15th INTERNATIONAL OPERATIONS & MAINTENANCE CONFERENCE IN THE ARAB COUNTRIES
UNDER THE THEME: **"SMART MAINTENANCE"** CONICIDE WITH THE 15TH ARAB MAINTENANCE EXHIBITION

Smart Cities Perspective

Leveraging IoT to Achieve Smart Maintenance

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LUCID urban transformation

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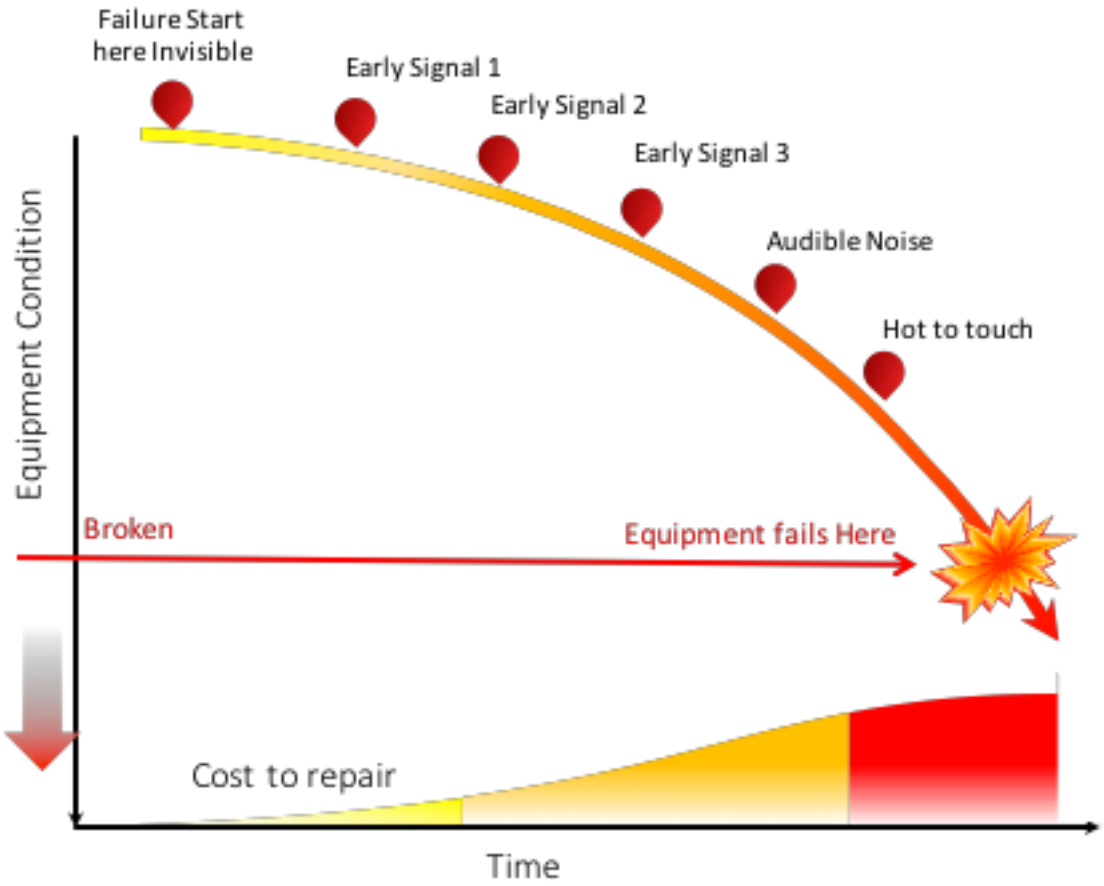
Maintenance mission to keep asset in existing condition and to preserve, protect and extend life.

