

# Smart Cities and Data Analytics

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Or

# What I would like to say to the future transportation leaders



Who conveniently are in this room.

# People



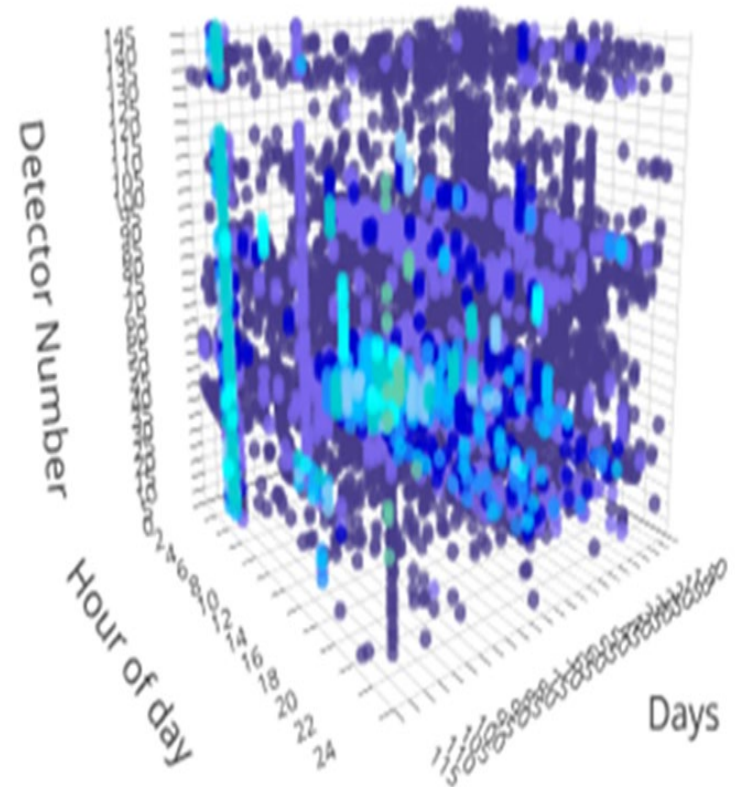
1

# Technology



2

# Data





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# People

human beings · persons · individuals · humans · mankind  
· humankind · the human race · Homo sapiens · humanity  
· the human species · mortals · (living) souls · personages  
· men, women, and children · folk · peeps<sub>3</sub>

**SAFETY FIRST!**

# Safety

## 10 Leading Causes of Death by Age Group, United States – 2014

Rank	Age Groups										Total
	<1	1-4	5-9	10-14	15-24	25-34	35-44	45-54	55-64	65+	
1	Congenital Anomalies 4,746	Unintentional Injury 1,216	Unintentional Injury 730	Unintentional Injury 750	Unintentional Injury 11,836	Unintentional Injury 17,357	Unintentional Injury 16,048	Malignant Neoplasms 44,834	Malignant Neoplasms 115,282	Heart Disease 489,722	Heart Disease 614,348
2	Short Gestation 4,173	Congenital Anomalies 399	Malignant Neoplasms 436	Suicide 425	Suicide 5,079	Suicide 6,569	Malignant Neoplasms 11,267	Heart Disease 34,791	Heart Disease 74,473	Malignant Neoplasms 413,885	Malignant Neoplasms 591,699
3	Maternal Pregnancy Comp. 1,574	Homicide 364	Congenital Anomalies 192	Malignant Neoplasms 416	Homicide 4,144	Homicide 4,159	Heart Disease 10,368	Unintentional Injury 20,610	Unintentional Injury 18,030	Chronic Low. Respiratory Disease 124,693	Chronic Low. Respiratory Disease 147,101
4	SIDS 1,545	Malignant Neoplasms 321	Homicide 123	Congenital Anomalies 156	Malignant Neoplasms 1,569	Malignant Neoplasms 3,624	Suicide 6,706	Suicide 8,767	Chronic Low. Respiratory Disease 16,492	Cerebro-vascular 113,308	Unintentional Injury 136,053
5	Unintentional Injury 1,161	Heart Disease 149	Heart Disease 69	Homicide 156	Heart Disease 953	Heart Disease 3,341	Homicide 2,588	Liver Disease 8,627	Diabetes Mellitus 13,342	Alzheimer's Disease 92,604	Cerebro-vascular 133,103
6	Placenta Cord. Membranes 965	Influenza & Pneumonia 109	Chronic Low. Respiratory Disease 68	Heart Disease 122	Congenital Anomalies 377	Liver Disease 725	Liver Disease 2,582	Diabetes Mellitus 6,062	Liver Disease 12,792	Diabetes Mellitus 54,161	Alzheimer's Disease 93,541
7	Bacterial Sepsis 544	Chronic Low Respiratory Disease 53	Influenza & Pneumonia 57	Chronic Low Respiratory Disease 71	Influenza & Pneumonia 199	Diabetes Mellitus 709	Diabetes Mellitus 1,999	Cerebro-vascular 5,349	Cerebro-vascular 11,727	Unintentional Injury 48,295	Diabetes Mellitus 76,488
8	Respiratory Distress 460	Septicemia 53	Cerebro-vascular 45	Cerebro-vascular 43	Diabetes Mellitus 181	HIV 583	Cerebro-vascular 1,745	Chronic Low. Respiratory Disease 4,402	Suicide 7,527	Influenza & Pneumonia 44,836	Influenza & Pneumonia 55,227
9	Circulatory System Disease 444	Benign Neoplasms 38	Benign Neoplasms 36	Influenza & Pneumonia 41	Chronic Low Respiratory Disease 178	Cerebro-vascular 579	HIV 1,174	Influenza & Pneumonia 2,731	Septicemia 5,709	Nephritis 39,957	Nephritis 48,146
10	Neonatal Hemorrhage 441	Perinatal Period 38	Septicemia 33	Benign Neoplasms 38	Cerebro-vascular 177	Influenza & Pneumonia 549	Influenza & Pneumonia 1,125	Septicemia 2,514	Influenza & Pneumonia 5,390	Septicemia 29,124	Suicide 42,773

