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EPRI Smart Grid Roadmap Guidebook

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Outline

- Background on EPRI's Roadmapping Projects
- Smart Grid Roadmap Methodology:
  - Vision
  - Requirements
  - Assessments
  - Planning
  - Roadmap Implementation
- Lessons Learned from Roadmap Projects
- Conclusions

EPRI Objectives – Roadmaps and the SGRM

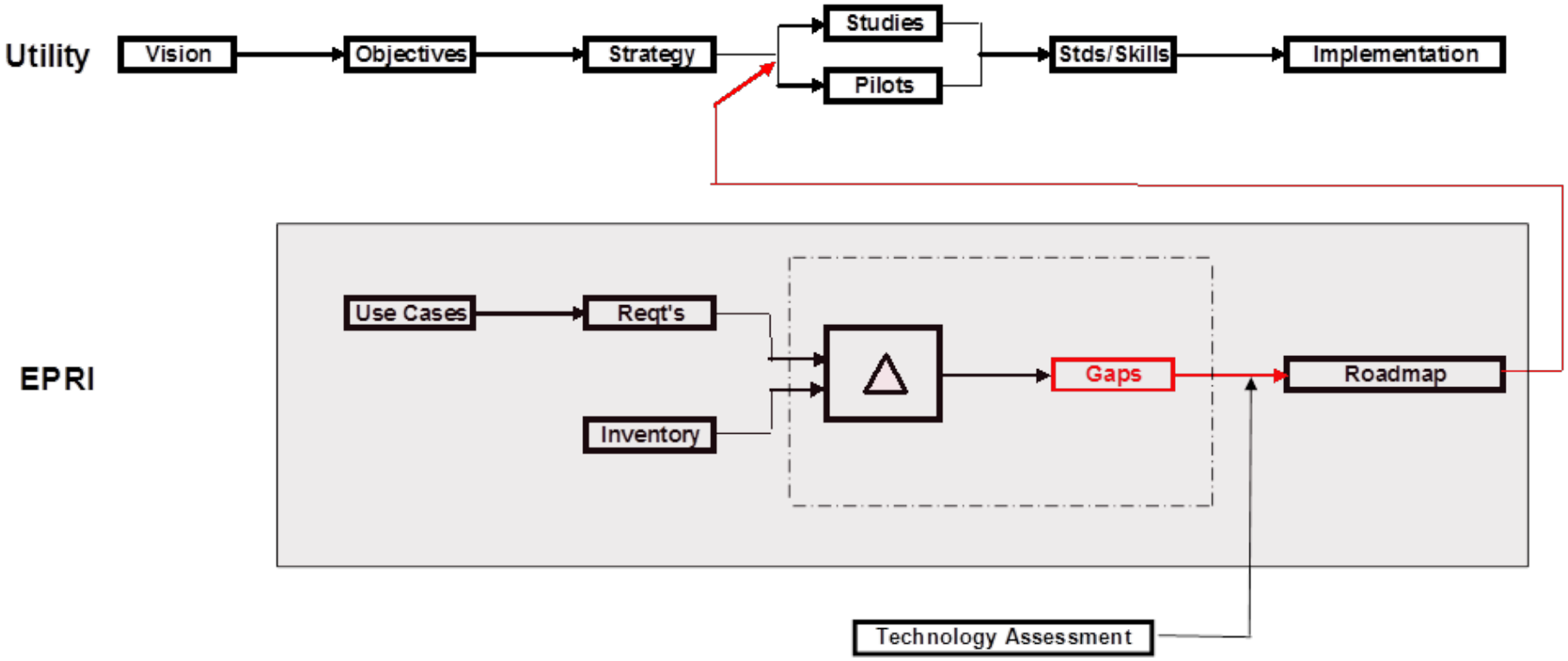
- Assist companies in the transition from understanding what the Smart Grid is generically …… to achieving the most effective timing and adoption of Smart Grid technology in a way that uniquely maximizes the benefits and minimizes risks.
- Enable the company to develop a superior technology portfolio optimization plan.

Smart Grid Roadmap Projects

- Tennessee Valley Authority
  - Transmission
  - Distribution
- Southern Company
- First Energy
- Long Island Power Authority
- California Independent System Operator
- Duke Energy
- Salt River Project
- American Electric Power

- California – in partnership with PG&E, SCE and SDG&E

The Overall Technology Adoption Process



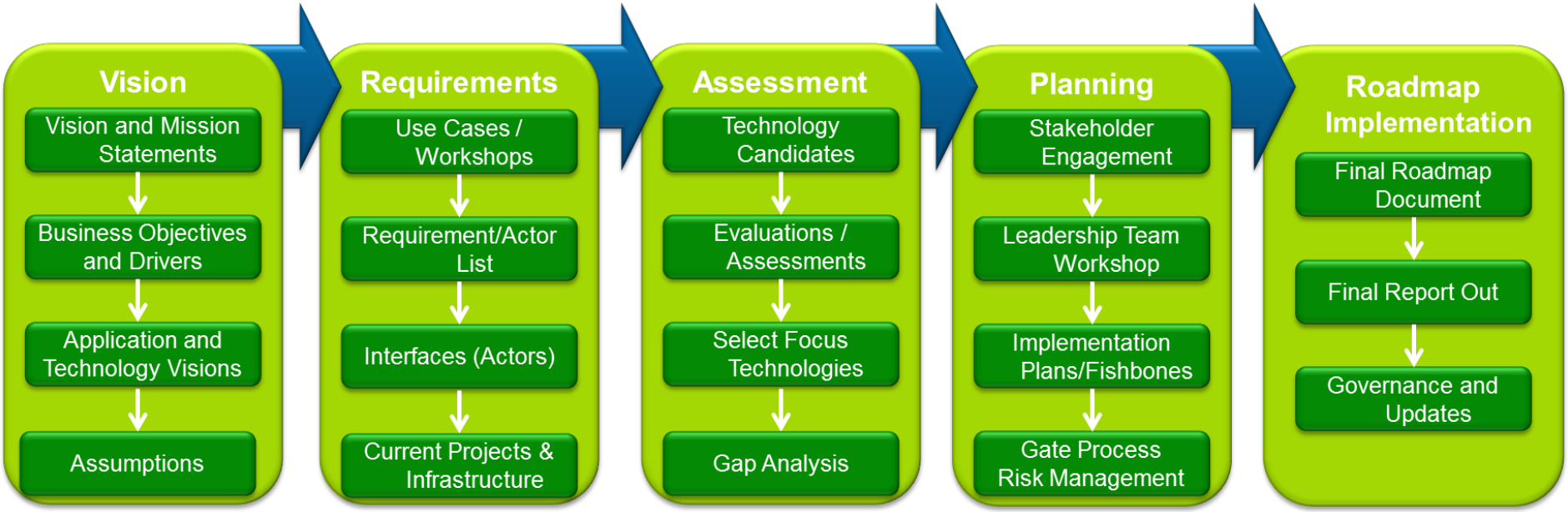
Smart Grid Roadmap Methodology (SGRM)

The SGRM comprises five key steps:

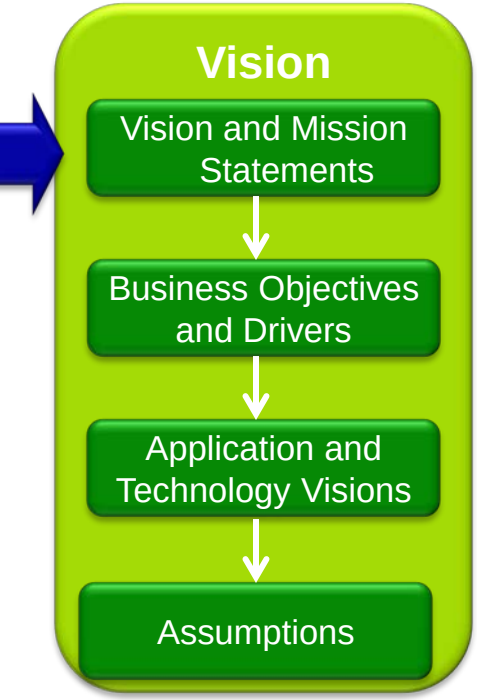
1. Vision
2. Requirements
3. Assessment
4. Planning
5. Roadmap Implementation

