Asset management practices and strategy – A discussion on the new outlook

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SUMMARY

This paper discusses the challenges utilities face with asset management practices in light of the current changing scenario within the electricity sector. It explains traditional asset management practices, the need of the day, signifies identifying gaps and examines the strategies and process for improvement.

Traditional asset management practices utilize a simple approach to maintenance during the functional life of an asset and replacement at the end of useful life. Utilities are increasingly transitioning to the use of modern asset analytics and condition monitoring technologies to assess asset health and prioritize maintenance and sustainment investments. However, with this transition, utilities face new challenges such as the quantity and quality of data, efficacy of data management and analysis tools, data management across multiple databases, disconnected approaches and the lack of strategic implementation of technologies. Utilities though have started addressing many of these challenges; however, the efforts still fall short due to the magnitude of problem going back to 30 to 70 years. These challenges have severely hampered asset management practices and utilities are still heavily relying on traditional maintenance and investment practices. Note that all issues listed above are general to the universal asset management practices experienced by utilities, industries and OEMs; the degree of impact changing with type of organization and the organization culture

One of the key challenges facing utilities is the average age and health of the asset population, which may result in the development of a backlog due to lack of strategic planning and regulatory restrictions. Further, inflation in the product, material and labor costs during the life cycle of an asset, other economic factors, and the discrepancies in financial planning considerations of assets such as depreciation accounting, utility constitution and regulatory configuration etc. increase the financial burden on utilities to maintain and replace an asset during and at the end of its useful life, respectively. Therefore, it is critical for utilities to develop a strategic asset management plan to avoid getting into a vicious cycle of deteriorating asset health, failing on the performance standards, increased failures, and substantial increases to tariffs, resulting in public disapproval.

The problem appears to be further aggravated by the fact that for utilities around the world, the expansion of generation capacity has outpaced transmission and distribution system capacity. This issue needs to be examined as part of asset management practices because of the pressing requirements of localized demand growth, unplanned power flow patterns, penetration of distributed generation and energy resources in the system, etc.

A strategic approach to asset management is a necessity that provides a comprehensive outlook to all the activities encompassing the management of assets, resulting in savings of resources, reduction in

backlog and improvement in system performance. All the activities falling under the broader umbrella of asset management, listed below, demonstrate significant improvement opportunities with scope, budget and schedule.

- Maintenance of assets: identifying the candidates, the activities to be carried out and the methodology of carrying out the maintenance activities
- Sustainment capital investment: defining the expected useful life and the end of useful life of an asset to identify the candidates for investment
- Planning and replacement of assets at or near the end of its useful life
- Planning and construction of new facilities addressing electricity needs to help curtail future asset management expenses

KEYWORDS

Asset management, condition monitoring, maintenance, performance monitoring and sustainment investment

OVERVIEW OF ASSET MANAGEMENT PRACTICES

The objective of this discussion paper is to list the relevant aspects that can lead to the development of optimal tools, effective methods, working processes and optimum strategies for strategic asset management identifying the gaps of current methodologies and long and short-term strategies. It is important to manage assets appropriately knowing the short and long-term socio-economic impacts of failures.

Various literature is published addressing multiple aspects of asset management such as equipment condition monitoring and health assessment techniques etc. and many authors have reviewed this literature but as mentioned above, it is not the objective of this paper. However to set the context for the conversation, this section provides a high-level overview of management practices citing few important references in literature.