Data Source: National Vital Statistics System, National Center for Health Statistics, CDC.  
Produced by: National Center for Injury Prevention and Control, CDC using WISQARS™.



Centers for Disease  
Control and Prevention  
National Center for Injury  
Prevention and Control

# Smart City People

## Who do we design for?

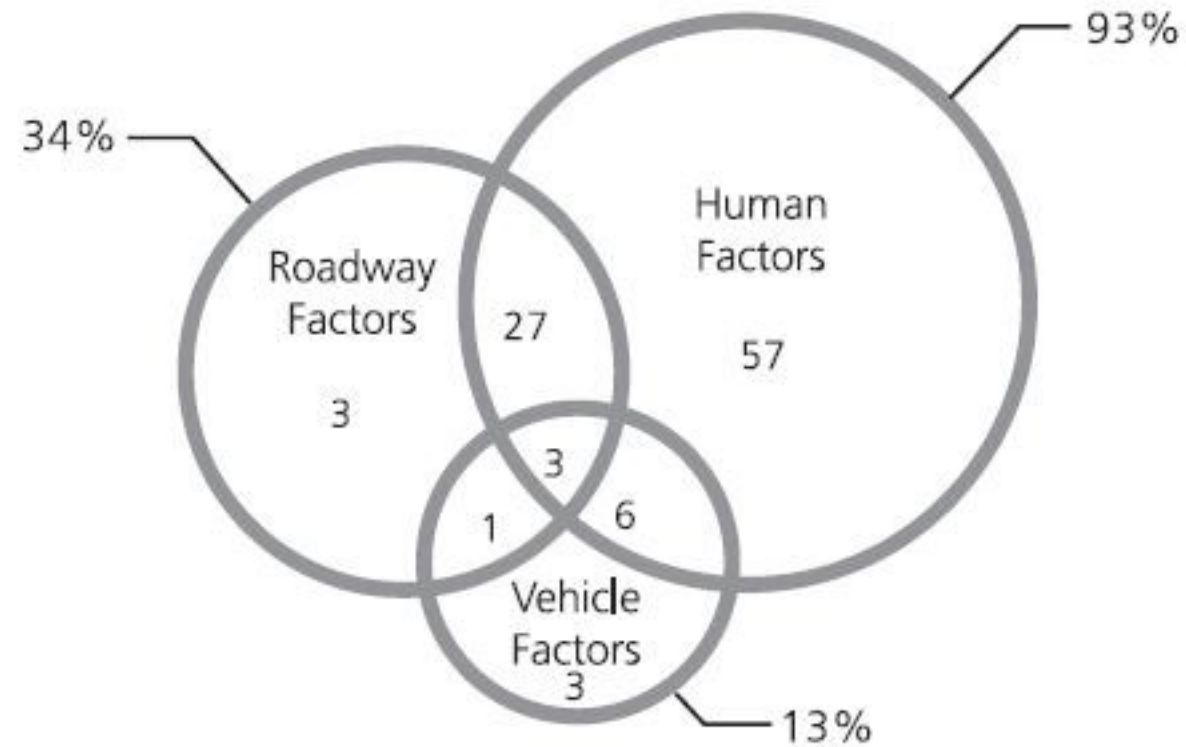
- Reasonable worst case
  - Reads road
  - Acts on feelings, impulse, attitude, frustration
  - Not an analytical engineer
  - Performs at 90<sup>th</sup> – 99<sup>th</sup> percentile





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How many times is the basketball passed  
by players in **WHITE** shirts?



Source: Treat 1979

Figure 3-3. Contributing Factors to Vehicle Crashes

# TRAFFIC ENGINEERING

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*...is the branch of engineering which applies technology, science, and **human factors** to the planning, design, operations, and management of roads, streets, bikeways, highways, their networks, terminals, and abutting lands...*

*- ITE Traffic Engineering Handbook*

# HUMAN FACTORS

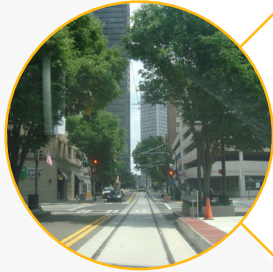
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*...is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system...*

*- International Ergonomics Association*

The Georgia Tech logo, featuring the text "Georgia Tech" in a bold, sans-serif font, with a stylized torch icon to the right. The logo is enclosed in a thin orange rectangular border.