- Machines often fail randomly; c90% of failures are unexpected.
- Two types of failure:
  1. Functional failure: the asset fails to meet a specified performance standard (operator)
  2. Potential failure: when you identify a physical condition which indicates a functional failure is imminent (maintenance technician).
- We spend 40% of time on reactive maintenance vs. 12% ideal

Think of …

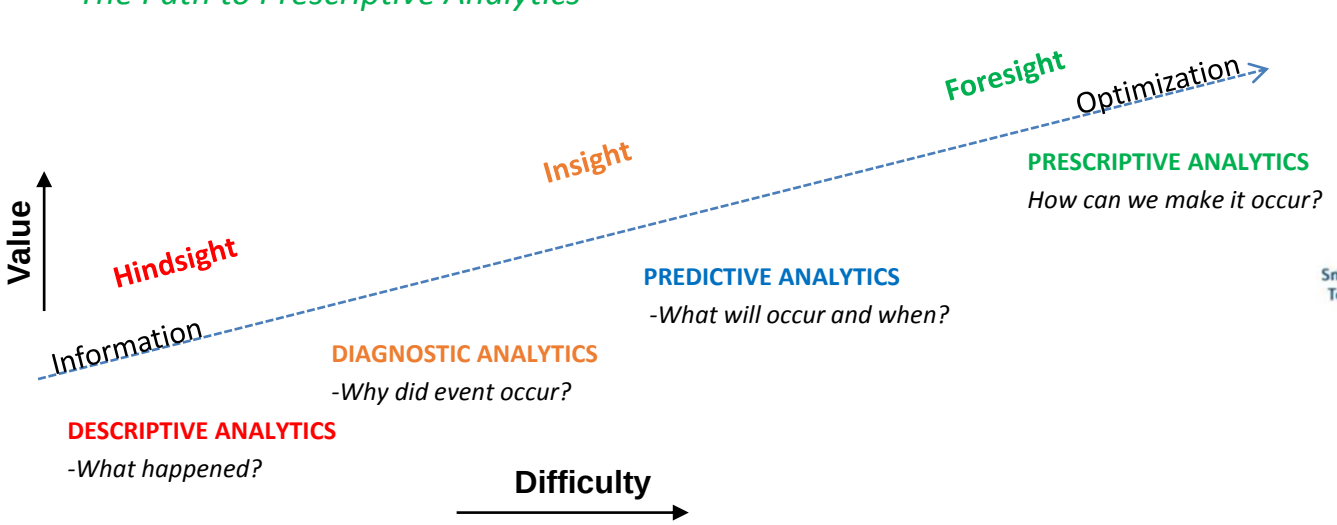
- City of New York black out 1977 (also 1965, 2003)
  - Cost $36M / Hour
- UK National Grid emergency blackout
  - Annual cost £113M
- South Australian Summer black out 2016
  - Cost $367M
- Chicago flood 1992
  - Cost $1.95B
- Mississippi River Bridge 2007



Could this been avoided or impact drastically reduced ?

