Situational XAI for Smart Infrastructure

Kim Mayyasi, CEO
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Black Box AI decision-support fails for smart infrastructure

The New York Times

Can AI Be Taught to Explain Itself?

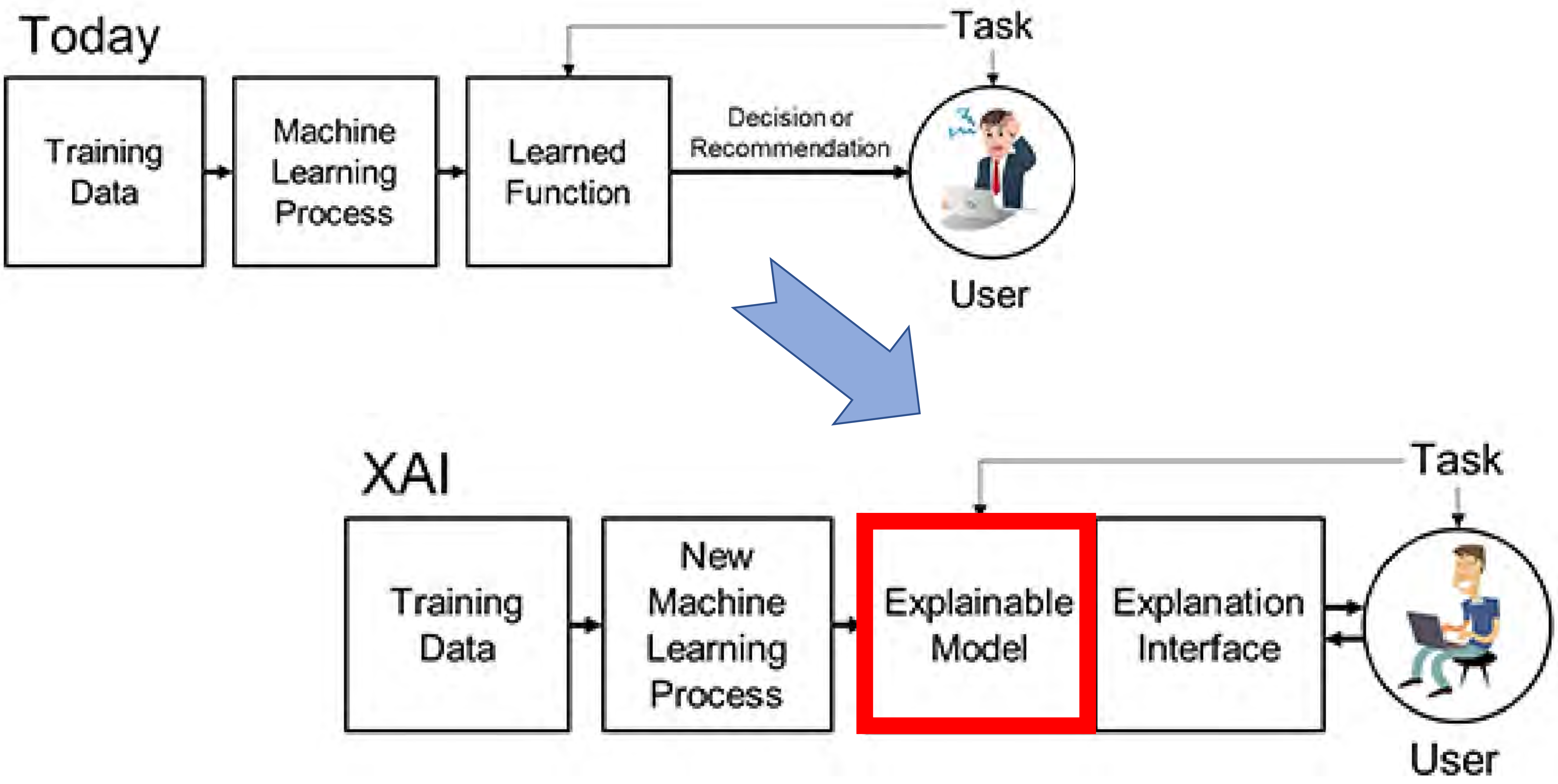
The Economist

For artificial intelligence to thrive, it must explain itself

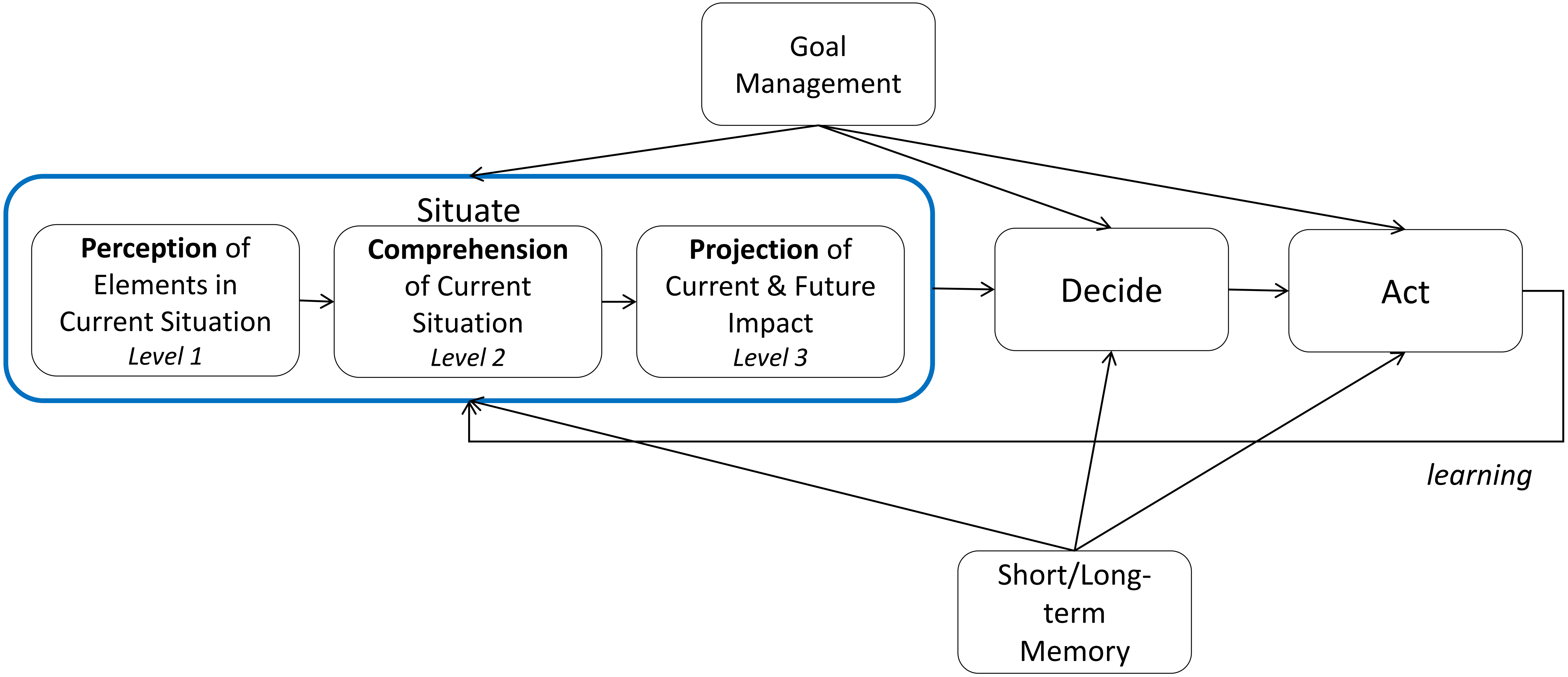
MIT Technology Review

The Dark Secret at the Heart of AI

Where to find an explainable model?