- Each step includes 3-4 tasks (methodologies) with options
- The SGRM is intended to be a flexible process

Smart Grid Roadmap Methodology (SGRM)

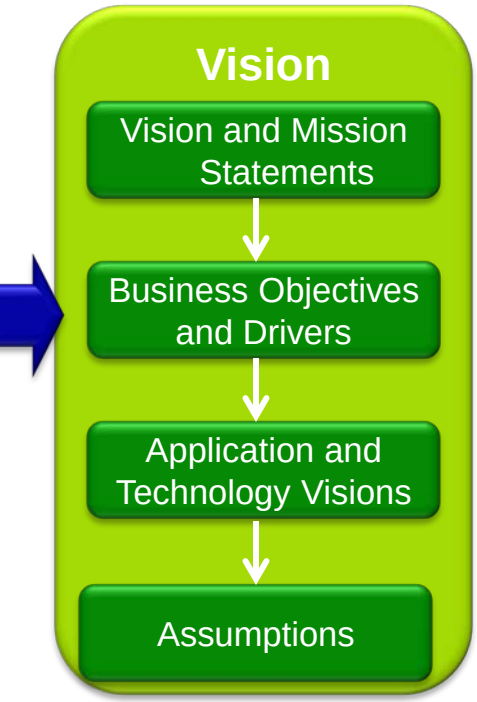


SGRM - Vision



- The purpose of a Smart Grid vision statement is to succinctly summarize the utility/ISO's goal to both leverage the existing and adopt new technologies and standards to address the applicable business objectives and drivers.
- The process of defining a vision statement begins with identifying and evaluating the essential business objectives and drivers that can be addressed by technology investments.
- A vision statement is a summary of "what" the utility/ISO intends to accomplish and why.
- The purpose of a Smart Grid mission statement is different; to provide a summary of the essential "how" the vision statement will be accomplished.

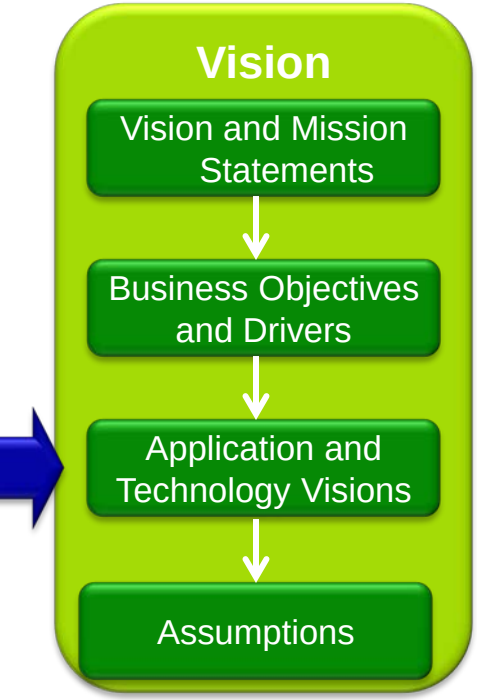
SGRM - Vision



Example business objectives related to technology are:

- Increase grid reliability, efficiency & situational awareness
- Facilitate resource integration including renewable resources and distributed energy resources
- Implement and maintain physical and cyber security
- Faster and better operational and business decisions
- Reduced operations and maintenance costs
- Enhanced service to our customers and the ability to offer value-added services
- Implement demand response to reduce peak demand
- Distribution grid management for protection & restoration
- Condition based maintenance of key assets
- PEV integration to meet customer needs
- Reduce greenhouse gas emissions
- Meet or exceed all regulatory and policy mandates
- Safety

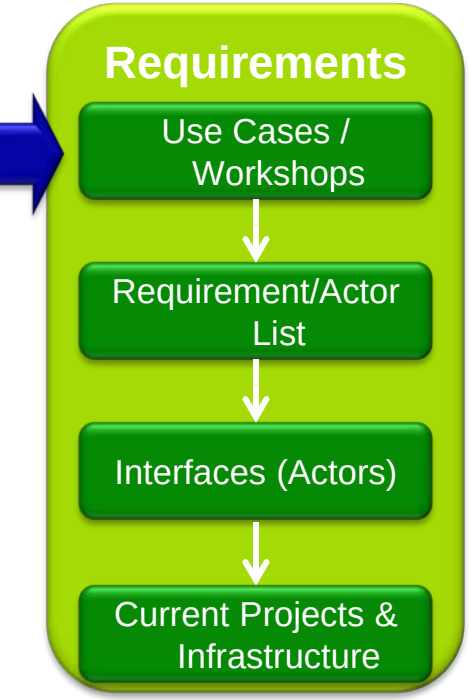
SGRM - Vision



Examples of application and technology vision statements are:

- We will deploy a range of standards based technologies to facilitate the integration of distributed energy resources on our distribution network.
- Establish secure, two-way, real-time communications links to all customers to support customer engagement and interaction.
- Implement a digital communications link to each critical transmission substation that allows secure communications to multiple substation devices on the same physical communications link.
- We will provide local and wide area grid awareness, intelligence and decision making capability to effectively conduct grid operations necessary to optimize power delivery performance in terms of reliability, power quality, and economy.