Improving Performance – Analytics Continuum

The Path to Prescriptive Analytics



IoT

ACCELERATION

Driven by pervasive penetration of Mobility & Analytics

\+

IT

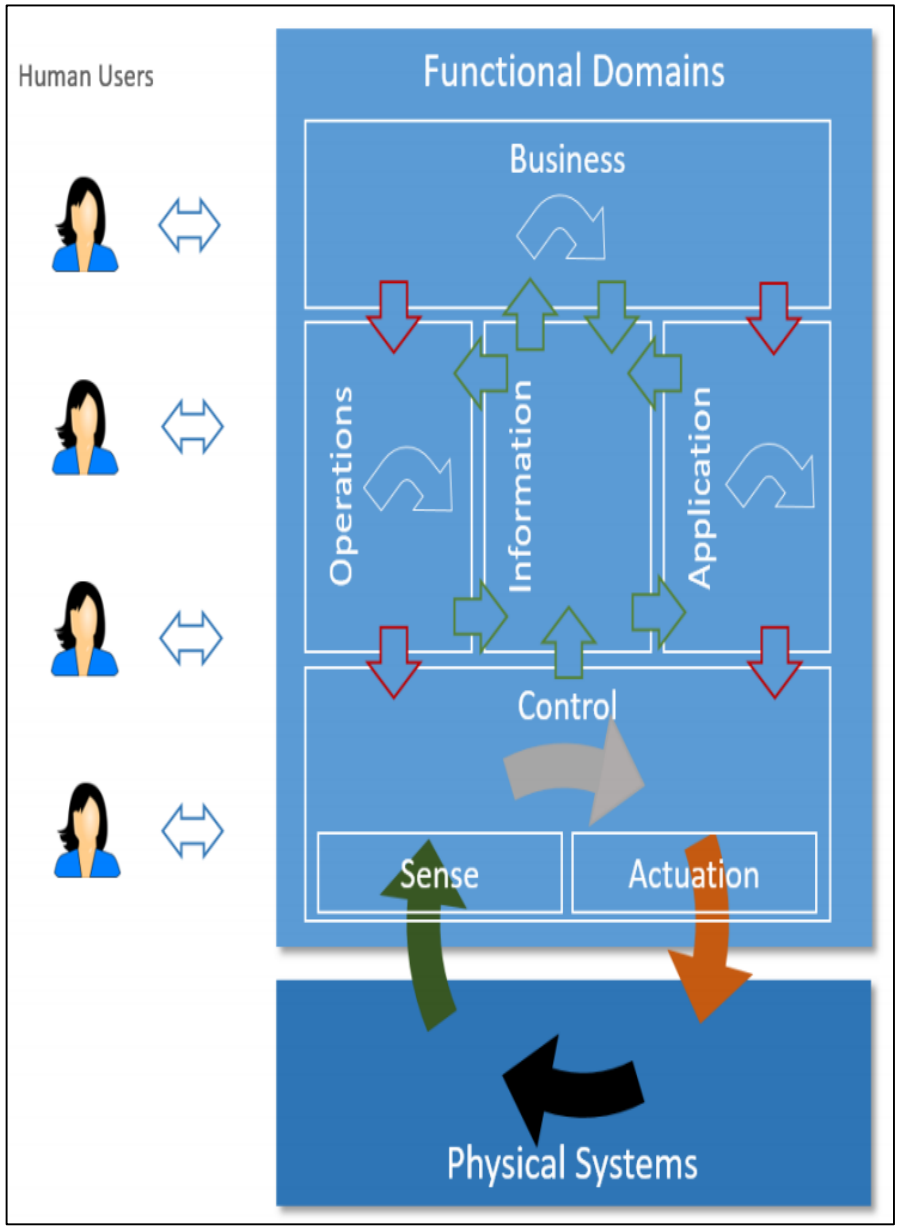
CONVERGENCE

OT

=

PROCESS & ASSET OPTIMIZATION

Same 5 Functional domains of IIoT



Business domain

A predictive maintenance service for an oilrig may have an application that forecasts failures in the field. To do so, it may require a resource planning system to ensure the required parts are available and reserved, and it may need to connect to internal or partner's service work schedule system and logistics management system, as well as the customer's, to schedule the field service.

Information domain

Optimizing the electricity generation level of a plant or a generator based on the condition of the facility, fuel cost and electricity price.
Changing the route of a fleet of freight trucks based on weather, traffic and the condition of the goods in the trucks.
Changing the temperature set-point of a boiler based on energy cost, weather condition and usage pattern.

