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+  
OTAN

NATO MODELLING & SIMULATION CENTRE OF EXCELLENCE



# Urbanization and its Impact on Future Conflict through 2035 – from model to the simulation

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# NATO M&S COE Mission

is to support NATO and its Nations as well as participating Partner Nations by providing subject matter expertise on all aspects of M&S activities.

The NATO M&S COE may also establish collaborative relationships with entities such as Industry, Academia and other organizations.



# Highlights from 2015 PoW

## Doctrine, Education & Training

- NATO M&S Basic Course
- NATO CAX Specialist Certification Course
- ADL Cadet Course Available through ACT
- Develop ADL (V&V)
- Establish Mobile TE Team
- M&S V&V Authority

## Concept Development & Experimentation

- SACT Urbanization Project
- JCBRN COE Collaboration
- CWIX - Lead for M&S FA
- MSaaS
- SIRI
- C2SIM
- SIMCJOH

## CAX Support

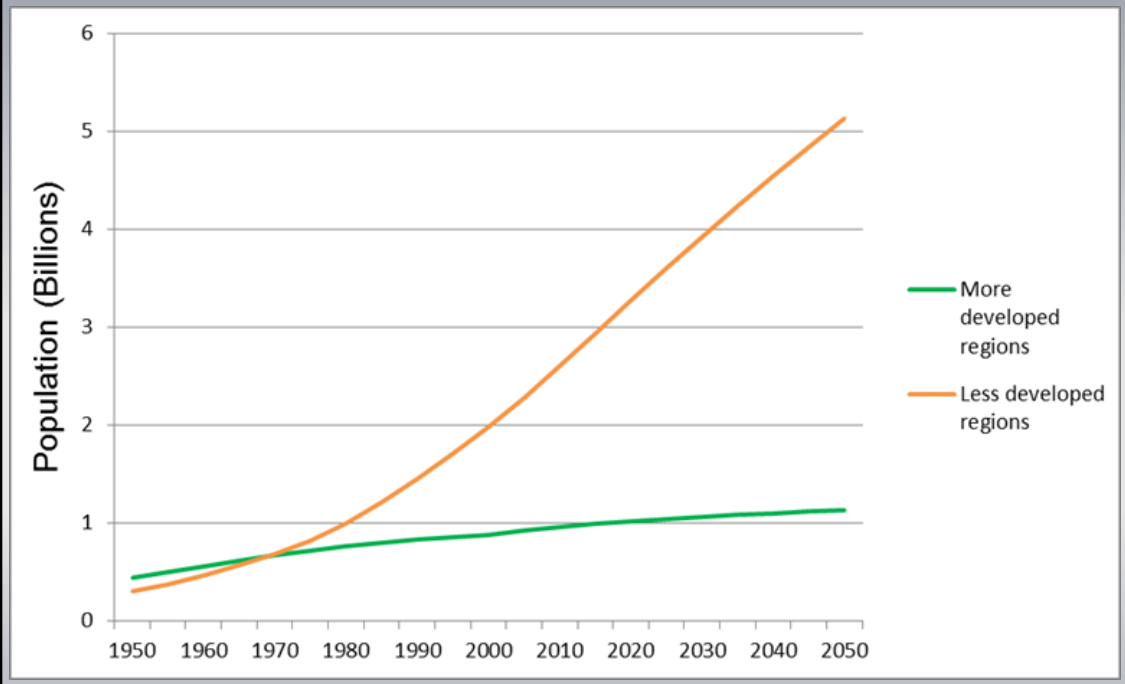
- TRIDENT SERIES
- Exercise Database Validation

## Hosted Events

- CAX FORUM '15 (Italy)
- MESAS '15 (Prague)

# WHY IS URBANISATION IMPORTANT

- World population projected to increase to 8.7 billion by 2035; **1.4 billion more than today**
- Most growth will occur in developing countries, and **in urban areas**
- **1.4 million people migrate to a city every week**
- **Future conflict** will be **increasingly urban, networked and littoral** against primarily non-state threats
- Demographic profile is changing with **population ageing** in developed regions



