

FOURTH INDUSTRIAL REVOLUTION: FROM ARTIFICIAL INTELLIGENCE TO ACTIONABLE INTELLIGENCE

ATHIAN PRAMADHITA

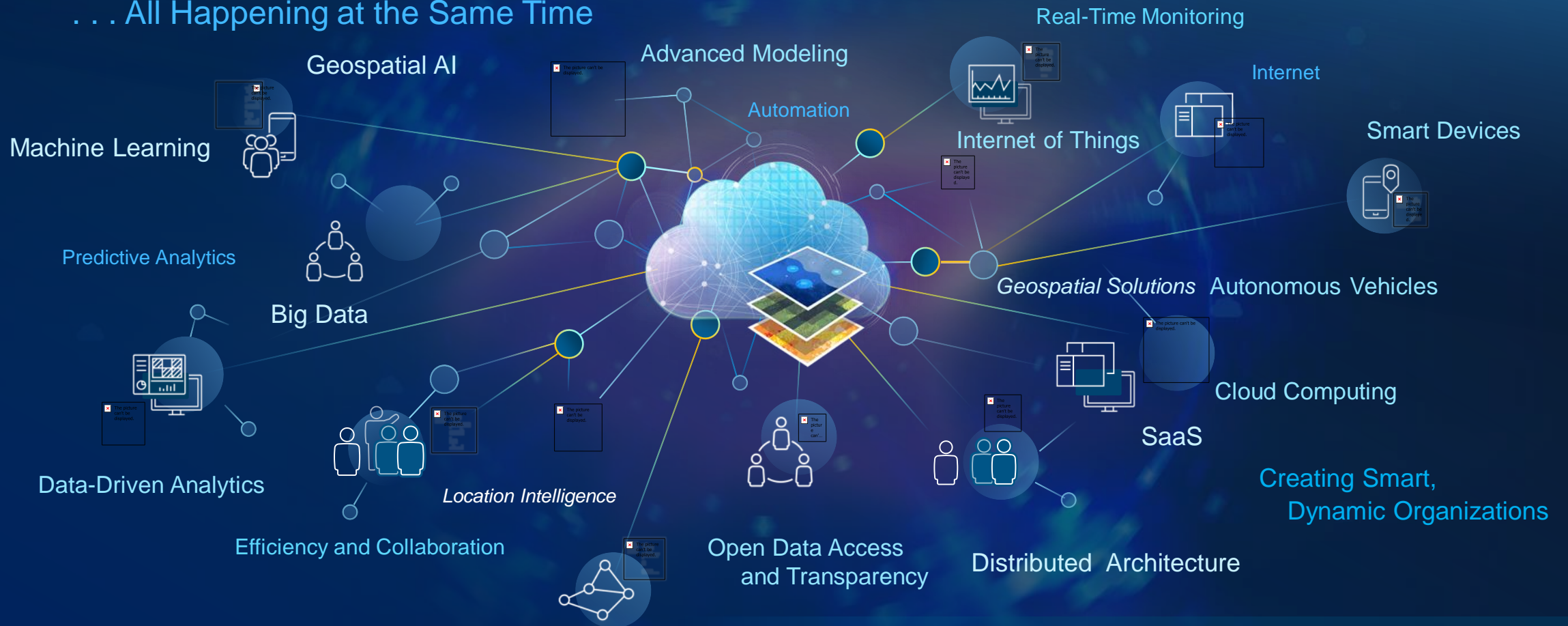
Senior GIS Specialist, Esri Indonesia

Enabling Indonesia 4.0



Geo-enable the 4th Industrial Revolution

Interconnected Information, Processes, and Workflows . . .
. . . All Happening at the Same Time



