UTILITY ANALYTICS

SEIZING THE OPPORTUNITIES TO IMPROVE SERVICE, REDUCE COSTS AND INCREASE RELIABILITY.

FIND OUT MORE

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Seizing the opportunities to improve service, reduce costs and increase reliability.

Utility analytics can unlock the power of data by coordinating various forms of information across organizational departments, applications and databases. Across the industry we are seeing utilities leverage analytical solutions to deliver real business advantages. These range from lower operations and maintenance costs, improved asset and load management, reduced outage frequency and better understanding of their customers.

The benefits can be significant; there are examples of utilities recovering half the costs of their smart grid programs by detecting and preventing energy theft. Other companies are reporting improvements in service reliability of over 35%, enabled in part by the deployment of sophisticated analytical capabilities. Analytics can also be used to help meet sustainability goals and integrate renewables.

It is, however, important to understand the detailed costs and benefits that different solutions can offer. Some analytics options can deliver return on investment ratios of between two and twelve times. Visualization and reporting are at the lower end of the benefits spectrum and predictive and control applications deliver the higher returns. For example, predictive analytics for asset failure can result in returns of three to five times if focused on maintenance optimization. These benefits could increase significantly if the utility is able to use analytics to avoid or dramatically shorten the impact of a catastrophic outage.

It is clear that there are real benefits to be gained from analytics but to ensure maximum advantage, utilities should take a holistic approach that manages, analyzes, and visualizes data across their organization. In this manner, utilities will be able to understand which solutions will create the most value in the long-term.

IMPLEMENTING DATA ANALYTICS SUCCESSFULLY REQUIRES A NEW APPROACH

Successful utility data analytics strategies are those which adopt true enterprise solutions, incorporating data from across the power infrastructure with other external data sources to create actionable intelligence and situational awareness.

In order to secure this comprehensive picture, the industry needs to manage the development and deployment of advanced analytics applications and understand that this requires a very different process from traditional software development. In this new world, applications need to be deployed rapidly and show immediate healthy returns, making plug and play solutions increasingly attractive.

Operations managers need to determine what data to collect, how to manage it, who should have access and how it should be used and stored to achieve optimum benefits. That means close collaboration between managers, executives, and their IT partners is critical.

In particular they need to ask and answer these critical questions:

- What are the best solutions to deploy in our organization given our current infrastructure?
- Do we have the right skill sets in our organization to unlock the potential of these solutions?
- Do we need a consistent model to integrate data?
- Should solutions be vendor hosted, utility hosted or cloud based?
- Who should have access to this data and what are the privacy concerns?
- What analytical solutions will provide the highest return on investment?
- Should we create a centralized data team?

PA's Utility Analytics Rapid Assessment and Deployment Methodology provides a proven approach to assessing, prioritizing and effectively managing the development of utility analytics. This methodology, combined with PA's comprehensive and software agnostic repository of Use Cases, can be used to develop a prioritized roadmap and associated business cases and action plans quickly. The following sections outline in more detail the six phases to be followed in the methodology.

UTILITY ANALYTICS

Please select area of interest.

1 DATA ANALYTICS CHECKUP

PHASE ACTIVITY

- Complete internal and external capability scan to support use cases
- Finalize current Use Case inventory
- Data Mapping

2 PRIORITIZED ROADMAP

PHASE ACTIVITY

- Prioritize Use Cases based on need, implementation effort and overall ROI calculations

3 INITIAL BUSINESS PLAN

PHASE ACTIVITY

- Refine high level cost benefit analysis and overall implementation effort based on characteristics

4 USE CASE REQUIREMENTS

PHASE ACTIVITY

- Develop use case requirements for priority areas and assign owners
- Develop Benefits Realization Plan

5 IMPLEMENT USE CASES

PHASE ACTIVITY

- Use Case status check
- Requirements Validation
- Implementation Plan
- Use Case Development & Deployment

6 REALIZE BENEFITS

PHASE ACTIVITY

- Track, monitor and display benefits across defined categories
- Prioritize quick win benefits

LOOKING FORWARD

PHASE 1: DATA ANALYTICS CHECKUP

The first phase of the methodology is to complete a holistic analytics and utility Use Case checkup.

This should examine current Use Case applications as well as data availability and quality across the organization. Once this is complete, utilities can look across various Use Case domains such as customer analytics, grid analytics, reliability analytics etc. to assess their existing capability and determine which Use Cases are most applicable to their environment. PA's comprehensive repository of Use Cases provides an externally referenceable list of areas against which utilities can conduct a gap analysis and maturity assessment. This will then provide a view of the initial opportunities. A market scan of available "in-production" Use Case applications can also be valuable in ensuring that the utility has a broad view of Use Case capability and the potential it offers.

Data Analytics Checkup Phase Completion Checklist:

- ☐ Document and agree the enterprise inventory of current Use Case capability.
- ☐ Conduct data mapping, availability and quality review.
- ☐ Complete a market scan of Use Case capability.
- ☐ Identify and select Use Cases relevant to the utility. (This may result in 50+ Use Cases being relevant but the next phase will focus on narrowing these down to priority Use Cases).

The image below highlights a cross section of Use Cases in PA's repository. The applicability of certain Use Cases will depend on the physical infrastructure, communication systems and sensors (Intelligent Electronic Devices) that a utility has in place, as such not all use cases may be suitable for deployment.

PA'S SAMPLE USE CASE REPOSITORY OVERVIEW

Grid
- AMI Operations & MDM
- Distribution Automation & SCADA
- Data Model/Store (Big Data Capable)
- Network Connectivity Analysis
- Network Models - T&D, Secondary
- Network Cyber & Physical Security
- Distributed Generation Analysis - Impacts, Interconnection
- Demand Response Control, Fuse Checker, PV Checker
- Demand Response Planning (EV's)
- Fault Location Isolation and Service Restoration (FLISR)
- Line Impedance & Matching
- Load Shedding
- Outage/Fault Location & Detection
- Phase Balancing
- Protection
- State Estimation

Reliabilty
- ASR Scheme Analysis
- Environmental/Sensitive Area Analysis (for Reliability, Works Management)
- Optimal Switch/Recloser Placement
- Reliability Analysis (including outage analysis)
- Reliability Optimization & Cost/Benefit
- Storm Analysis (Monte Carlo, etc..)
- Vegetation Management

Asset Management
- Asset Performance & Health
- Asset Management & Maintenance
- Materials Management

Enterprise
- Financial Management
- Human Resource Management
- Meter to Cash Analysis
- Business Process Operations
- Fleet Optimization
- Program/Project Management
- Settlements

Customer
- Customer Service & Call Centre Performance
- Customer Reliability & Safety
- Customer Segmentation & Targeting
- Revenue Protection/Energy Theft