Various organizations have developed guidelines for asset management and the majority of utilities around the world have acknowledged and/or referred to these guidelines when developing and/or modifying their processes, methodologies and strategies. Organizations like the Electric Power Research Institute (EPRI), the International Council on Large Electric Systems (CIGRE), the British Standard Institution's (BSI) the Institute of Asset Management (IAM) and the International Organization for Standardization (ISO) are the few leading organizations that have developed such guidelines. Per EPRI, an "asset is any resource that is important to an Organization's function and requires management. These assets are used to service and supply the end users or to facilitate performing such services". Per the ISO, "assets are the basis for any organization delivering what it intends to. Assets can be physical, financial, human resources or 'intangible'; a good asset management maximizes its worth for the organization. Asset management comprise of coordinated and optimized planning, asset selection, acquisition, construction or development, utilization, maintenance and ultimate disposal or renewal of assets and asset systems". Bringing out the essence of the asset management, BSI states that "delivering the best value for money in the management of physical assets is complex and involves careful consideration of the trade-offs between performance, cost and risk over all stages of the assets 'life cycles".

EPRI issued one of the first asset management guidelines specifically for utilities. It outlines three entities 1) the asset owners, 2) the asset managers, and 3) the service providers that support asset management. The asset owner sets the business goals and policies and communicates with the users and regulators on the asset performance requirements etc. The asset manager develops asset strategy, asset policy and directs investment planning and risk management. The asset manager decides how and where to spend money for both capital and operations maintenance. The service provider carries out actual work. In many organizations, roles of asset owners and managers may be found overlapping and there can practically be only two (2) entities, asset owner / managers and the service provider [1], [2]. The asset management decisions are categorized based on decision time frame, operational or tactical (near term), long range or long term and strategic. Strategic decisions are to ensure the future of organization's asset management culture.

CIGRE, similar to EPRI, provided a risk based approach to asset management practices defining three aspects of asset management viz., 1) long term business objectives and goals (strategic), asset management plans and program (tactical) and execution of plans and monitoring (operational) [3].
The Institute of Asset Management, under BSI developed PAS 55-1 and PAS 55-2 in 2004 that were later updated in 2008. It outlines the basic principles of asset management and emphasizes on assessment of the performance and the actions in asset management to determine and understand the ability of an organization to manage its assets, based on the quality improvement approach called plan-do-check-act cycle [4], [5].

The ISO, taking PAS 55 as the basis, published three (3) standards, 55000, 55001 and 55002 in 2014. Similar to PAS-55, it focuses on integrating and aligning policies and processes to attain the best asset management practices. The standard 55000 provides an overview of the concepts and terminology

used in asset management framework, 55001 outlines the requirements for an asset management system to obtain best practices and 55002 provides guidelines for implementing the asset management framework [6].

TRADITIONAL ASSET MANAGEMENT

Utility asset management places emphasis on ensuring that the infrastructure required for delivering electricity in a safe, economic and reliable manner are planned, procured, constructed, maintained and operated such that they achieve the expected level of performance in a sustainable manner. Asset management practices ideally should strike the right balance between the customer needs and economic and regulatory constraints, as applicable, in delivering required function.

Traditional asset management practices utilize a simple approach to maintenance during the functional life of an asset and replacement at the end of its useful life. Most utilities still follow traditional practices of carrying out routine and time based maintenance of the assets as prescribed by the manufacturer during its functional life. Many of the utilities have developed a system of modified practices, based on operating experience, where manufacturer prescribed timelines and maintenance practices are adjusted on less critical assets, for example, switches, to relieve the burden on the resources, reduce costs and still maintain the expected level of functionality. However, the structure remains more or less the same with periodic maintenance of equipment in line with manufacture prescribed activities.

Over the years, there have been developments in technology where the performance and condition of assets can be monitored to predict the preventive maintenance requirements, schedule such activities ahead of time to better utilize resources by avoiding unnecessary maintenance activities and to better utilize the assets. The concepts of predictive and prescriptive maintenance are now gaining attention [7], [8], which are based on condition monitoring of equipment using sensors, transducers, measuring instrumentation and through performance parameter monitoring. In predictive maintenance, new technology is utilized to collect data that describes the condition of equipment. The collected data is analyzed to predict equipment failures and maintenance needs. In prescriptive maintenance, similar analysis (to predictive maintenance) further recommends the corrective and operational measures required to be implemented so that the equipment life can be maximized. For example, the prescriptive maintenance may prescribe a list of activities to be carried out such as de-rating equipment, specifying its anticipated impact on the service life of the asset in question. Note that this is not a new concept; many utilities may be following similar practices for short or long term issues with a specific assets on a case by case bases; for example de-rating specific equipment or imposing a conditional operation of an asset. The only difference here is it being treated as a systematic approach now than the existing circumstantial, case-by-case approach.