Using the Power of Location to Integrate Everything

Industry 4.0: Key Challenges for Government

Integration

Interoperability

Data QC

Time Consuming

Analytics

Dissemination

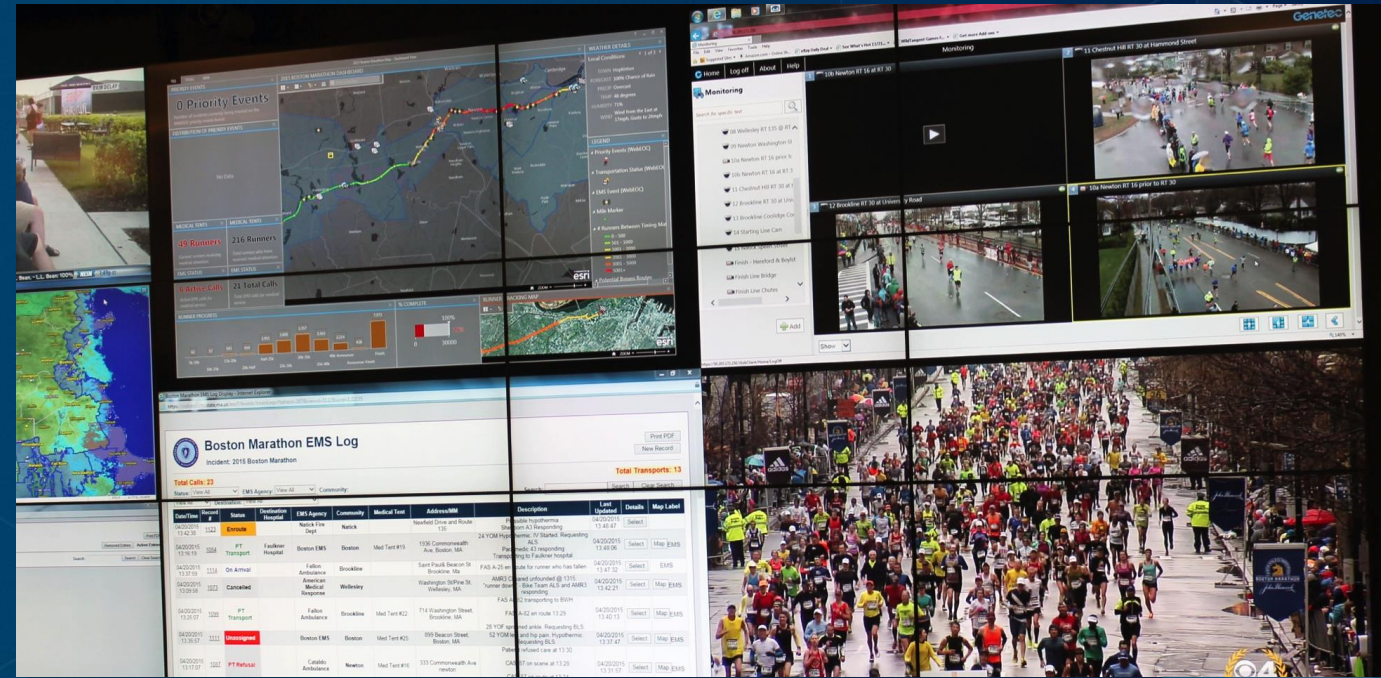
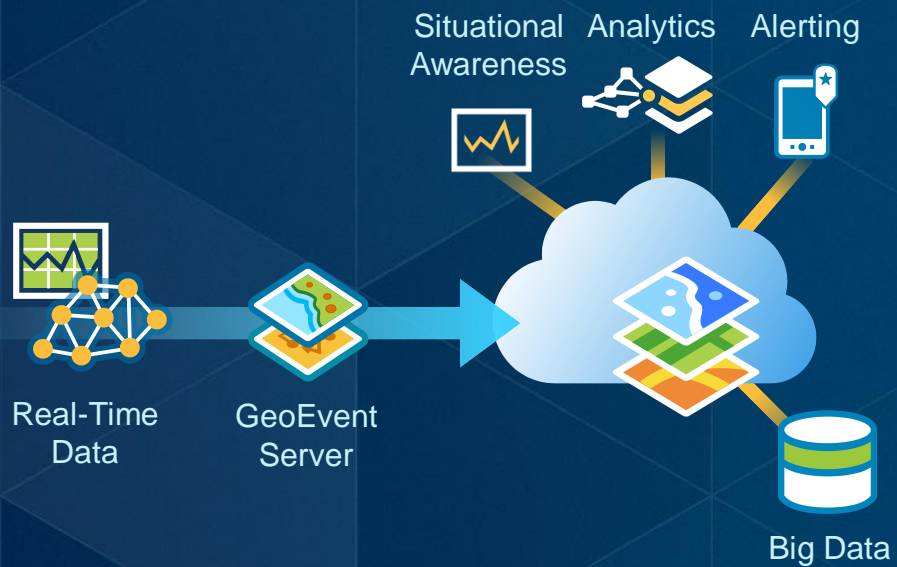