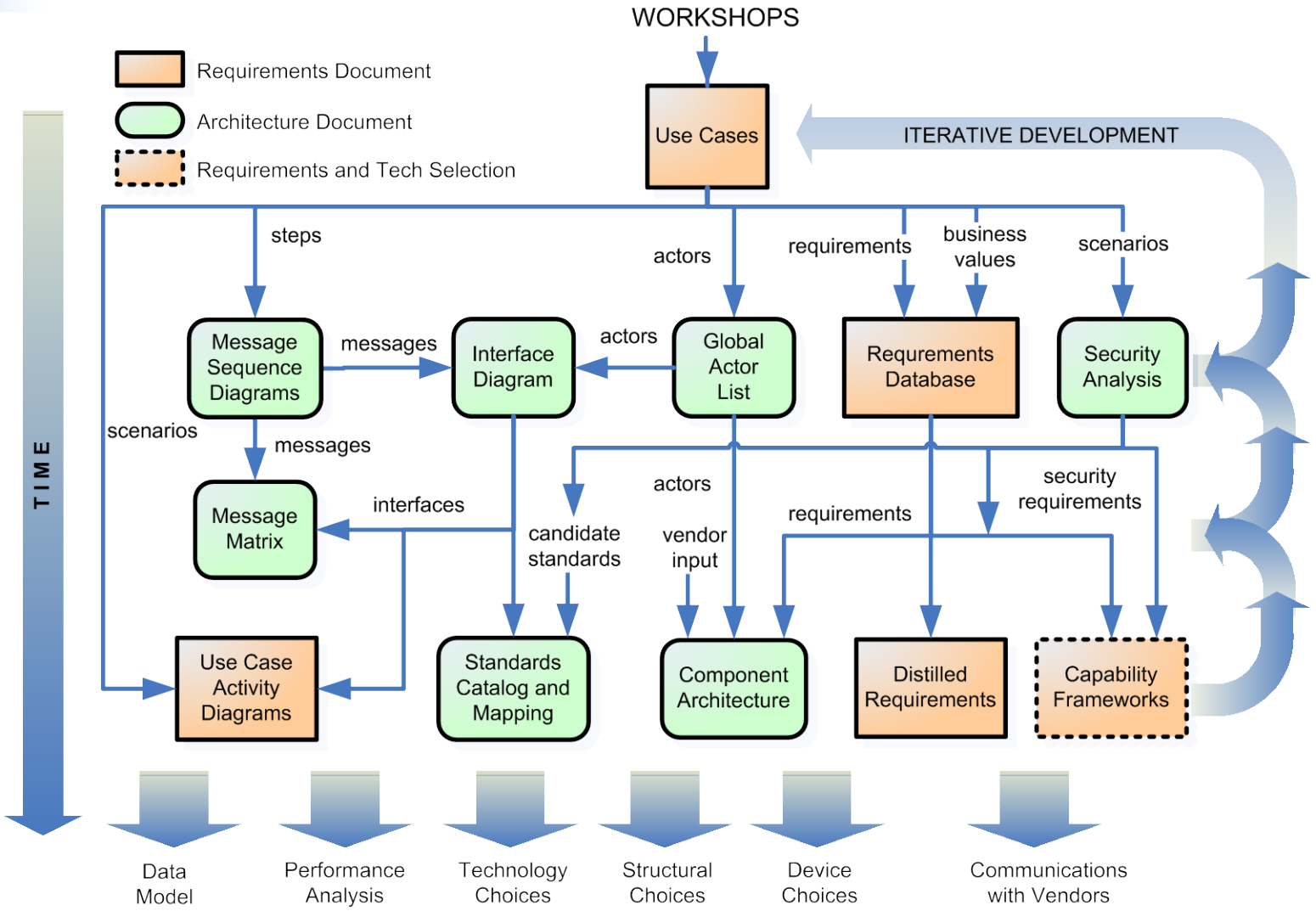
SGRM - Requirements



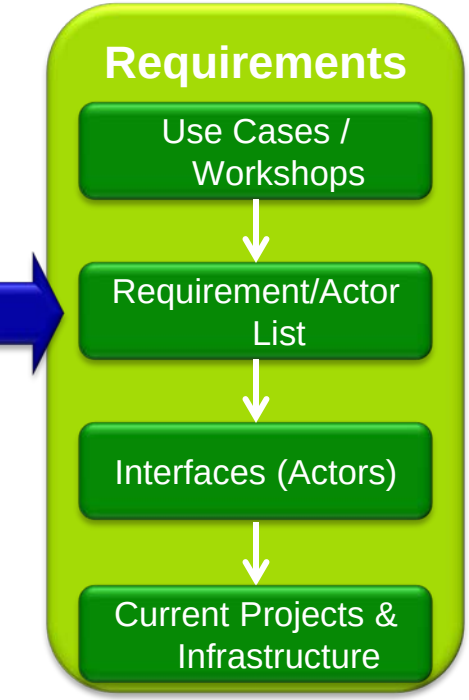
How do use cases aid in developing requirements?

1. A use case is simply a **“story”** that includes various “**actors**” and the **“steps”** they take to achieve a particular functional goal.
2. By considering the actions of the **all stakeholders** and actors working to achieve this functional goal, a completed use case results in the documentation of multiple **scenarios**, each containing a **sequence of steps** that trace an end-to-end path.
3. These sequential steps describe the functions that the proposed systems and processes must provide, directly leading to the **requirements** for the given use case.