Currently, even the utilities following traditional practices have initiated transitions to using modern asset analytics tools and condition monitoring technologies to assess asset health and prioritize the maintenance and sustainment investments, to the extent possible.

Ironically, due to the lack of clear strategy; even traditional asset management practices face severe challenges and utilities are underutilizing these new technologies used for condition assessment, asset analytics, data collection, maintenance, and asset management practices. Further, the need of the day mentioned in the section below, makes it more difficult for the utilities to be ready for the future.

NEED OF THE DAY

The technological advancement in renewable generation, electricity storage, and power conversion technologies, new and smart electric loads such as electric vehicles, smart metering and communication technologies etc. that seem to revolutionize the electricity sector by providing solutions to all the problems are only observed at the equipment level, in a piecemeal form. However, the implementation aspect for these new innovative technologies to transform the current power system poses challenges in terms of the infrastructure that connects between load and generation or distributed energy resources (DERs), which is still the same and constrained. Most critical challenges will be the readiness of utilities to transform the business and electricity delivery model, selecting the business model and the transformation process. Regulatory reforms, business and electricity delivery model transformations are inevitable considering the high penetration of DERs at both transmission and distribution levels and their technical capabilities to participate in both energy and multiple ancillary services markets. Some factors that significantly govern the future of electricity delivery is the affordability, the reliability of supply, and future maintenance and sustainment costs. Independent system operators around the world have already initiated efforts on the transformation of the electricity sector to be ready for the future, touching up on various aspects of electric power supply system [9], [10].

In light of transformational changes to the power sector with innovative technologies on one hand and traditional challenges with asset management systems on other, a strategic approach to modern day asset management is a necessity. The approach must provide a comprehensive outlook to all the activities encompassing the management of assets to drive resource savings, reduction in backlog, and improvement in system performance. All the activities falling under the broader umbrella of asset management, listed below, demonstrates significant improvement opportunities with scope, budget and schedule:

- Maintenance of assets: identifying the candidates, the activities to be carried out and the methodology of carrying out the maintenance activities
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As mentioned earlier, the tools used by utilities to meet the objectives of maintaining the assets in optimal condition need to be properly designed to meet day-to-day operational requirements and must be suitable for the utility specific culture. Issues can start developing when gaps are left between tools and day-to-day operational practices; which utilities often try to bridge via training and development. It is clear that training and development of employees, specifically field staff, is required but when the tools are not designed considering the utility culture, even the most facilitated training would fail to develop the necessary cultural changes; as cultural changes naturally happen in a gradual manner and not overnight. Therefore successful implementation of asset management strategies utilizing asset management tools is only possible if these tools and strategies are designed keeping in mind the utility culture; understanding the magnitude of cultural change required to implement the strategy and the required time and effort to facilitate this change. It also demands a detailed change management plan to ensure success of any fundamental changes in the asset management practices and strategies.

GAPS AND FALLOUTS

How do traditional utilities practice asset management? Defect reporting, defect call management and associated corrective work provide the base data for the further preventive, corrective maintenance and/or sustainment capital investment. Asset managers use this data to generate the indicators to assess the equipment and system health and make decisions on maintenance and sustainment capital work, and at times they are coordinated with the planning of new development work to relieve burden on the

existing assets and change or defer sustainment capital investment due to evolving needs in a given area.