Complex characteristics of future conflict will not go away and must be faced by NATO

# ACT TASK

- UP requirement
  - ACT was tasked by the Military Committee to initiate the potential impact of ongoing urbanisation on future NATO operations and in order to support the NATO Defence Planning Process.
- NATO M&S COE engagement
  - SME in the synthetic environment implementation to develop M&S tool to support an experiment over a generic megacity, called 'ARCHARIA', in the year 2035.
  - ARCHARIA
    - Coastal city
    - Population over 5 million
    - Mediterranean weather
    - Rising sea levels

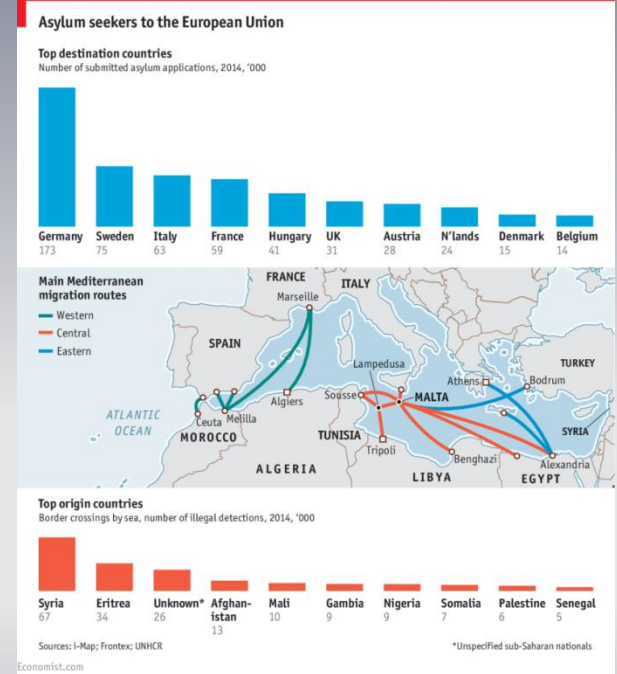
# UP VIGNETTES



**INNER CITY TURMOIL**



**LARGE SCALE  
NATURAL DISASTER**

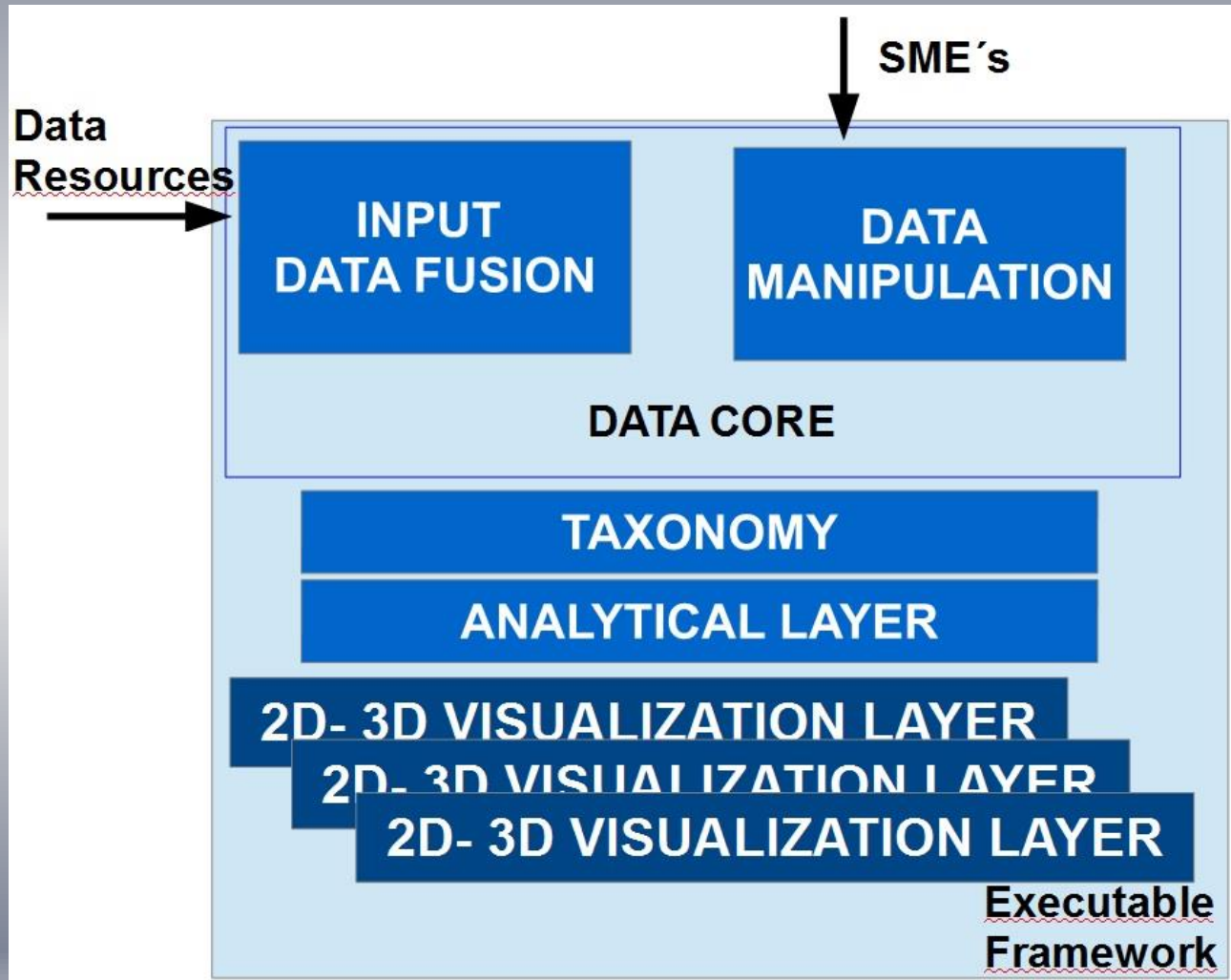


**DISRUPTIVE IMPACT OF  
MASS MIGRATION**

# MODEL INTERACTIVITY VERSUS SIMULATION

- M&S to support preparation, execution and evaluation of operation & CD&E
- LEVELS OF USAGE OF MODEL/SIMULATION
  - Problem Definition
  - Interactive Visualization
  - Demonstration
  - Scenarios
  - On-going Decision Support

# MODEL FOR UP EXPERIMENT





## Model of 'Archaria' - Layers

LAYERS	SUBLAYERS
<b>POPULATION</b>	Night/day Distribution, Population Census Distribution
<b>ETHNICS GROUPS(EG)</b>	per census area aggregation/municipality aggregation
<b>RELIGIOUS GROUPS(RG)</b>	per census area aggregation/municipality aggregation
<b>TRANSPORT NETWORKS</b>	Roads Graph&Station, Subways Graph&Station, Railroads Graph&Station, Cable railway Graph&Station, Multi-Network Graph (interconnection)