Load
- Asset Load Analysis
- Distribution Load Forecasting
- Load Balancing
- Load Profiling
- Power/Load Flow Analysis

Voltage
- Voltage Monitoring
- Voltage Optimization & Cost/Benefit
- Conservation Voltage Reduction
- Optimal Capacitor Bank Design & Placement
- Volt/VAR Control

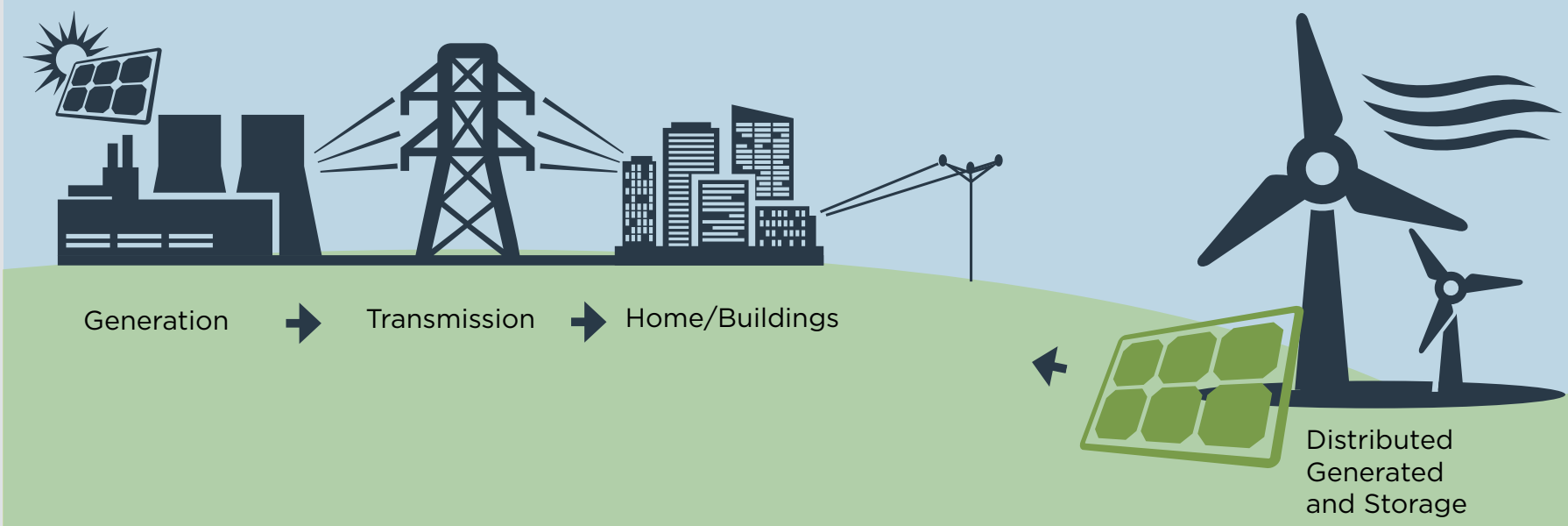
Work
- Field Force Performance
- Work Management Analysis

SECURITY LAYER

COMMUNICATIONS LAYER

INTELLIGENT ELECTRONIC DEVICE AND APPLICATION LAYER

PHYSICAL INFRASTRUCTURE LAYER



PHASE 2: PRIORITIZED ROADMAP

Mapping and Prioritization

Once a Use Case inventory assessment is complete, the next step is to map and prioritize a utility's applicable Use Cases. Each of these will have various returns on investment and levels of complications related to their implementation. In order to assess which Use Cases to deploy first and which offer the quick wins, they should be assessed across two core dimensions:

- Return on Investment (ROI) – a multiplier determined by the class of the Use Case (report, tactical, strategic or predictive). This multiplier is "discounted" to account for the existing Use Case capability (actual or planned from the Use Case inventory) and applied to the base implementation cost of that Use Case to give an "order of magnitude" ROI;
- Ease of Implementation (EOI) – this is determined by factors such as implementation duration; data sources; Use Case class; the stakeholders' technology maturity; vendor and business maturity; and buy in from the business. Using this weighted analysis, an EOI scale can be determined and a base implementation cost assigned.

Research suggests that the ROI multiplier can vary by Use Case. For example, reporting analytics can yield a 2X ROI, while predictive analytics can yield a 12X ROI. While returns will vary across utilities, due to the low maturity of utilities across the majority of use cases, these healthy returns are often in line with this order of magnitude.