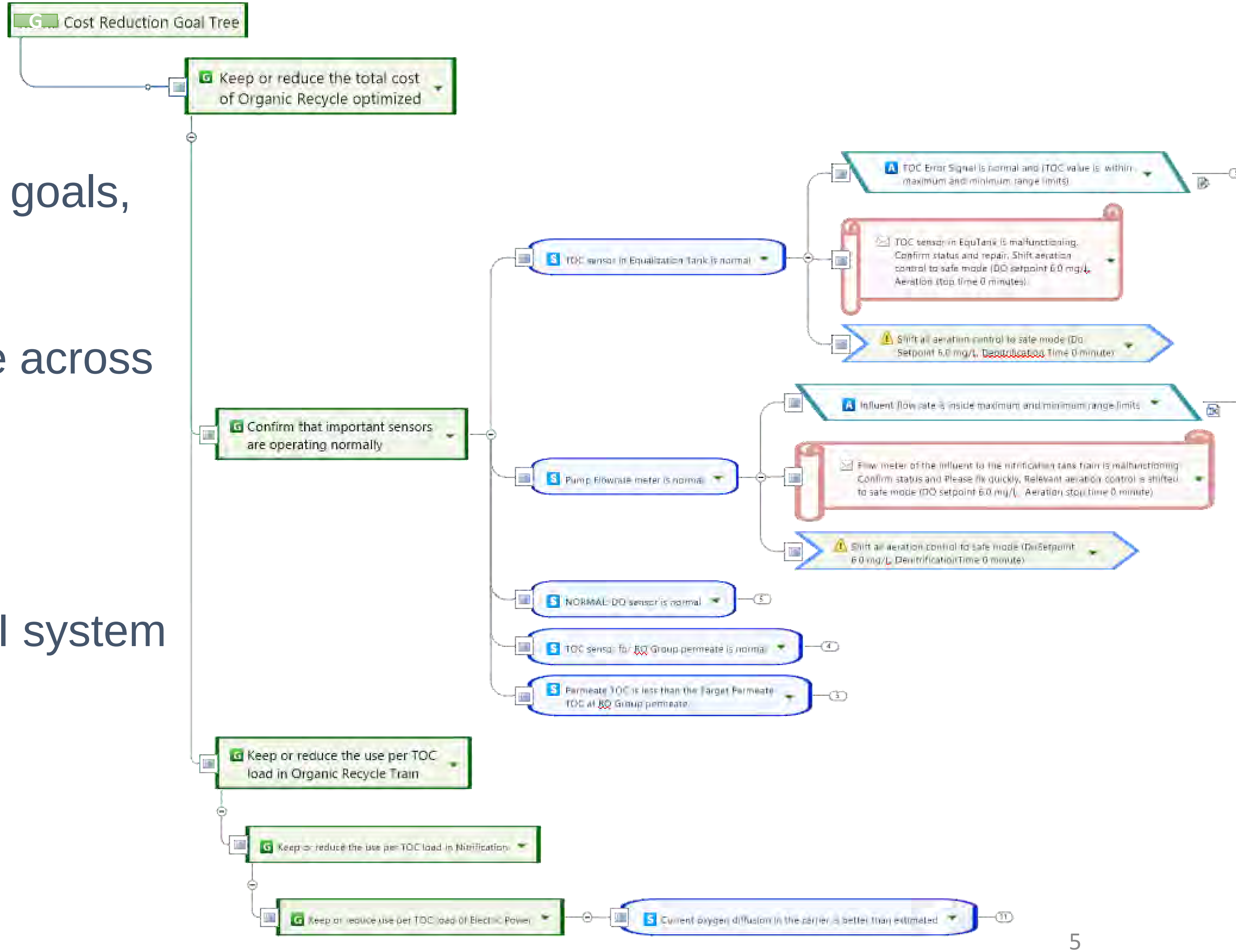


Endsley Situational Awareness model for Explainable AI (XAI)

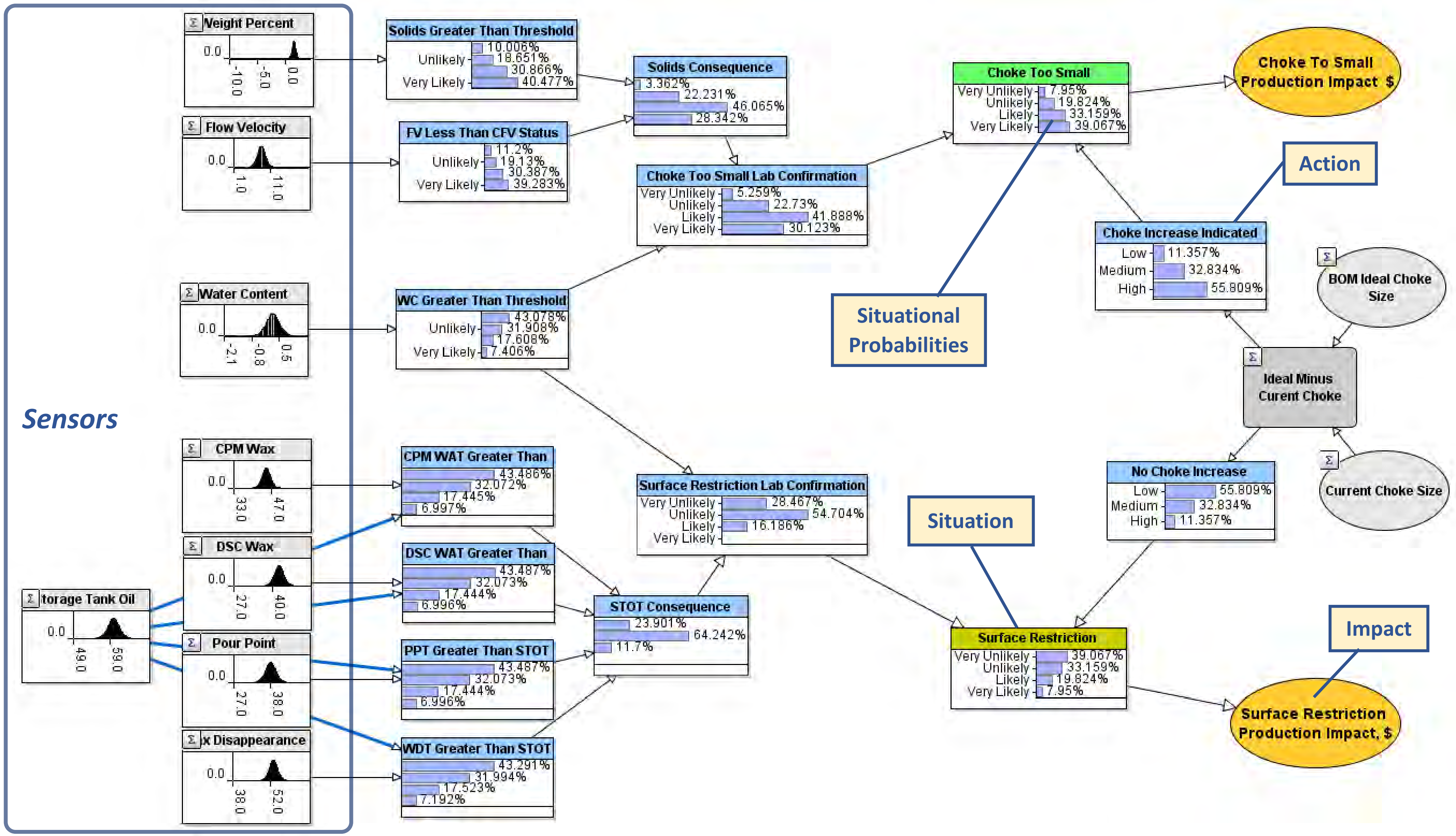


Cognitive mapping captures expert-specified goals, situations, and assessor models

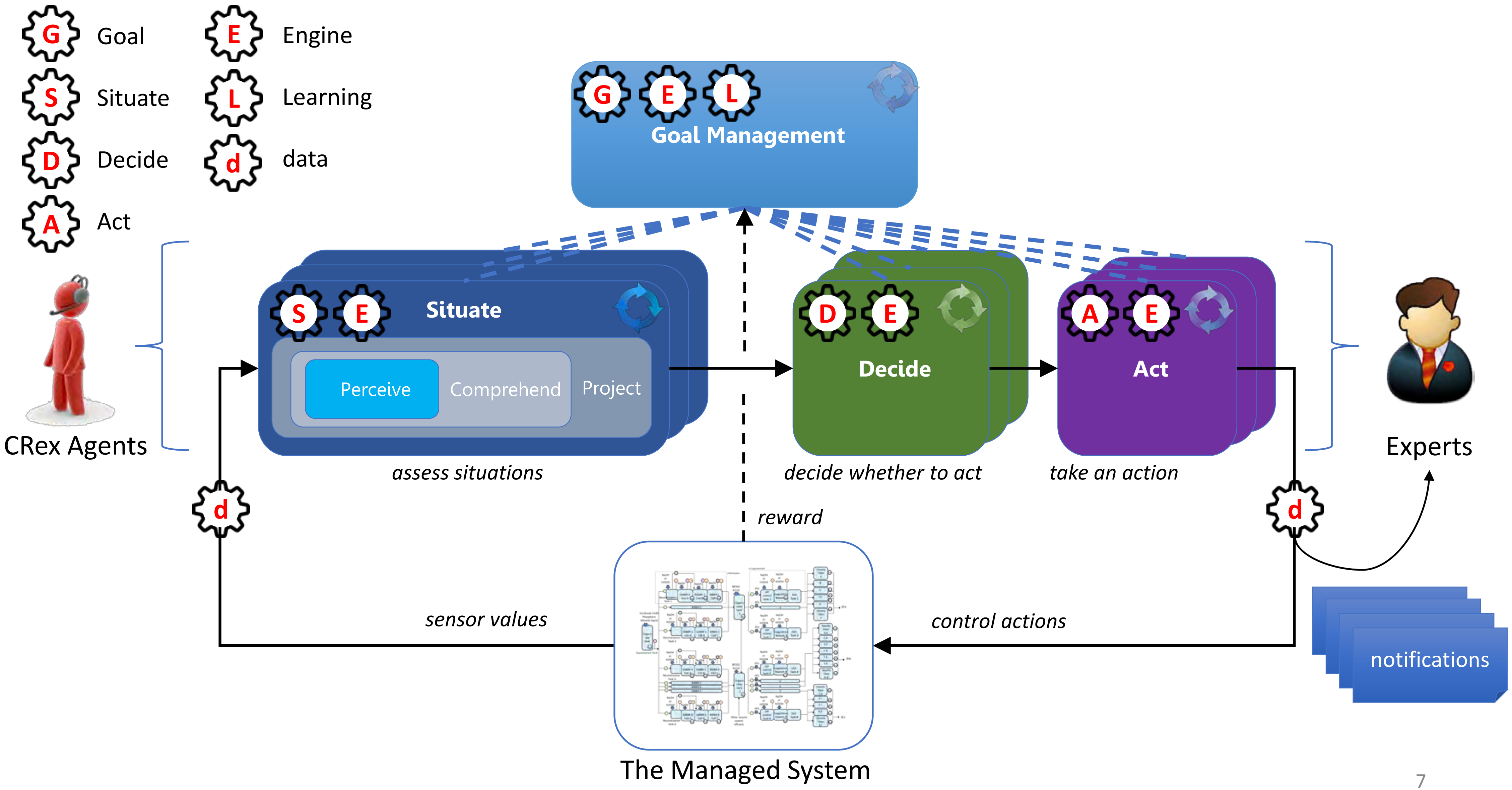
- Graphical representation of goals, situations, assessors
- Quickly captures big picture across multiple stakeholders
- Supports brainstorming
- Automatically programs XAI system