<b>GAS/OIL NETWORK</b>	
<b>ELECTRIC NETWORK</b>	Hight/Medium Voltage Electric Graph, Electric Power Sources, external power sources, Primary cabine From high to medium voltage, Secondary cabine From medium to low voltage, Isolating switches, Electric zones
<b>WATER NETWORK</b>	Water pipes, Water sources, Water treatment plants, Water tanks, Water zones
<b>LOGISTIC NETWORK</b>	Logistic centre, Ports, Airports, Warehouses
<b>TELECOMMUNICATION</b>	Optical fiber fixed network, mobile network, radio
<b>POINT OF INTEREST(POI)</b>	Banks, Detention Centre, Fire Stations, Hospital, Industrial, Minister and Embassy, Monuments, Offices, Parking, Police, Post Offices, Schools, Shopping Malls, University, Warehouses, Worships, Courtes, Server farms, Hi-tech industry, Research centre, Unemployment centre, Hotels
<b>ENVIRONMENT – LAND USE</b>	Industrial Areas, Port Harbors, Airport Areas, Farmlands & Forests, Urban Green Areas, Natural Areas, Landfill, Urban Areas
<b>BUILDINGS</b>	Buildings type (21 categories)
<b>ENVIRONMENT – UTZ</b>	Urban Terrain Zones
<b>ENVIRONMENT – GEOLOGY AND GROUNDWATER</b>	Faults, Piezometric lines, Groundwater flow direction, Geological map
<b>ENVIRONMENT - DRENIAGE</b>	Floodplain, Waterways, Water zones categories, Drainage basins
<b>ENVIRONMENT - BOUNDARIES</b>	Future Development Area, City blocks, Area of interest
<b>CRIME</b>	Criminal organizations, Districts/Municipality/Area of influence
<b>WEATHER</b>	
<b>ENVIRONMENT – SEISMIC CLASSIFICATION</b>	Seismic Risk, Seismic Classification