Creating Smart,
Dynamic Organizations

Industry 4.0 Enabler: Real-Time, IoT, AI/Machine Learning

Real-Time Analytics | Integrating Sensor Networks and the IoT

- High-Velocity Data Streams
- Monitoring and Alerting
- Dynamic and Big Data Analytics



Dashboard

Supporting Real-Time GIS Applications . . .
. . . Enabling Smarter Organizations

Internet of Things (IoT)

enabling geospatial insights with your IoT







Predictive Analysis – Accident Probability

Training machines to derive predictions from big data



Temperature
Sun, Mon, Fri..



Wind Speed
Fast, Slow..



Visibility
High/Low



Snow Depth
High/Low



Day of the Week
Sun, Mon, Fri..



Time of the Day
12:45, 23:00



Month
Feb, Dec..



Road Width
20-30 M



Road Alignment
Straight / Curved



Proximity to
Intersections



Speed Limit
120 km/h



Sun Direction
East, West



Daily Traffic
AADT



Proximity to
Billboards



**10s of
Variables**

7 Years of Data
400,000 Accidents
500,000 Segments



**Impossible
to Manually
Analyze**



**Train a
Machine to
do?**

What is Machine Learning?

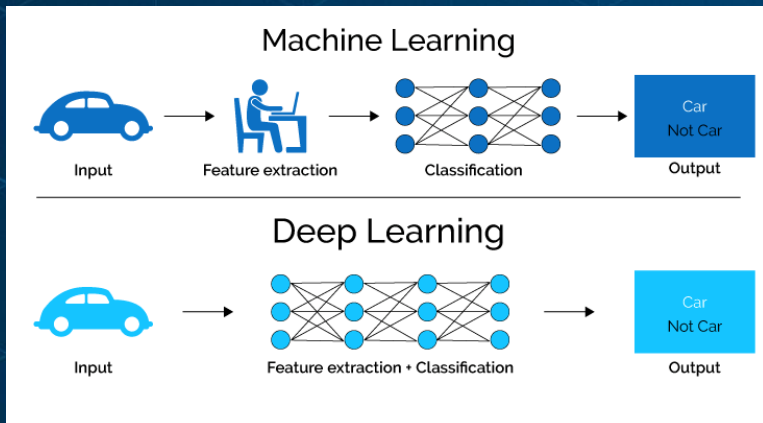
Data-driven algorithms and techniques that automate **prediction**, **classification** and **clustering** of data

Traditional Machine Learning

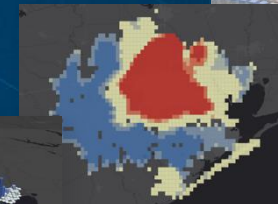
- Useful to solve a wide range of spatial problems
- Geography often acts as the 'key' for disparate data