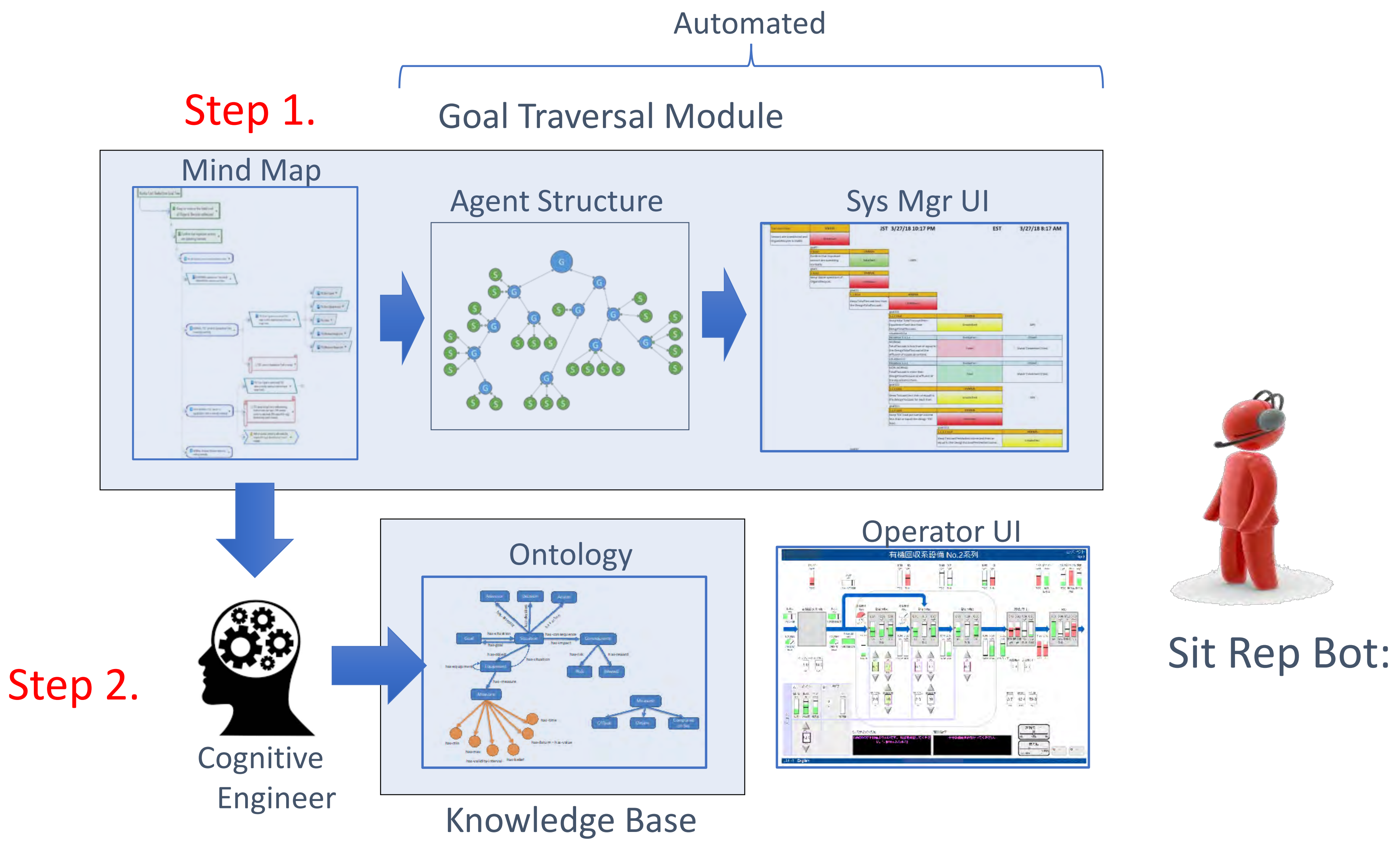
Expert reasoning can be augmented with Bayesian situational assessors



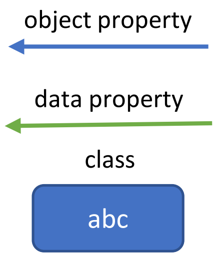
XAI agents execute the situational cognitive process defined in the concept map – including Bayesian assessors

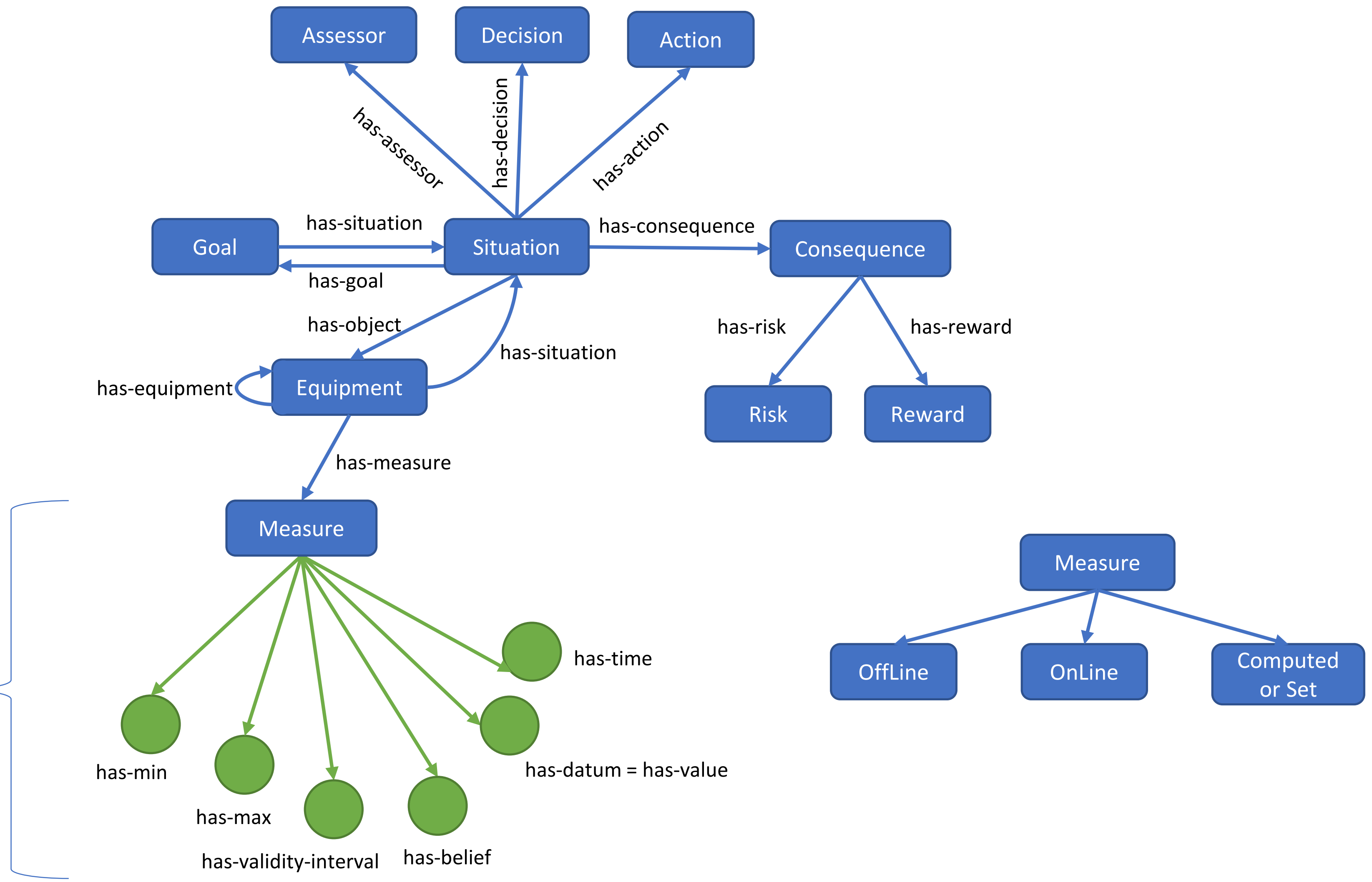


The XAI system includes a graph database for improved contextual awareness.