# Model of 'Archaria' - Layers

LAYERS	SUBLAYERS
POPULATION	
ETHNICS GROUPS(EG)	
RELIGIOUS GROUPS(RG)	
TRANSPORT NETWORKS	
GAS/OIL NETWORK	
ELECTRIC NETWORK	
WATER NETWORK	
LOGISTIC NETWORK	
TELECOMMUNICATION	
POINT OF INTEREST(POI)	
ENVIRONMENT – LAND USE	
BUILDINGS	
ENVIRONMENT – UTZ	
ENVIRONMENT – GEOLOGY AND GROUNDWATER	
ENVIRONMENT - DRENIAGE	
ENVIRONMENT - BOUNDARIES	
CRIME	
WEATHER	
ENVIRONMENT – SEISMIC CLASSIFICATION	

# BUILDINGS

## URBANISATION PROJECT – REAL DATA

LAYER	SUB LAYER	Apr
Building	Residential buildings	276.086
	Worship buildings	1.239
	Offices	81
	Shopping mall	74
	Warehouses	62
	Schools	4.379
	Gov'l and Int'l entities	58
	Detention Centre	62
	Hospital	201
	Industrial	15.109
	Police Station	242
	Military Barracks	407
	Open Area	233
	Transportation (Stations, Ticket Offices,...)	163
	Other Buildings	17.955
<b>Total:</b>	<b>316.351</b>	

Detailed building analysis thanks to additional data and requests from SME.

## URBANISATION PROJECT - REAL DATA

Description	Value
Population	5.449.152
Buildings	316.351
Surface (km <sup>2</sup> )	1.652