# HUMAN FACTORS APPLICATIONS



Transportation System Design & Traffic Guidance



Comprehensive Transportation System Planning



In-Vehicle Assist Technologies and Safety Systems



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autonomous vehicle · connected vehicle · drones · cell phones · apps · video processing · side-fired radar · DSRC · cellular communication · pedestrian detection · 3D printing · hyperloop · internet of things · scooters, flying cars · and on · and on · and on · . . .

# Driverless Car



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# Assumptions

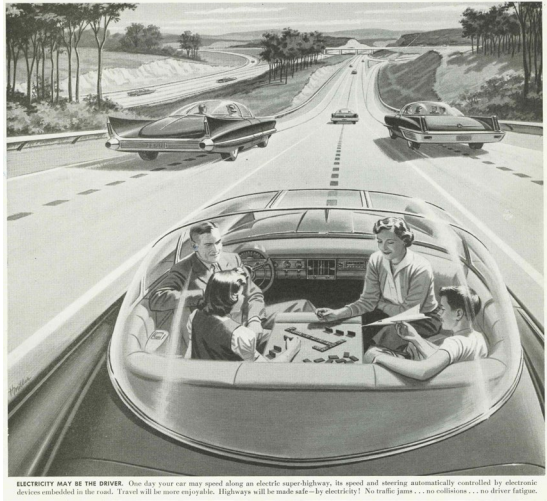
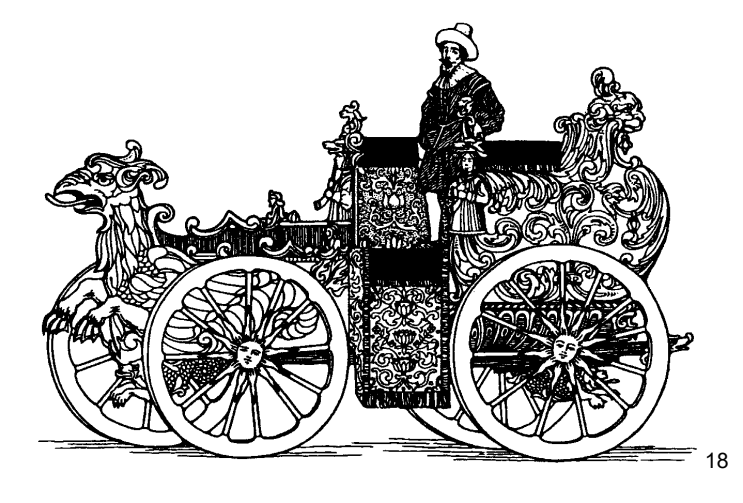


*"Nice, but as long as there are readers there will be scrolls."*

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# Everything Old is New Again

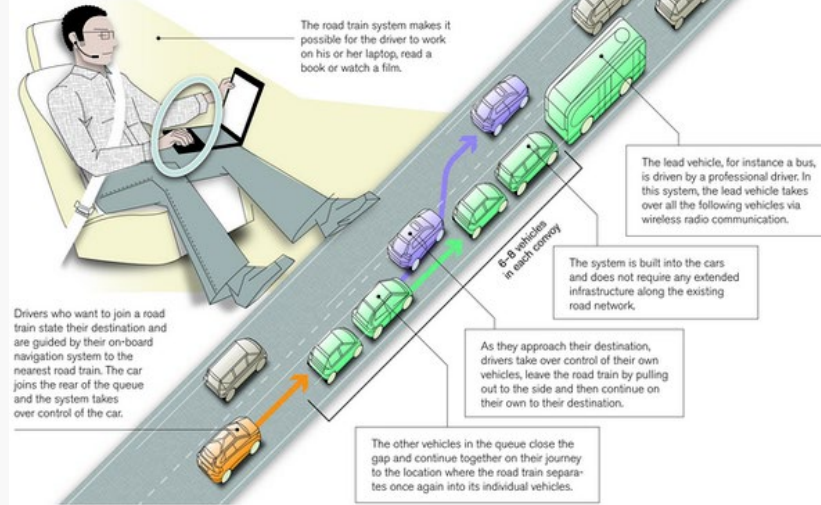


**ELECTRICITY MAY BE THE DRIVER.** One day your car may speed along an electric super-highway, its speed and steering automatically controlled by electronic devices embedded in the road. Travel will be more enjoyable. Highways will be made safe—by electricity! No traffic jams...no collisions...no driver fatigue.

