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NAC Executive Insights

Sound Asset Management

Key Points

- Requirements for a sound asset management system are laid out.
- Specific considerations in infrastructure management are highlighted, but recommendations extend across capital asset classes.
- Characteristics of a sound asset management system are detailed.
- Major strategic and tactical impediments to a comprehensive asset management strategy are laid out and include gaps in vision, executive level support, and creating and resourcing an asset management organization, among others.
- Common tactical impediments to asset management system implementation are identified.
- Strategic and tactical benefits of successful asset management programs are summarized.
- Bottom line: Asset management success occurs when asset management is part of the daily work function, it is trusted, and more importantly, its data are seen as reliable and extensively relied upon for decision making and for driving asset management.

Introduction

Life cycle asset management is an area of growing focus and importance across all industries. This life cycle focus must not only be “cradle to grave,” but also holistic, addressing each of the triple bottom lines. This Executive Insight looks at one aspect of this life cycle asset management approach and reflects a growing focus on infrastructure asset management that is driven by roles in planning, designing, building, financing, and operating and maintaining road and rail systems that are delivered under a public-private partnership (PPP) model. Under PPPs, the provider assumes many of the life cycle roles and responsibilities traditionally and solely within the purview of the public sector. The introduction of this broadened triple bottom line perspective is starting to shift life cycle considerations from a good business practice to a significant business imperative.

Triple Bottom Line – measures the concept of sustainability performance in corporations. The 3Ps of the triple bottom line are People – Planet – Profit or Social, Financial, and Environmental performance.

One other dimension that is increasingly coming into play and that is totally reliant on strong asset management practices is a system performance dimension that manifests itself as business continuity in

the private sector, but is more closely akin to resilience in public, and for that matter, privately owned infrastructure.

This Executive Insight focuses on five questions:

1. What is asset management?
2. What are the characteristics of a sound asset management system?
3. What are the impediments or obstacles with respect to achieving its strategic intent?
4. What tactical challenges exist?
5. How is success defined and achieved?

While there is a primary focus on infrastructure asset management, many of the conclusions and recommendations here are more broadly applicable. Effective asset management arguably begins at the planning stage, but in new assets the population of the initial asset database begins in the engineering and construction phase.

1. What is asset management?

The classical definition of asset management is “the management of fixed capital assets to minimize the total cost of owning and operating them while providing the desired level of service at an acceptable level of risk.” Typically, risk is calculated as a cost and often is not managed separately.

This definition increasingly will prove inadequate or, at the very least, incomplete. A shift towards “life cycle analysis” occurs when:

1. Not only risk but uncertainty associated with long project delivery durations and increasingly longer asset lifetimes must be recognized and reflected in the analysis and management of capital assets. Are the assumptions made today assured of continued validity throughout a 100-year lifetime? How are capital assets provided and optionally preserved in the face of an unknowable future?
2. Life cycle performance, often measured by life cycle cost, is not a sufficiently adequate measure of an asset’s performance. Increasingly, however, the environmental and social performance attributes over its full lifetime must be considered. Nowhere may this be more important than in public infrastructure, where a “sweet spot” must be found on financial, environmental, and social performance. This change alone suggests an expanded and increasingly important role for proactive management of infrastructure assets.
3. The true measure of a well-managed asset is not just one configured to provide the lowest life cycle cost, but rather the highest life cycle returns. This means delivering an asset that is positioned to serve an evolving “market” and capture maximum value from that market. This is important as delivery models such as public-private partnerships are considered. Also related to maximizing returns is the selection and structuring of optimal project finance models. As the industry moves beyond exclusive use of municipal finance models to finance infrastructure, the delivery and the returns will grow in importance.
4. System-level performance characteristics, in particular resilience of infrastructure assets, will be achieved not only through good design, but most importantly how they are operated and

maintained. This sustained resilience is an essential objective of asset management systems in the near future.