*GTM Research, 2013

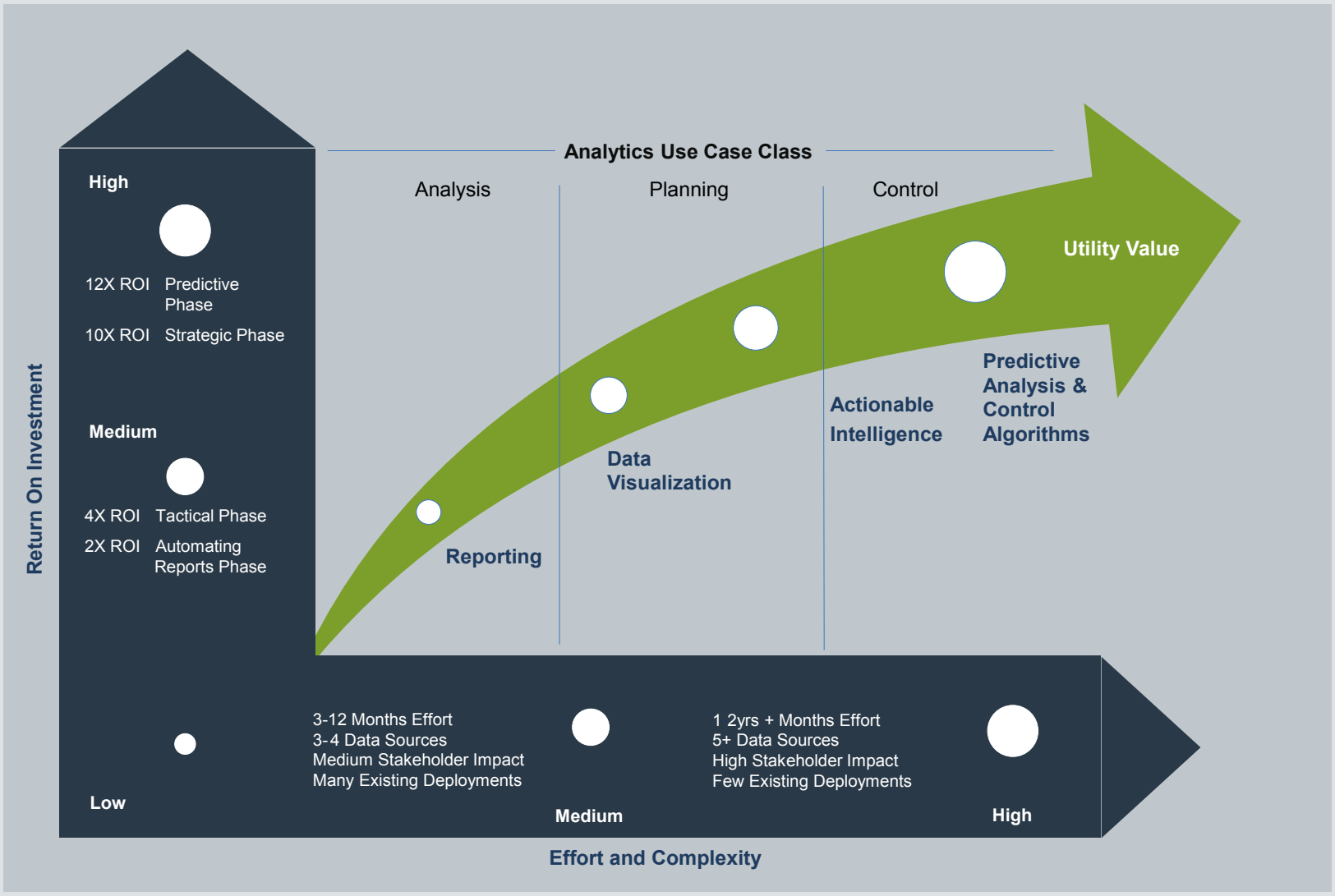
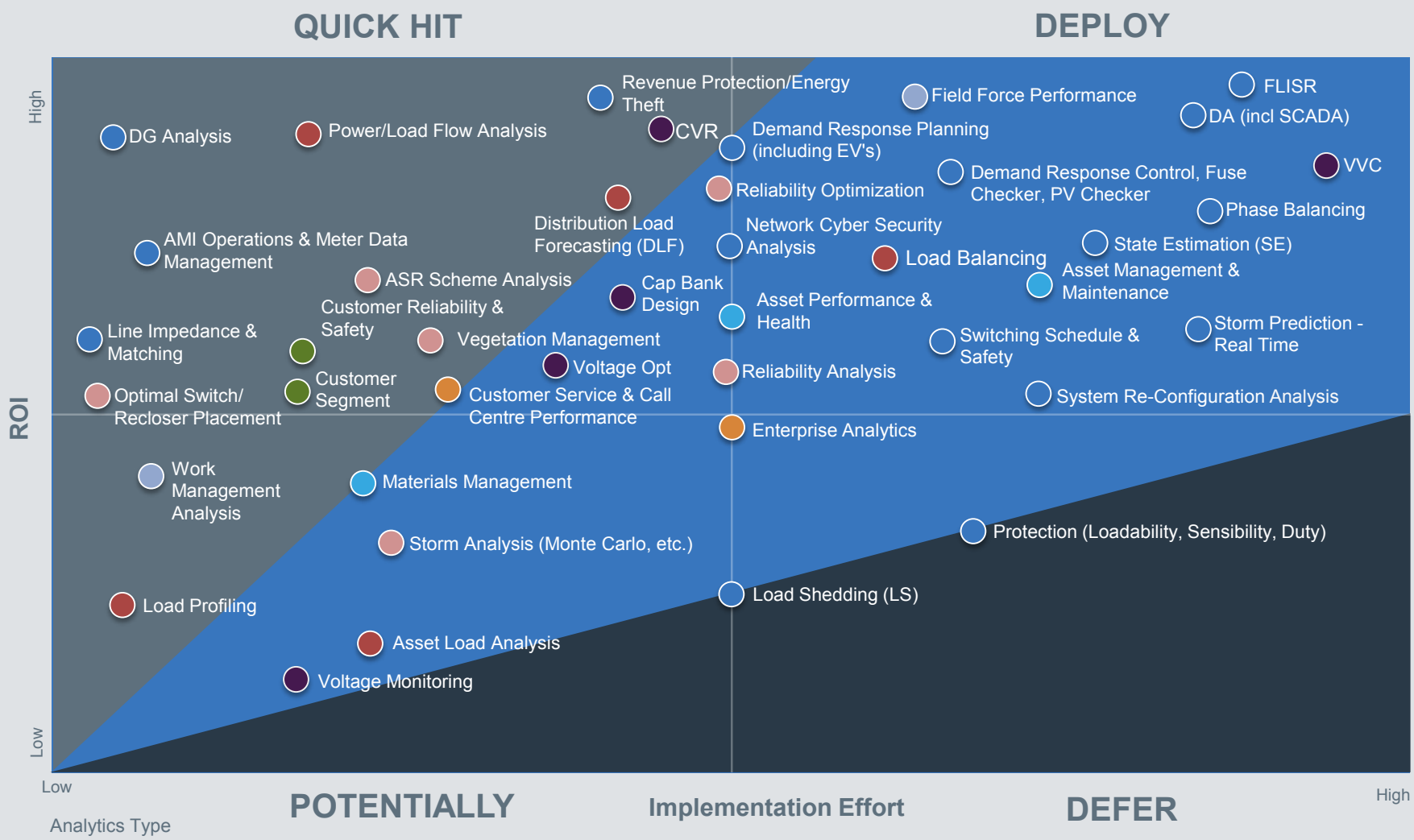


FIGURE 1: PA'S USE CASE PRIORITIZATION FRAMEWORK

Using the ROI and EOI dimensions calculated above, the Use Case can be plotted on to a graph like the one shown above in figure 1. Unsurprisingly the utility value and effort rises as the Use Case moves from analysis, into planning and then into control. This is why there is complexity, cost and high ROI associated with Distribution Management Systems (DMS) Use Cases such as Fault Location, Isolation and Service Restoration (FLISR) and Volt Var Control (VVC).



Enterprise Load Grid Reliability Work Asset Customer Voltage

FIGURE 2: ILLUSTRATIVE USE CASE PRIORITIZATION MAPPING

Figure 2 shows how to prioritize Use Cases. Those in the quick hit section have a high relative ROI for low to medium implementation effort/complexity. Use Cases that are worth pursuing fall into three areas:

- Quick Hit – medium to high ROI, low to medium EOI – quick win Use Cases to build base infrastructure and momentum
- Deploy – medium to high ROI, medium to high EOI – longer term strategic Use Cases that may require an earlier start
- Potentially – low to medium ROI, low to medium EOI – these are included because they already may be in current planning, or have a data/function affinity with other Use Cases
- Defer – High implementation effort and low ROI, these use cases should be set aside and only reassessed if solutions in the other quadrants prove unviable.