As mentioned earlier, traditional utilities are beginning to experience penetration of asset condition monitoring devices such as transformer gas analyzers and modern analytic tools to improve on their asset management capabilities. However, challenges with the quantity and quality of data, efficacy of data management and analysis tools, data management across multiple databases, disconnected approaches, and the lack of strategic implementation of technologies, can severely hamper asset management practices. These issues are general to all asset management practices, experienced by utilities, industries and OEMs, the degree of impact changing with type of organization and the organization culture.

Another key issue is the average age and health of the asset population, which results in the inconsistent treatment of assets or challenging maintenance practices as a mix of asset conditions and ages that have different needs must be maintained. An asset at the end of its useful life can be replaced as a whole or maintained consistently until obsolete. Once the replacement of select obsolete technologies begins, efficiency is negatively impacted, for example, with multiple technologies in service for circuit breaker interrupting mediums such as oil, air blast and SF6 etc., all with multiple and differing needs, it leads to the development of a backlog, due to lack of strategic planning. This may also be exacerbated by regulatory requirements that dictate specific strategies. Further, increases in product, material and labour costs during the life cycle of an asset due to inflation, other economic factors, and discrepancies in financial planning considerations of an asset such as depreciation accounting, utility constitution and regulatory environment etc. increase costs associated with maintenance and capital investments for the replacement of an asset during and at the end of its functional life, respectively. Therefore, it is critical for utilities to develop a strategic asset management plan to avoid getting into a vicious cycle of deteriorating asset health, falling on the performance standards, increased failures, and substantial increases to tariffs, resulting in public disapproval.

The problem appears to be further aggravated by the fact that for utilities around the world, the expansion of generation capacity has outpaced transmission and distribution system capacity. This issue needs to be examined as part of asset management practices because of the pressing requirements of localized demand growth, unplanned power flow patterns, penetration of distributed generation and energy resources in the system, etc.

NEXT STEPS

As discussed, it is critical for utilities to develop a strategic asset management plan to avoid getting into vicious cycle of deteriorating asset health, falling on the performance measures, and increased failures of critical assets. You either can successfully maintain an asset knowing when to replace or if you don't, you need to move towards replacement faster. It is also critical for asset managers to work closely with regulators to ensure there is full understanding of the consequence of lagging or deferred investments. Often regulators may not understand that replacing an asset just before its imminent failure is not always possible and therefore the goal is to minimize this risk rather than accepting the failure and consequences to customers.

This section lays out a systematic approach that will help utilities streamline their current asset management practices keeping in mind all the possible gaps discussed earlier in the paper from corporate culture to financial modeling and management direction to political and regulatory constraints; to achieve business objectives without sacrificing the quality of services.

A simple systematic approach as a foundation guideline is depicted in Figure 1. Following are the four key elements of this approach:

- Identification of gaps or fall outs in the current asset management practices
- Impact Assessment for each gap of interest to prioritize per severity of impact

- Devise and implement corrective measures to address each gaps of interest
- Monitoring effect of corrective measure and accordingly redefine the objectives and parameters

The process begins with defining objectives, the timelines through which utilities start and finish monitoring the performance of the corrective measures, setting validation parameters for the performance measures and the process review interval. Once the process definitions are finalized, the review of the existing system is to be carried out to identify current gaps, starting from bottom up, in parallel from the top-down, and assessing the impact of each factor on the anticipated asset management outcomes (if possible determine the magnitude of the impact by anticipating how far is the actual status of the particular asset category health from the ideal) to help prioritize the corrective measures. Subsequently, developing corrective measures for each gap, preparing a priority implementation matrix for corrective measures, developing an implementation plan, and implementation of recommended corrective measures per the priority matrix. It further suggests performance monitoring for the implemented corrective measures against set parameters and review of process performance at pre-determined intervals updating the process definition. This approach is suitable for multi-level modular implementation. This process can be applied not only to prioritize the gaps in modular fashion but also to prioritize the implementation of resolutions in addressing of prioritized gaps.