EPRI IntelliGrid - Requirements and Design



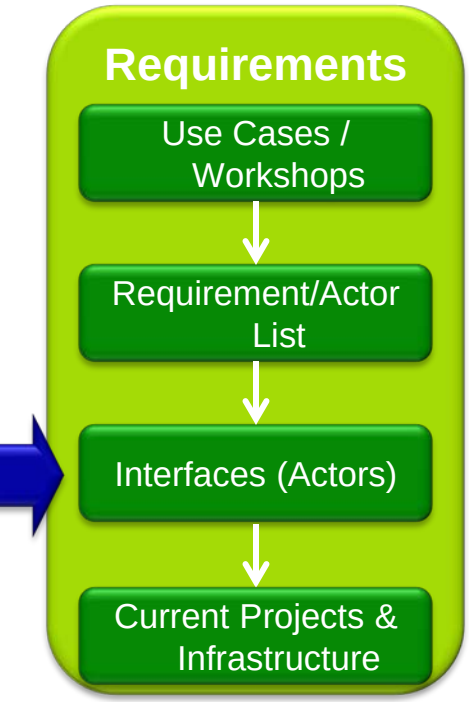
SGRM - Requirements

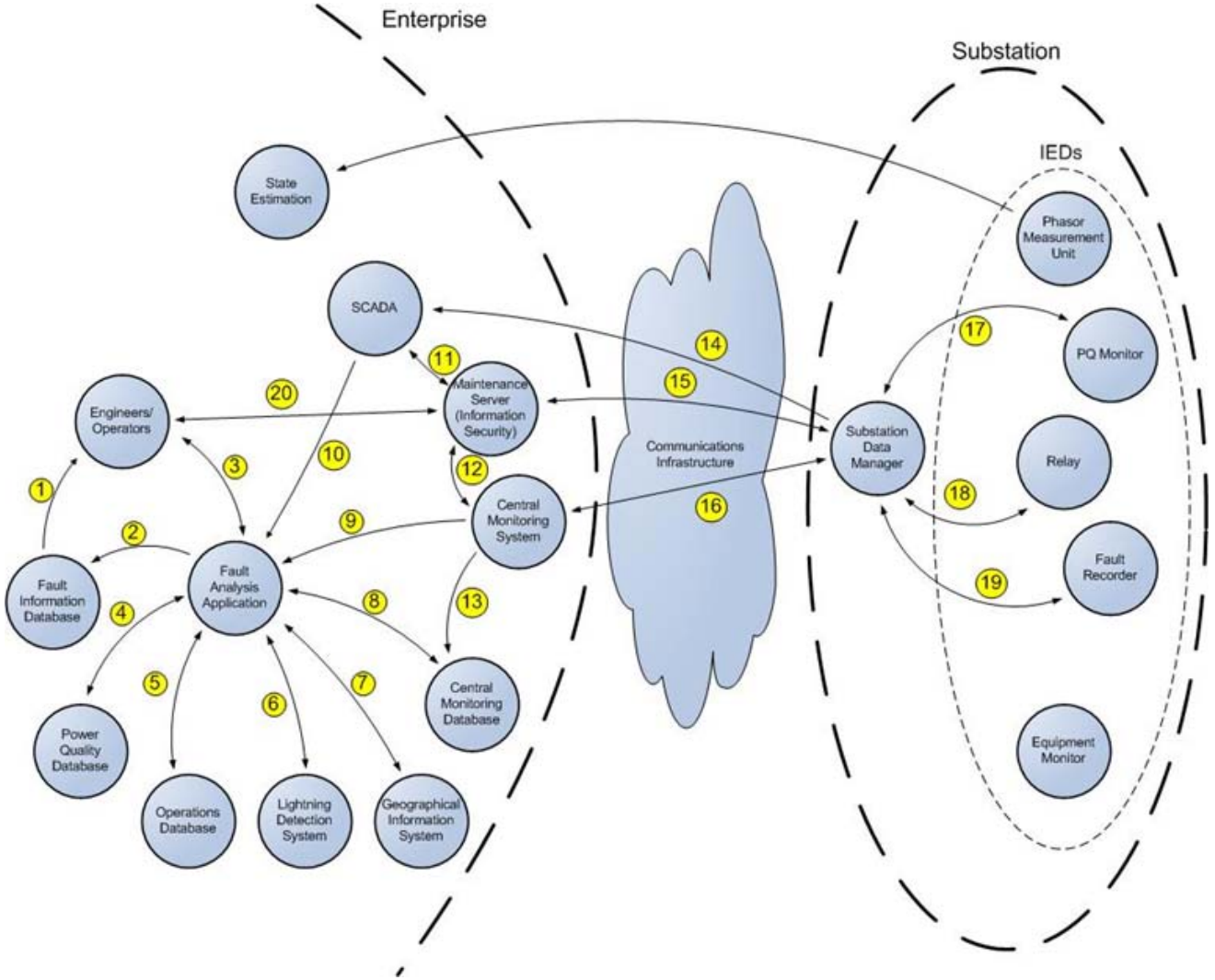


Actor/ Component	Reqt ID	FR or NFR	Requirement Description
			Distribution Load Shed Application
Communications System	1.0	FR	Communications system shall securely support reliable remote access from the Distribution Load Shed application to the substation relays controlling the breakers.
Communications System	1.1	NFR	All aspects of the communications infrastructure used to enable the Distribution Load Shed application shall comply with the Cyber Security Policy and applicable NERC requirements.
Communications System	1.2	NFR	All aspects of the communications infrastructure used to enable the Distribution Load Shed application shall be designed for a high level of availability.
Distribution Load Shed application	1.3	NFR	All software and hardware equipment used operate the Distribution Load Shed application shall be designed for a high level of availability.
Operator – TCC or ISO	2.0	FR	The Distribution Load Shed application shall accept input data from the TCC operator.
Operators – TCC and SOC	3.0		

Actor	Type
Operator - SOC	Person
SOC	System
Operator - TCC	Person
TCC	System
Reliability Coordinators / MISO	System
Bulk Power Marketing staff	System
DRAACS	Application
DLRC, TLRC	Applications
Planning	Person
OMS/CIS	System
Communications system	System
Communications processor and RTU	Device
Relays	Device
Customer	Person
GIS	Application