Spatial Machine Learning

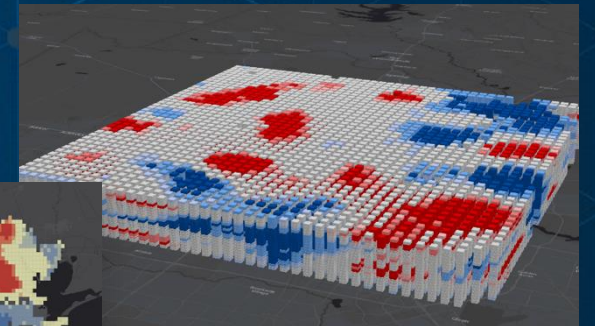
- Incorporate geography in their computation
- Shape, density, contiguity, spatial distribution, or proximity



Density



Hot Spots



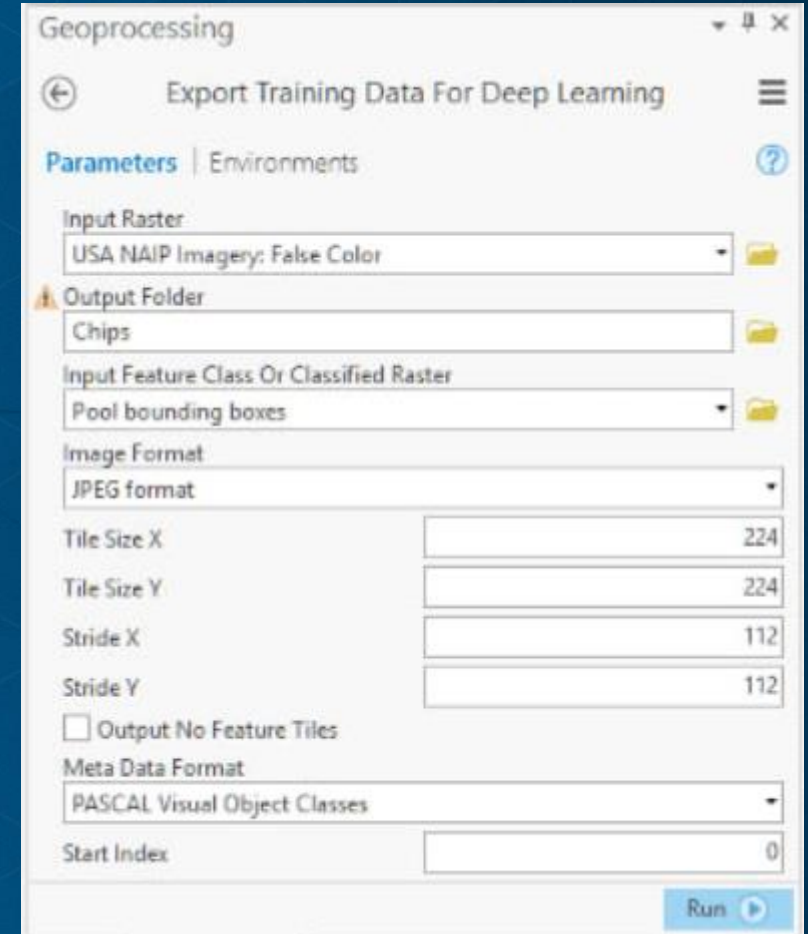
Space-Time Cube



Integrating Deep Learning with GIS



Object Detection Using Drone Imagery





Working with External AI Engines - TensorFlow

Real-Time Object Recognition from Video

The dashboard displays the following data:

- Real-Time Vehicle Count:** 7 vehicles (out of a maximum of 15).
- Real-Time Detected Object Counts:** 7 Cars, 0 Trucks, 0 Buses, 0 Motorcycles, 0 Pedestrians, 0 Bicycles.