# Autonomous Platoons

## Join a road train

A safe and energy-efficient way to travel

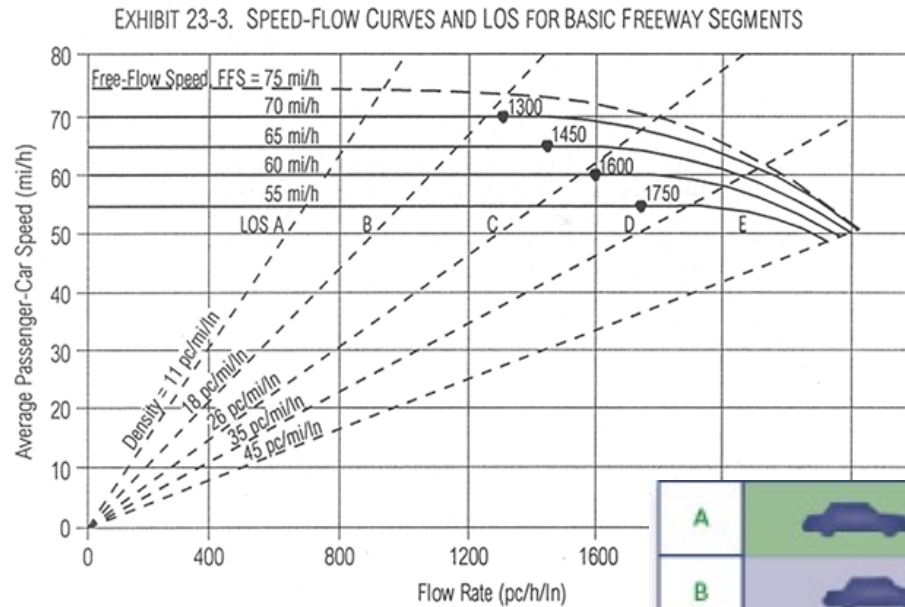


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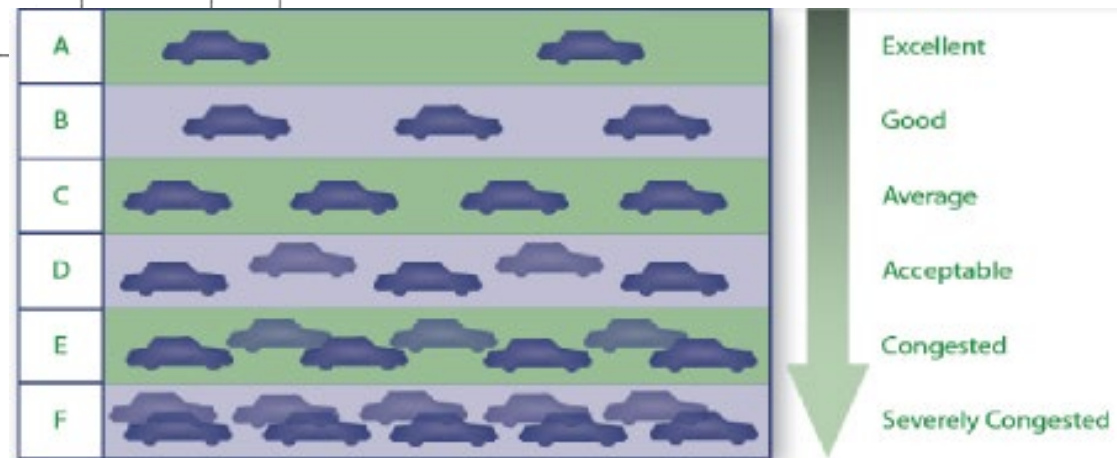
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# Capacity: Maximum Sustainable Flow



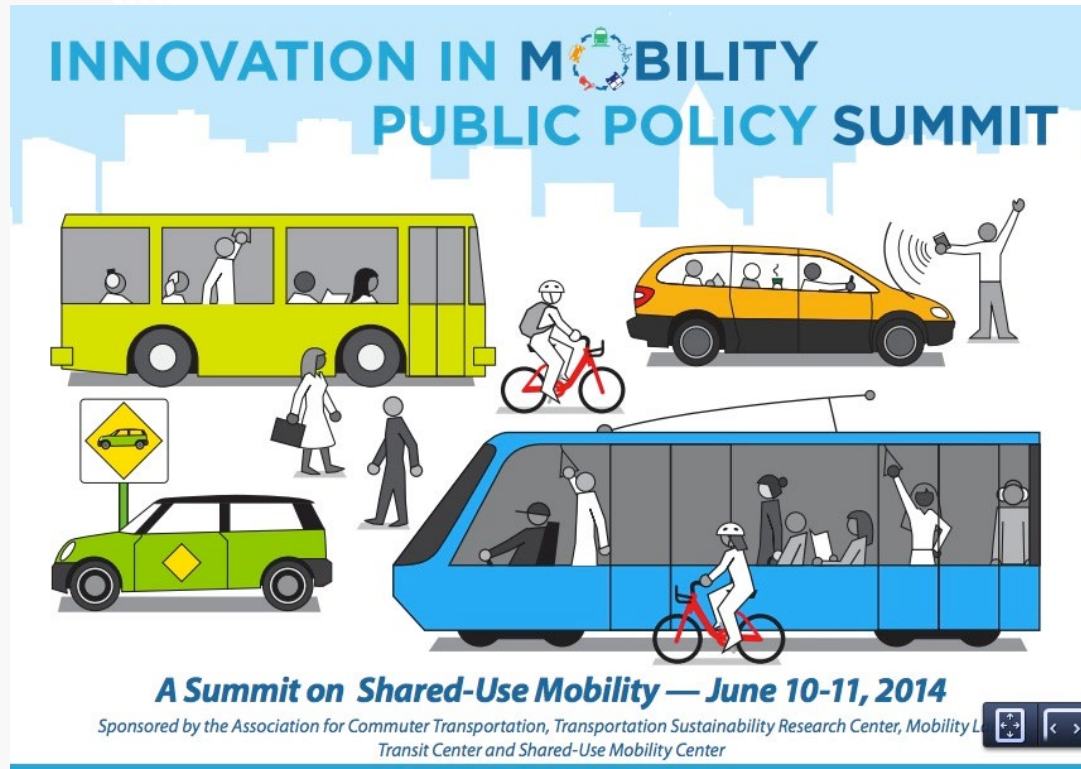
Speed Flow Density Curve from the Highway Capacity and Quality of Service Manual

