Challenges In Deploying a Feature Rich Distribution Management System

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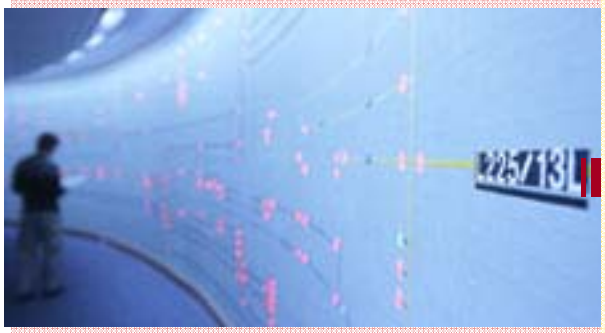
October 23, 2013

Transforming Distribution Operations

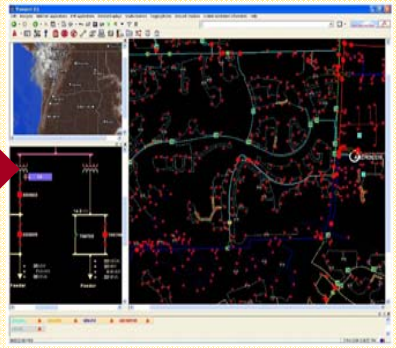
PAST*



Wall Board Mimic

Little or No Decision Support Capability within the Control Room Environment

PRESENT*



In Control Center

POWERON

(POCC)

FUTURE

DMS

Electronic Mimic with Advanced Apps for Decision Support

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Expected Business Outcomes

- **Financial:** Providing financial benefits stemming from **feeder deferrals, energy conservation, reducing fault locating and restoration times**.
- **Environmental** : rapid expansion of **energy conservation** will result in an incremental reduction in electrical intensity of 252 GWhrs between F2012 and F2026
- **Reliability /Customer**: will **reduce system CAIDI by 3 minutes**.
- **Employees:** the employees will be empowered with **enhanced decision support capability**
- **Safety**- provide a **more secure and safe environment** for field personnel
- **Alignment with BC Energy Plan** - aligns with the **Clean Energy Act**, which calls for the use of innovation and technology

Most DMS financial benefits provided by:

Volt-VAR Optimization (VVO)

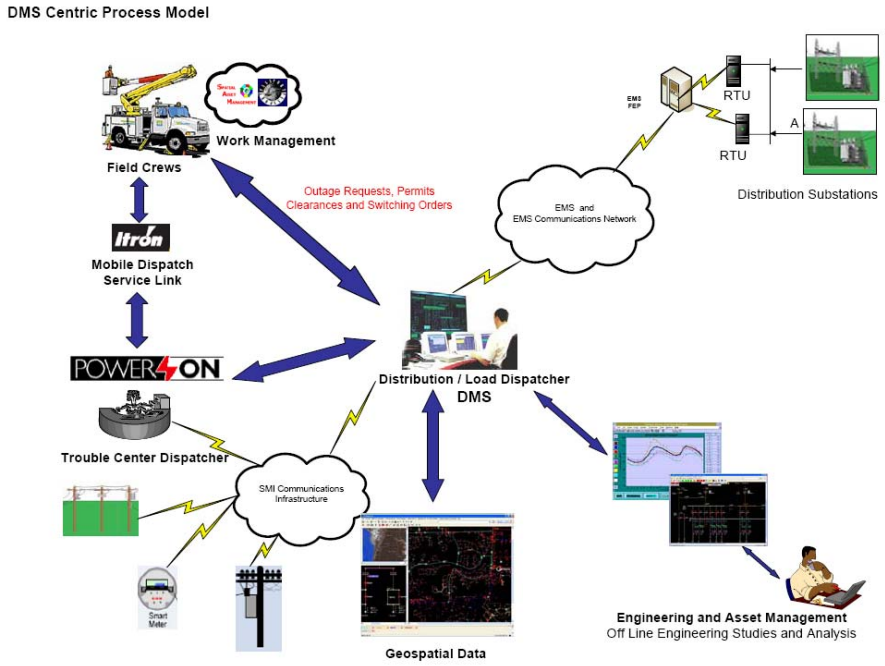
Predictive Fault Location, Switch Order Mgmt