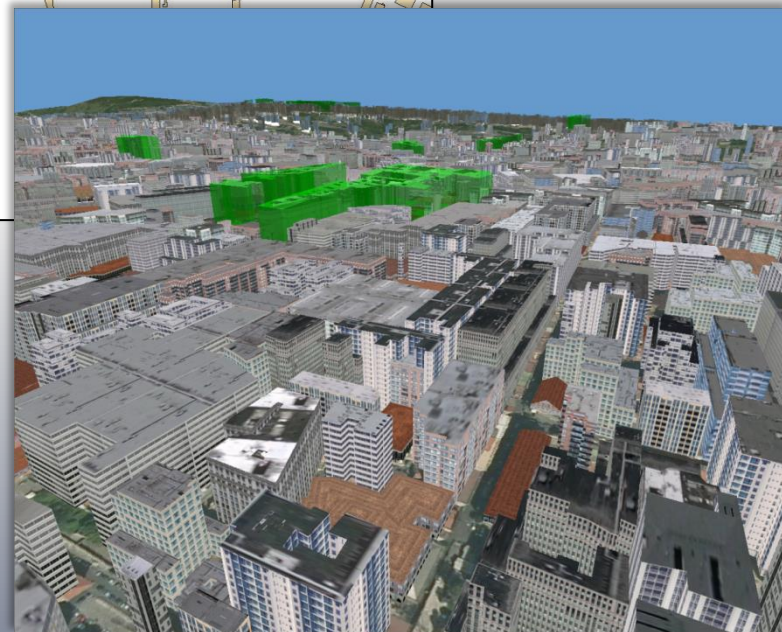
# HOSPITAL

**URBANISATION PROJECT**  
HOSPITALS LAYER – 2D

Field	Value
Doctors	
Nurses	
Total beds	
Total available beds	
Emergency first aid Department	Yes/No
Gynecology Department	Yes/No
Surgery Department	Yes/No
Orthopaedics Department	Yes/No
Pediatrics Department	Yes/No
Cardiology Department	Yes/No
Dermatology Department	Yes/No
Oncology Department	Yes/No
Surface [m <sup>2</sup> ]	



**HOSPITALS 2D MAP**



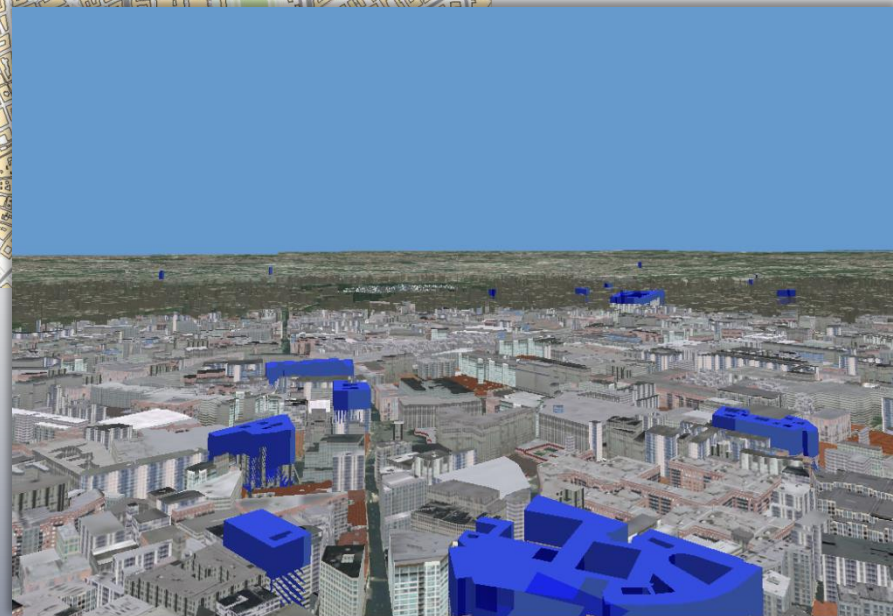
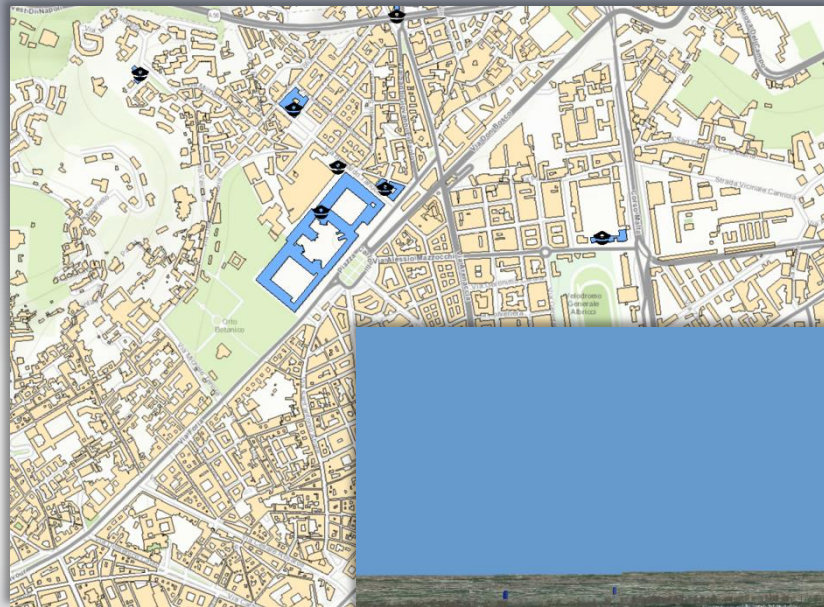
**HOSPITALS 3D VIEW**