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# Ride Hailing vs Ride Sharing



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# Aggressiveness



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# Mobility Devices



4



10



11



12



8

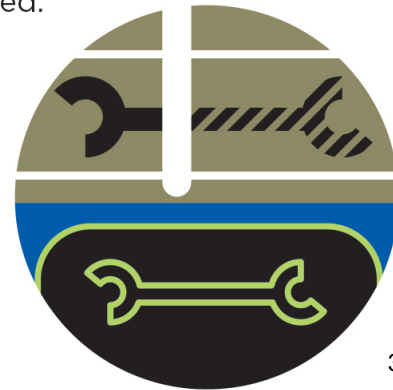
# 3D Printing

## 3D Printing

Manufacturers can render precise **3D objects**, such as spare parts and cars—**on demand**.

3D printing will **disrupt supply chains** as manufacturing becomes decentralized.

The first **3D printed car** was created in 2014.



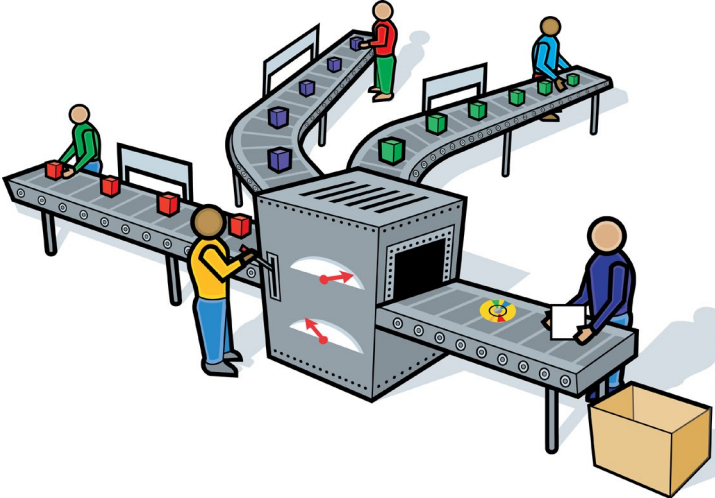
30

*“3D printing has the potential to disrupt traditional supply chains and counteract the growth of imports by reducing the need for large-scale manufacturing, transportation, and storage.”*

# Convergence of Transportation and Manufacturing



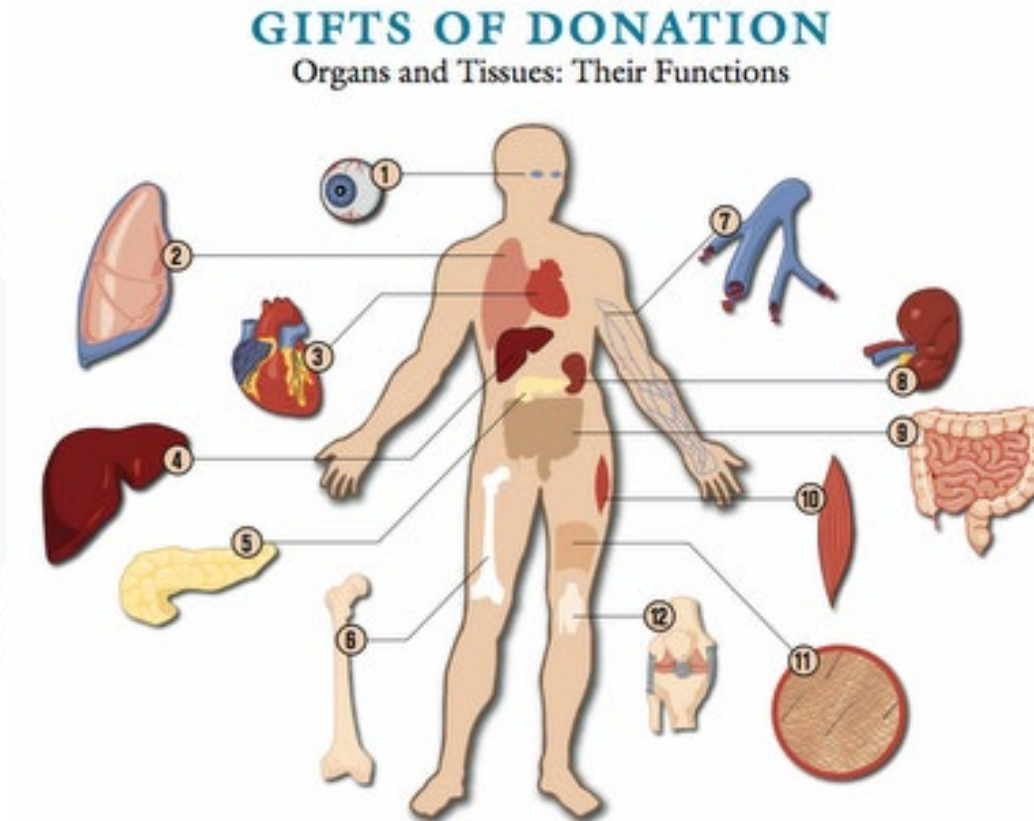
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# Law of Unintended Consequences