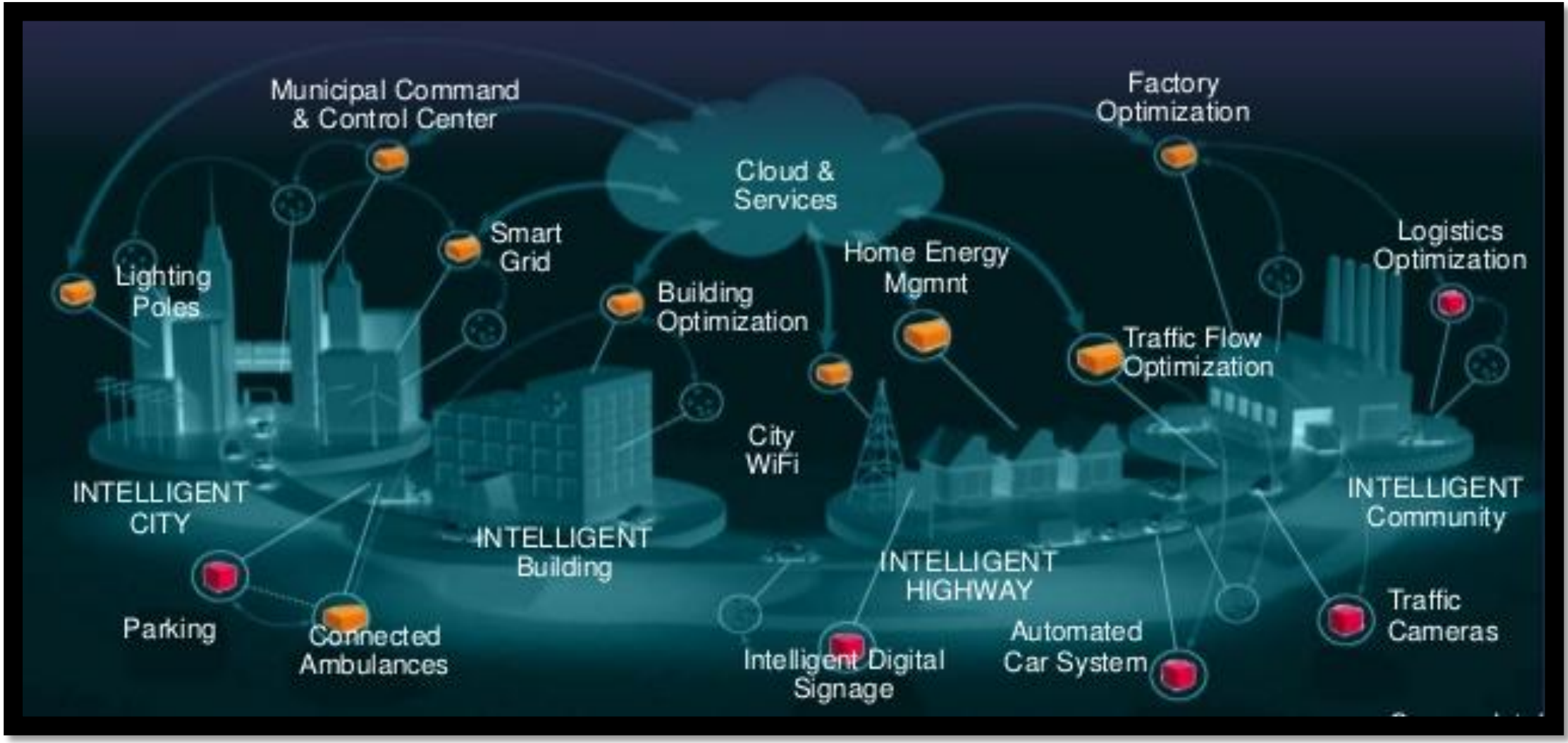
Operations domain

Optimizing the operation of one train has obvious cost savings, but optimizing train operations and routes across a fleet yields more, and combining data from fleets owned by different railroads can optimize the utilization of the rail network within a country.

Control domain

A control room in electricity utility plant, control units in a wind-turbine, and control units in autonomous vehicles.

Impact on how we THINK, DESIGN, BUILD & Operate our cities Services



2014/15

- Operated 80m train km
- Enabling 1.305bn passenger journeys
- 619 Trains
- 14 Maintenance depots
- 4 Major signalling systems
- 1,000+ Kilometres of track
- 1,000+ Points & Crossing units
- 270 Stations
- 427 Escalators & Passenger Conveyors
- 196 Lifts
- 500+ Kilometres of drainage
- 16,000 Bridges & Structures
- 350 Kilometres of Deep Tube Tunnels
- 235 Kilometres of Earth Structures
- …other communication, fire, electrical, mechanical and power systems

Cost of maintaining and renewing assets: £2.4bn per annum.

Approximately 60% of the investment in assets focuses on upgrade and renewal projects, with 40% supporting day-to-day maintenance:

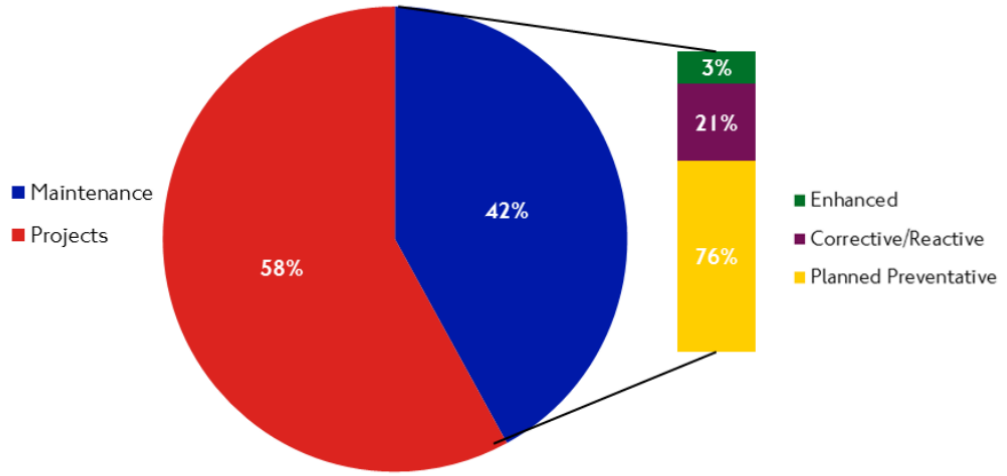


Figure 3: Breakdown of LU asset spend by type of spend (TfL Business Plan)

UNDERGROUND

OPEN DATA

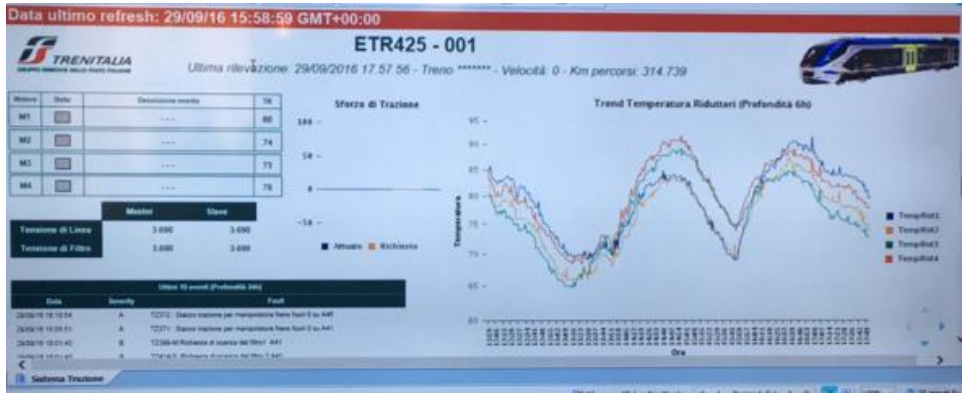
TrenItalia invested Euro 50M to cut maintenance cost by up to Euro 130M annually, increase train availability and improve customer satisfaction.
(8 – 10% savings in the annual maintenance budget of €1.3bn).

Operating 8000 trains per day

Before
Maintenance was scheduled based on
1. how long the train was in service,
2. how many kilometers it had travelled,
3. or if a failure occurred.

As a consequence many times the maintenance happened before it was needed.

After
- Trains have between 500-1000 sensors installed, generating up to 5000 data points per second
- Measuring variables like motor temperature, line voltage, braking effort etc…
- reporting back detailed data on the trains' performance in real-time.
- The data is used to track where the trains are, to schedule maintenance when it is actually needed, and to increase the safety, and reliability of the entire locomotive fleet.

