

Auto-Steered Information-Decision Processes for Electric System Asset Management

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Bill Meeker: Statistics – Reliability, Decision

Daji Qiao: Computer Engineering – Sensor Networks

Ron Roberts: Aerospace Engineering – Nondestructive Evaluation

Sarah Ryan: Industrial Engineering – Stochastic Optimization

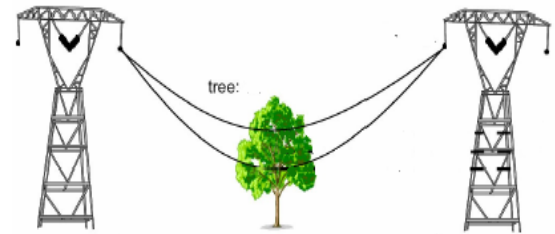
Iowa State University

Power Systems Overview: Transmission

- Commodity market + complex, delicate machine
- Equipment:
 - Ubiquitous, capital-intensive, distributed, failure-prone
 - 150,000 transformers, 600,000 circuit breakers, 254,000 miles of lines. Replacement cost is ~300 billion dollars
- Asset-system management: a decision-science
 - Operate, maintain, expand
- Decision-drivers
 - Equipment health, Failure consequence, Resources

Objective

Develop a hardware-software prototype for auto-steering the information-decision cycles inherent to managing operations, maintenance, & planning of high-voltage electric power transmission systems.



Main Thrusts

- Layer 1: Long-term power system simulation
 - Areva commercial grade simulator (DTS), Iowa/ISU grid
- Layer 2: Sensing and communications
 - One or two field installations on campus, wireless sensors
- Layer 3: Data integration
 - Ontology-based, query-centric, federated
- Layer 4: Converting condition data into failure predictors
 - Steady-state & transient failure probabilities
- Layer 5: Integrated decision algorithms
 - Interacting, rolling, multiobjective, stochastic optimization
 - Two stage info valuation for uncertainty reduction to decide new sensor deployment