Roadmap Development

Once the Use Cases have been mapped on to the previous charts (Figures 1 and 2) and the priority Use Cases have been identified, a multiple year roadmap plan should be developed to cover short, medium and long term time horizons. A number of factors need to be considered when moving from prioritization to this planning stage:

- Use Case inventory and current status of Use Cases
- Availability of quality data from reliable sources
- Functional and data affinity across Use Cases
- Current commitments, plans and budgets
- Capacity of utility to take on Use Case development projects
- Organizational impact – process, people.

Prioritized Roadmap Phase Completion Checklist:

- ☐ Use Case ROIs determined and discounted based on inventory.
- ☐ Use Case EOIs determined.
- ☐ Use Cases mapped on to prioritization matrix.
- ☐ Prioritized Use Cases determined based on value, EOI and overall ROI calculations.
- ☐ Practical and contextual multiple year Roadmap developed and socialized.

Helping Increase Network Reliability

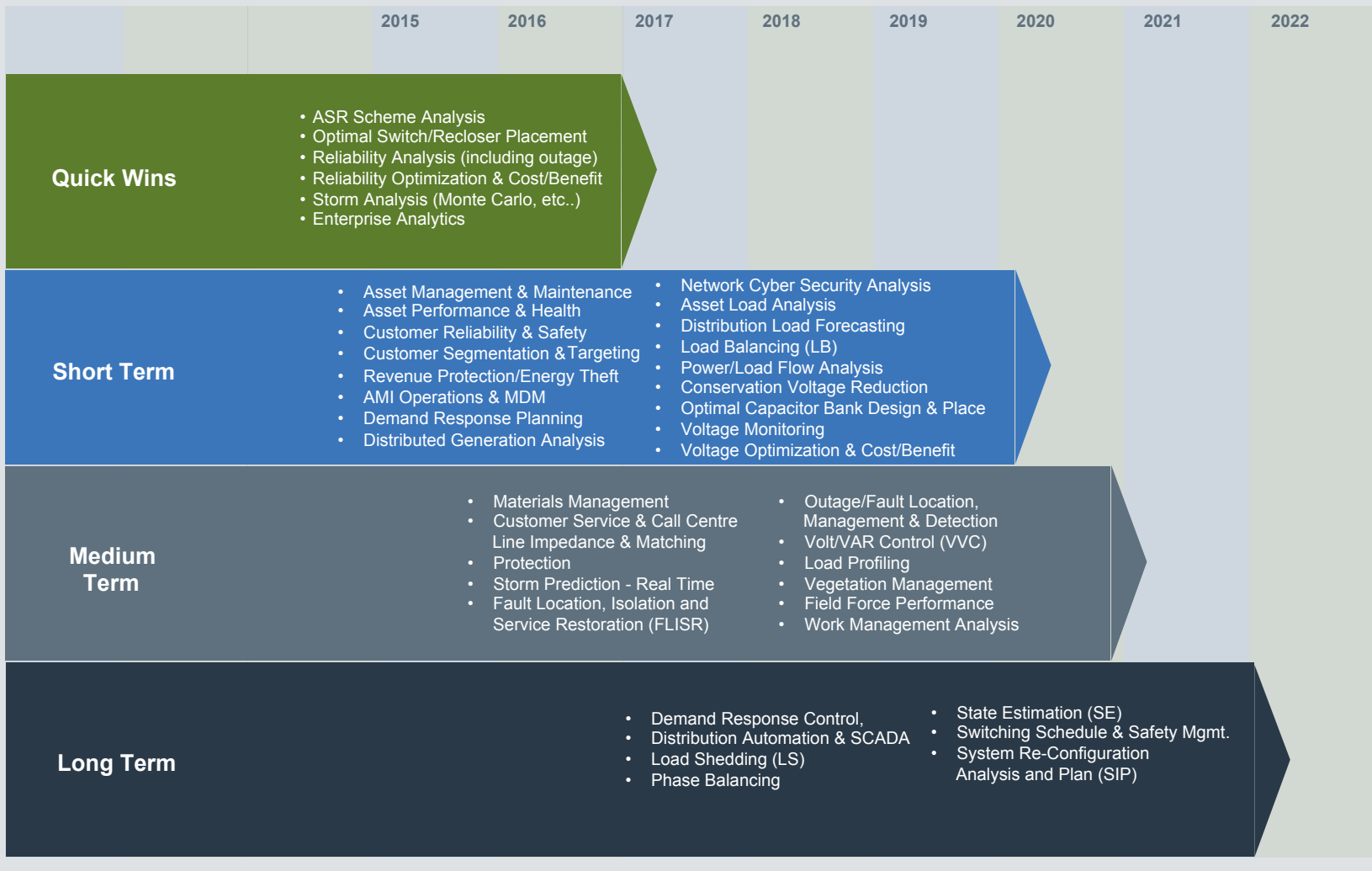
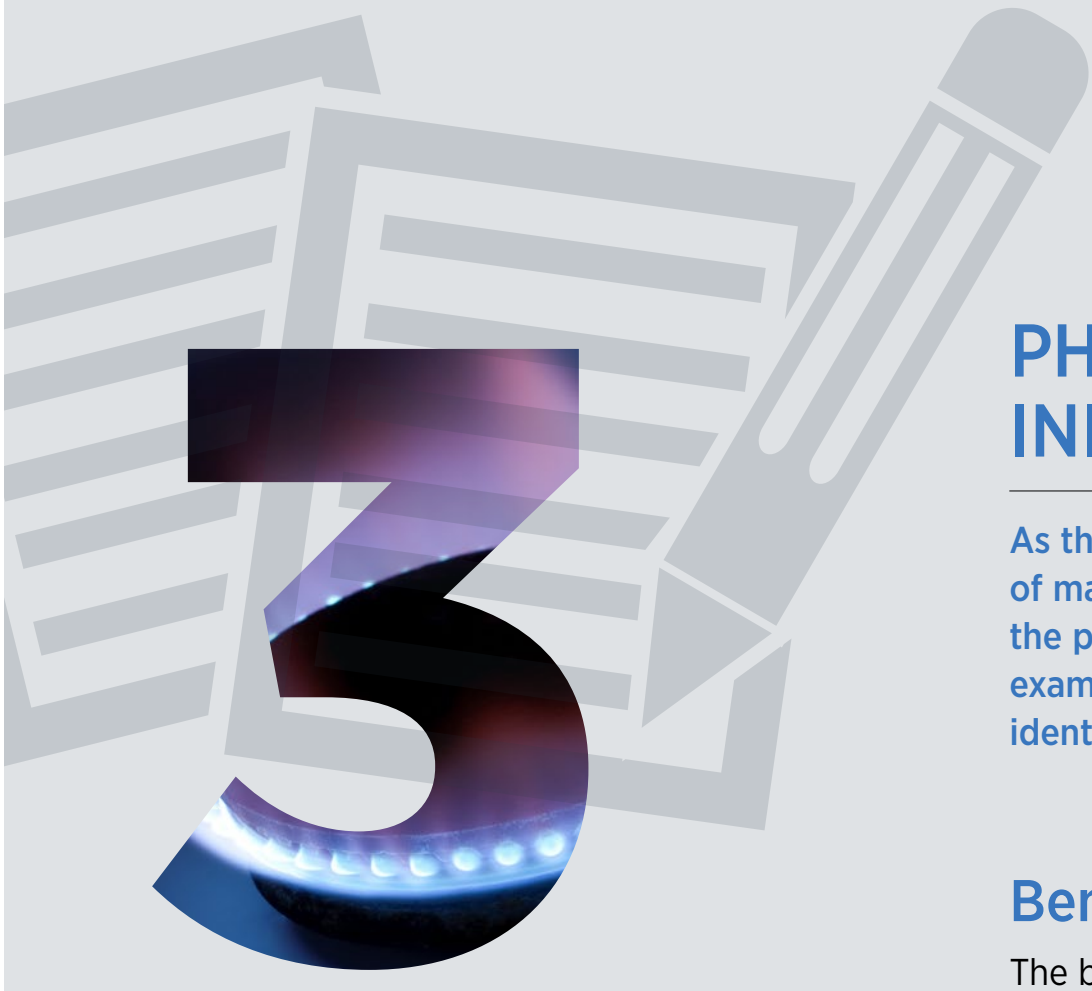