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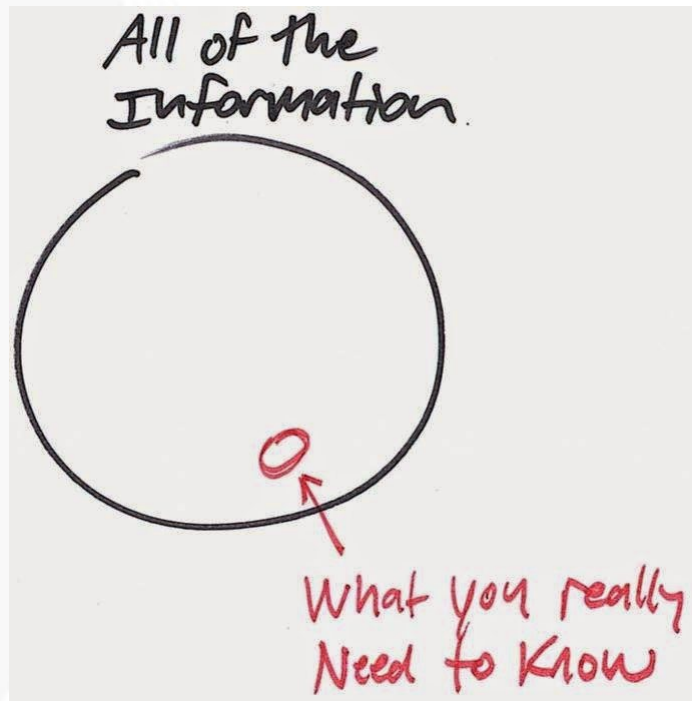
# Data

signal phasing and timing · volume · emissions · density ·  
location · occupancy · occupancy · basic safety message  
· time to impact · origin-destination · demand · speed ·  
sample vs screenline · fuel consumption · delay · ridership  
· headway · illumination · toilet flushes · · ·