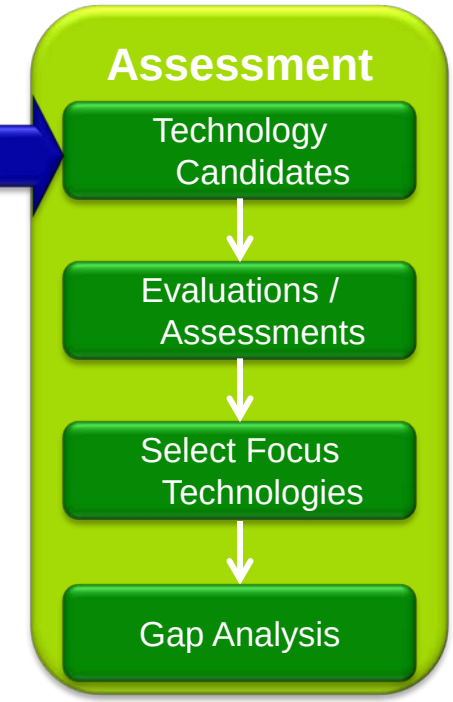
SGRM - Requirements

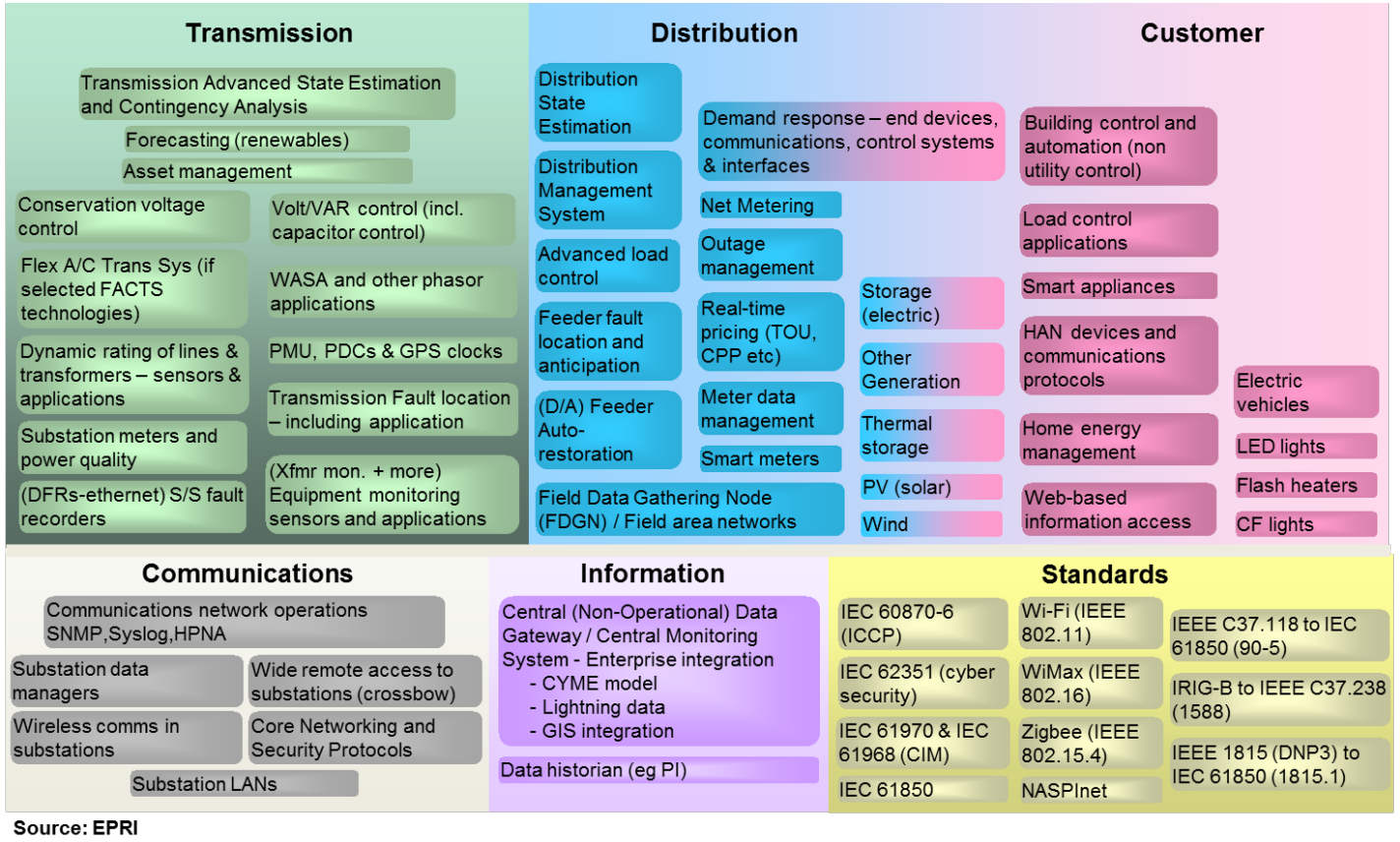




Typical Actor Interface Diagram

SGRM - Assessment



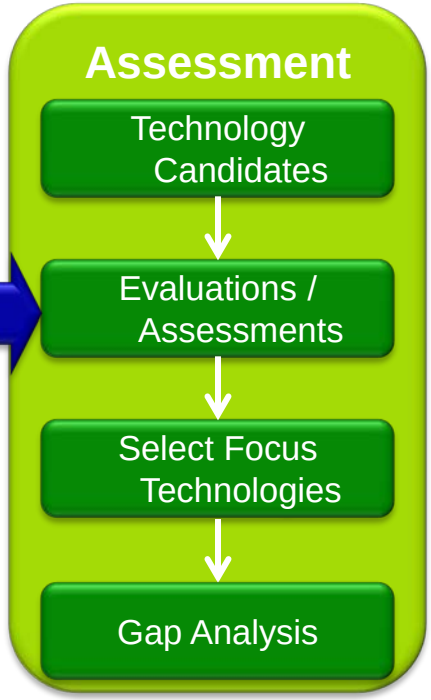


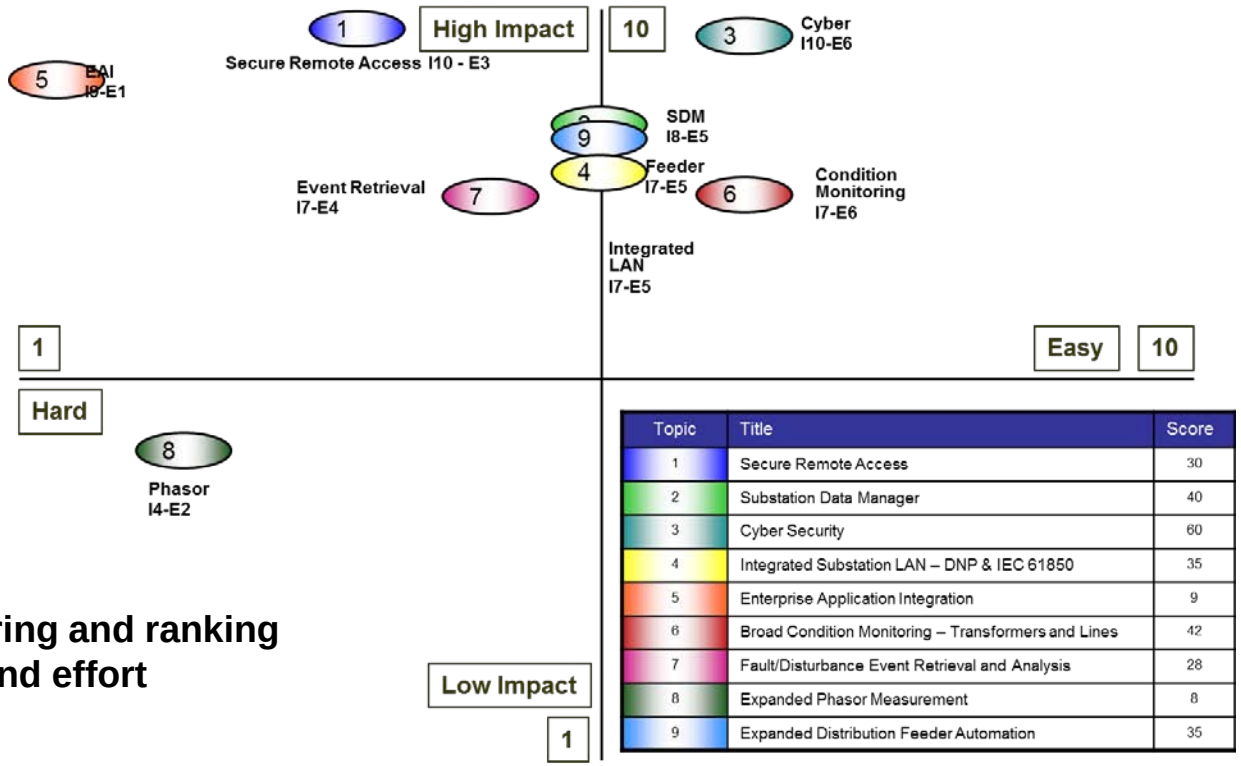
Source: EPRI

Key Smart Grid Technologies and Standards by Domain

SGRM - Assessment

- For the EPRI SG Roadmaps we have deployed a number of technology assessment methods.
- One of the simpler approaches used involves ranking a technology by impact and effort

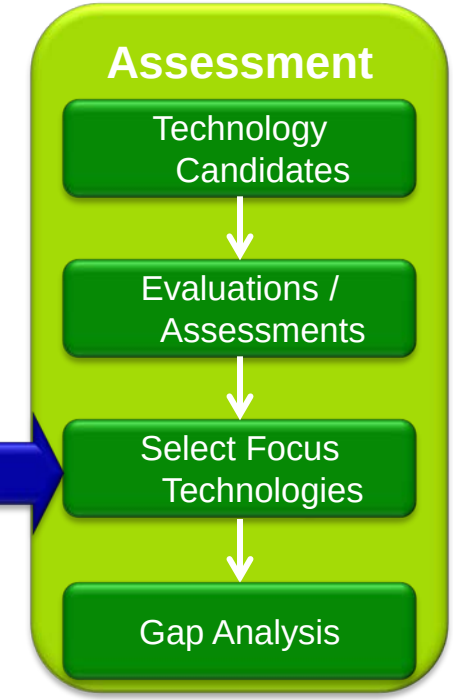




Topic	Title	Score
1	Secure Remote Access	30
2	Substation Data Manager	40
3	Cyber Security	60
4	Integrated Substation LAN – DNP & IEC 61850	35
5	Enterprise Application Integration	9
6	Broad Condition Monitoring – Transformers and Lines	42
7	Fault/Disturbance Event Retrieval and Analysis	28
8	Expanded Phasor Measurement	8
9	Expanded Distribution Feeder Automation	35

Example technology scoring and ranking showing impact and effort

SGRM - Assessment

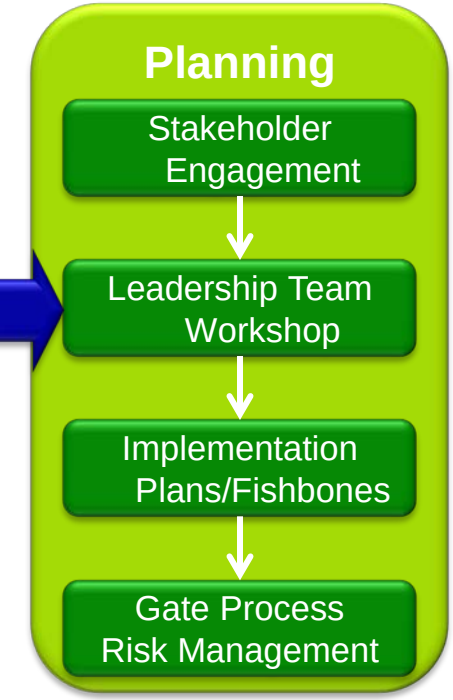


- Once the assessments are completed, the utility's Smart Grid Roadmap team, with facilitation by EPRI, is in a position to select the top candidate technologies, applications or standards for further focus.
- Upon selection, a new vision or objective statement is developed for each of the focus technologies. This statement will be used in the development of the gap analysis as well as the implementation plans.

SGRM - Planning

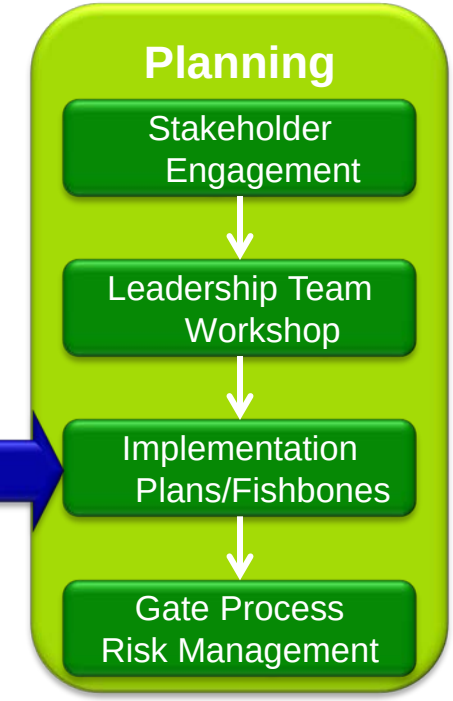
- It is important to ensure that all stakeholders impacted by a possible technology decision have the opportunity to have input in aspects of the decision.
- This can also be an opportunity for the subject matter experts (SMEs), knowledgeable in the area of the technology, to assume ownership of the selected technology for the next tasks.
- The SMEs may present the needed material to the utility's Smart Grid leadership team. The same individuals are central in the development of the Ishikawa (fishbone) diagrams for each of the selected technologies.