Project Scope

- **Manage the operation of equipment located in**
  - distribution substations;
  - on radial and “looped” distribution feeders (overhead and underground),
  - “spot” primary networks
  - underground secondary networks
  - monitor distributed generating resources located out on t distribution feeders

- **Optimize the performance and reliability of the distribution system and provide effective decision support tools for the distribution operators, including**
  - On line power flow (OLPF)
  - Switch order management (SOM)
  - Volt-VAR optimization (VVO)
  - Fault Location, Isolation and Supply Restoration (FLISR)

- **Provide effective interfaces between DMS and other enterprise systems, including**
  - Geographic Information System (GIS)
  - Energy Management System (EMS)
  - Outage Management System (OMS)



DMS Evaluation Roadmap

Tendering , Evaluation , Negations and Award Phase

JAN 09 | FEB 09 | MAR 09 | APR 09 | MAY 09 | JUN 09

Risk Registry Workshop

Objective:
To develop a risk registry for all risks identified leading to the finalization of the DMS RFP.

Risk Registry to Cover the following functional areas.

- Functional specs
- Technical specs
- Program Delivery
- Procurement

Evaluation Matrix

- Develop evaluation Measures/metrics
- Assign Weightings
- Review/Establish
- Procurement process and governance for evaluation
- Review lessons learnt from DMS RFQ and BCH SMI

RFP Closes Jan 12

Internal BCH/BCTC RFP Reviews

Objective:
To jointly review Vendor submissions and build an understanding of the DMS vendors offerings

- Distribute vendor responses to DMS Core Team
- Organize internal review workshops for Functional, Technical Commercial streams.
- Liaise with vendor via procurement for clarification on RFP Responses
- Conduct Initial ranking of DMS Vendors

Vendor Demos

Vendor Demo :
- Vendor #1 (Feb ,2009)
- Vendor #2 (Feb , 2009)
- Vendor #3 (Feb 19,2009)
- 3 days per vendor
- Oral questions and Answers
- Initial scoring of vendor proposals

Vendor Site Visits

Vendor Site Visits (Top 2)
- Travel to top 2 Vendors sites
- Following each vendor visit core team to update Scoring sheets

Finalize Evaluation

Select Top 2 Vendors

Negotiations w/ Top Vendor

Award To Successful Vendor

Implementation Planning

Commence Implementation

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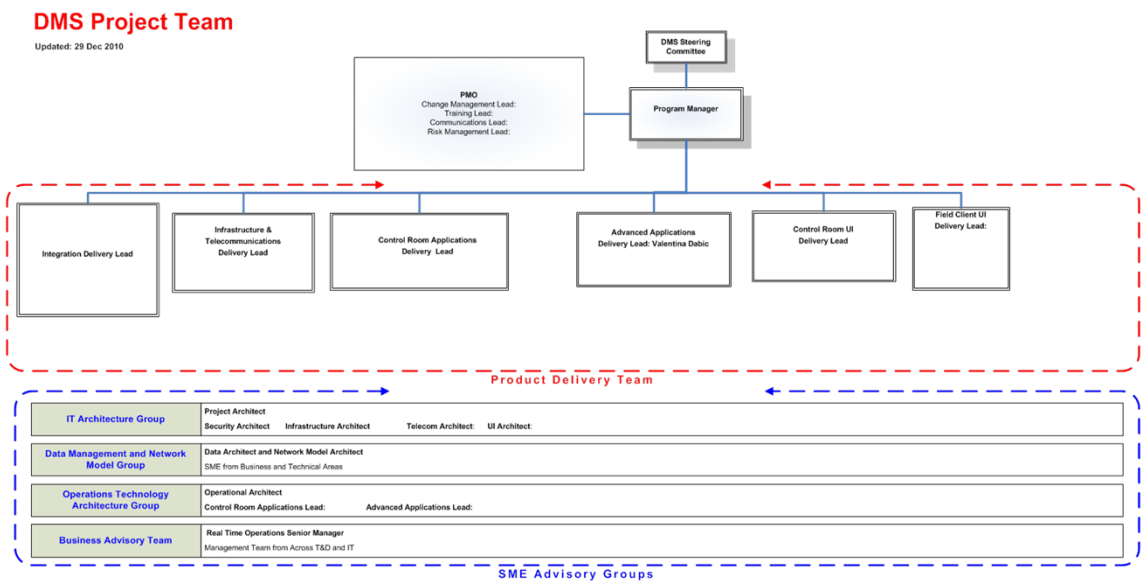
Contract Negotiations

- Scope Optimization
  - aligning scope to meet business case objectives.
  - Zero in on must have vs nice to have's
- Total Cost of Ownership
  - Total Cost of Ownership (TCO) =

  Implementations Costs (Capex) + Licensing Costs + Sustainment Costs (Opex).
- Fixed Price Vs Time and Materials Contract.