# Key Attributes

## Little Data



*Not all Data is big.*

*Not all big Data is useful.*

**Data**



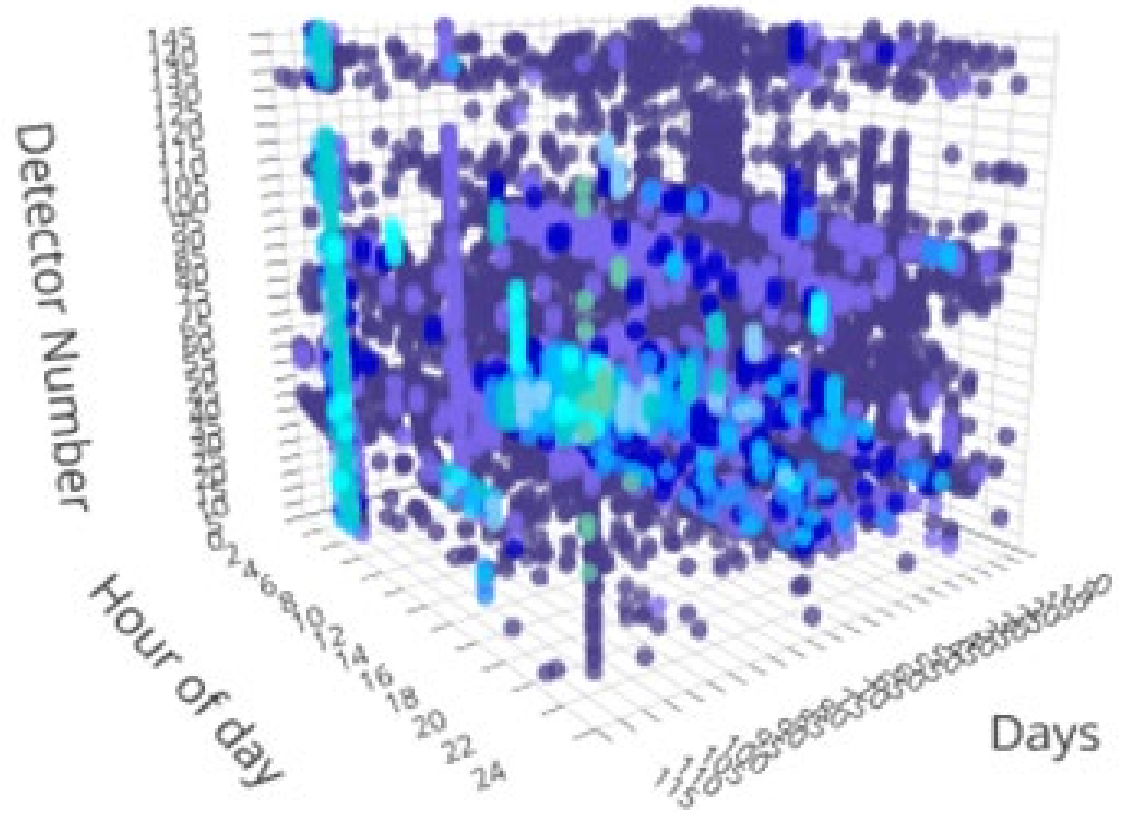
**Information**

# Requirements



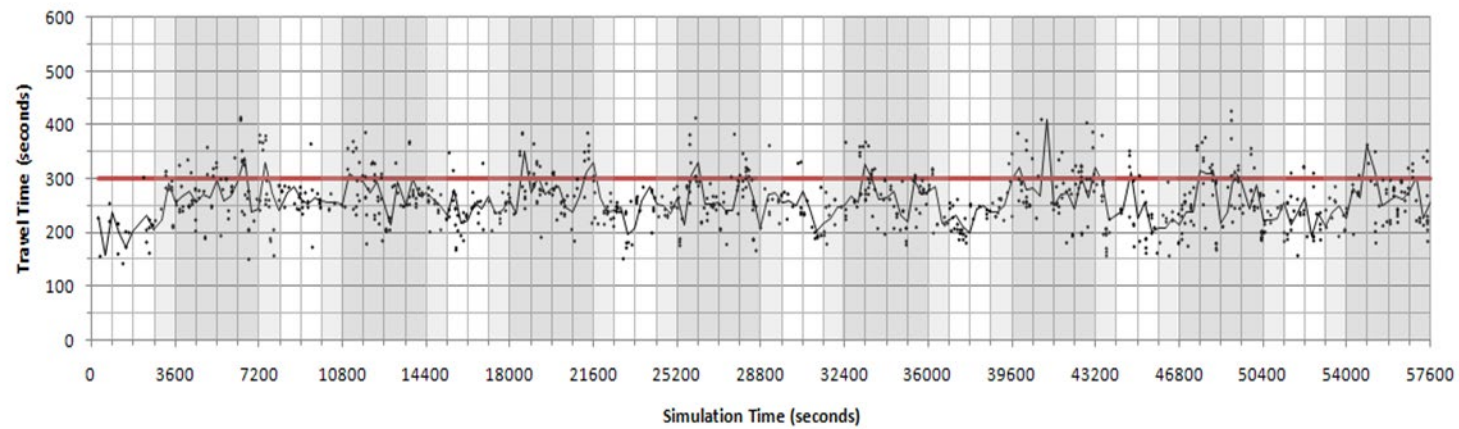
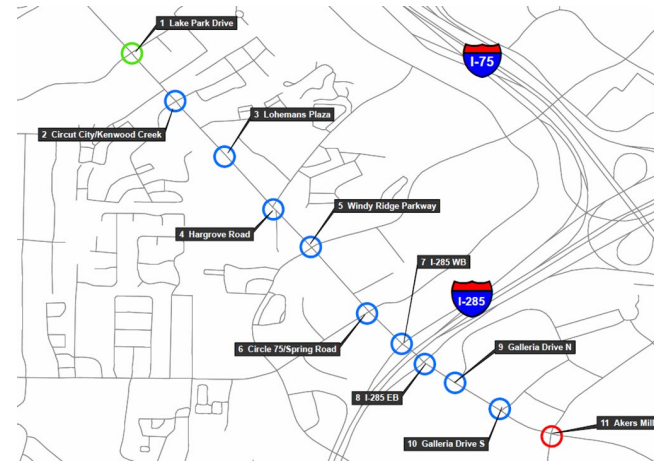
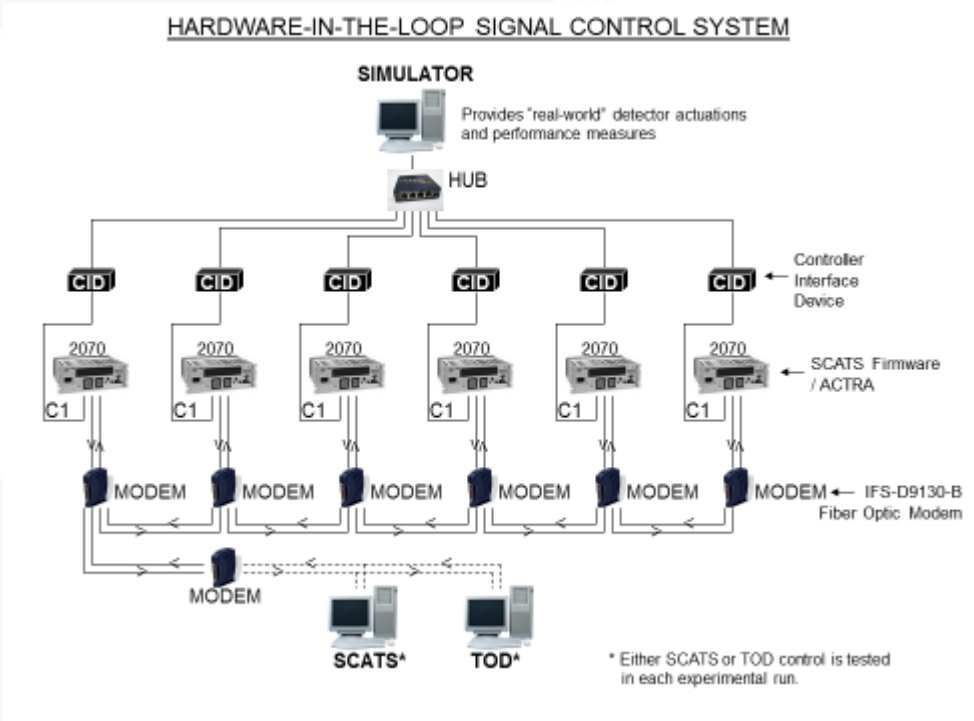
36

- Who needs it?
- Who gets in trouble if it is not there?