Layer 2: Sensing and Communications

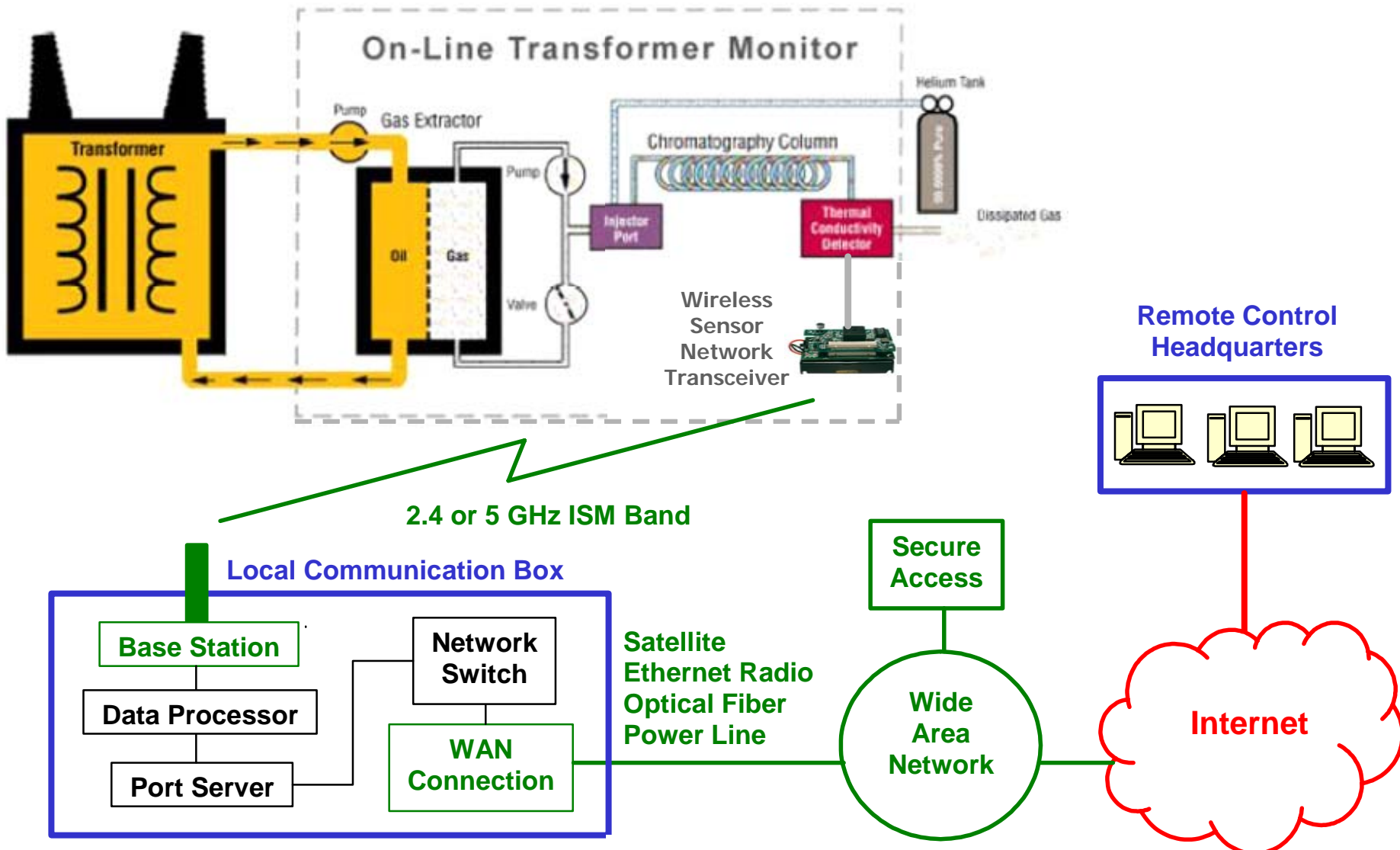
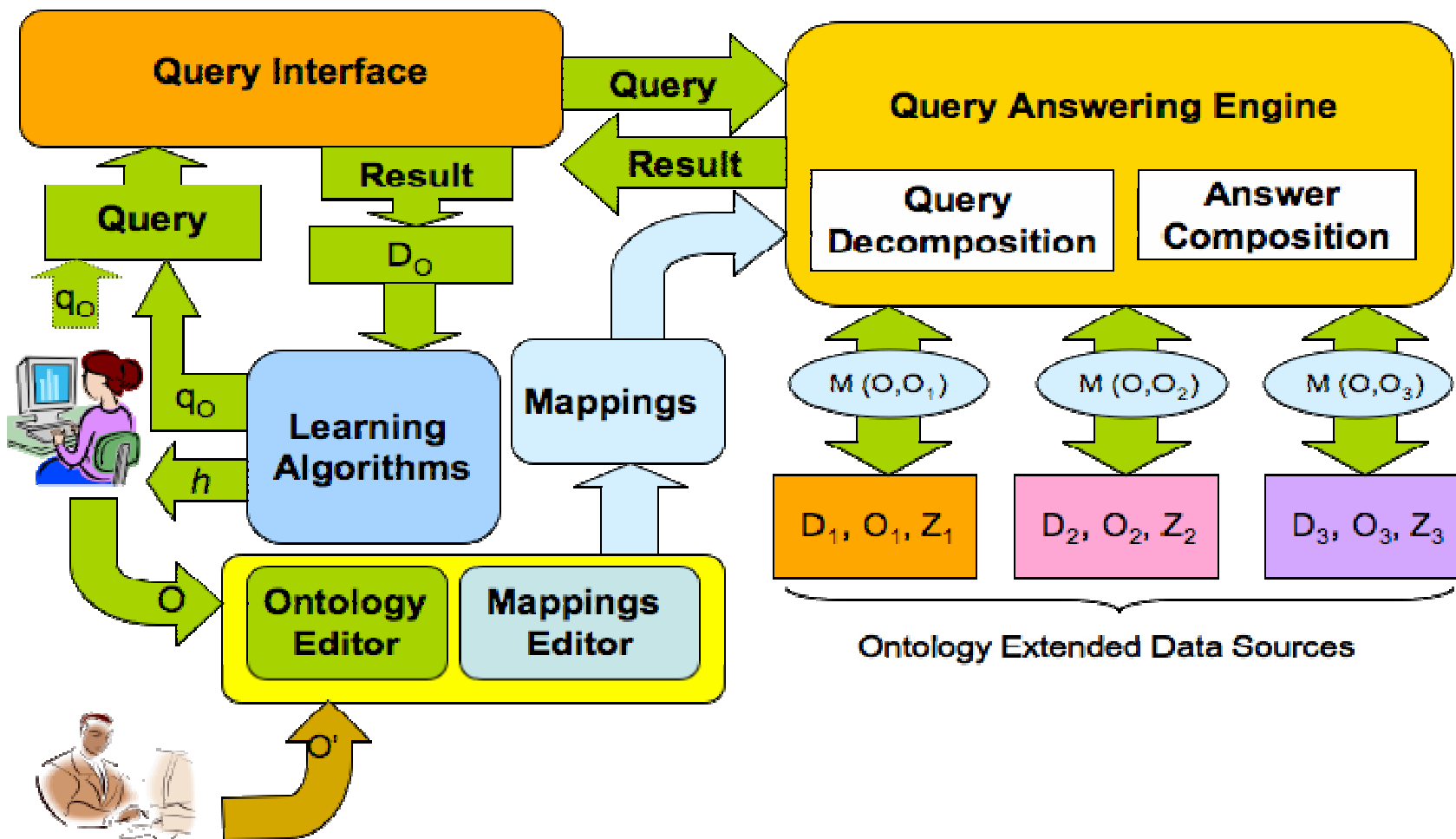