Project Resourcing

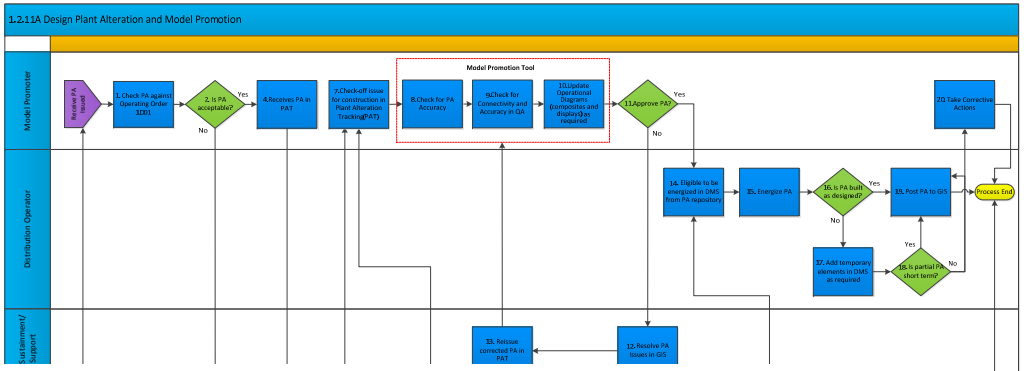
- Systems Integration Role
- Internal resource constraints and competition of resources with other large initiatives SMI
- Cross functional team IT and OT resources with end users



KBU	FTE
Grid Ops	1.6
OCIO	2.2
Contractors	1.7
T&D Operations	1.8
Total	7.3

Process Design

- Unlocking business value through transformation
- Mapping Current and Future State
- Determine Gaps
- Change Plan
- Training Plan
- Transition Plan



Process Details – Description and attributes for each task within the process flow. Roles played by each participant for each process step are defined as follows:
R = Responsible: Individual(s) who perform a task and responsible for action/implementation. Degree of responsibility is defined by the Accountable person. R's can be shared.
A = Accountable: Individual who is ultimately accountable has Yes/No power, as well as power of veto. Only one 'A' can be assigned to a task.
C = Consulted: Individual(s) to be consulted prior to an action taken or final decision for input/insight. Two-way communication. C's can be shared.
I = Informed: Individual(s) who need to be informed after an action is taken or a decision is made. I's can be shared.

ID #	Name	Input	Description	Output	Participants	Approx. Time	Tools Used
Trigger	Receive PA issued		Distribution designer completes PA design in DAD GIS system then issues it to PAT and is processed by the model promoter (currently PA Coordinator)	PA appears in PAT	▪ Distribution designer ▪ Model promoter		PAT
1.	Check PA against Operating Order 1D01	Operating Order 1D01	Model promoter verifies PA against criteria specified in Operating Order 1D01 in PAT.		▪ Model promoter		PAT
2.	Is PA acceptable?		Model promoter determine whether this PA aligns with 1D01 standard		▪ Model promoter		PAT
3	Revise PA		Unaccepted PA is sent back to Distribution Designer to update PA to meet 1D01 standard or to break up the PA into smaller steps	PA reissue to PAT	▪ Distribution Designer		DAD PA GIS
4	Receives PA in PAT		Model promoter acknowledges receipt of PA (As-is, checks off "Hard Copy Package Recv'd", in future, model promoter accepts PA electronically.)		▪ Model promoter		PAT
5	Will PA be "energized" as designed?	Accepted PA	Field crew receives the accepted PA as part of their work package and determines at that time if work can realistically be done in one		▪ Field Crew		Phone / email