FIGURE 3: ILLUSTRATIVE USE CASE ROADMAP



PHASE 3: INITIAL BUSINESS PLAN

As the ROI simply gives an indication of an order of magnitude of benefits for planning purposes, the prioritized Use Cases also need to undergo examination of the detailed benefits, costs and risk identification, and implementation planning.

Benefits Identification

The benefits of each Use Case will primarily fall into the main groups set out in the table below and will be either tangible or intangible.

Group	Sub-category	Example	Type
Increased Revenue	Revenue optimization	Meter to cash leakage	Tangible
	Rate case approvals	Positive price outcomes	Tangible
Avoided Cost	Cost of capital	Deferred capital programs	Tangible
	Cost of operations	Cost Out – truck rolls, supply chain	Tangible
Improved Service	Regulator compliance	Regulator satisfaction, reduced queries	Intangible
	Customer satisfaction	Satisfaction increase, advocacy	Intangible
	New services	New tariffs, incentives (load shedding)	Tangible
Improved Efficiency	Workforce productivity	Overtime, FTE reductions, throughput	Tangible
	Service/process efficiency	Process waste reduction, automation	Tangible
	Resilience/responsiveness	Improved SAIDI, SAIFI, etc	Intangible

The chart below shows a worked example of three of the benefits groups, banded for each of the Use Case categories.

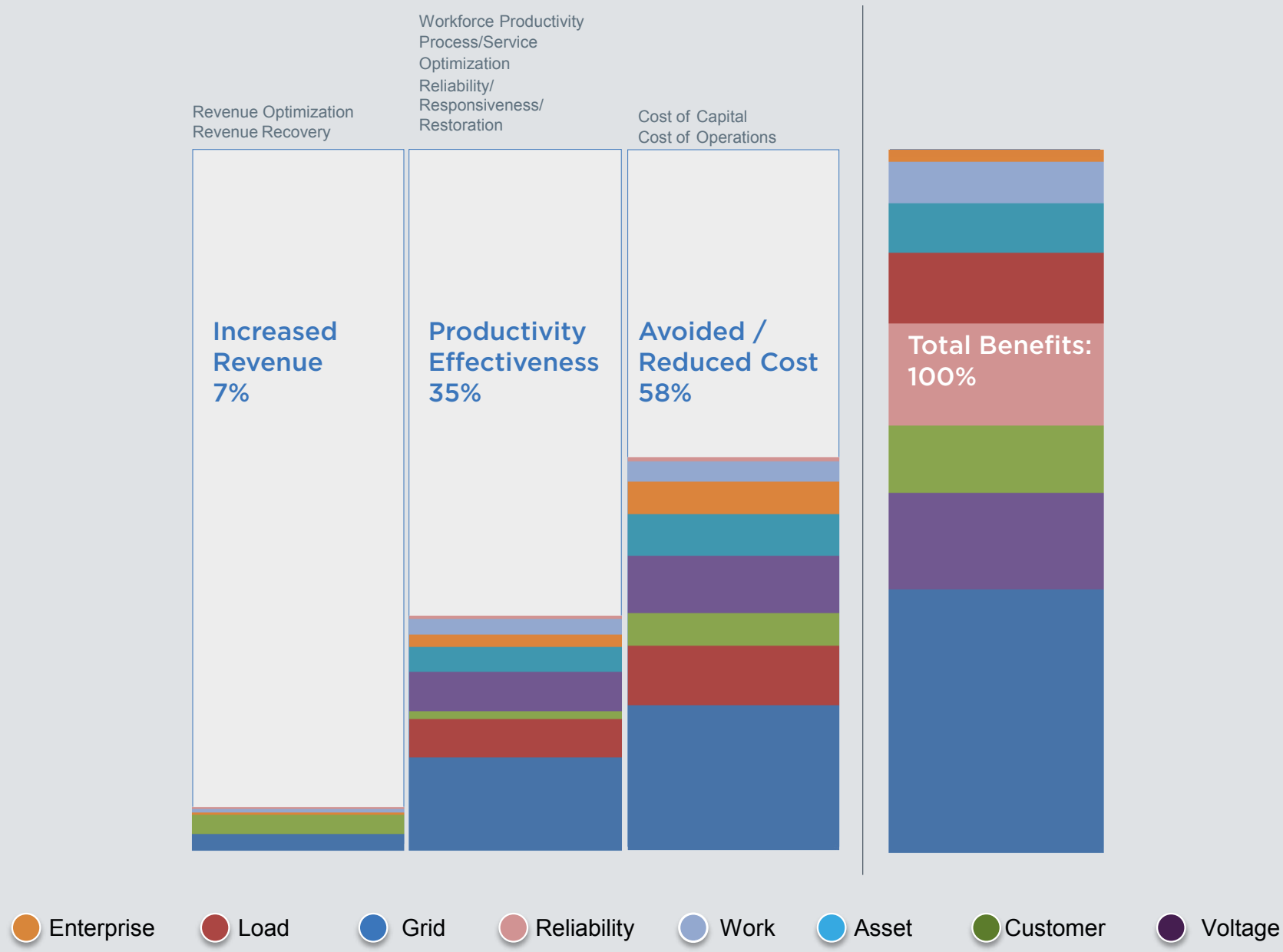


FIGURE 4: ILLUSTRATIVE ROI CATEGORIES

Costs

Prioritized Use Case deployment solutions will include a range and combination of people, process, and system initiatives and the Use Case Roadmap approach is not dependent on the use of particular software. That means costs will come from a wide range of sources, both one off or ongoing and relate to both capital and O&M expenditure. Particular costs will include:

- Process establishment or update
- FTE related costs – separation, etc.
- Systems integration, licensing, hardware, etc.
- Data sources and quality
- Change management
- Benefits realization
- Program management

Risks

Risk	Likelihood	Impact	Mitigations
Ability to execute – capacity of utility to deliver this program in the current business environment with competing priorities, demands and funding	H	M	Executive team sponsorship, involvement and support. Business Cases and priorities revisited and re-planned. Throttling of work. Independent delivery team.
Benefits not realized or double counted	M	H	Detailed benefit identification and analysis to ensure they are realistic and not double counted. Realization plan and governance established. Appropriate checkpoints to go/no-go Use cases.
Moderate IT infrastructure required	M	H	Early planning with IT/OT. Look to leverage existing capability – processes and/or technology.
Access to quality data	M	H	Involvement of Enterprise Architect and data owners. Detailed assessment of required data sources. Critical path item.
Non-compliance of regulatory requirements – demonstrating the return on investment	L	H	High visibility of Use Case deployment status and benefits realization.

While the risks in any program of this nature and size are relatively straightforward, they need to be carefully identified, managed and mitigated. The table above shows an indicative list of common risks associated with this type of program.

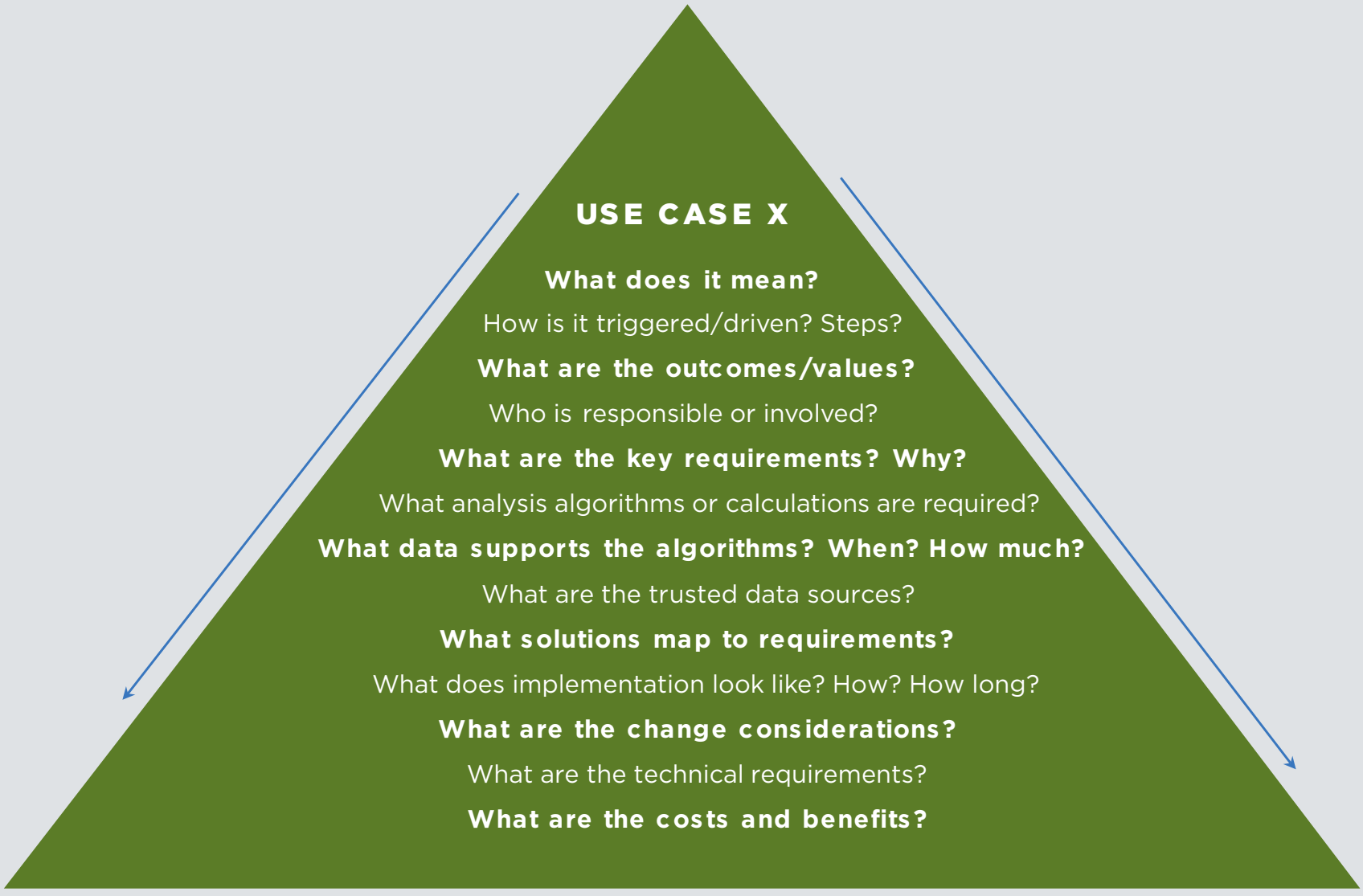
Initial Business Plan Phase Completion Checklist:

- ☐ High level benefits identified, analyzed and quantified for priority Use Cases.
- ☐ Business/process owners signed off benefits for priority Use Cases.
- ☐ High level capital and O&M costs identified (one off and ongoing).
- ☐ Business plan developed outlining key program items – timing, transition, savings/ return, change, impact.
- ☐ Risks identified, mitigations planned and incorporated into business plan.
- ☐ Business plan reviewed, agreed and signed-off.

PHASE 4:
USE CASE REQUIREMENTS

Requirements Gathering

Managing the development and deployment of utility analytics requires a very different process than that used for traditional software and solutions. There is an increased need for rapid deployment schedules and to show immediate healthy returns, as well as to support plug and play solutions. To meet these challenges, Use Case requirements should be collected with a focus on capturing a Use Case's business requirements independently of any software or system. It is also important to involve all those who benefit from the Use Case definition and implementation in defining the requirements of relevant Use Cases. This should focus on what the analytics can deliver, using the top down approach set out in the figure below:



Benefits Realization Planning

A core component in this entire approach is the early identification, tracking and realization of benefits associated with a Utility Analytics program. Illustrative examples of these benefits have included reducing nontechnical revenue losses from between 1% to 3% of revenue each year, reducing forecasting errors to less than 1% and ensuring a 35% improvement in service reliability.

In general and across the sector, benefits are found in the following areas:

- Grid – both avoided cost and lower capital spend on equipment and reductions in operational costs, by using optimal asset design and deployment and analysis of productivity. Using an integrated T&D system model will also add to the benefits in this area (CAPEX cost per asset reduced or O&M per asset reduced).