**Remarks:** 62 Hospitals

# POLICE STATION

**URBANISATION PROJECT**  
**POLICE STATION LAYER – 2D**

Field	Value
Station Name	
Station Address	
Personnel	
Total Vehicles	
Off Road Vehicles	
Surface [m <sup>2</sup> ]	

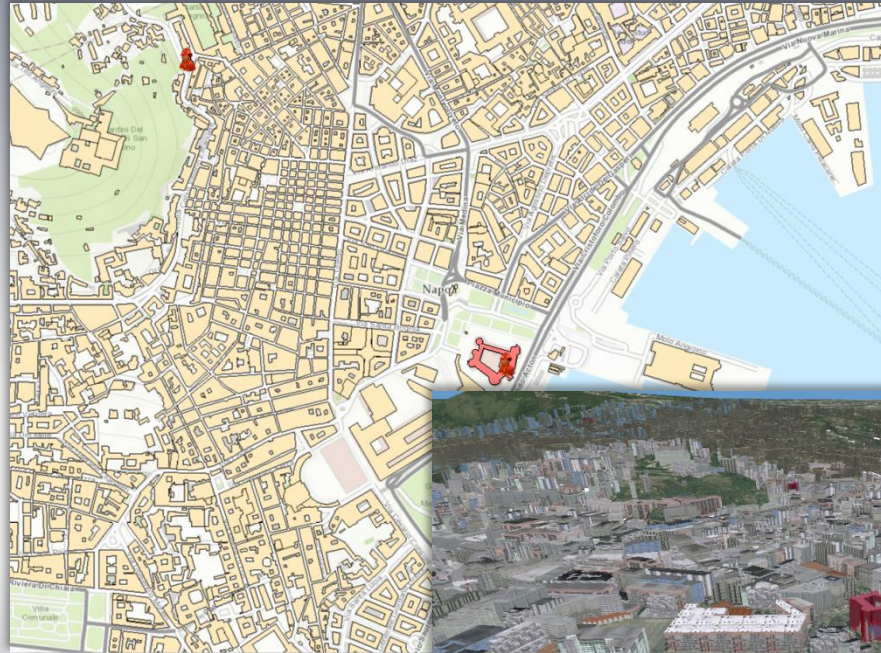


POLICE STATIONS 3D VIEW

# FIRE STATION

**URBANISATION PROJECT  
FIRE STATION LAYER – 2D**

Field	Value
Fire Station Name	
Fire Station Address	
Personnel	
Rescue Vehicles	
Fire Engine	
Surface [m <sup>2</sup> ]	