DMS Project – initial impact assessment

Team	Safety				Reliability		Operational excellence		
	Visibility	Real-time operations	Mitigate risk	One source of truth for the dynamic network	Improved PA process	Fault location prediction	New quality in design	Leverage technology	Optimizing the system
Control Room (including MPT and schedulers)									
Technology support									
Drafters (Distribution Engineering)									
Designers and Distribution Engineers									
Field Crew (Managers, Crew, resource allocation, contractors)									
Asset management									
HRC)									

Legend

Significant impact on how they do their job or what they do	Some impact on "how" or "what"	Little / no impact on "how" or "what"

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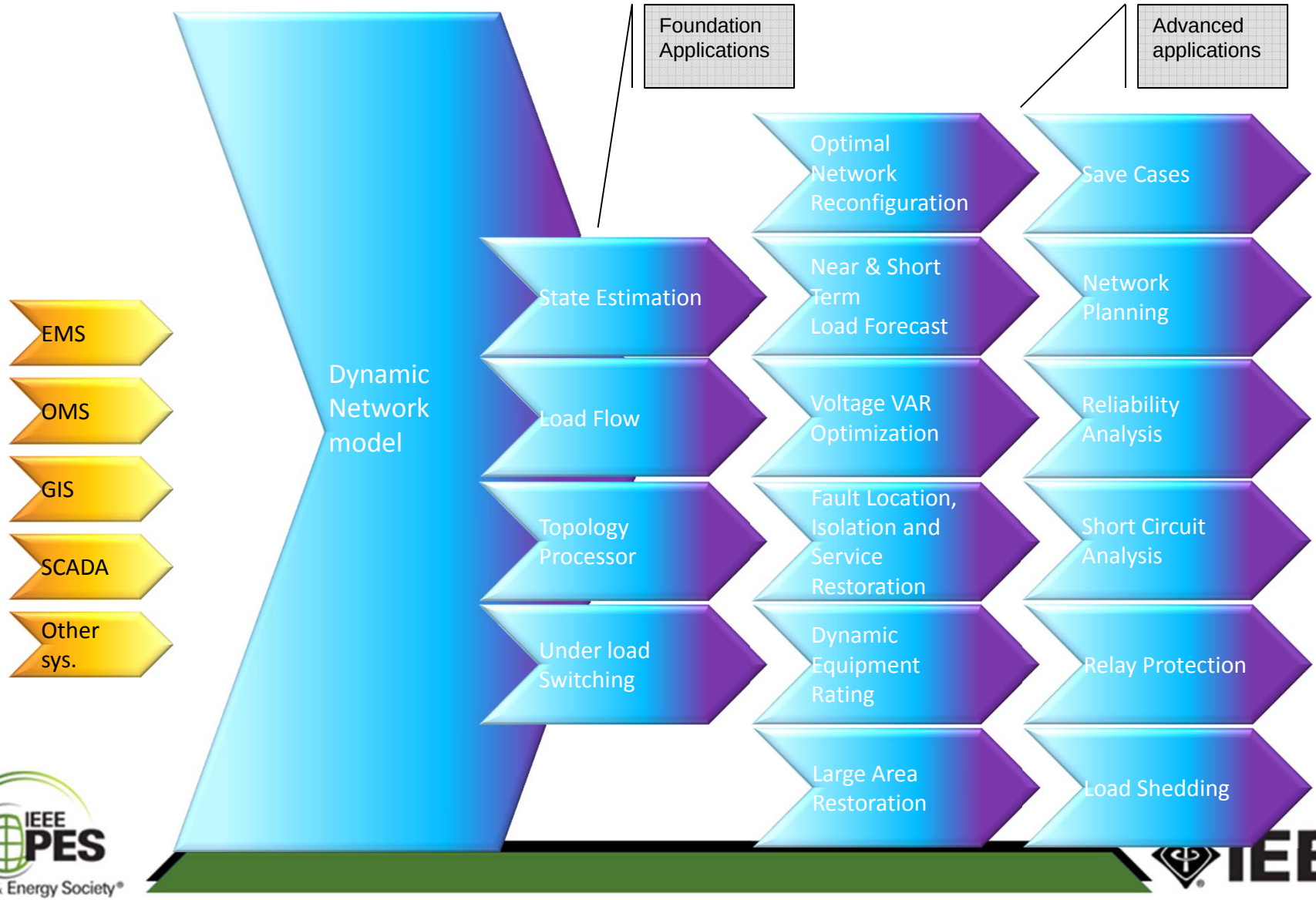
Technology Design