Consider two descriptions of an asset management system:

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1. The American Association of Highway and Transportation Officials (AASHTO) Transportation Subcommittee's vision for asset management – "...a standard for State DOTs and others for making investment decisions and managing the nation's transportation system. Asset management should be applied/considered as part of the decision making process at all levels of an organization."
 2. The Federal Highway Administration (FHWA) Office of Asset Management's vision for asset management – "Asset management reflects and supports FHWA's vital few priority areas of Safety, Congestion Mitigation, and Environmental Stewardship and Streamlining. It addresses these areas by identifying capacity expansion or system management alternatives to alleviate congestion and improve mobility, by incorporating the costs of crashes or incidents in evaluating transportation alternatives, and by considering the impacts of projects on the environment."
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The first impediment to a sound asset management system may be an inadequate definition of what it is. True success must first be recognized in order to have any chance of achieving it.

2. What are the characteristics of a sound asset management system?

The key elements of asset management are:

- A cradle-to-grave life cycle approach.
- Developing and implementing cost-effective strategies, recognizing the long-term purpose and nature of these assets.
- Defining, establishing, and providing for a defined nature and level of service.
- Monitoring, maintaining, and where possible enhancing asset performance.
- Anticipating, mitigating, and managing risks associated with asset degradation and failures.
- Implementing asset management to achieve these objectives on a financial, environmental, and societal basis.
- Sustaining and where possible enhancing system-level characteristics of an asset, such as resiliency, flexibility, and future optionality.
- Deploying the limited financial, physical, and human resources of the asset owner in an efficient, effective, and sustainable manner. It is about making informed tradeoffs as part of the decision-making process.
- Continuously improving asset management practices.

Asset management must be not only systematic. It must be systemic. The asset management focus must consider total asset portfolio performance, not just individual elements. This is particularly true when higher level system characteristics such as resilience are considered.

Sound asset management systems exhibit several characteristics, such as:

- Clearly defined and well-communicated strategic business objectives.
- Executive recognition of the value that asset management brings and a commitment to making it successful.
- A focus on addressing the strategic-level impediments that may exist.
- Clarity in identifying and removing the tactical-level impediments that such programs face.
- Recognition of what success looks like.

Asset management, with its strategic focus across an entire asset portfolio and its use of quality information, fosters decision-making process that encourages preventive strategies rather than reactive “worst-first” approaches.

3. What are the impediments or obstacles with respect to achieving its strategic intent?

Major impediments that a comprehensive asset management strategy faces can be categorized simplistically into strategic and tactical. Of the various strategic impediments faced, the first is a lack of clarity on what is meant by asset management. It is not a maintenance program on steroids. Rather, it is much more, going to the strategic business objectives of the asset owner. In considering strategic impediments, it is useful to consider “gaps” that are often encountered in the asset owner’s approach—either when setting out on implementation or in programs not delivering adequate results. Some of the major gaps that impede asset management success include the following:

- **Vision and executive level support.** This includes establishing strategic business objectives for both the enterprise as well as the asset management program. These must be supported by *outcome* type metrics as well as the more traditional range of key performance indicators (KPIs). In capital program delivery, which is only one phase of overall asset life cycle, two-thirds of all major programs that fail suffer from inadequate definition, communication, and management of strategic business objectives.
- **Creating and resourcing an asset management organization** to implement the asset management plan, provide timely and valuable input to the management decision processes, and to learn and continuously improve the owner’s asset management practices. The establishment of a dedicated asset management organization represents an insurance policy for dealing with “off normal” events since they may best understand the inherent resiliency in the “system.”
- **Stakeholder management.** This begins with clear and comprehensive identification of all stakeholders and stakeholder groups. This is a growing challenge especially as asset management must consider not only financial life cycle performance, but also environmental, social, and a new cast of financing stakeholders as new delivery models such as PPPs are utilized. Stakeholder

communication must increasingly be synonymous with engagement, at times having to educate stakeholders, as the complexity of infrastructure assets and infrastructure “portfolios” increases.