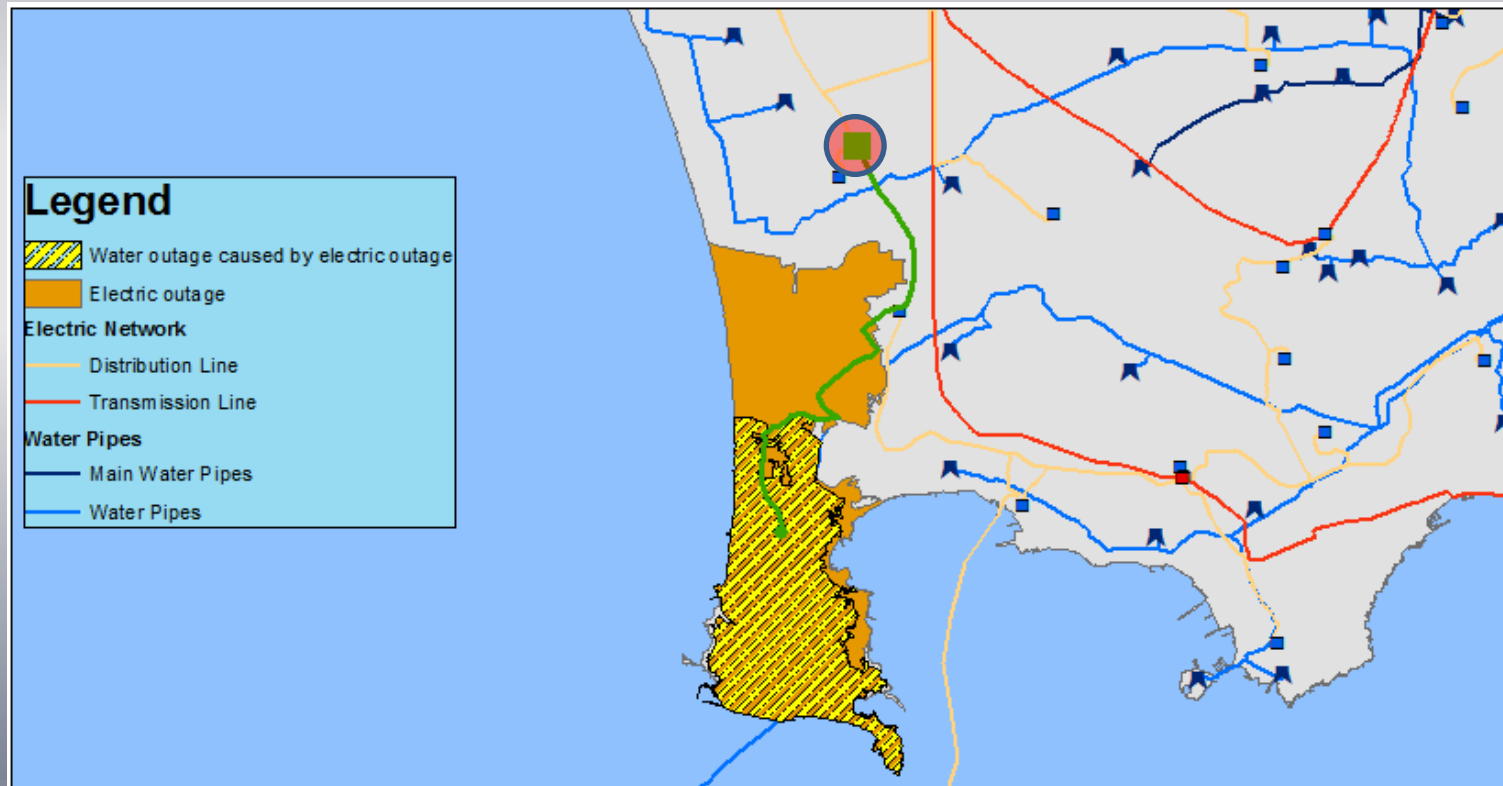
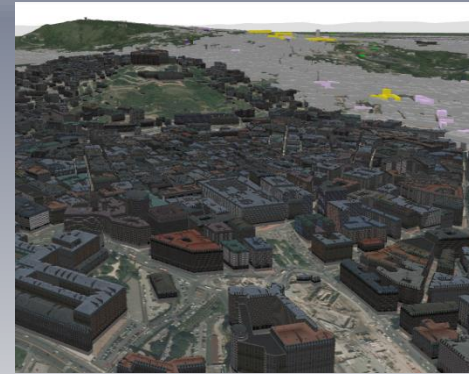