- BCH requirements are extensive and forward looking (900 + requirements in SoW)
- DMS Product Maturity
  - Not all requirements can be met within core product.
  - Ratio of extension to base product

DMS Applications



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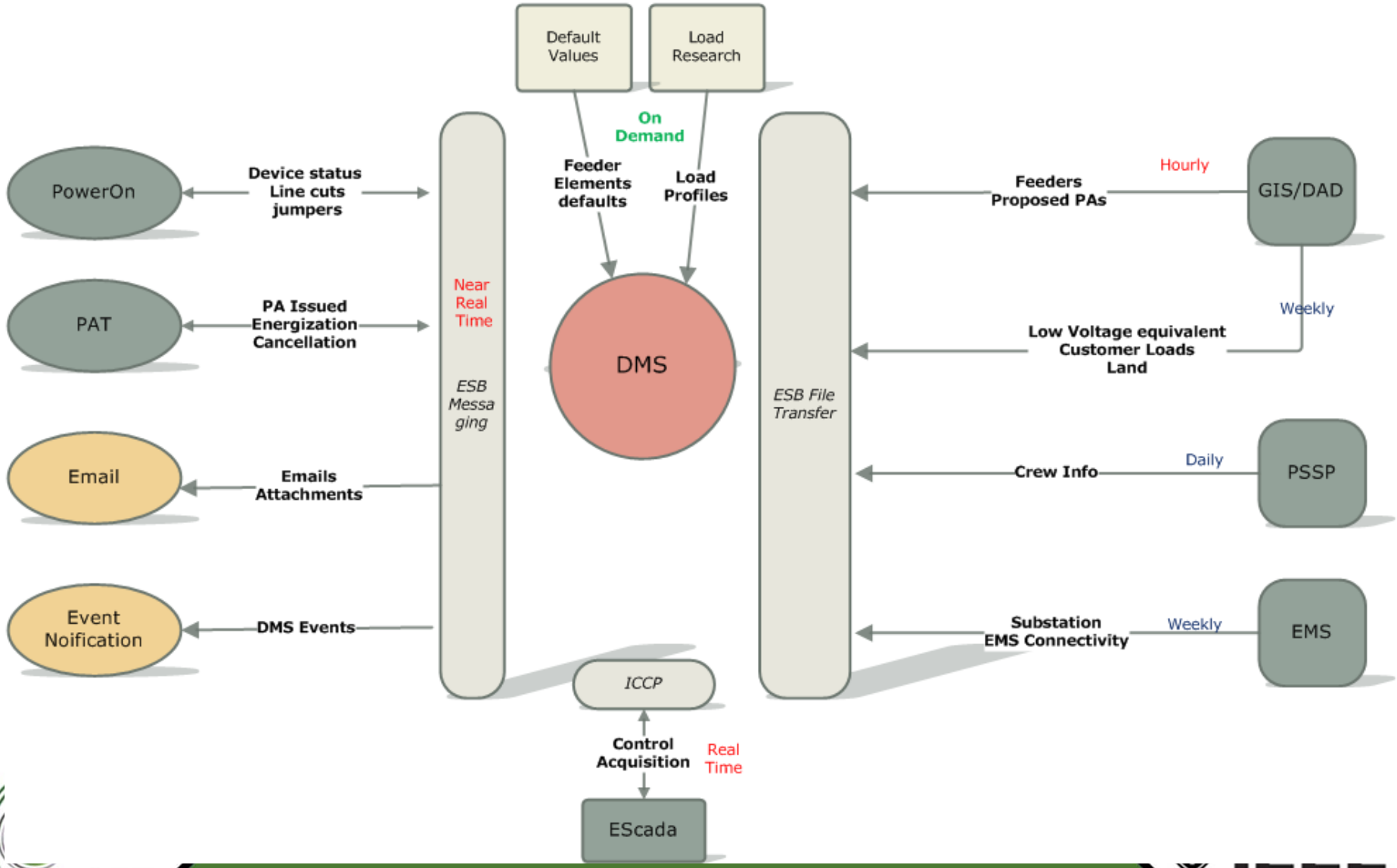
DMS Integrations