The video feed shows a street scene with several cars. The detected objects and their confidence scores are:

- traffic light: 82%
- car: 52%
- car: 58%
- car: 56%
- car: 92%



Working at Scale - TensorFlow

Multiple Cameras – Analysis at machine speed

Jupyter TensorFlow_ObjectDetection_Demo05_ScreenCap_and_Update-Copy1 Last Checkpoint: 4 hours ago (unsaved changes) Logout

File Edit View Insert Cell Kernel Widgets Help Trusted Python 3.0




logging = "none"

ArcGIS API for Python and TensorFlow Deep Learning Model

Traffic Intersection Object Detection

```

### Training Dataset Labeled Classes
1: {'id': 1, 'name': 'person'},
2: {'id': 2, 'name': 'bicycle'},
3: {'id': 3, 'name': 'car'},
4: {'id': 4, 'name': 'motorcycle'},
5: {'id': 5, 'name': 'airplane'},
6: {'id': 6, 'name': 'bus'},
7: {'id': 7, 'name': 'train'},
8: {'id': 8, 'name': 'truck'},
9: {'id': 9, 'name': 'boat'},
10: {'id': 10, 'name': 'traffic light'},
11: {'id': 11, 'name': 'fire hydrant'},
13: {'id': 13, 'name': 'stop sign'},
14: {'id': 14, 'name': 'parking meter'},
15: {'id': 15, 'name': 'bench'}
    
```

```

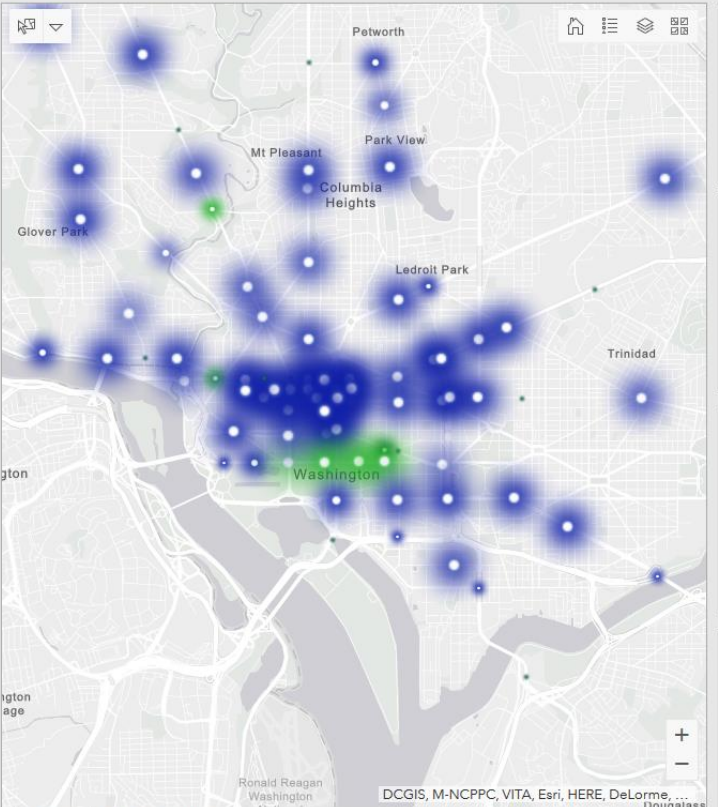
object_point_srv = gis.content.search("JHWY_ML_Detection")
object_point_srv
    
```

JHWY_ML_Detection Object Detection Layer
Feature Layer Collect Last Modified: Nov 07, 2017 0 comments, 44 views

```

# Top Left config
with detection_graph.as_default():
    with tf.Session(graph=detection_graph) as sess:
        # Define input and output Tensors for detection_graph
        image_tensor = detection_graph.get_tensor_by_name('image_tensor:0')
        # Each box represents a part of the image where a particular object was detected.
        detection_boxes = detection_graph.get_tensor_by_name('detection_boxes:0')
        # Each score represent how level of confidence for each of the objects.
        # Score is shown on the result image, together with the class label.
        detection_scores = detection_graph.get_tensor_by_name('detection_scores:0')
        detection_classes = detection_graph.get_tensor_by_name('detection_classes:0')
        num_detections = detection_graph.get_tensor_by_name('num_detections:0')
        while True:
    
```