Presented below is a discussion on one of the critical gaps, the data inaccuracy that significantly affects any organization regardless their asset management system. It outlines the probable causes of data inaccuracy and illustrates the modular implementation of sample approach (Figure 1) to modify existing asset management system; as a guideline to strategically develop a utility specific systematic approach.

The data for asset health is the collection of inputs from all the stakeholders who have dealt with the particular asset. There can be numerous reasons for data inaccuracies. These include, lack of due diligence on the part of stakeholders inputting the information, lack of a platform in which the data is entered in a clear and concise manner in digital form, multiple disconnected data collection tools, lack of data verification/validation or processes and so on. Utilities who intend to transform processes with minimal investment need to identify these gaps at a minimum and address it through implementation of corrective measures such as meticulous training programs to drive cultural change. Utilities may further define processes for data entry and data verification at various levels before it is validated. The well-known adage, “garbage in is garbage out”, regardless of multimillion dollar tools and certification efforts, the majority of utilities can at least develop a streamlined systematic approach to clean up data and any other high impact gaps identified without prolonged and increased efforts. This strategic approach can be built to address one or only few critical gaps initially helping utilities significantly improve on their asset management objectives in a piecemeal fashion, and ultimately form a foundation to build a full-fledged system in future.

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CONCLUSION

The paper presents a discussion on asset management practices and strategy, brings out some important gaps from current requirements and presents a simple foundation for developing a systematic approach to transform existing asset management practices to strive for meeting current and future utilities objectives.

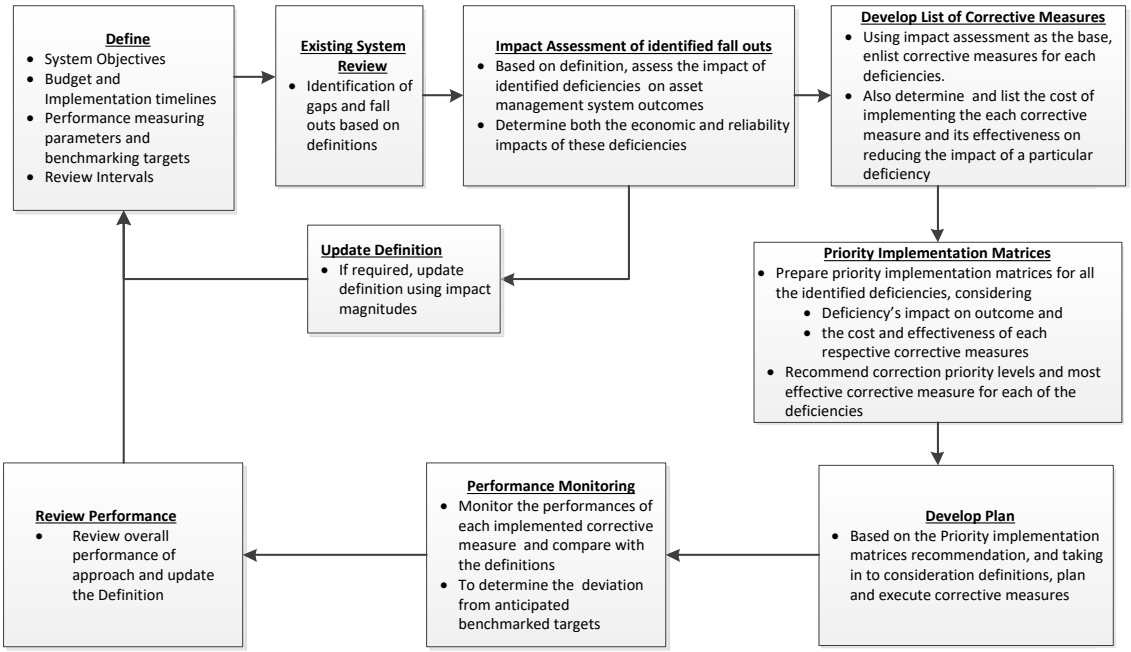

Fig. 1 Simple Systematic Approach to Modifying Asset Management Processes

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