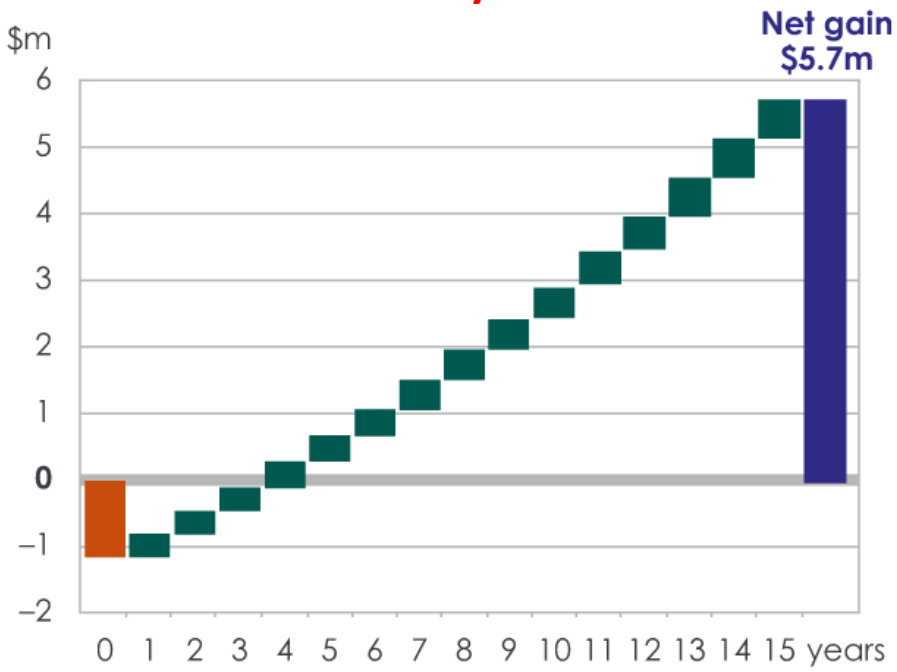


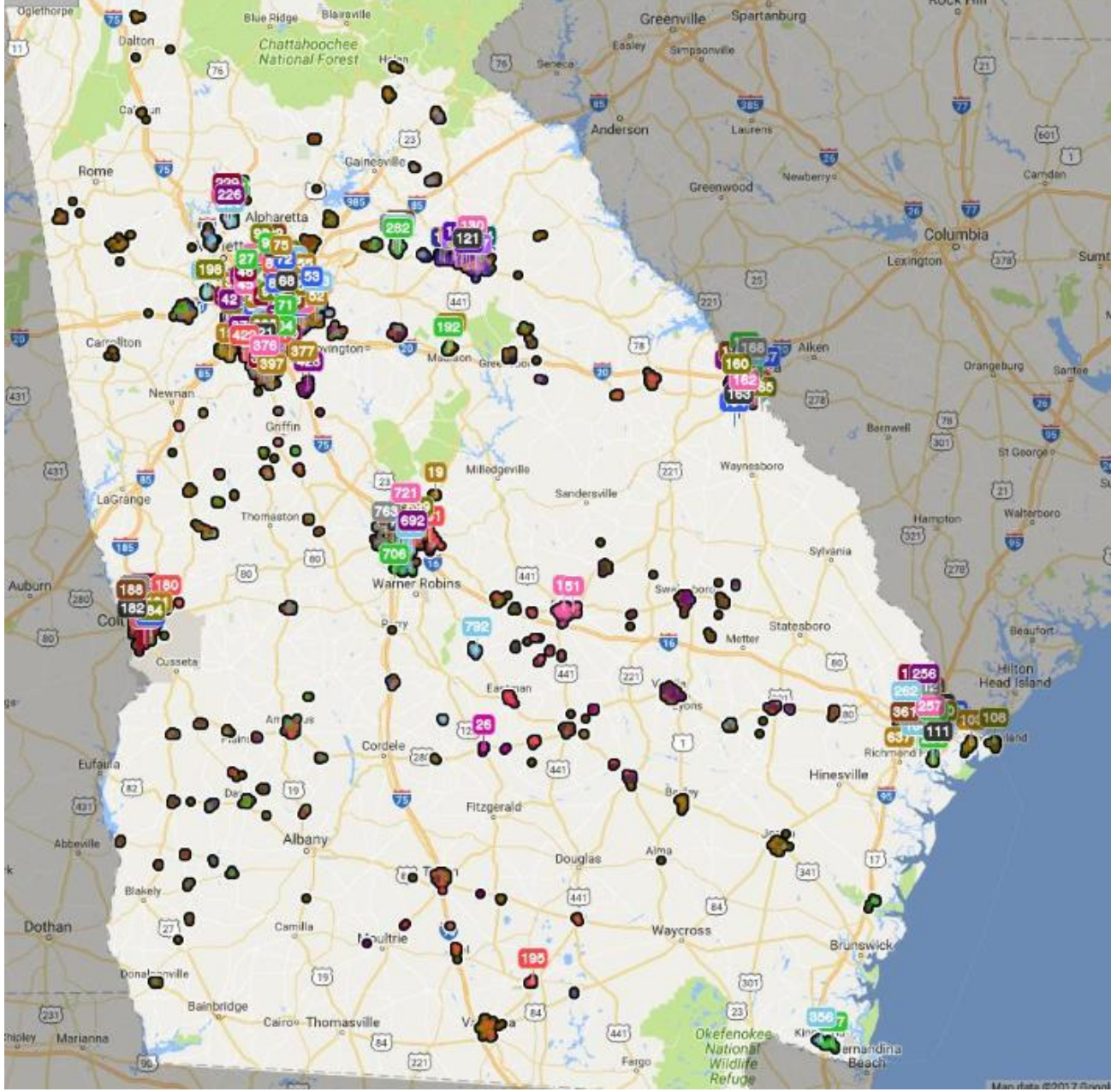
TRENITALIA
GRUPPO FERROVIE DELLO STATO

Georgia®

140,000 Street Lights
50,000 sq. miles area

< 3 Years Payback





Telensa

Smart Street Lighting

150,000 nodes of street lights & signs and bollards

- 41% energy savings
- Efficient lighting management
- Maintenance cost reduction c40%
