized car**  
Brand: AUDI  
Color: Black  
Displacement: 3,993cc  
Price : \$ 153,565.80

**Umbrella**  
Color : Brown & White dot  
Price : \$ 14.00

20°C



**N Seoul Tower**  
Height: 236.7m / 777ft



**Man**  
Job: Student  
Age: 29

**Shirts**  
Brand: UNIQLO  
Price: \$ 220.00  
Color: Black



**Jong-ro**  
Vehicle Speed: 70km/h  
Fine Dust: 67µg/m³

**Bag**  
Brand: H&M  
Price: \$ 220.50  
Color: Baize

**Cup**  
Material: ceramic  
Volume: 380ml  
Color: White  
Price : \$ 12.34



**MID SIZE CAR**  
Brand: Hyundai  
Color: Black  
Displacement: 1,999cc  
Price: \$ 18,715.82



**Yeongdong-Daero**  
Vehicle Speed: 20km/h  
Fine Dust: 83µg/m³

**SUV**  
Brand: Hyundai  
Color: Black  
Displacement: 2,476cc  
Price: \$ 29,550.83

**Raw Rice Wine**  
Raw Rice Wine  
Price: \$ 6.91

18°C



**Woman**  
Job: Student  
Age: 23



**Myeong-dong**  
Vehicle Speed: 50km/h  
Fine Dust: 50µg/m³

19°C

**Sidewalk**  
Material: Stone  
Size: 40 x 20 (cm)



**Bag**  
Brand: PRADA  
Price: \$ 420.00  
Color: Black



**Pants**  
Brand: LEVIS  
Price: \$ 210.80  
Color: Blue

**Shoes**  
Brand: FENDI  
Price: \$ 220  
Color: Black



**Event**  
Dining Together

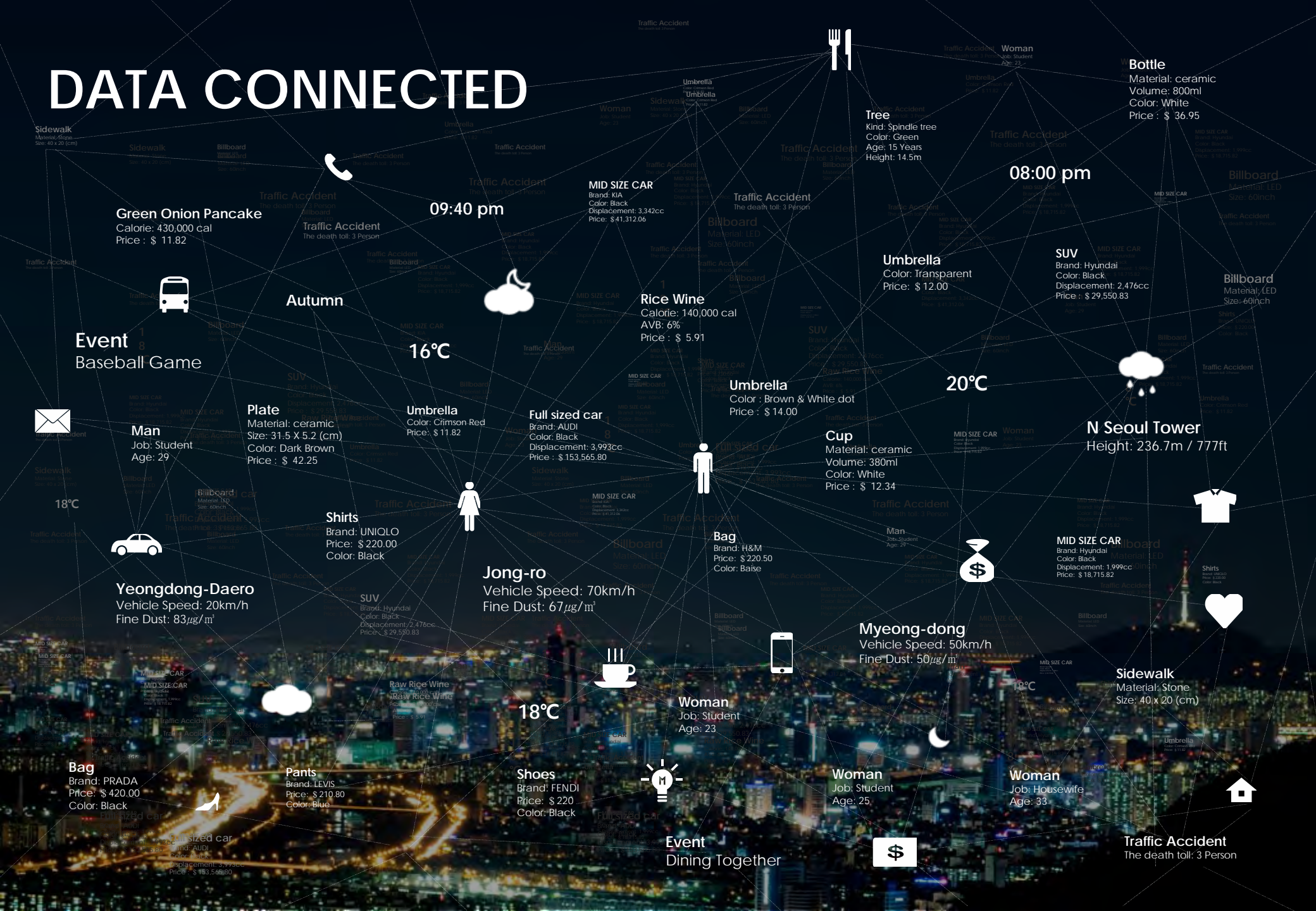
**Woman**  
Job: Student  
Age: 25



**Woman**  
Job: Housewife  
Age: 33



**Traffic Accident**  
The death toll: 3 Person





# SMART VALUE