- **SMART asset management plan development.** Asset management plans must be Specific, Measurable, Achievable, Realistic, and Targeted. In other words, they must be SMART. The plans begin with understanding the destination desire, knowing the current situation, performing an objective and comprehensive gap analysis, and evaluating alternative strategies and tactics to close the gaps. How can an organization change what it does not know when it only knows how it does it? There must be assurance that the right things are being done in the best possible way. Recognition that change is required is essential. Understanding the importance of deliberate and facilitated organizational change management is an important first step. It is only then that the new work processes required can be defined. Also being defined will be the new metrics that will matter most. Additionally, the essential training that must go hand in hand with an organizational change management program will need to be developed.

4. What tactical challenges exist?

The asset management systems on the market that are labeled as “commercial off the shelf (COTS)” are relatively expensive, and even more so if customization to a particular group of assets and/or integration with other systems is desired. Most COTS systems do not correspond to desired outcomes, that is, the performance metrics that are seen as tied to long-term infrastructure contracts.

In addition, today’s systems do not include a provision for timeliness requirements or tracking those items that will generate penalties. This is comparable to the regulatory or permit compliance challenges faced in industrial asset management programs.

As infrastructure owners increase their focus on asset management, the first steps often center on putting in place a maintenance management system (MMS). While this is far short of what is required for comprehensive asset management, an owner’s implementing an MMS or contacting out maintenance management for the first time are challenged by the necessary agreement that must be achieved on value-adding metrics.

Even when an effective MMS has been identified and demonstrated that it is capable of efficiently managing and reporting (with outcome-oriented metrics in addition to input styled metrics), agreement with the owner on those metrics can be challenging as well.

On existing infrastructure, agreement on the current condition, remaining service life, investment to attain service life versus analysis for early replacement, rehabilitation, or other intervention can all be interesting conversations.

The demarcation between preventive, routine, and major maintenance versus replacement and rehabilitation is a gray area at best.

And when it comes to technology, this becomes even grayer. The MMS may indicate that the technology in question is in perfect condition with remaining service life, but analysis of emerging or next

generation technology may demonstrate that replacement will be more cost effective than the required preventive maintenance on the older technology while providing more efficient operations.

The MMS chosen is only as good as the information present. Brownfield projects must have the assets surveyed for location and condition for input into the system. Often, maintenance history is not well documented, making investment strategies and maintenance/replacement plans less precise.

Finally, tactical impediments exist in the use of the system. Unless there are protocols for data entry and limited users, the data inputs can greatly affect the value of the data outcomes.

In a nutshell, when the system works it can save time, money, and enable good decisions. When it does not, teams develop work-arounds or simply ignore the data. Table 1 summarizes some of the tactical impediments often encountered to implementing an asset management system.

Table 1 Common Tactical Impediments to Asset Management System Implementation	
Cost/value of COTS	Mapping optimal work processes
Lack of outcomes based performance metrics	User training
Lack of timeliness provisions	Integration with other systems
Lack of regulatory and permit compliance provisions	Selected system does not organize and allow easy visual access to all asset physical data (i.e., identification, location, dimensions, material, connectivity, construction method, environment).
Agreement on current condition of an asset	Selected system does not provide the ability to forecast operations (and operations costs), maintenance (and maintenance costs), repairs (and repair costs), refurbishments (and refurbishment costs), and replacements (and replacement costs) and compare predicted costs to realized costs for improved decision making.
Agreement on remaining service life	Absence of standard procedure for approving capital project spending
Demarcation between maintenance and replacement and rehabilitation (MMS perspective)	Selected system does not contain and allow easy visual access to the required cost data necessary for making decisions regarding asset spending.
Technology philosophy and transition	Personnel are not trained according to documented procedures and the procedures are not regularly audited.

Inadequate asset surveys	Data quality and transition
Inadequate maintenance records	Limited system users
Weak data entry protocols	

An analysis of a private transportation company’s use of asset management principles and systems highlights several best practices:

- Proactive maintenance is more efficient than “worst-first.”
- Coordinating mechanisms between various asset classes must exist.
- Workers responsible for making asset management trade-off decisions require proper education and training in making those decisions.

With this as context, defining and achieving success will be examined.