A situational ontology provides the foundational schema for the graph database



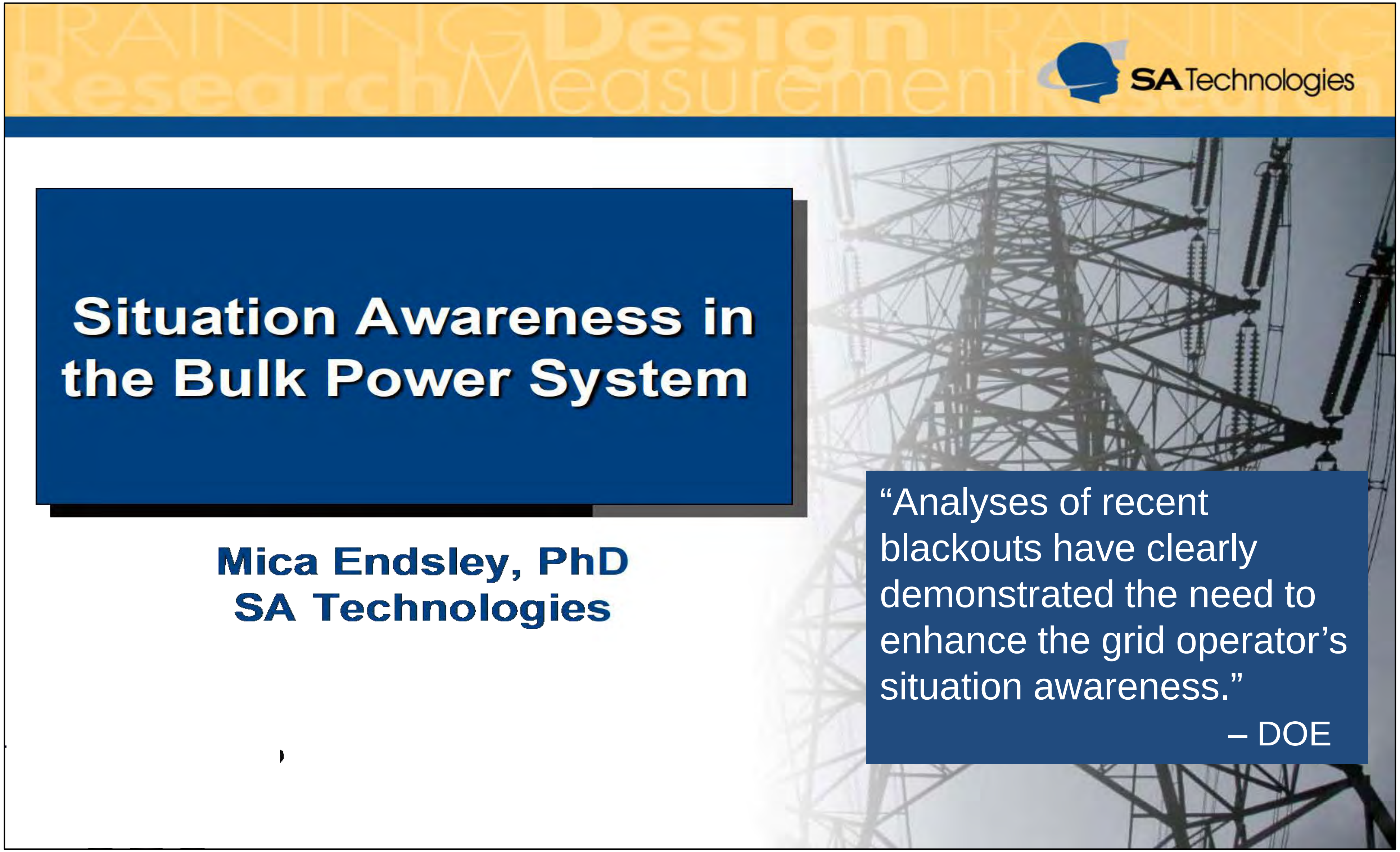


Semantic sensor network ontology links in here.

https://www.w3.org/TR/vocab-ssn/

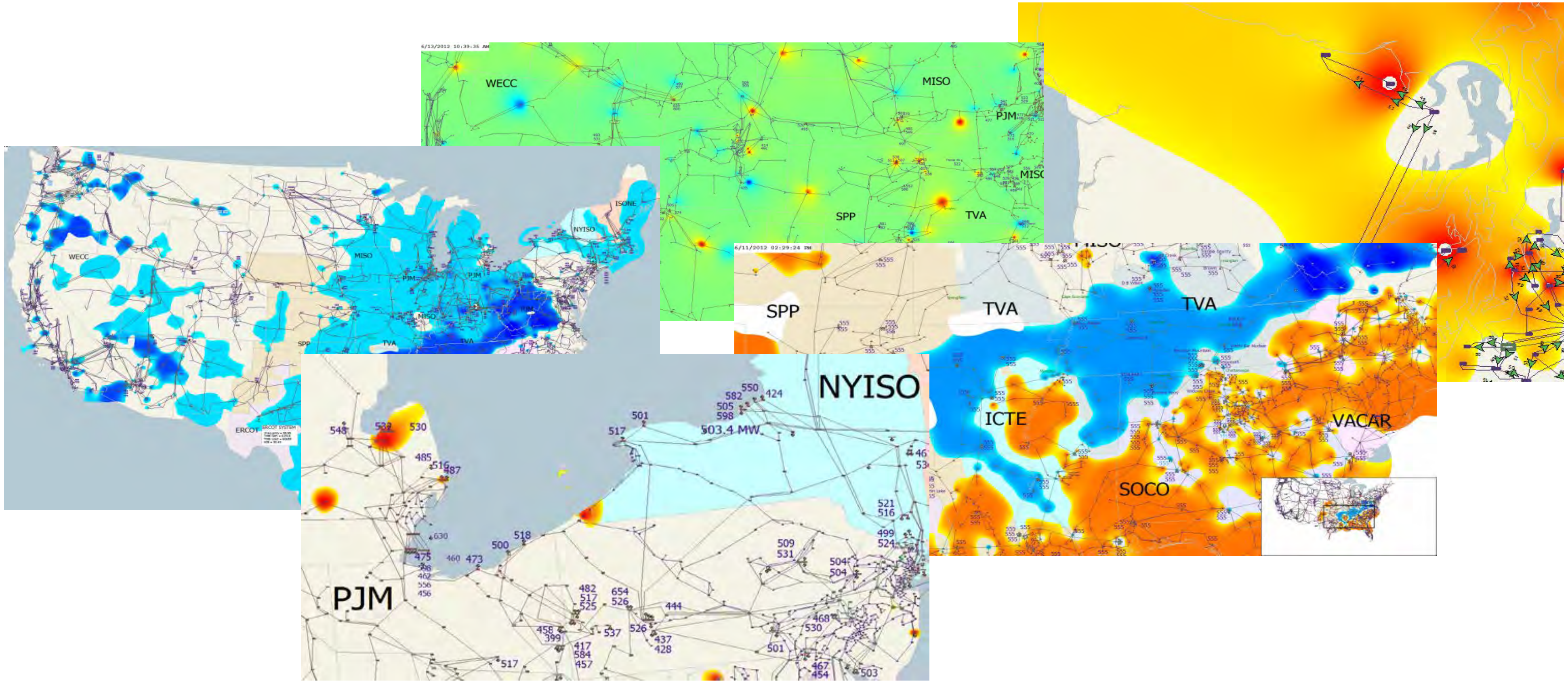
Electric Power Use Case

In 2003, Dr. Endsley presented situation awareness to FERC as the best approach for preventing large-scale blackouts