Data Quality and Network Model Tuning

Tuning Milestones	Milestone Description	Definition of what does meeting this milestone means/ requires:
Phase 1	Basic validation (Phase 1 validation)	Validation of substation elements in particular:
		✓ Rated power of substation transformers
		✓ Modeling of LTC controller (direction and location of tap changer)
		✓ Short circuit transformer impedances
		✓ All feeders (breakers) are imported and correctly stitch to feeder from GIS
		✓ Customer equivalents are imported successfully and connected to the right feeder, transformer and phase.
		✓ LV equivalents properly represented and match GIS data (Rcritical, Xcritical)
		✓ Equipment completely modeled – Voltage regulator modeling, Capacitor controller modeling, Schedules for Generators and Capacitors
Phase 2	Topology validation for tuning of LF & SE	✓ Using the Advanced Network Analysis tool in DAD
		✓ Topology Validation For Substation Display, Composite And Single Circuit Diagrams, Circuit Trace
		✓ SCADA Model Validation and validation of mapping – substation and field devices, in particular, analog measurements from field devices to be visible and displayed on
		✓ Display validation for LF& SE tuning
		✓ Analysis of load flow and state estimation reports for validation
		✓ *POCC and EMS pseudo point updates*
Phase 2a	Topology analysis for control room testing and cutover preparation	✓ Validation of single circuit diagrams
		✓ Validation of tie points
		✓ Validation of loops, composite dwg etc.
		✓ Element isolation and tracing validation
Phase 3	Analysis of violation reports (simulation- load flow and real time- state estimation reports for validation)	✓ Overloaded transformer
		✓ Overloaded section
		✓ Feeder phase unbalance
		✓ Customer voltage problems – voltages above/below threshold
		✓ LV equivalent validation
Phase 4	Load Flow results analysis	✓ Large discrepancy between Load flow and State estimation results on feeder analysis
		✓ Analysis of feeder phase unbalance in preparation for tuning of trust factors
Phase 5	State Estimation Tuning	✓ Tuning of measurements (substation transformer, feeder head)
		✓ Tuning of field measurements (measurements from reclosers, capacitors and other field devices)
		✓ Tuning of load group trust factors

- Significant manual effort to verify and tune the network model
- Cross functional skills set required
  - GIS and EMS (data verification)
  - Model Promotion (propagate changes to the model)
  - Applications Engineer (runs apps to verify results)
  - Load Operator (check displays)

Testing

- Changing product and network model as we are implementing has had an impact on test approach
- Frequent Network Model changes through development cycle with risk of application code not being in synch with schema
- Prioritization of variances & variance resolution

DMS Release Plan

The release plan will provide an acceptable rate of adoption in the business

Business Outcomes

- Reduced Scope i.e. without Model Promotion, reduce SAT
- **Operational Excellence:** Early Energy Conservation / VVO benefits realization.

- Full implementation, full SAT
- **Safety :** Increase discipline and safety management functions to support safe activity for field crews performing work in the field
- **Operational Excellence:** Use automation to increase productivity and of load operators

- Use smart meter data to optimize power flow
- Enable control center and field crews to avoid outages and increase reliability
- **Reliability:** increase customer experience for outages with reduced outage durations.
- **Operational Excellence:** Optimize Energy Conservation / VVO for increased benefits realization.

DMS Functions

R1 Scope of Functions
- SCADA – data acquisition
- Online Power Flow
- Topology processing
- State Estimator
- VVO
- Load models, Load Allocation and Load estimation

R2 Scope of Functions
- SCADA – Alarms and Tagging
- Safety Management
  - Work Request
  - Permit
  - Safety Protection Guarantees
  - Switch Order Management
- User Interface & Mimic
- Real-time Network Model

\+ R1 Scope of Functions

R3 Scope of Functions
- SMI Integration for VVO
- Short Term Load Forecasting
- Dynamic Equipment Rating
- Optimal Network Configuration