5. How is success defined and achieved?

A direct linkage exists between the principles of asset management and those of sustainability. Asset management is “a systematic process of tracking and managing assets and the resources and activities required to construct, operate, and maintain them.” Sustainability can be defined as “using, developing, and protecting resources to meet current needs while ensuring that future generations can meet their needs.”

Success is achieved by:

- Linking asset management to the vision or mission of the agency.
- Securing sustained political commitment and leadership from the executive staff.
- Transforming data into useful information for decision makers.
- Facilitating the sharing of information between agency divisions and a broader stakeholder set.
- Maintaining a customer focus.

Asset management will add value if done well. National and international best practices must be adopted and processes and procedures developed and refined to take advantage of proven methods. Doing so creates an asset management system that is responsive, adaptive, and one that meets changing business needs brought about by new technologies or changed regulatory or legislative requirements.

The asset management system must build on existing good management systems and, in their absence, act as a catalyst for their creation. Asset management systems must recognize that the world of Big Data now is present. The ability to handle unstructured as well as structured data opens up new insights and new possibilities.

Asset management success occurs when asset management is part of an agency’s daily work function and is trusted and, more importantly, its data are seen as reliable and are relied upon for decision

making and driving asset management. In today PPPs, the provider is compensated for being able to run a train within say a six-minute window or is only paid for every lane-mile available to move traffic.

Asset management processes are regularly monitored as well as the data it produces. An effective asset management system underpins not only day to day maintenance activities, but longer-term strategic investment decisions. These processes support the case for funding requests in ways not previously possible. As they demonstrate achievement and improvement in outcomes, the processes become fundamental to strategy development, operational management, and reinvestment case development.

Asset-by-asset reports complement higher level assessments of system resiliency, which is a growing concern and a focus area—not only for infrastructure asset owners, but also for enterprises concerned with business continuity.

Successful asset management programs have:

- A system for ensuring programmed maintenance.
- A system for obtaining condition information and programming capital asset replacements to avoid capacity limitations or sub-optimal system financial, environmental, or societal performance.

Successful asset management programs have undertaken the foundational work required with respect to:

- Vision and support
 - Obtained understanding of program objectives and support from executive management and higher levels (board; commissions; political leadership—executive and legislative).
 - Establish relationships between levels of service and costs.
- Program organization
 - Established the asset manager position and formally chartered the asset management organization or team.
 - Obtained resources necessary to implement and sustain the asset management program.
- Program communications
 - Identified key asset management stakeholder groups and identified their interests.
- Program planning

Near-term actions are well-defined and address:

- Asset knowledge
 - Define the minimum level of detail for an asset (what assets to track).
 - Establish a uniform asset enumeration scheme (asset organization).
 - Identify existing assets and related attributes (asset data).
 - Identify the probability and consequence of failure of an asset (asset risk).
 - Establish the level of asset management performed (asset management strategy).
- Asset planning
 - Asset planning is important for two reasons:

1. A key goal is reducing asset ownership costs. Asset management accomplishes this through the classical plan/act/measure/control cycle. Asset management works by preparing plans for assets, carrying out the plans, measuring the results, and updating the plans accordingly.
 2. Having cost of ownership plans for all significant assets means the asset owner can accurately forecast aggregate ownership costs well into the future, giving a solid foundation for long-range funding plans.
- Asset Planning has three objectives:
 1. Establish short-interval portions of asset plans
 2. Establish long-interval portions of asset plans
 3. Develop procedures to update asset plans
 - Asset refurbishment and replacement (R&R):
 - Improved R&R planning arising from asset knowledge greatly improves the quality of capital funding strategies and has three objectives:
 1. Improve R&R planning.
 2. Improve R&R analysis.
 3. Ensure R&R actions are properly reflected in financial reporting.