# Emerging Technologies

## Adaptive Signal Control - Hardware in the Loop Evaluation



SCATS PM Southbound Base Travel Time

HILS Architecture/Implementation





# People



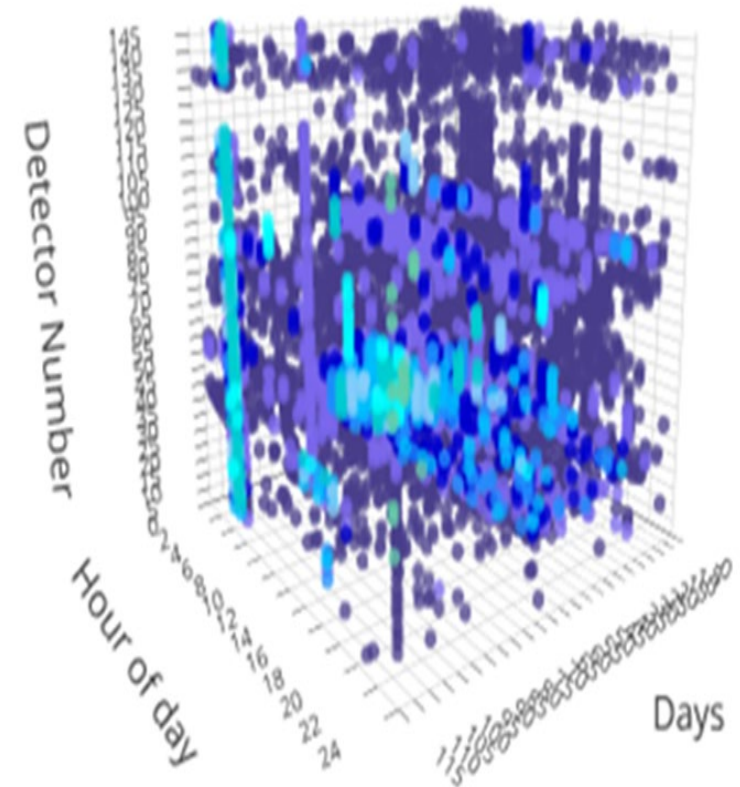
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# Technology

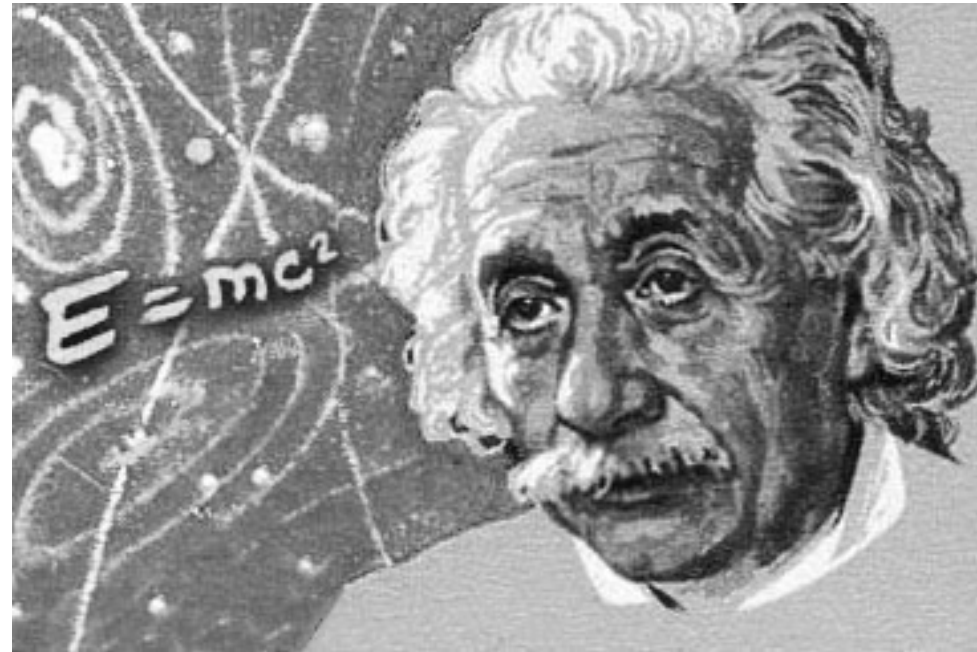


2

# Data



***The intuitive mind is a sacred gift and  
the rational mind is a faithful servant.  
We have created a society that honors  
the servant and has forgotten the gift.  
–Albert Einstein***



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**CALLS ON STUDENT TO SHARE  
IN THE MEANINGFUL DISCUSSION**



**STUDENT ASKS,  
"WHAT TIME IS LUNCH?"**

Thank you for your time.

Please feel free to contact me at  
[michael.hunter@ce.gatech.edu](mailto:michael.hunter@ce.gatech.edu)

# Image Credits

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