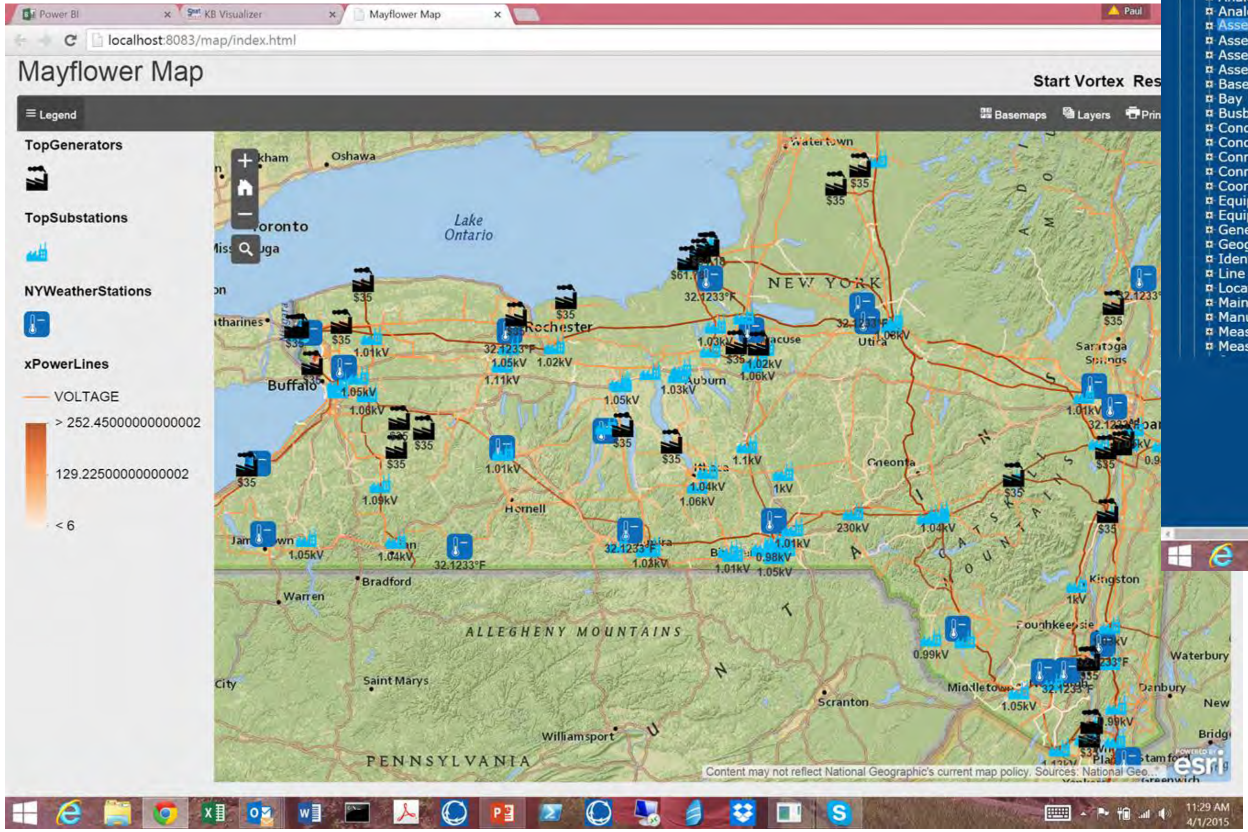


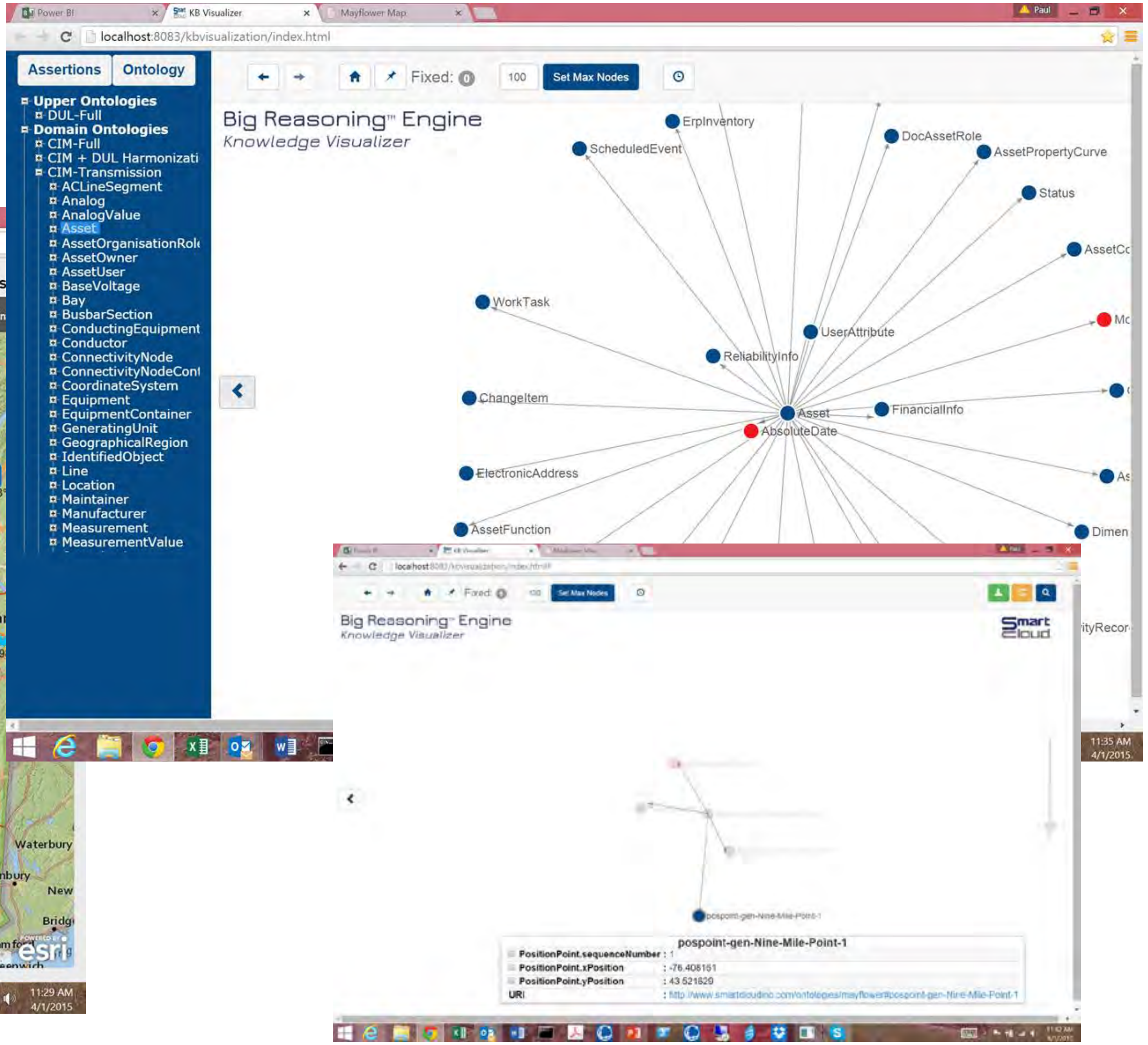
In 2011, a system for real-time SA decision-support of North American power grid was deployed

- Agent software identifies abnormal situations across 36,000 sensors in real time
- Semantics fuse data from 14 RCs, 7 different EMS vendors
- Two NOC's – DC and Atlanta - display important visualizations of emerging situations