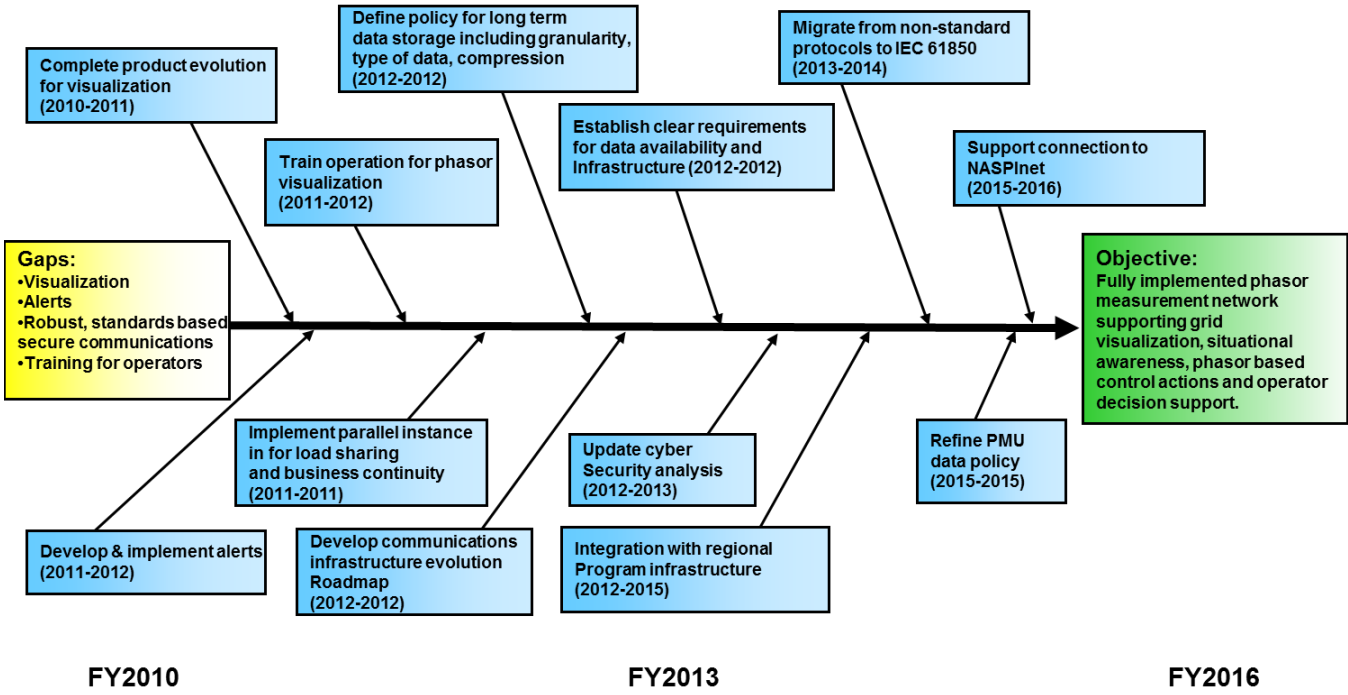
SGRM - Planning



- The Leadership Team Workshop is the optional task of presenting the Roadmap findings to the utility's Smart Grid Leadership team for validation.
- This task, if successfully completed, can have a significant impact on the successful adoption of the technologies.
- Possible outcomes of this workshop could be:
  - approval to proceed to the next stage of adoption (per the Stage Gate process),
  - approval to spend $$ for short term,
  - broad cross functional support for a program.

SGRM - Planning

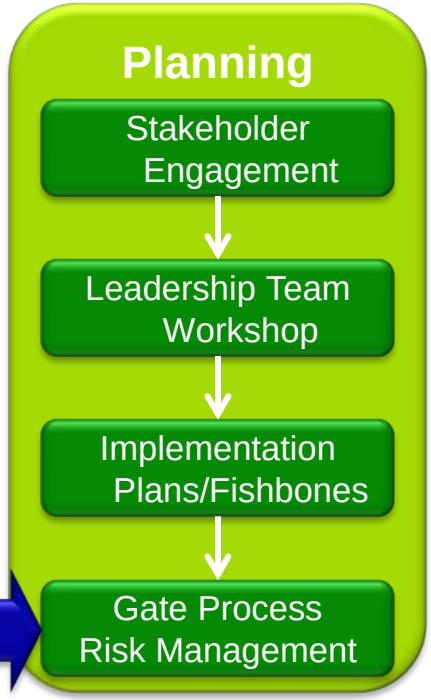


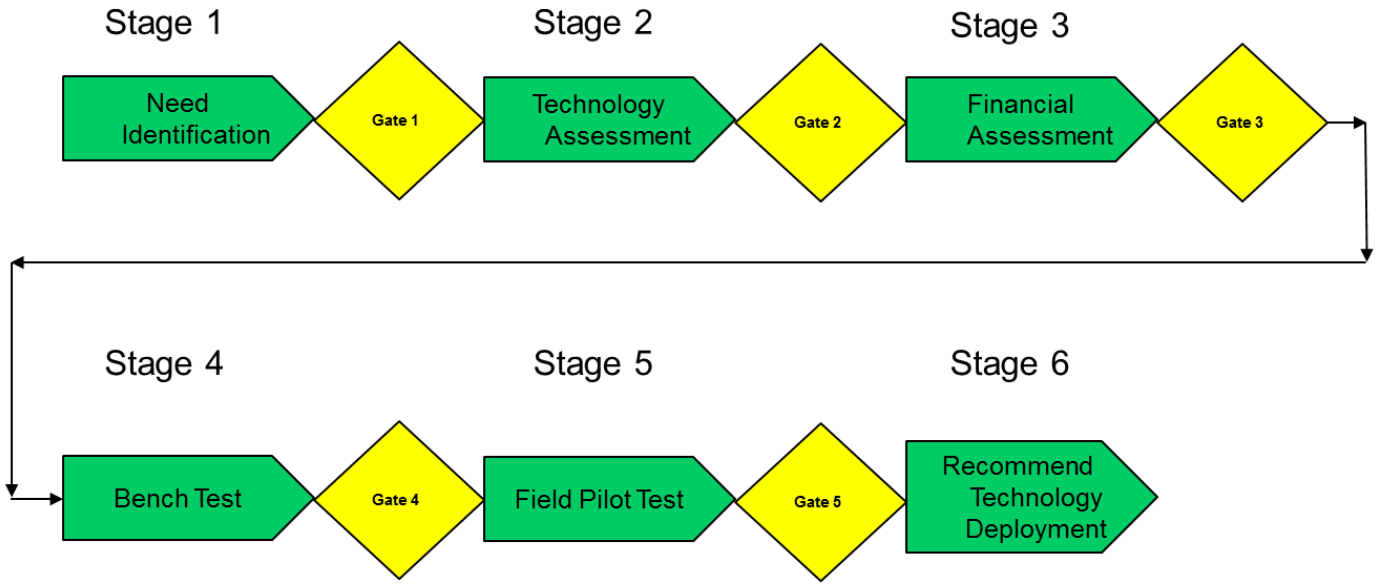


Example of an Ishikawa (Fishbone) Diagram Showing Gaps and Objective

The fishbone diagram (above) is a technology implementation plan that shows the gap or current situation as the “tail” of the fish and the future objective as the “head” of the fish. The “scales” shown are the steps in order that will be implemented to achieve the objective. The objective can be any of the steps in the stage gate process. The estimated time frame is shown as well.