- Voltage – visualization and optimized planning of solutions to voltage issues on the network. The benefits include better productivity from planning staff, as well as avoided costs by optimized placement of solutions such as capacitor banks, reduced truck rolls and voltage issues, and optimized capital spending. It can also lead to increased customer satisfaction, with better response times and fewer complaints about low voltage, as well as lower crew overtime.

- Customer – theft recovery, and revenue assurance as a result of better processes such as meter to cash to prevent leakage of revenue and reduced non-technical outages. Other advantages could be seen from enhanced segmentation of customers to enable better tailoring of products and services.

- Reliability – improved visualization and optimized planning of solutions for reliability issues on the network. This includes enabling increased productivity of planning staff, as well as avoided costs from optimized placement of solutions such as reclosers, undergrounding, and vegetation management. This can also reduce outages, and truck rolls, as well as deliver improved SAIDI/SAIFI and increased customer/regulator satisfaction while optimizing capital spend.

- Load – better visualization and management of load issues on the network. This can lead to increased productivity of planning staff and improved planning outcomes including right sizing equipment and better collaboration between planning groups, as well as optimized capital spend.

- Asset – enhanced management of assets and setting a base for predictive maintenance will be enabled by better asset information being available to planners. Details of an asset's specifications, ratings, health indices, temperatures, etc., will enable more integrated planning and maintenance. That should lead to avoided capital costs, lower operational costs, and increased productivity of staff, as well as reduced asset/equipment failure rates.

- Work – the provision of integrated data (from AMI, GIS, Outage, Asset Management, Financial) combined with works information will help ensure the best scheduling of crews for both planned an unplanned work. This will optimize operationalcosts, and increase the productivity of works management staff. It will also reduce time to restoration from first outage indication and OT, and single outage detection time.

- Enterprise – enhancements to reporting and analytics across customer, financial and HR functions will improve decision making which should lead to reductions in costs and general process cycle time (connections, collections, etc.)

Clearly one of the most critical elements in realizing these benefits is to establish a rigorous plan and mechanism to track and bank these (and their associated costs) throughout the deployment. The key elements of this plan should include:

- Effective governance structures, processes and oversight/audit
- Identified benefit owners
- Detailed benefit definitions (see below) directly related to requirements
- Clear metrics and targets where applicable
- A reporting/dashboard mechanism and frequency (with part-time FTE to support)
- Trusted and reliable data sources (mostly financial)
- A realization and ramp-up timeline.

Detailed Benefits Definition

It is imperative that there is a detailed and SMART (Specific, Measurable, Achievable, Realistic, Timely) definition of benefits. There should also be rigorous system to check with process owners and finance to ensure there is no double-counting of benefits.

The key elements of a SMART benefit definition include:

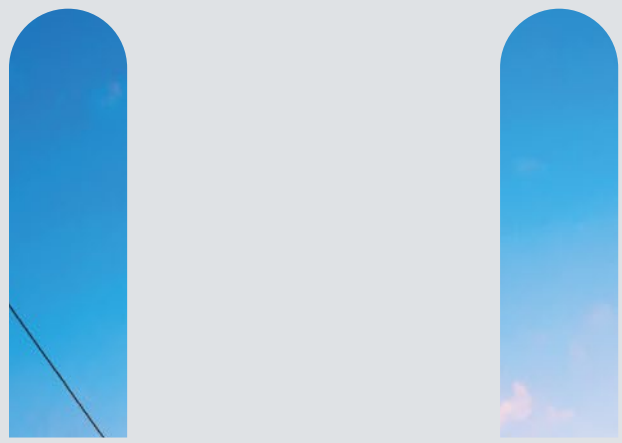
- Distinct name
- Business scope
- Owner
- Benefit recipients
- Calculation
- Data requirements and sources
- Metrics – targets, ranges, baseline
- Realization timing & phasing
- Frequency of capture and reporting
- History.

The following example steps through a worked example related to Reliability Planning process.

1. Through mapping the current reliability planning process it was discovered that to go from initial identification of a feeder for analysis through to the approval of the designed work program from that feeder took approximately 64.5 effort hours over 10 days duration, allowing for field inspection.

2. The analytical tool suite was then embedded into this process and it is estimated that the same process for the same feeder would take a maximum of 27.1 effort hours over 5 days duration.

3. The 58% improvement in this process, when extrapolated over the normal annual average of feeders being worked on (~230), resulted in a significant reduction in the overall duration from 33 weeks to 8 weeks assuming an appropriate FTE mix of Distribution Engineer, Planning Engineer and Field Engineers, and an average load of 27 feeders per Planning Engineer per year.



Use Cases Requirements Completion Checklist:

- ☐ Priority Use Case requirements identified and documented.
- ☐ Required data quality and sources identified and understood.
- ☐ Benefit areas identified and SMART benefits definitions detailed and quantified.
- ☐ Benefits realization plan developed and approved by process owners.

PHASE 5: IMPLEMENT USE CASES

Implementation Planning and Proposed Schedule

As utilities move from planning to deployment they should apply the following key principles across their analytics programs:

- Ensure they have comprehensively accounted for the current state and capability of various Use Cases within the utility
- Where possible focus efforts on the highest value outcomes and overall applicability to the utility (Priority Use Cases)
- Ensure the identified Use Cases have available data sources of adequate quality, and reflect industry best practice and overall suitability
- Wherever possible accelerate quick wins to build momentum and trust
- Leverage affinity (both function and data) across Use Cases to maximize the value of their deployment and ensure coordinated implementation
- Link implementation to rigorous benefits ownership, tracking and reporting during roadmap deployment to ensure value is being realized throughout
- Be aware of the change issues related to deployment – organizational, stakeholders and processes
- Use a Program Management organization within the utility governed by, but separate to the business
- Acknowledge that Use Case deployment will be an evolving value proposition that needs to be agile, resilient, and responsive to business needs, utility capacity and changing priorities
- Ensure the eventual schedule for implementation covers all stakeholders' tasks and dependencies.

Implementation of Use Cases Completion Checklist:

- ☐ Priority Use Case deployment schedule and implementation plan finalized.
- ☐ Change management plan developed.
- ☐ Program governance established.
- ☐ Benefits realization plan aligned.

PHASE 6: REALIZE BENEFITS

Based on the Benefits Realization Plan and the deployment schedule developed from the implementation planning, utilities need to establish the necessary governance, ownership and tracking processes, systems and data. This will then enable the effective realization of the benefits for the priority Use Cases.

A particular focus should be on Use Cases that could provide early benefits and help build momentum for the program. Proven early success will also create trust from stakeholders and may help secure funding for subsequent deployments.

The following diagram provides an example of Use Case deployment and ramp up. It is important to note that not all benefits are fully realized at deployment and some are seen months after deployment as the outcomes of better processes start to take hold and set a new normal.