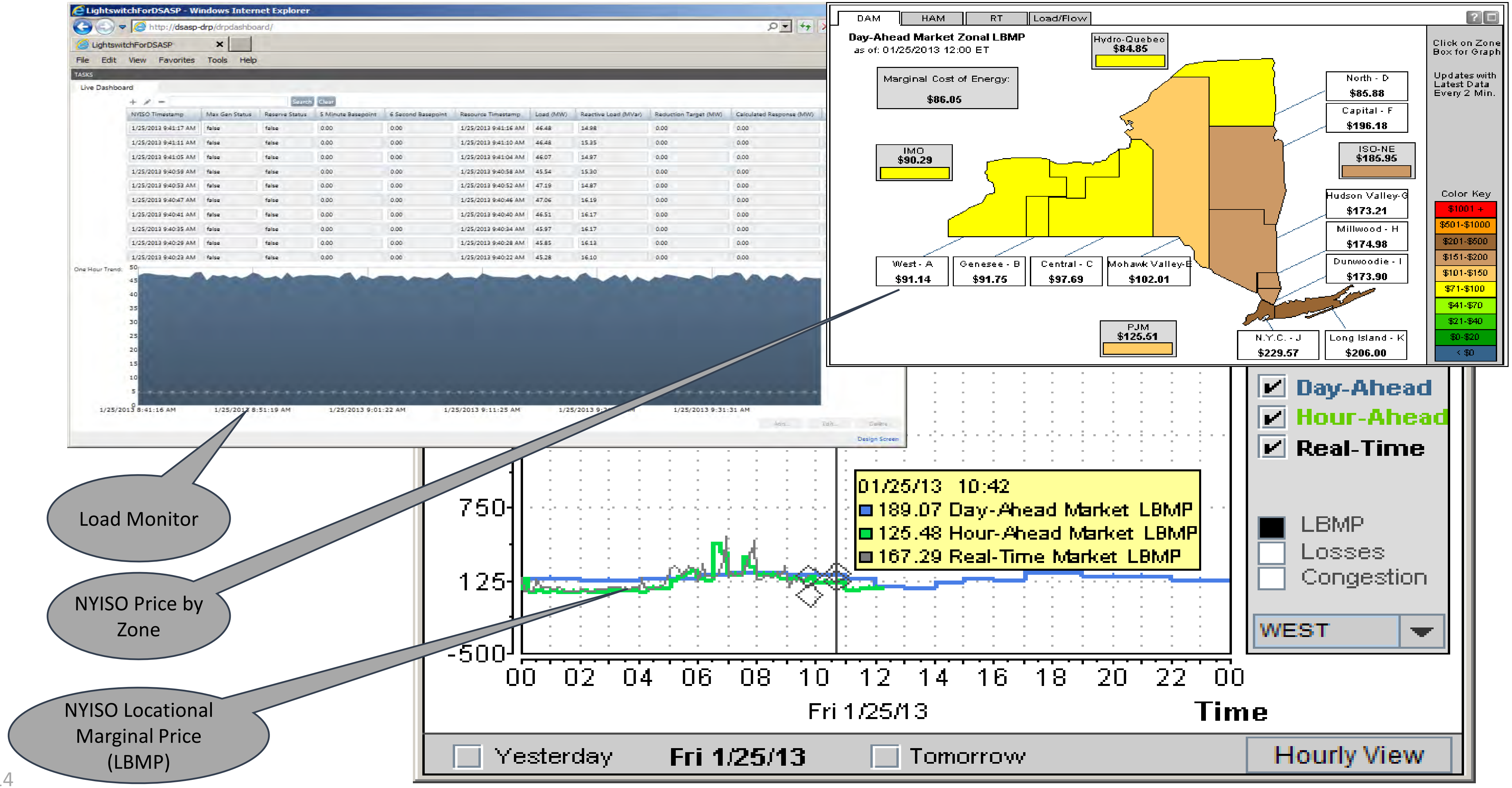


Situational AI in action: Managing upper NY state polar vortex





Polar vortex hits



Polar vortex

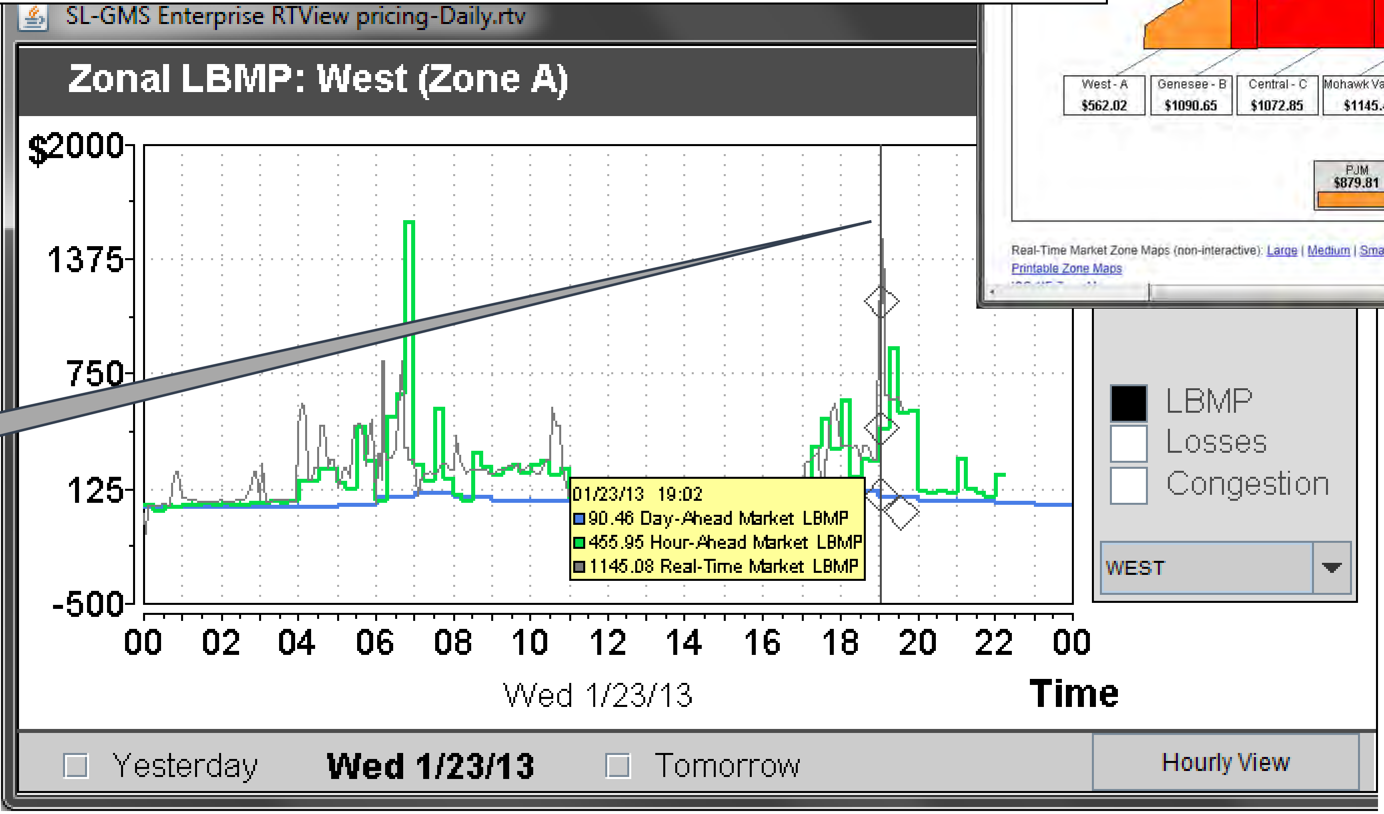
#2. Price spike

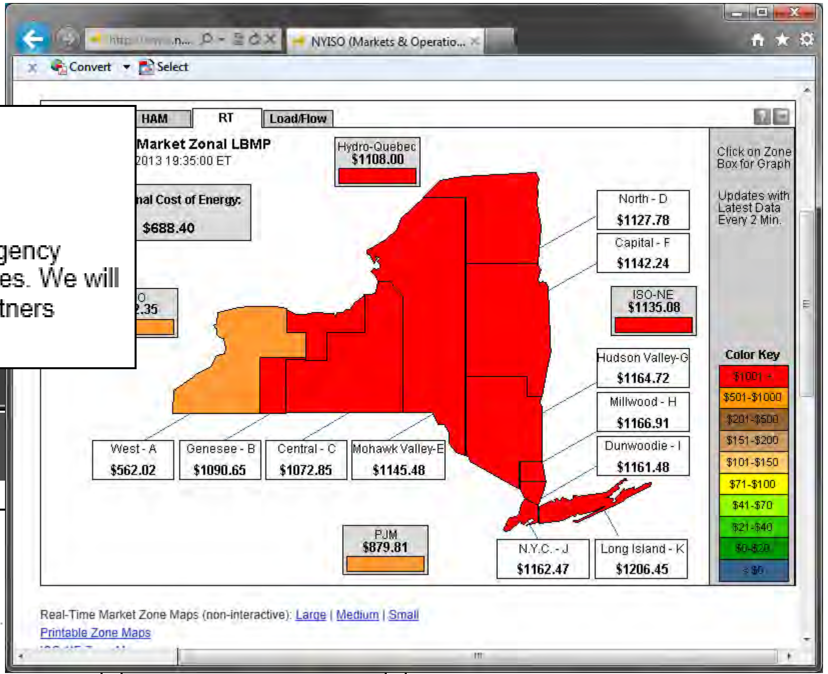
On Wed, Jan 23, 2013 at 6:55 PM, Demand Response Partners
<16116389_1354983348@notify2.mir3.com> wrote:

> SCI First Responders .,
> . DRP Emergency STANDBY Message. The New York grid has initiated an electric emergency event. Unless it is cancelled, you must be at the target level of 4.5 megawatts in 10 minutes. We will confirm this event in a follow up message. Good bye. Thank you, Demand Response Partners

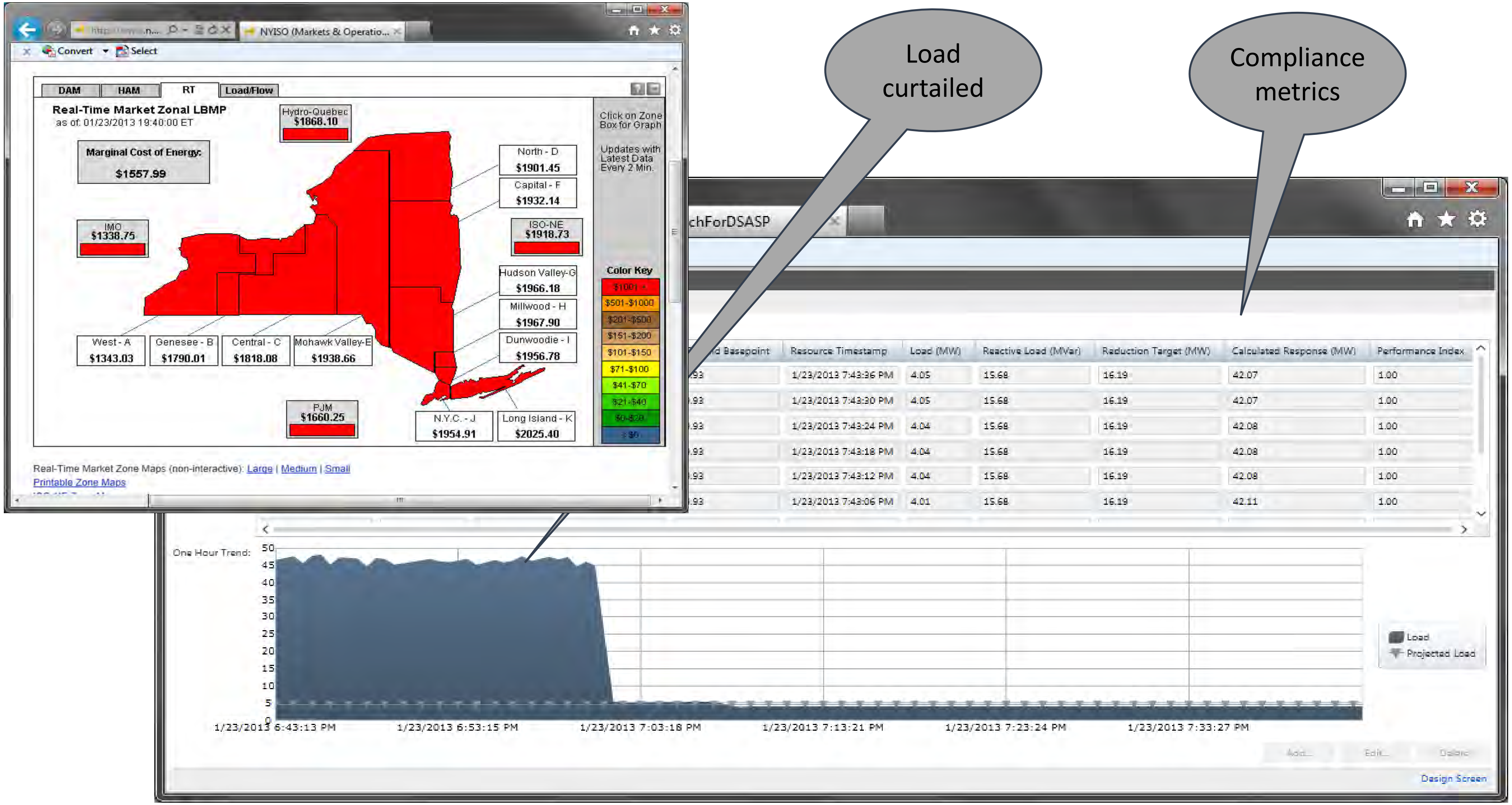
Emergency alert.