Fig. 2

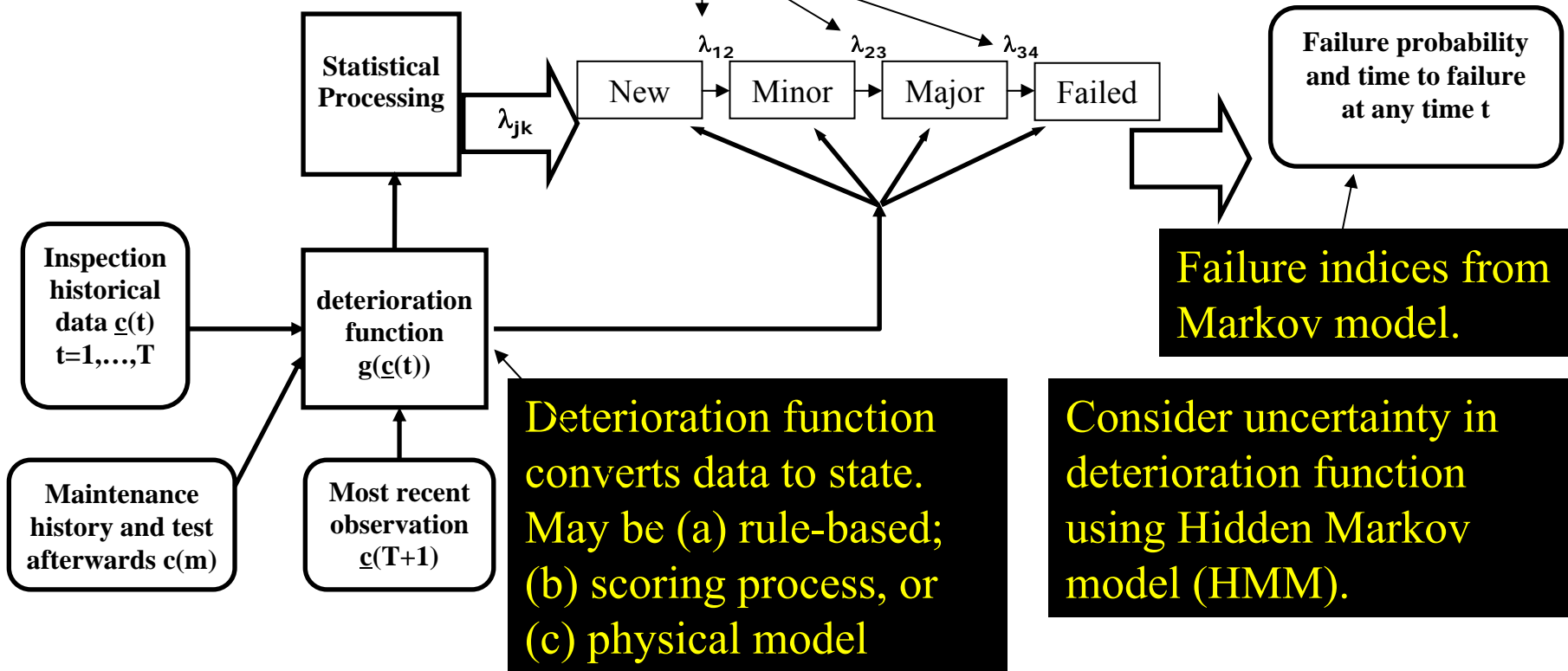
Layer 3: Data Handling and Integration

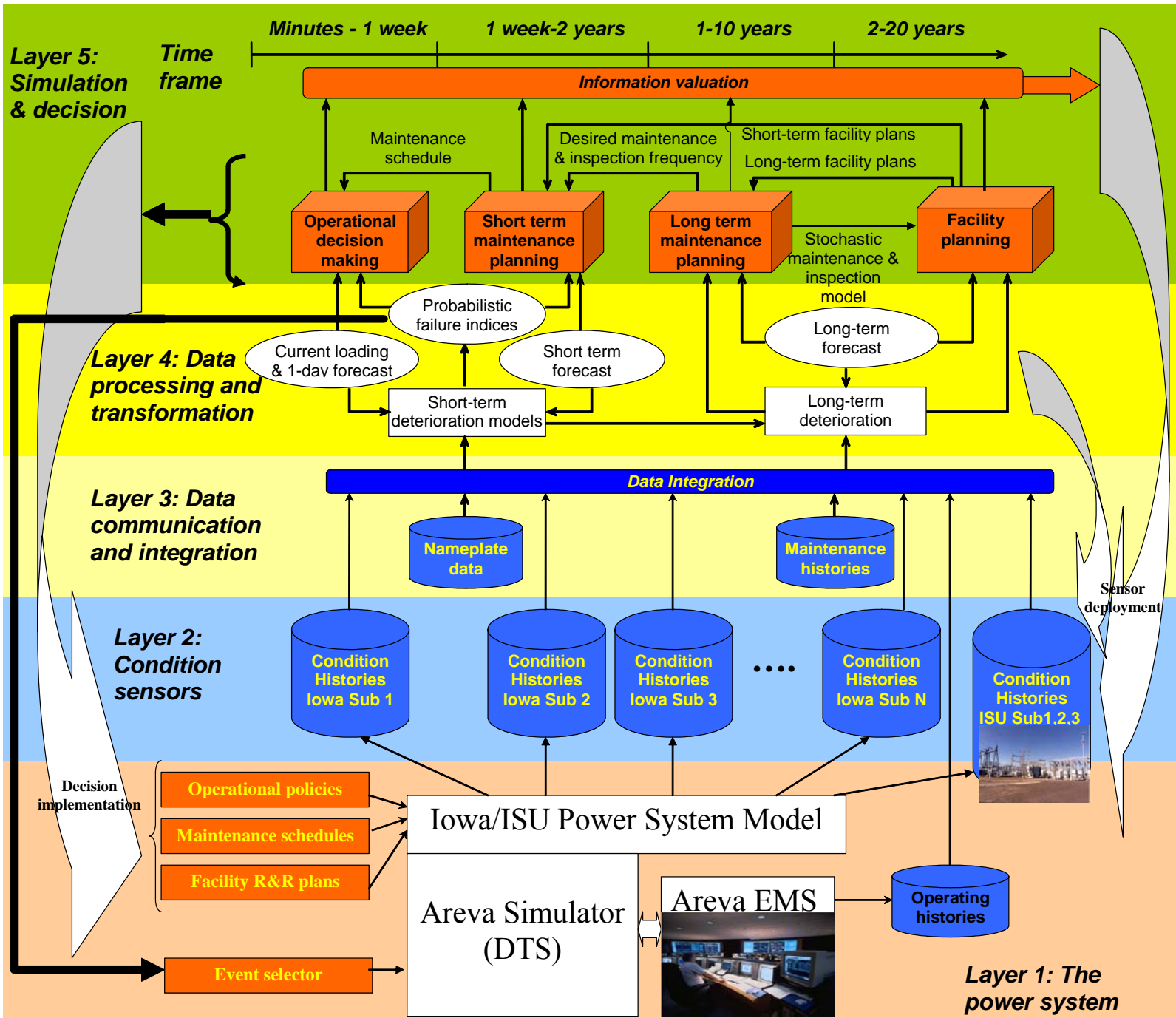


INDUS: Intelligent Data Understanding System

Layer 4: Data Transformation

Transition intensities λ_{jk} computed from condition histories





Industrial Partners

Cannon Technologies (Mike Cannon) – Sensors, communication networks, & diagnosis from data

TjH2b (Dave Hansen)– Data transformation

ISU Facilities & Management (Randy Larabee) – Access to field installation on campus

Field
Installation

Areva T&D (Jay Giri) – Power system simulator; equipment monitoring system.

Field
Installation &
Simulator

MidAmerican Energy (Ali Chowdhury) – Data

Karen O’connor (Alliant Energy) - Data

Data