Activity Detection in Washington D.C. (March 11th, 2018) Machine Learning and ArcGIS



7th St @ H St
Last Detection: 3/11/2018, 12:20 PM

- 17 Cars Detected
- 1 Pedestrians Detected
- 0 Buses Detected
- 0 Trucks Detected

Rhode Island Ave @ S Dakota Ave
Last Detection: 3/11/2018, 12:19 PM

- 16 Cars Detected
- 0 Pedestrians Detected
- 0 Buses Detected
- 0 Trucks Detected

13th St @ I St
Last Detection: 3/11/2018, 12:22 PM

- 16 Cars Detected
- 0 Pedestrians Detected
- 0 Buses Detected
- 0 Trucks Detected

15th St @ K St
Last Detection: 3/11/2018, 12:22 PM

- 15 Cars Detected
- 0 Pedestrians Detected
- 0 Buses Detected
- 1 Trucks Detected

Independence Ave @ 7th St
Last Detection: 3/11/2018, 12:19 PM

- 14 Cars Detected

All Cars Pedestrians Bus Trucks Time

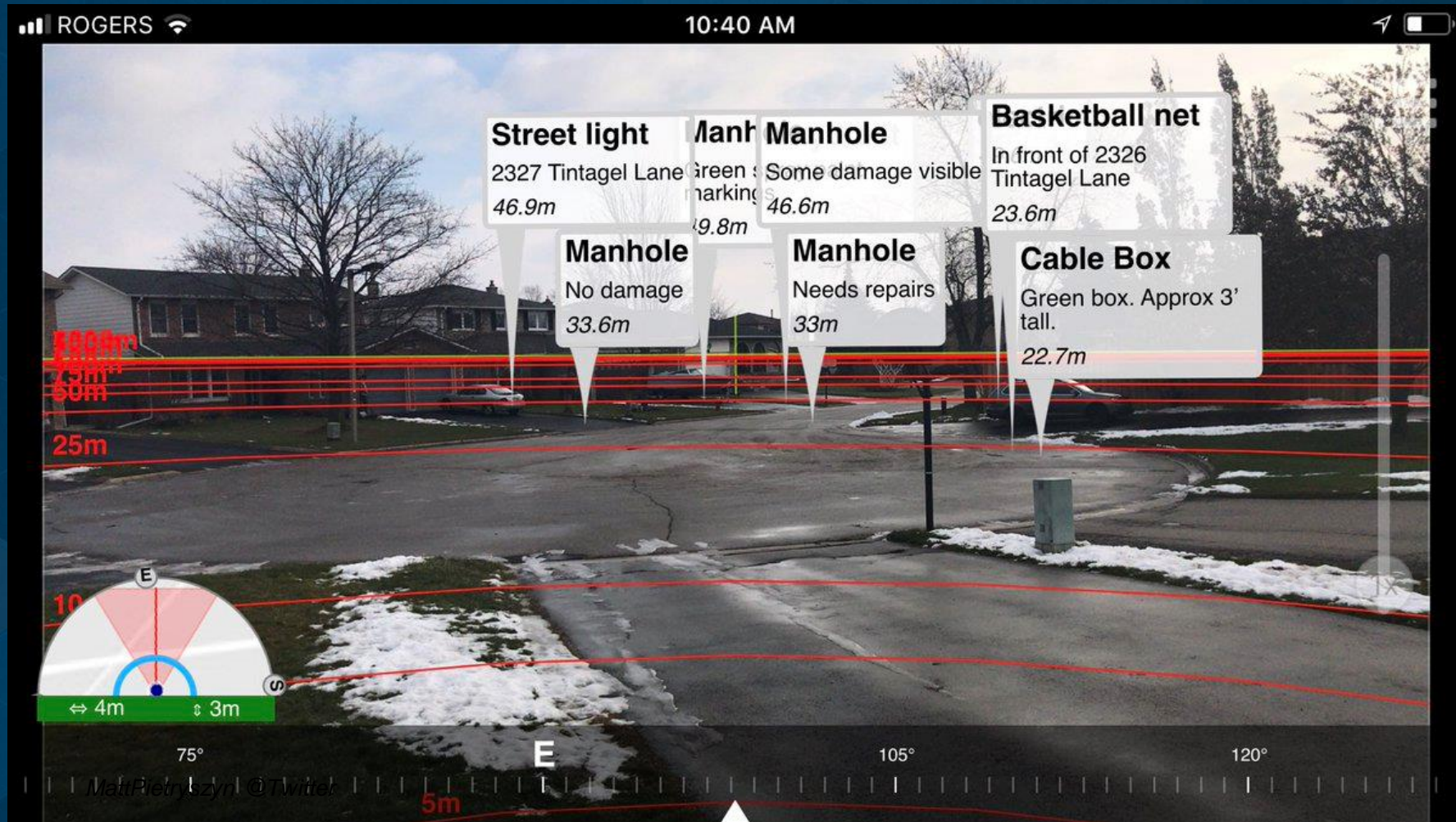
Map View Traffic Camera View

DCGIS, M-NCPPC, VITA, Esri, HERE, DeLorme, ...



Augmented Reality

“See” your asset where you cannot see

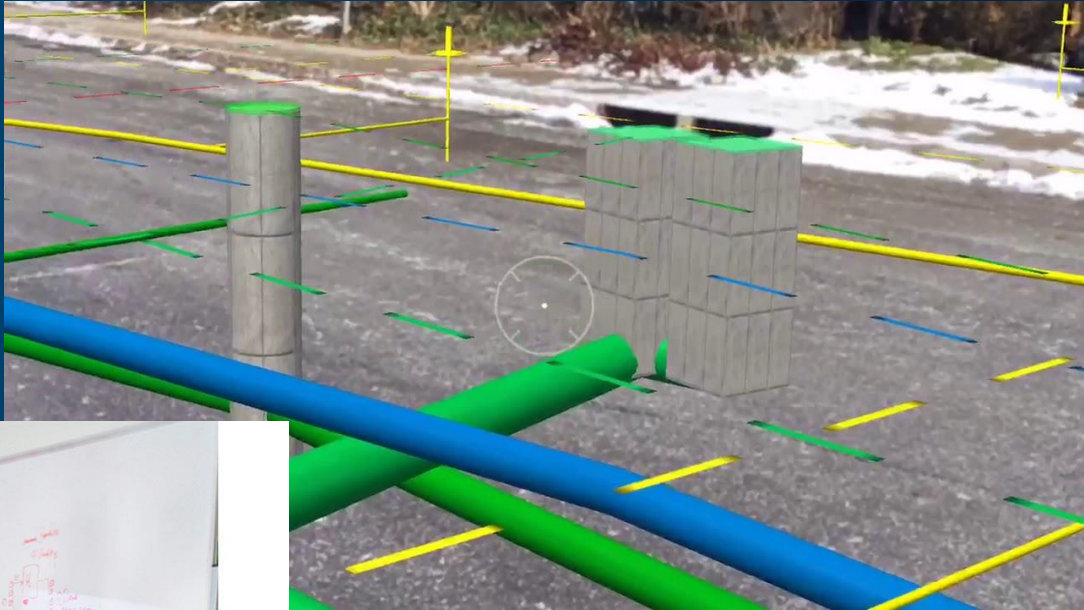


Underground assets: pipes, valves, holes ...



Inspect your asset better

Increase Safety, Easy Maintenance





Conclusions

Successful Large Enterprise Implementation

Requires More Than Technology

- **Vision and Leadership**
- **Executive Support**
- **Developing Sustainable Value**
- **Change Management**
- **Planning and Implementation**
- **Technical Enablement**



The application of GIS is limited only by the
imagination of those who use it.

Jack Dangermond



esri Indonesia