The Value Proposition for Synchrophasor Technology:
Itemizing and Calculating the Benefits From Synchrophasor Technology

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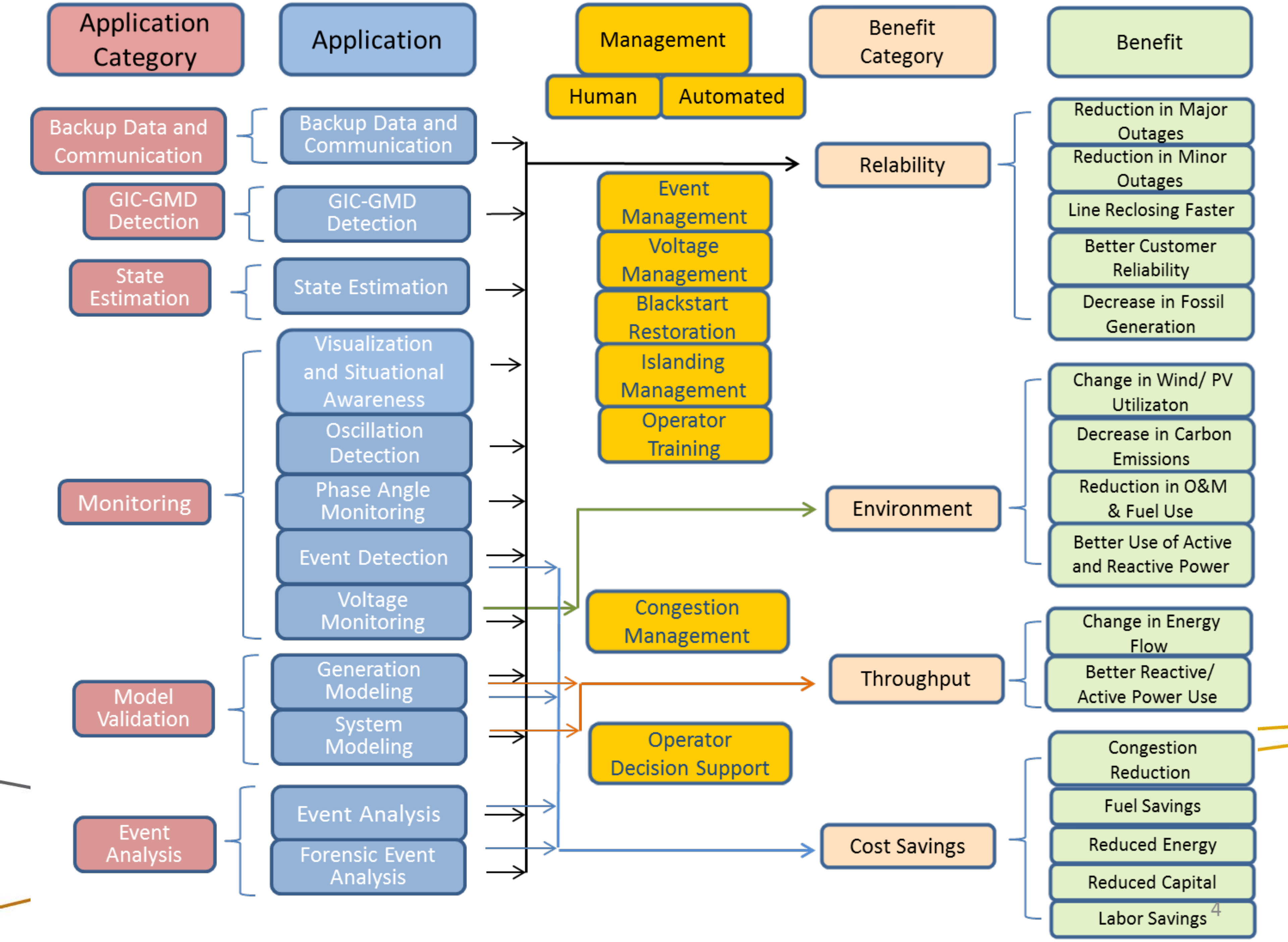
Synchrophasor Benefits Framework

- Approach to the framework
  - Classes of benefits
  - Quantify metrics and benefits
  - Show examples and calculations
- Reliability & resiliency benefits
- Cost savings and efficiency benefit
- Grid throughput and efficiency benefits
- Environmental and policy benefits
- Scaling from annual to longer cycle benefits

- New NASPI Technical Report on the Synchrophasor Value Proposition at https://www.naspi.org/File.aspx?fileID=1571

Approach to framework

- Benefits occur from multiple applications in combination, not one-by-one
- Risk of double-counting benefits
- Active use of synchrophasor data required for benefits to be realized
- Some benefits may be hard to quantify
- Following diagram illuminates the approach