Price spike!

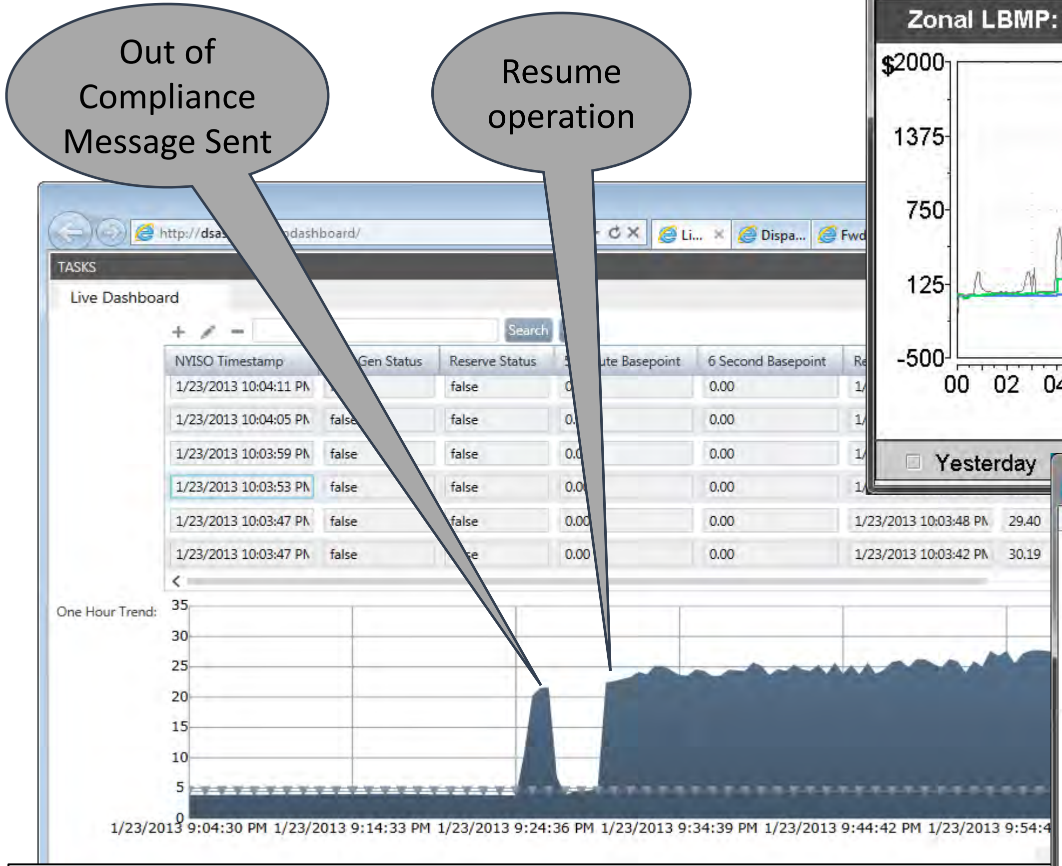


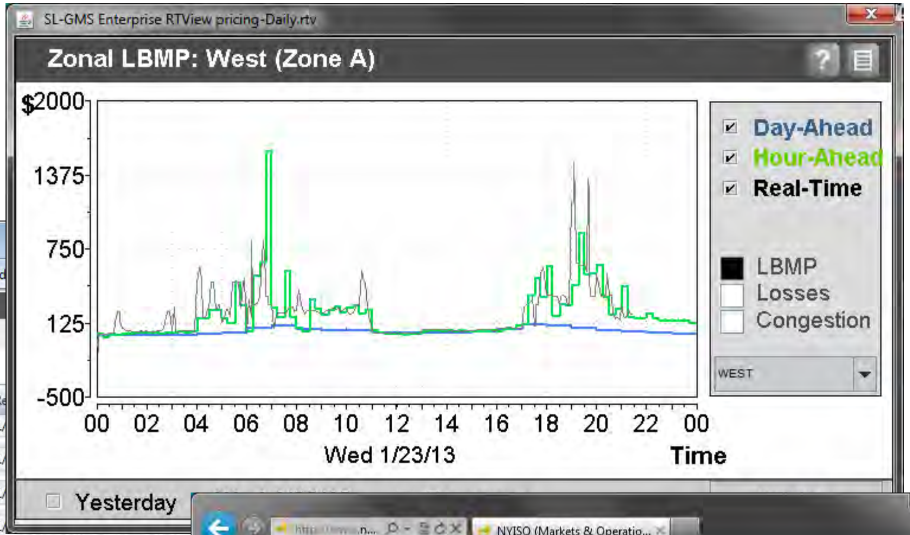


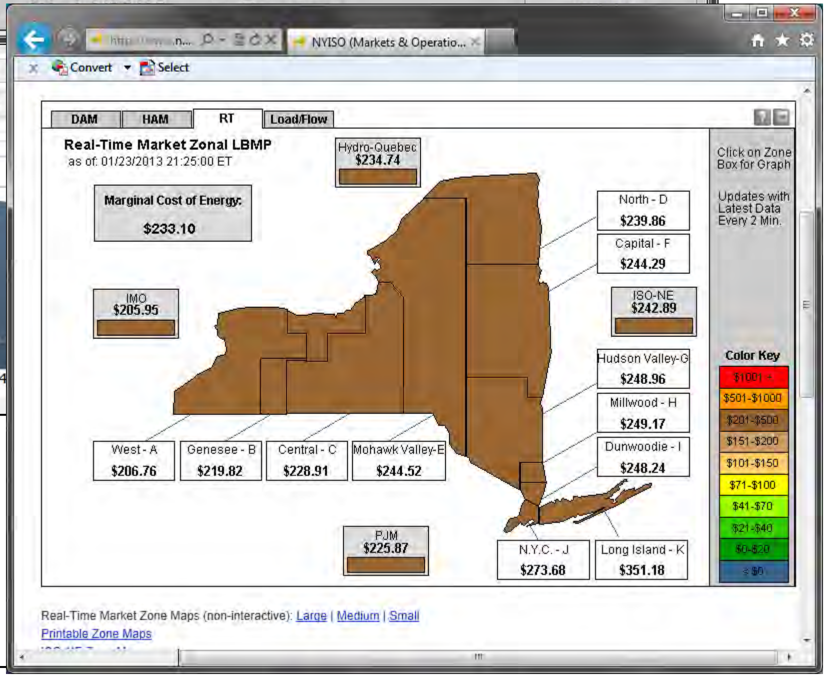
Polar vortex #3. Load curtailment



Polar vortex #4. End of event





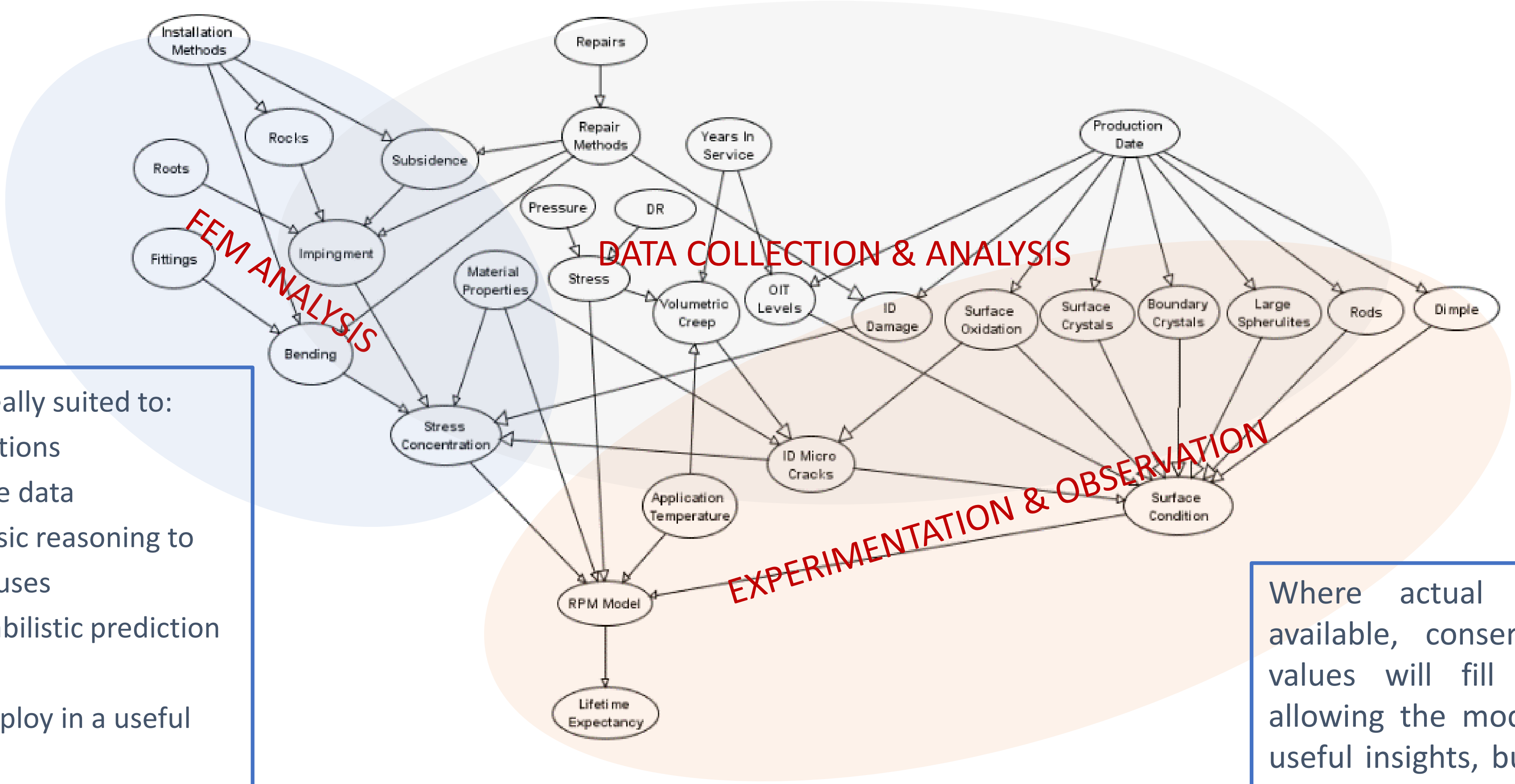


On Wed, Jan 23, 2013 at 7:25 PM, Demand Response Partners
<16116389_1354983348@notify2.mir3.com> wrote:

SCI First Responders, ReserveInadequate Message.
Attention: reserve event in progress. Your average usage over the last minute was 22 MW and exceeds the target load of 4.5 MW. Please reduce load.

Gas Pipeline Resilience Use Case

Bayesian situational risk assessor is at the heart of XAI to determine key risk probabilities



Bayesian AI is ideally suited to:

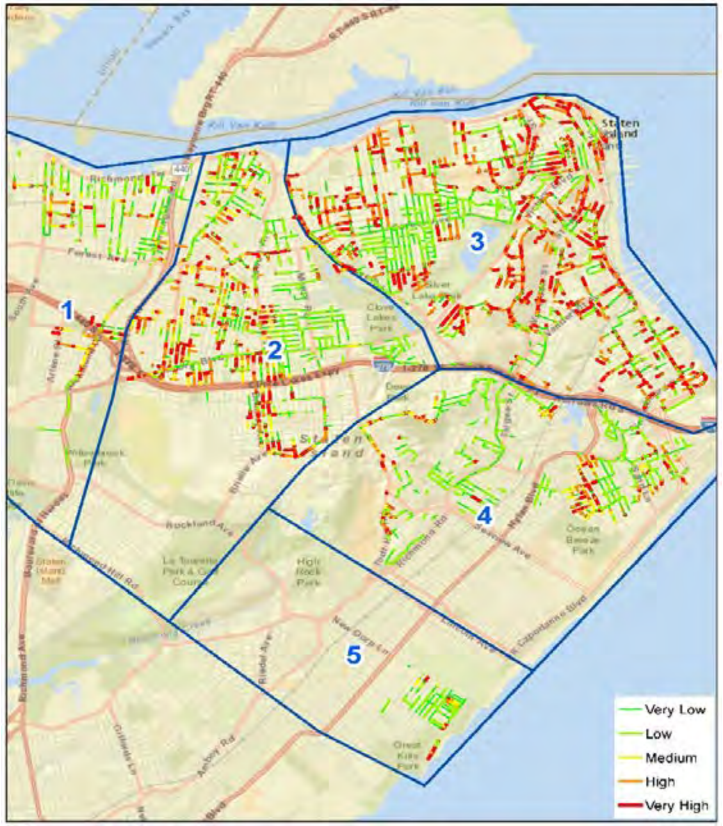
- Address interactions
- Deal with sparse data
- Providing forensic reasoning to identify root causes
- Providing probabilistic prediction of future states
- Immediately deploy in a useful way
- Improve as data gets better and system learns

Where actual data is not available, conservative default values will fill in the gaps, allowing the model to produce useful insights, but with greater uncertainty.

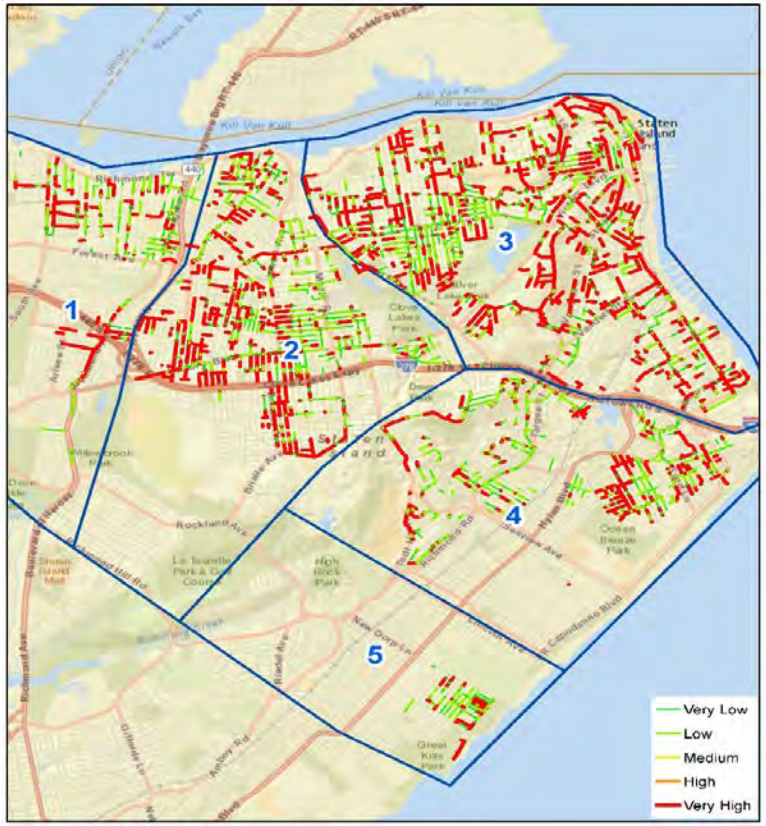