SGRM - Planning

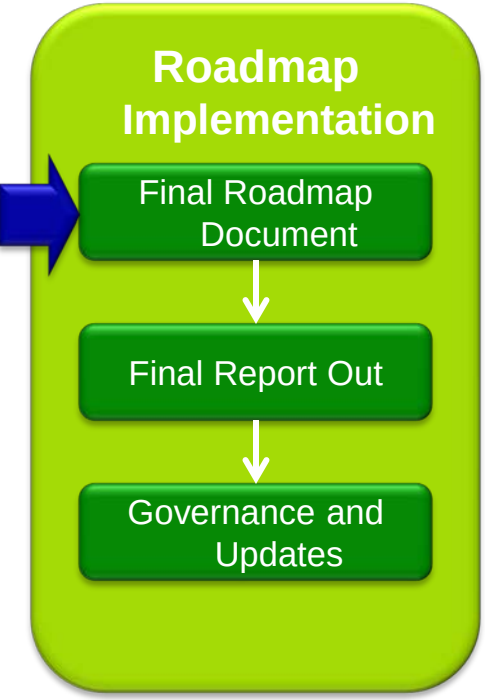




Example of a Technology Adoption Stage Gate Process

The stage gate process is an excellent tool for managing the implementation of multiple complex technologies. Each stage includes a gate or review process with formal requirements and the information necessary for the review team to make an informed decision on proceeding to the next stage. Normally a cost benefit analysis is developed (with increasing detail) for each gate review. This process is also valuable in identifying and mitigating business risks.

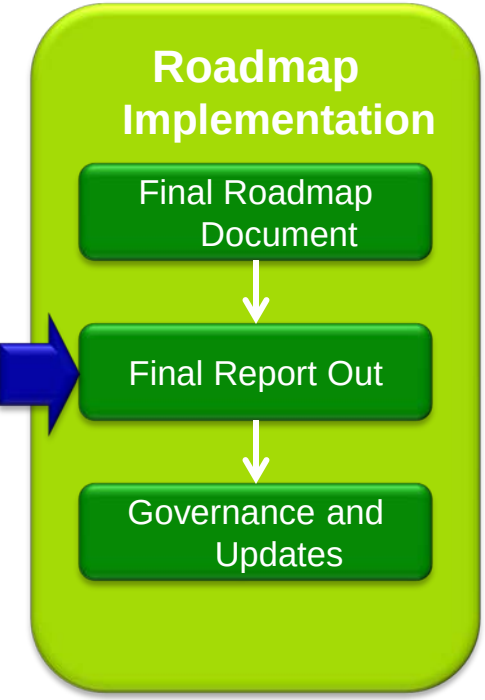
SGRM – Roadmap Implementation



A typical Roadmap document will include:

- Executive Summary
- Chapter 1- Introduction
- Chapter 2- Utility Team and Vision
- Chapter 3- The Requirements Development Process
- Chapter 4- Use Cases
- Chapter 5- Requirements Summary
- Chapter 6- Technology Assessment
- Chapter 7- Existing Infrastructure Overview
- Chapter 8- Developing the Future Infrastructure- Strategy and Roadmap
- Chapter 9- Managing the Roadmap- Dealing with Changes
- Appendices: Project Plans, Use Case Diagrams, Applicable Standards, Acronyms and Definitions

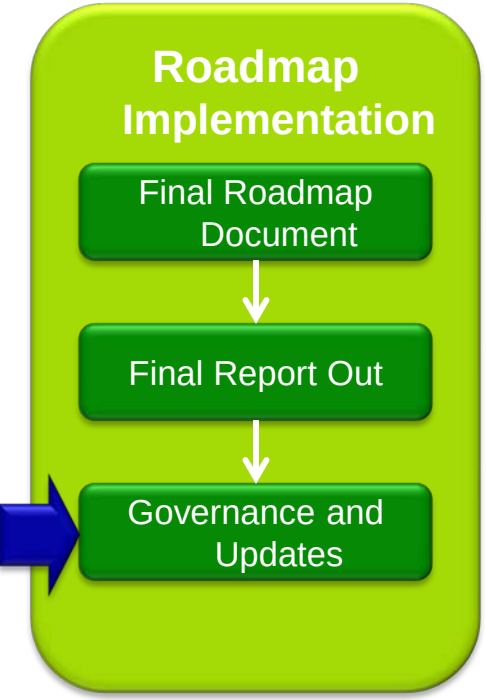
SGRM - Roadmap



To ensure the largest possible benefit is derived from the Roadmap effort, the final report presentations need to be delivered to three key sets of stakeholders. Those key presentations should be to the following:

- The C level sponsor or the Smart Grid Executive Oversight Committee.
- The Smart Grid Technology Steering Committee
- Director, Manager, Engineering and other staff stakeholders

SGRM - Roadmap



Experience has shown that the leadership and governance policies and capabilities of an organization are by far the biggest determinants of the degree of impact of a Roadmap development. Example elements of governance are:

- Establish a Visible, Long Term, Roadmap Leadership Team (RLT) with C-Level (VP or higher) Support.
- Develop a RLT Governance Model
- Develop Personnel Skills to Support Infrastructure
- Participate in Standards and Industry Groups
- Monitor and Manage the Progress
- Modify the Roadmap Based on Technology Assessments and Trials
- Update the Roadmap periodically

Smart Grid Roadmap Lessons Learned

1. Developing a Roadmap is Always a Bigger Effort Than You Think it Will Be
2. There is as Much Value From the "Journey" as in the End Product
3. A Successful Roadmap Must be Driven From the Top
4. A Successful Roadmap Must Take a Holistic View
5. A Successful Roadmap Put the Stakeholders at the Center
6. Need a Future State Vision That Stakeholders Can Understand and Embrace
7. Always Be Thinking About the Value Proposition
8. Tremendous Important to Define the Current State
9. Don't Get Lost in Technology
10. Don't Get Lost in Systems Integration
11. Importance of Enterprise Policies
12. Communications Technology is a BIG Part of the Smart Grid
13. Don't Just Add – Think Replacement and Transition
14. A Successful Roadmap Has a Strong, Well-Defined Governance Structure
15. Training and Change Management are Important

Developing a Roadmap is Always a Bigger Effort Than You Think it Will Be

- Consultants are costly…
- …but nowhere near as costly as the internal resources needed
- Key internal people from across the organization must be involved in developing the roadmap

There is as Much Value From the "Journey" as in the End Product

- Tremendous value from the shared experience of defining the future vision and developing use cases
- Participants have a hand in developing the roadmap

A Successful Roadmap Must be Driven From the Top

- Need a senior executive sponsor
  - To make resources available
  - To provide credibility to the activity
- Roadmap is both top-down and bottoms-up

A Successful Roadmap Must Take a Holistic View

- Need to look across the entire enterprise
- Need to understand how a change in one part of the organization can impact another part of the organization
- Need to understand activities underway in different parts of the organization
- Need to break out of “silo” thinking

A Successful Roadmap Put the Stakeholders at the Center

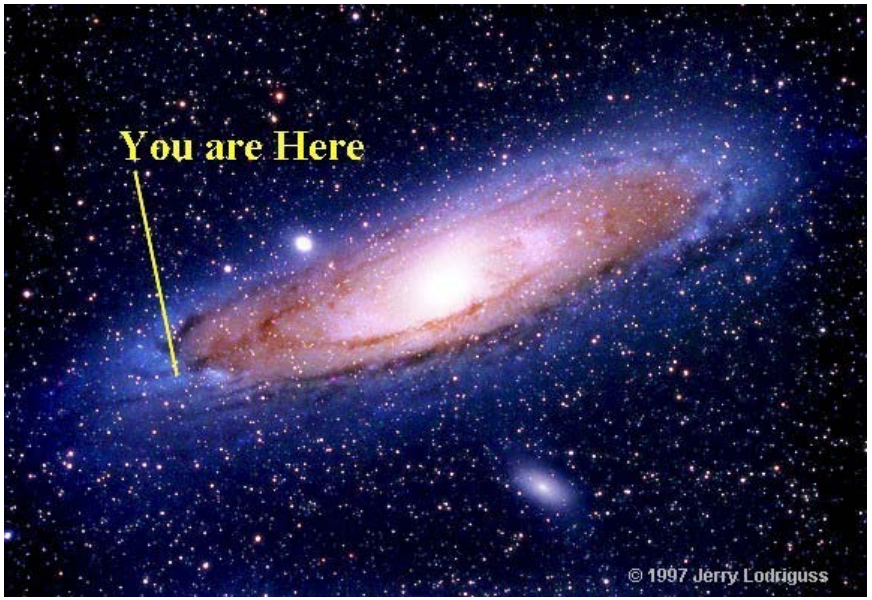
- Need to identify who are the stakeholders – both within the company and outside of the company
- Need to define what the stakeholders value

Always Be Thinking About the Value Proposition

- At every level of Roadmap development

Tremendously Important to Define the company's "Current State"

- Much more difficult to develop than most people think
- Need to have key technical people engaged
- As you think about the future state, you will constantly be referring back to the current state



Don’t Get Lost in Technology

- Easy to do
- There is a tremendous amount of technology involved in the Smart Grid
- Sometimes you need to pry the smart meters out of people’s hands
- “Trust me. We’ll get to technology.”