Application Category
Application
Management
Human
Automated
Benefit Category
Benefit
Backup Data and Communication
Backup Data and Communication
GIC-GMD Detection
GIC-GMD Detection
State Estimation
State Estimation
Monitoring
Visualization and Situational Awareness
Oscillation Detection
Phase Angle Monitoring
Event Detection
Voltage Monitoring
Model Validation
Generation Modeling
System Modeling
Event Analysis
Event Analysis
Forensic Event Analysis
Event Management
Voltage Management
Blackstart Restoration
Islanding Management
Operator Training
Congestion Management
Operator Decision Support
Relability
Environment
Throughput
Cost Savings
Reduction in Major Outages
Reduction in Minor Outages
Line Reclosing Faster
Better Customer Reliability
Decrease in Fossil Generation
Change in Wind/ PV Utilizaton
Decrease in Carbon Emissions
Reduction in O&M & Fuel Use
Better Use of Active and Reactive Power
Change in Energy Flow
Better Reactive/ Active Power Use
Congestion Reduction
Fuel Savings
Reduced Energy
Reduced Capital
Labor Savings

Reliability and Resiliency – Metrics and Benefits

Fundamental benefits about reducing the odds and consequences of outages, so look at how synchrophasor technology affects:

- Number of major and minor outages that occur
- Number of customers affected
- Duration of those outages
- Customers' financial value of the outages
- Two approaches
  - Estimating impact of each component
  - Using relationship of transmission to distribution outages to calculate impact

Reliability and resiliency benefits (cont'd)

- Benefits will be area-specific
  - Probability, causes and lengths of outages in each area without synchrophasor technology use
  - Numbers and types of customers
  - How could your uses of synchrophasor technology affect the occurrence and duration of outages?

How synchrophasor technology could enhance reliability and resiliency

- Better wide-area situational awareness and applications to prevent outages and cascading failures
- Fewer equipment failures
- Faster service restoration
- Faster line reclosing
- Faster generator synchronization
- Faster black-start restoration
- Faster island resynchronization
- Faster forensic analysis and lessons learned implementation
- Back-up network and data source for SCADA failure

NERC – Reliability standards using synchrophasors

Synchrophasor technology can be used to improve performance and establish compliance with at least seven NERC reliability standards

Standard Number	Title	Status
BAL-003-1	Frequency Response and Frequency Bias Setting	Subject to Enforcement
FAC-001-2	Facility Interconnection Requirements	Subject to Enforcement
IRO-003-2	Reliability Coordination – Wide-Area View	Subject to Enforcement
MOD-026-1	Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions	Subject to Enforcement
MOD-027-1	Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions	Subject to Enforcement
MOD-033-1	Steady-State and Dynamic System Model Validation	Subject to Enforcement
PRC-002-2	Disturbance Monitoring and Reporting Requirements	Approved, pending enforcement

Source: Information provided by Ryan Quint, NERC, September 2015

Cost savings and efficiency metrics

- Less transmission congestion (MWh and $ value)
- Labor cost reductions (time and $)
  - Forensic analysis
  - Model validation
  - Fault location
  - Detecting equipment failure before catastrophic failure
  - Equipment commissioning
- Capital deferral and avoidance savings
- Standards compliance

Grid efficiency and throughput benefits

- Congestion management

These are hard to quantify:

- Better voltage and reactive power management
- Line loss reduction

Environmental and policy benefits

- Increased delivery and use of renewable generation
  - From better power plant models, voltage stability, oscillation monitoring, state estimation, congestion management, dynamic line ratings, automatic operation of transmission assets, etc.
- Valuing incremental renewable generation
  - Identify an incremental percentage of renewable generation enabled by synchrophasor technology
- Fossil fuel offset by renewables
- Emissions reduction offset by renewables

Aggregating benefits over time

- Factors affecting the calculation of project benefits
  - Operational impacts significant in early years, level out as technology matures
  - Benefits from transmission-level synchrophasors may decrease with more customer-level energy efficiency, DG and storage
  - Create a baseline without synchrophasor technology and compare to the alternative with synchrophasors
- Net present value for time stream of financial benefits; sum up or discount non-monetary benefits

Conclusions

- Benefits from synchrophasor technology arise from actively using combinations of applications
- Identified benefits and where possible estimated values for:
  - Resiliency and reliability (outage #, duration, customers affected, value of customer service)
  - Cost savings (time and $)
  - Grid efficiency and throughput (MWh, energy cost)
  - Environmental (mostly renewable) impacts (MWh, emissions
- Provided methodology to quantify and estimate project benefits

Find "The Value Proposition for Synchrophasor Technology: Itemizing and Calculating the Benefits from Synchrophasor Technology Use" is on the NASPI website at:

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