Realize Benefits Completion Checklist:

- ☐ Governance, tracking, reporting and banking processes, systems and data established.
- ☐ Resource in place to manage and administer benefits tracking Prioritized quick win benefits.
- ☐ Benefits realized and banked in line with deployment plans.
- ☐ Monitor success against defined metrics.

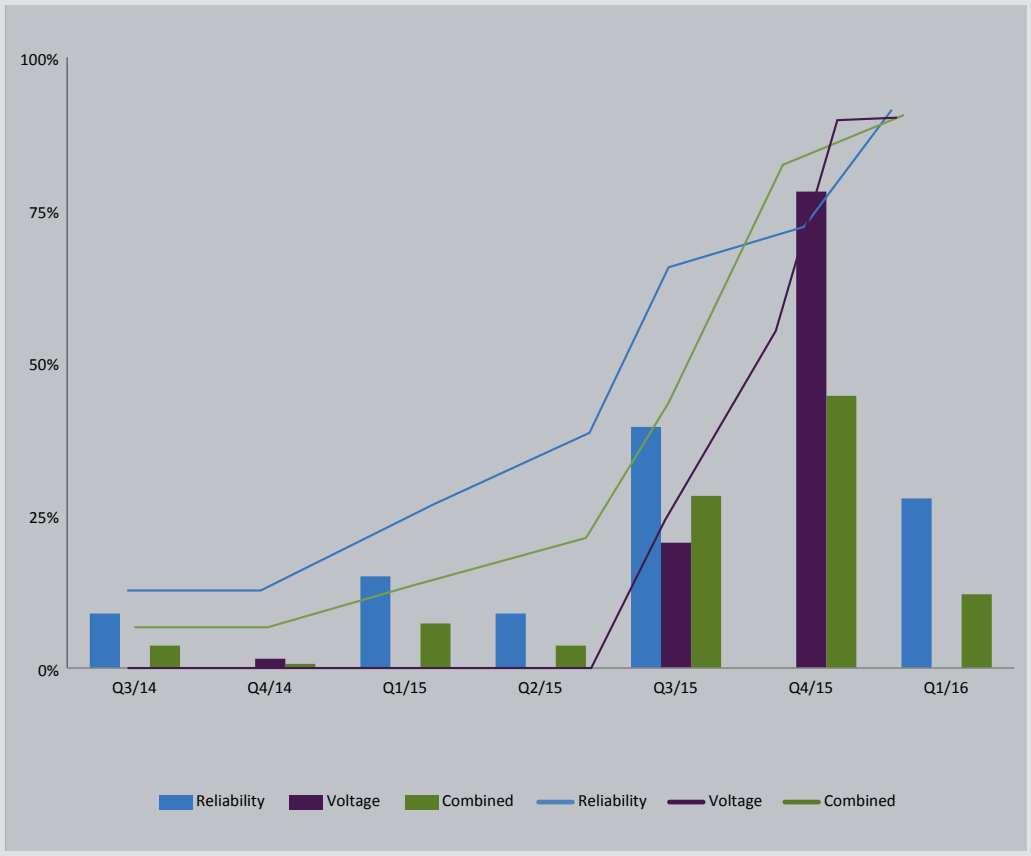


FIGURE 5: USE CASE BENEFITS RAMP UP

CONCLUSION

Looking Forward

The benefits of Utility Analytics are no longer theoretical, there are now a growing number of real examples of what utility companies have achieved. Half of the recovery costs of BC Hydro's smart meter program will be found in detecting and preventing energy theft. PPL Electric has reported a 38% improvement in service reliability enabled in part by the deployment of sophisticated analytical capabilities. Oklahoma Gas & Electric, in a bid to substantially shed load by 2020, is using customer analytics to gain visibility on individual customers' responses to price signals. This is enabling them to identify the best customers to target with specific marketing campaigns. In each of these cases, clear strategic goals or business problems have been addressed by using a combination of analytical solutions.

So while companies will prioritize different actions to meet their particular needs, there is growing clarity over the solutions that offer most benefits including:

- Outage management – Analytical solutions are being deployed that offer efficient detection and restoration of outages by remotely rerouting power flow to quickly reconnect customers. In addition, in preparation for weather based outages, some utilities are using predictive analytics to understand how distribution lines respond to environmental factors and where best to place crews.
- Reliability – integrated information and powerful algorithms deployed to assess the optimal location of reliability solutions (switches, vegetation management, undergrounding) at the optimal cost to improve the overall resiliency of the network. Improvements in reliability metrics are expected and the overall productivity of reliability planners is expected to double.
- Revenue protection – According to Electric Light & Power, nontechnical revenue losses are estimated to cost US utilities 1% to 3% of revenue each year and many of those losses stem from theft or metering defects. Analytical capabilities can now be deployed to tackle this by identifying and analyzing energy diversion by comparing and correlating usage with other similar customer profiles.
- Load Forecasting Analytics – Increasingly sophisticated algorithms and software are being deployed across the utility landscape, enabling more accurate predictions of the volume, magnitude and location of energy demand. This brings significant financial rewards as utilities reduce forecasting errors to less than 1%.
- Asset management – Utilities are improving total uptime and reducing overall maintenance costs by deploying predictive maintenance analytics that increase the quantity and quality of maintenance schedules.
- Voltage optimization – Analytical capabilities are being used that allow distribution operators to deploy solutions that dynamically lower voltage by a few percentage points to end-customers while still meeting the mandatory service-level voltages.
- Vegetation management – Analytical solutions are allowing utilities to create optimal plans for vegetation management by predicting vegetation growth that may lead to future problems.
- Customer segmentation – Integration of customer consumption data with external data sources such as demographic data can provide utilities with valuable insights to inform the creation of new targeted products and services.

These examples show that the benefits of analytics are now clear. The challenge now is to create a holistic data analytics strategy which the organization can deliver. Utilities can meet this challenge by following the six steps outlined above. This will allow them to combine data sources and integrate them effectively across new and existing systems. This will then provide a powerful and intelligent resource for utilities to manage the grid, customers and operations, and unlock the full potential of utility data analytics.

To find out more about how PA's methodology can help you realize the benefits of analytics, contact us at energy@paconsulting.com or visit www.paconsulting.com/energy.

UTILITY ANALYTICS

OUR EXPERTISE

Use Our Expertise

For over 30 years, PA Consulting Group has been working with utilities, offering deep sector insight and providing solutions to a wide range of challenges, including improving reliability, enhancing the performance of critical processes, and delivering IT integration. PA can help utilities realize the benefits of digital technologies across the value chain to optimize performance, customer service and, of course, safety and reliability.

For more information on how we can help your utility undergo the transformation to the Next Generation Utility. please contact us at **energy@paconsulting.com**

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