Similar to near-term actions, well-founded asset management programs also ensure that long-term actions are well-founded, including:

- Asset development, including achieving these objectives:
 - Develop a systematic approach to creating assets.
 - Consider constructability, maintainability, and operability in the design process.
 - Require that enumeration schemes be followed by designers and contractors.
 - Maximize contractor contribution to asset development.
 - Prepare asset plans coincident with asset delivery.
- Asset operations and maintenance (O&M)
 - Defining required preventative maintenance activities
 - Preventative maintenance scheduling
 - Performing defined preventative maintenance activities at the prescribed intervals
 - Using indirect condition assessment where cost-effective
 - Performing corrective maintenance on a timely basis
 - Management of maintenance using a balanced approach between preventative and corrective maintenance
 - Recording maintenance costs on an activity basis, by asset
 - Management of operational methods to minimize the combined costs of O&M
 - Key objectives of asset O&M:
 - Proactive safety management
 - Track asset failures consistently
 - Prioritize work order backlog by risk
- Asset condition monitoring has three goals:
 1. Define condition monitoring methods

2. Define condition monitoring program
 3. Integrate condition monitoring with other management and work processes
- Asset financing is facilitated by more readily identifying refurbishment and replacement needs.
 - Asset financial reporting has the following two objectives:
 1. Improve consistency of asset accounting database.
 2. Improve change management procedures in fixed asset records.

Successful asset management programs provide strategic and tactical benefits such as those summarized in Table 2.

Table 2	
Strategic & Tactical Benefits of Successful Asset Management Programs	
Strategic	Tactical
<ul style="list-style-type: none"> • Improved reliability 	<ul style="list-style-type: none"> • Reduced labor costs
<ul style="list-style-type: none"> • Empowered workforce 	<ul style="list-style-type: none"> • Reduced materials/spare parts costs
<ul style="list-style-type: none"> • Streamlined organizational structure 	<ul style="list-style-type: none"> • Increased productivity
<ul style="list-style-type: none"> • Achieved business case for the improvement investment 	<ul style="list-style-type: none"> • Standardized maintenance
<ul style="list-style-type: none"> • Maximized use of existing assets 	<ul style="list-style-type: none"> • Integration of all software systems
<ul style="list-style-type: none"> • Best practices identified and made available across asset classes; shared with partners 	<ul style="list-style-type: none"> • More efficient scheduling and execution of work
<ul style="list-style-type: none"> • Improved asset availability 	<ul style="list-style-type: none"> • Eliminated worker complaints concerning human factors
<ul style="list-style-type: none"> • Reduced time to market 	<ul style="list-style-type: none"> • Reduction in equipment breakdowns
<ul style="list-style-type: none"> • Reduced inventory costs and shortened inventory turnover 	<ul style="list-style-type: none"> • Accelerated program development of maintenance craft training materials
<ul style="list-style-type: none"> • Raised plant capacity and production availability 	<ul style="list-style-type: none"> • Foundation of basic maintenance skills
<ul style="list-style-type: none"> • Made possible national accounts/ consolidated purchasing 	<ul style="list-style-type: none"> • Technology transfer of process specific knowledge and skills
<ul style="list-style-type: none"> • Total quality improvement 	<ul style="list-style-type: none"> • Documentation of maintenance improvement opportunities

<ul style="list-style-type: none"> • Reduced risk exposure 	<ul style="list-style-type: none"> • Integration of Lean principles into operational and production work processes.
<ul style="list-style-type: none"> • Reduced non-value activity 	<ul style="list-style-type: none"> • Shared maintenance expertise and spares inventory among assets
<ul style="list-style-type: none"> • Preservation of assets through optimal preventive maintenance program 	<ul style="list-style-type: none"> • Accurate spare parts inventory
<ul style="list-style-type: none"> • Reduction in costly equipment failures and replacements 	<ul style="list-style-type: none"> • CMMS with accurate reorder and reporting capabilities
<ul style="list-style-type: none"> • Reduced operations costs by optimizing plant layout for O&M 	<ul style="list-style-type: none"> • Accurate equipment lists for each location
<ul style="list-style-type: none"> • Improved resource allocation 	<ul style="list-style-type: none"> • Accurate P&IDs that meet all regulatory requirements
<ul style="list-style-type: none"> • Developed maintenance philosophy 	<ul style="list-style-type: none"> • Improved safety and hazard prevention

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