**FIRE STATIONS  
DEPARTMENT 2D MAP**



**FIRE STATIONS DEPARTMENT 3D VIEW**

# CONNECTION BETWEEN ELECTRIC AND WATER NETWORKs

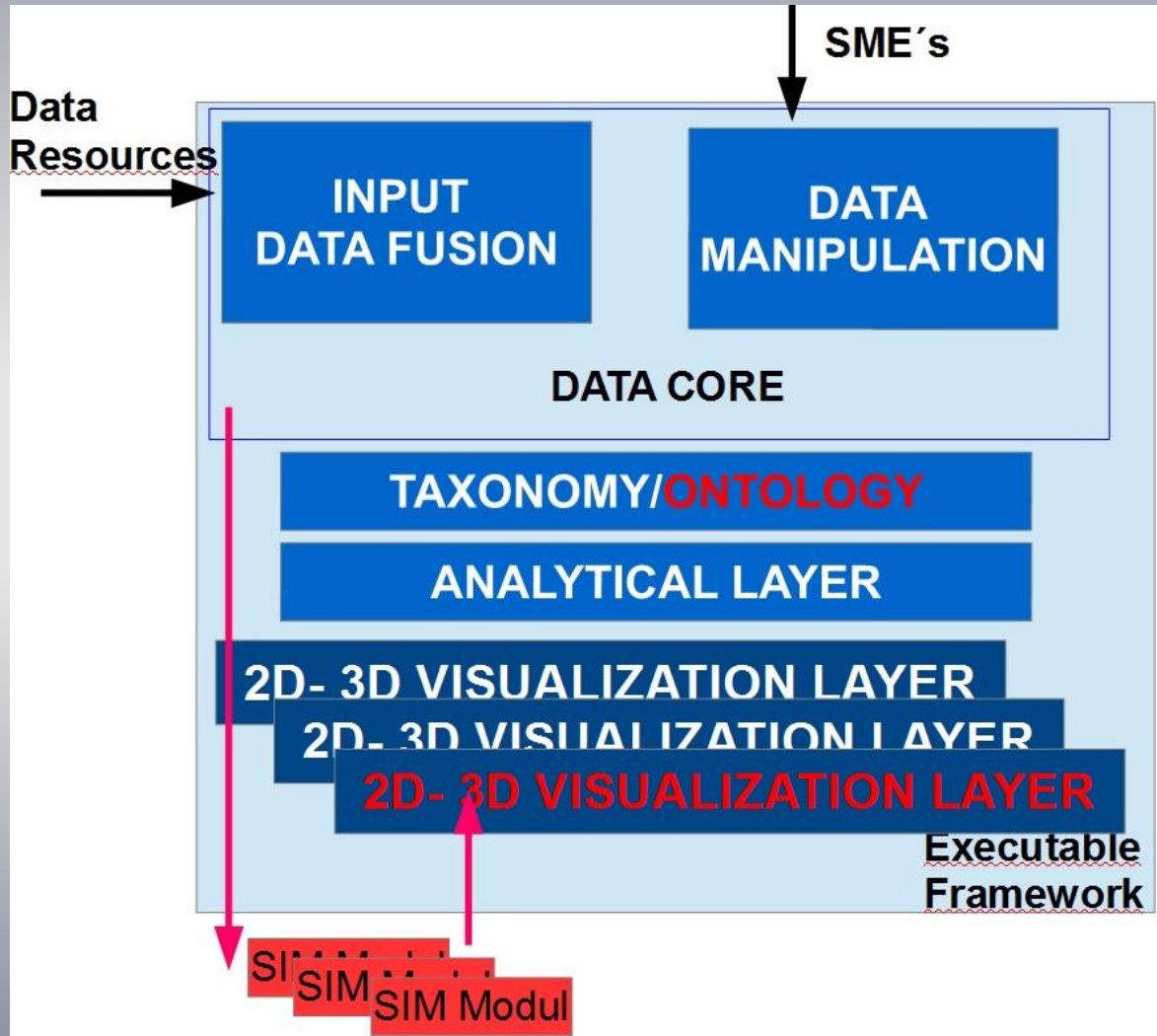


# UP EXPERIMENT RESULTS

- Interactive visualization category suitable
- 2D visualization at the operational/strategic level suitable
- 3D visualization questionable, not added value identified
- Questionnaire shaping the model
  - New layers / attributes
  - Attributes on pop up menu
  - Inputs for the library of prebuild analysis over data
  - Interconnected layers based on the parameters



# FUTURE ARCHITECTURE



# CONCLUSIONS

- 2D is more suitable for majority of layers
- Moving from taxonomy towards ontology for DM
- Ontology defines a profile of a big city data for DM
- Inputs for a prototype of rapid terrain generation in Urban Areas
- Prototype available for NATO and Partners

## FUTURE

Define profiles for other type of cities

Demonstrate value and cost of simulation