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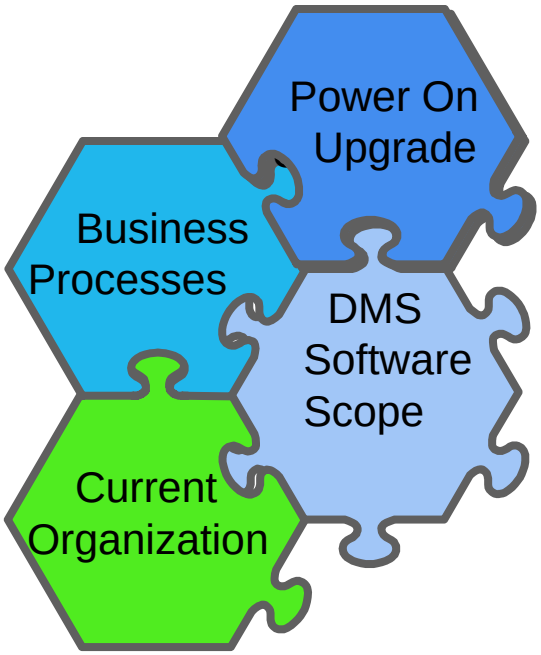
Transition Planning

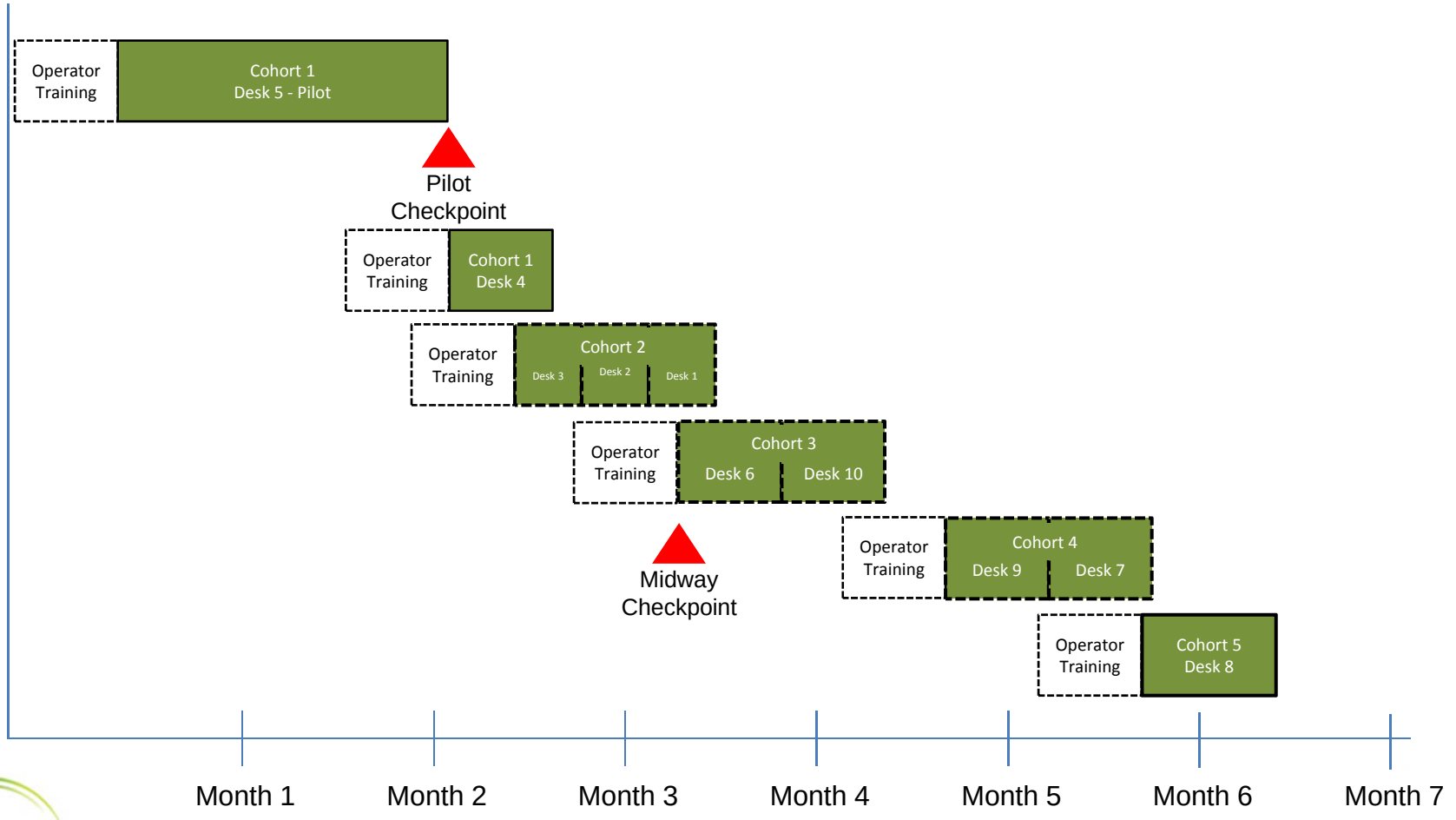
Inputs



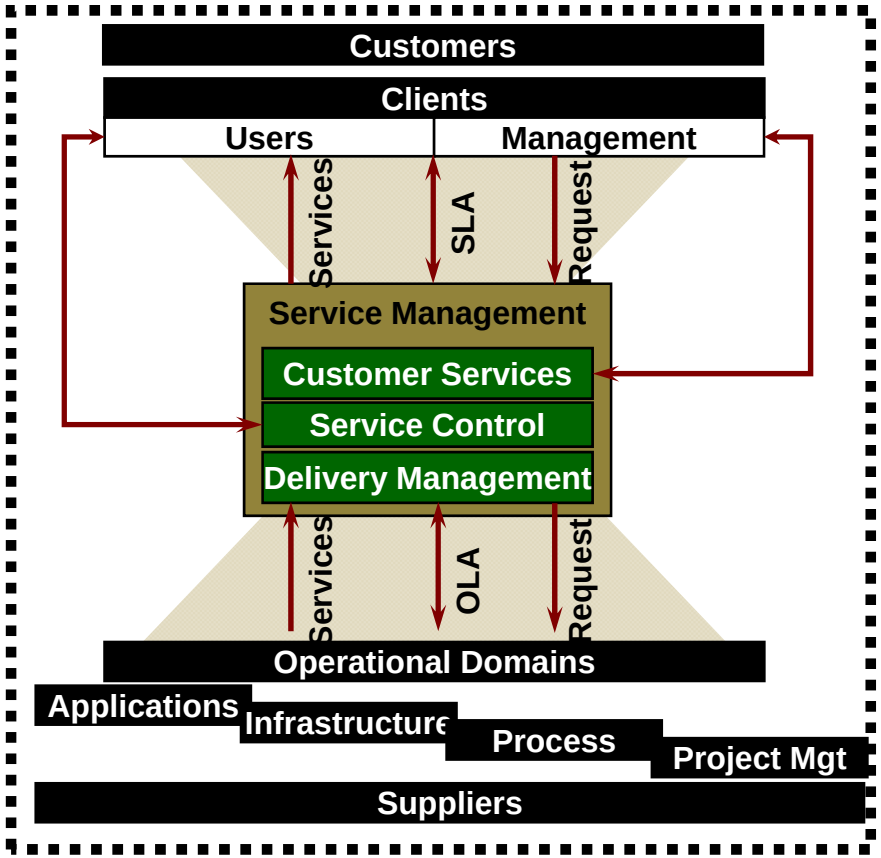
Outputs

Transition Plan	■ Capability Scope ■ Roll-out Plan ■ Contingencies ■ Post conversion activities
Transition Work Plan	■ Task Plans (non-software)
Cut-Over Plan	■ Scope of new, converted, decommissioned
Cut-Over Work Program	■ Specific task by Desk and AOR to be addressed to implement a desk

Rollout will progress across the Province over a 7 month duration



The Distribution and DMS sustainment capability was non-existent needed to be built through several building blocks



- Confirm Service Providers
- Determine service levels (SLA/OLA)
- Deploy technical environments
- Establish key processes (e.g. change management)
- Establish governance approach
- Approximately 180 workdays will be needed to establish the sustainment capability prior to cutover
- The work will need approximately 6 months lead time to minimize cost of set up

In Summary

- ✓ DMS is a foundational element to Smart Grid providing centralized visibility and operations for the Modern Distribution Grid.
- ✓ DMS is integral to transforming BCH Distribution Operations.
- ✓ DMS will provide BCH with the optimization capability to support **Energy Conservation** objectives.
- ✓ DMS will allow the BCH Field Personnel and Load Dispatchers to operate and manage the Distribution Grid in a more **Safe, Reliable, Secure and Efficient** manner.

Questions