- Flag faults
- Inventory management
- Variable Lighting control
- Ability to predict and model energy savings

Hampshire County Council

4500 lanterns and lights

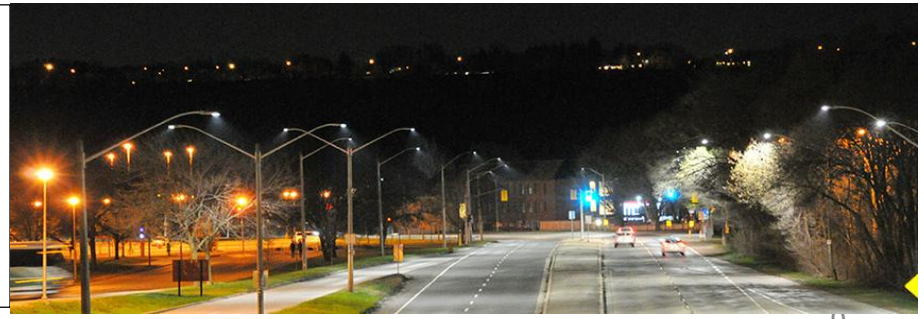
- 30 to 80% energy savings (variable % dimming)
- Detect faults
- Safety and community input defines the light %
- Maintenance cost reduction c50%