Don’t Get Lost in Systems Integration

- System Integration is a HUGE part of implementation
- A Smart Grid is a highly integrated “system of systems”
- Common trap is to get caught up in SI issues
- “Trust me. We’ll get to systems integration.”

Importance of Enterprise Policies

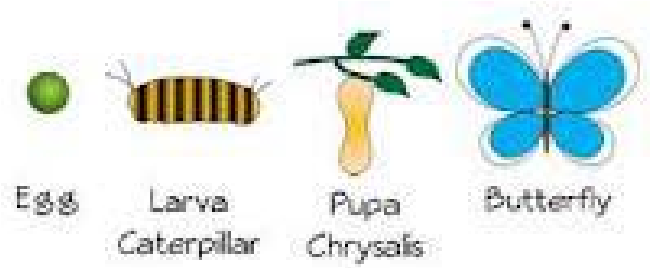
- Organization-wide security policy
- Organization-wide privacy policy
- Organization-wide integration policy
- Establishing these policies is typically the first items on the roadmap

Communications Technology is a BIG Part of the Smart Grid

- Typically an early item on the roadmap
- Need to develop requirements
- Need to evaluate current and emerging technologies

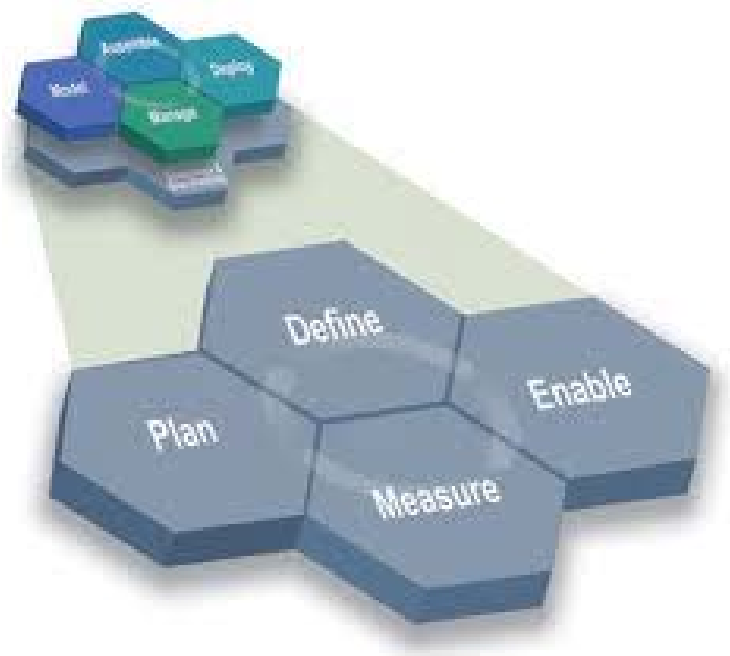
Don’t Just Add – Think Replacement and Transition

- Easy to focus on the new IT systems, communications systems, IEDs, etc.
- Large existing infrastructure in place
- Need to develop transitioning and management strategies



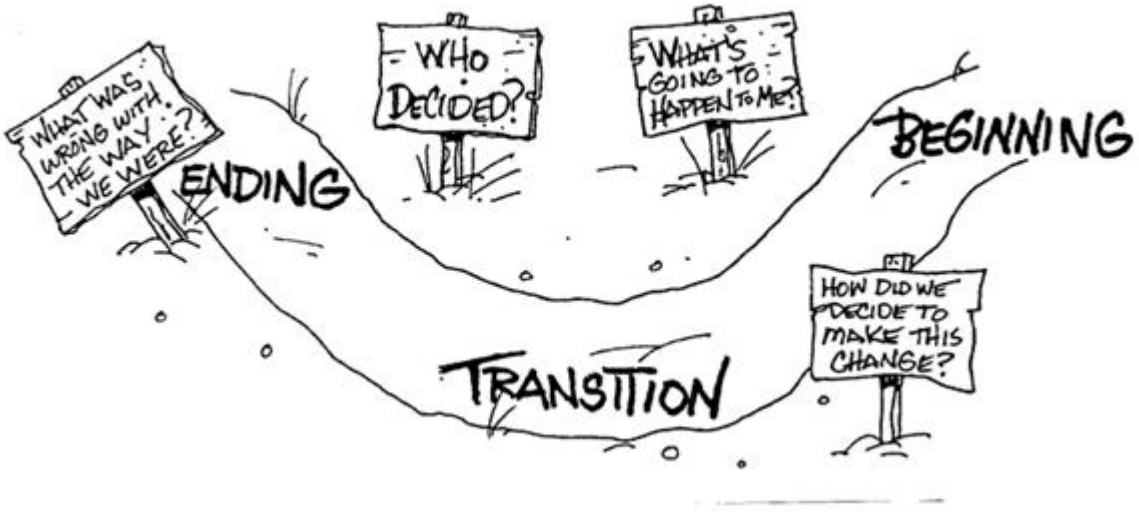
A Successful Roadmap Has a Strong, Well-Defined Governance Structure

- Cross-departmental executive steering committee
- Cross-departmental implementation teams
- Well-defined roles and responsibilities
- Metrics to define success
- Process for updating the roadmap



Training and Change Management are Important

- It will be the people that will make or break the success of the roadmap and its implementation



CONCLUSIONS

- A roadmap links regulatory policy, corporate business strategy, and customer needs with vendor, technology, and standards adoption decisions.
- Roadmapping allows a team to clearly relate planned features and system performance metrics in terms of value for the customer.
- As its name implies, roadmaps explicitly incorporate a time ordered string of events and actions.
- Roadmapping helps ensure that the team has access to technologies, personnel, best practices and other capabilities at the time they are needed to carry out the overall strategy.
- Roadmaps generally identify gaps in a company's technology evolution and adoption plan and organizational change management plan. These gaps become apparent quickly and can be addressed in a timely fashion.

CONCLUSIONS (2)

- Roadmapping allows a disciplined approach to driver identification and prioritizing capital expenditures based on those drivers. At every step of the roadmap process focus is maintained on the basics of customer needs, regulatory compliance, institutional capability and technology investment.
- Roadmaps help set realistic targets for what can be accomplished in your organization given existing infrastructure, personnel, ability to adapt to and adopt new technology, and the regulatory environment. Realistic targets help build buy-in to the roadmap and underlying strategy and allow all stakeholders to see the positive results of the process.
- Roadmapping is an effective communication tool internal to the organization as well as externally for consumers, regulators, and vendors.

CONCLUSIONS (3)

- Roadmaps also allow the team to see when a detour is required to act on external events and other unforeseen circumstances. Part of the process involves identifying risks along the way so the events that might require a change in direction are not a complete surprise.

Together…Shaping the Future of Electricity