Bayesian situational AI for risk assessment of vintage polyethylene pipes

A structured XAI system to reduce operational risk in vintage plastic distribution systems susceptible to Slow Crack Growth failures.

Bayesian situational assessors determine the probability of pipeline failure and displays results on GIS map



5 years



10 years

Gains chart facilitates replacement cost-risk tradeoff

Probability of Failure within 5 years	Number of Segments	Percent of Segments	Cumulative %	Average Years in Service	Linear Feet	Replacement Cost	Cumulative Replacement Cost
90%+	183	2.38%	2.38%	51.8	12,426	$2,795,756	$2,795,756
80-90%	975	12.66%	15.03%	44.1	82,997	$18,674,363	$21,470,118
70-80%	985	12.79%	27.82%	44.0	81,316	$18,296,065	$39,766,183
60-70%	993	12.89%	40.71%	44.1	88,431	$19,896,967	$59,663,150
50-60%	398	5.17%	45.88%	40.4	31,286	$7,039,312	$66,702,463
40-50%	218	2.83%	48.71%	44.1	16,707	$3,759,120	$70,461,583
30-40%	64	0.83%	49.54%	43.9	4,141	$931,670	$71,393,253
20-30%	1,162	15.09%	64.62%	45.3	121,652	$27,371,634	$98,764,887
10-20%	1,494	19.40%	84.02%	37.0	131,774	$29,649,092	$128,413,979
<10%	1,262	16.38%	100.40%	40.7	123,825	$27,860,680	$156,274,660