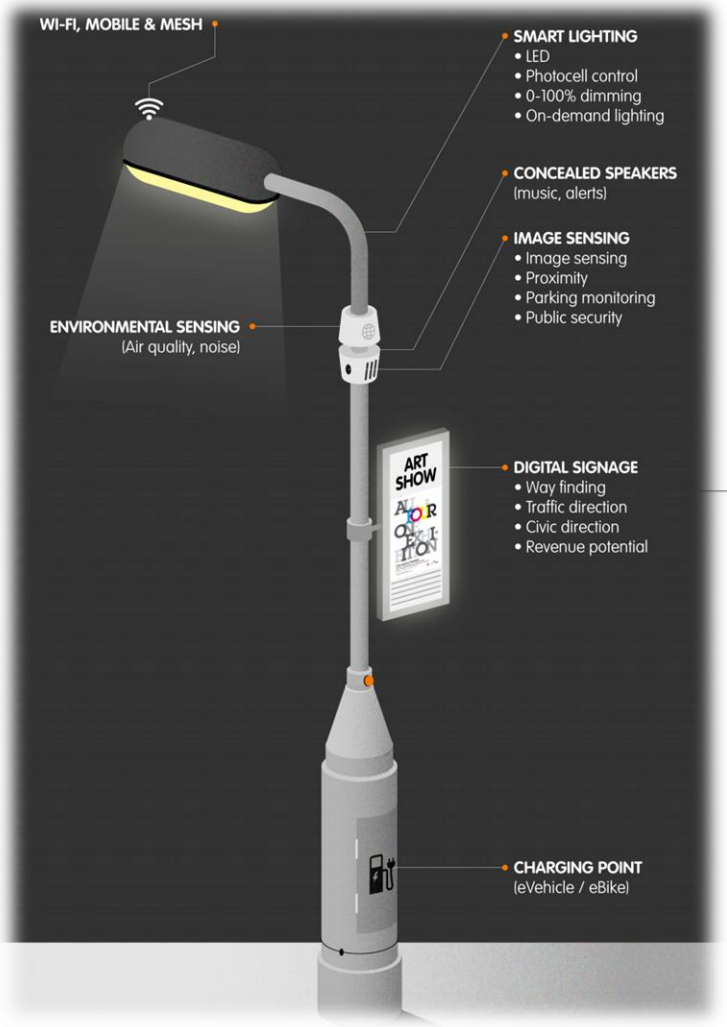
City of Oslo

10,000 street lights

- Quality of lighting drastically improved
- 700K$ annual savings
- Saving 6.9MKWh energy per year
- Maintenance cost reduction c40%

Hamilton





Future of Smart Street Lighting

Public Safety: CCTV, noise sensor, …
Public Wi-Fi: for users as well as to enable IoT deployment. New revenue stream.
Environmental Monitoring: air quality, motion and weather sensors, noise…
Digital Signage and Public Communications: Way finding, traffic management, public communications and advertising.
Transport Optimization: traffic optimization, parking guidance, smart parking, incident management
Electric Vehicle (EV) Charging

Smart Water – Collection system maintenance

Cleaning routine based on historical data
Monthly 204 sites
Quarterly 620 sites

Cost of cleaning per site:
$500 per site per instance
2,448 monthlies per year
$1.224M annual cost

12 Months results

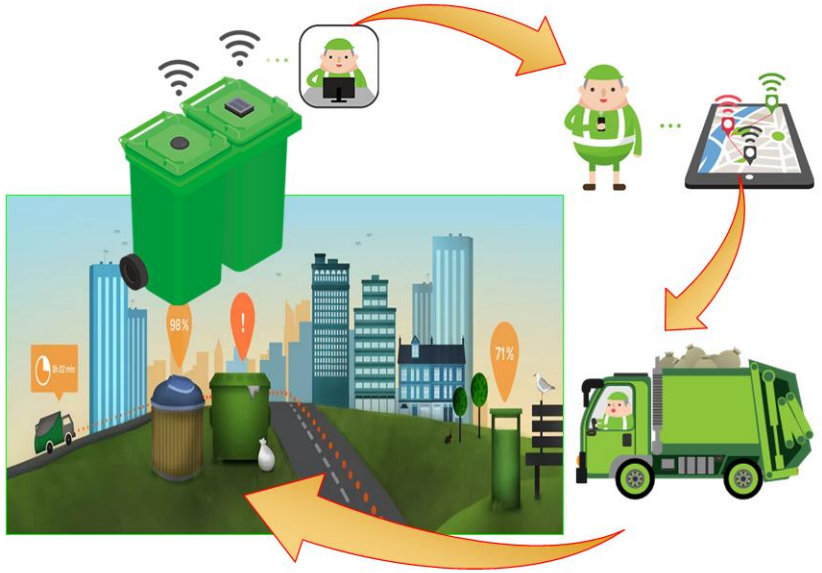
Smart clean result **85% reduction**

Investment repaid within 3 years

Smart Waste Management

100s of case studies coming from around the world
Results indicate reduction in

Collections	40% to 80%
Service cost	c50%
• **Number of Trucks**	
• **Maintenance cost**	
• **Fuel consumption**	
• **Labor cost**	
CO & Nox	Environment footprint and air quality improvement
Traffic, Health & Complaints	



Example

- 600K Population
- 400K collection per 10 days
- 32 vehicles to complete
- 7M collections / year

Results

- Fleet from 15 to 11 Vehicles
- From 6 working days to 4
- £10M savings / Year
- Mileage from 122.1K to 84K / Year

Newcastle City Council

The sum of all

Ajuntament de BCN

Smart Lighting | Smart Buses | Smart Water | Smart Bus Stop | Smart Parking | Smart Waste






Smart Bicycle

Smart Energy

Etc…

Population 1.6M
Public Sector Workers 16.5K
Results 2008 - 2014

- 4,500 New Companies
- 56,200 New Jobs due to Smart City
- $53M New Smart parking Revenues
- $50M Savings from Smart Lighting
- $58M Savings from Water /Year
- 19,500+ Smart meters in 1 District

THANK YOU