

## Role of a Sound Asset Management System in Life Cycle Program Management

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In my most recent book, “Application of Life Cycle Analysis in the Capital Assets Industry”<sup>1</sup>, I highlight that life cycle program 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 paper looks at one aspect of this life cycle based program management approach and reflects experience as a provider of a comprehensive range of asset management services to a broad cross section of industries. This experience base includes a growing focus on infrastructure asset management driven by our role in planning, designing, building, financing, operating and maintaining road and rail systems delivered under a Public Private Partnership model. Under PPP’s we assume many of the life cycle roles and responsibilities traditionally solely within the purview of the public sector.

While our asset management experience is much more extensive in various federal government and industrial facilities, we are seeing a convergence across all the markets we serve towards this more holistic, life cycle approach to capital asset portfolio design, initial delivery and the balance of a cradle to grave life cycle. Importantly, we see this perspective encompassing all three of the bottom lines comprising the Triple Bottom Line we associate with sustainability. The introduction of this broadened perspective is starting to shift life cycle considerations from a good business practice to a significant business imperative.

*In the contract between the government and Infrasppeed, as are provider, infrastructure provider, Infrasppeed guarantees 99.46 percent of the line availability of the line during 25 years. The fees earned depended on the actual availability of the system.*

Let me mention one other dimension that is increasingly coming into play and that is totally reliant on strong asset management practices. This 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 paper focuses on five questions:

- What is asset management?
- What are the characteristics of a sound asset management system?
- What impediments or obstacles exist with respect to achieving its strategic intent?
- What are the tactical challenges that exist?
- How do we define and achieve success?

## 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 not managed separately.

I will suggest that increasingly this definition will prove inadequate or at the very least incomplete. We are seeing a shift towards what I would call “life cycle analysis” where:

1. Not only risk but also uncertainty associated with long project delivery durations and increasingly longer asset lifetimes must be recognized and reflected in the analysis and management of our capital assets whether they are a mining operation at 13,000 feet in Peru, a manufacturing facility producing the nuts and bolts of construction or a new bridge spanning the Hudson. Are the assumption we make today assured of continued validity throughout a 100 year lifetime? How do we provide and importantly preserve optionality for our capital assets 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 assets performance but increasingly must consider its environmental and social performance attributes over its full lifetime. Nowhere may this be more important than in public infrastructure where we must find a sweet spot on financial, environmental and social performance. This change alone suggests an expanded and increasingly important role for proactive management of our 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 we consider delivery models such as Public Private Partnerships. Related to maximizing returns is the selection and structuring of optimal project finance models. As we move beyond exclusive use of municipal finance models to finance our infrastructure this will grow in importance.
4. System level performance characteristics, in particular resilience of our 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 now these two descriptions of an asset management system:

- **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.”
- **FHWA’s Office of 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.”*

**Let me suggest that the first impediment to a sound asset management system may be an inadequate definition of what it is.**

We must recognize true success to have any chance of achieving it.

Let's turn now to our second question.

**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 our decision making process.
- Continuously improving asset management practices.

One final thought is important. Asset management must be not only systematic but more importantly systemic. Our asset management focus must consider total asset portfolio performance not just individual elements. This is particularly true when we consider higher level system characteristics such as resilience.

Sound asset management systems exhibit several characteristics:

- Clearly defined and well communicated strategic business objectives similar to what we see in all well managed programs.
- Executive recognition of the value asset management brings and a commitment to making it successful
- 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, foster decision-making process that encourage preventive strategies rather than reactive “worst-first” approaches.

- *“In the past, it may have taken weeks to determine the activity related to a piece of equipment now it’s available immediately.”*
- *“This system allows easy monitoring and modification of equipment schedules when needed.”*
- *“This system has the ability to schedule preventative maintenance work to a specific location rather than scattered across the facility, reducing travel time and increasing productivity.”*

### **What impediments or obstacles exist 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, articulated previously, 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” often encountered in the asset owner’s approach either when setting out on implementation or in programs not delivering adequate results. Let’s look at some of the major gaps which impede asset management success:

- Vision and executive level support. Importantly this includes establishing those 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 KPIs. In capital program delivery, just one phase of overall asset life cycle, we see that

- *“The ability to see work orders for a process location reduces work orders written and provides information to operations that work is progressing.”*
- *“Planners can provide better estimates on bigger jobs based on work order histories for similar work, allowing management to make better informed decisions.”*
- *“Various users (engineers, craftsmen, managers) are able to easily query on information and tailor reports to their specific requirements.”*

two thirds of all major programs that fail suffer from inadequate definition, communication and management of strategic business objectives. While I am unaware of a comparable study in the asset management area it would not surprise me to see comparable findings.

- Creating and resourcing an asset management organization to implement the asset management plan, provide timely and valuable input to 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 stakeholder 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. They begin with understanding where you want to get, knowing where you are now, performing an objective and comprehensive gap analysis, and

evaluating alternative strategies and tactics to close the gaps. Continuously we must ask how we can change what we do not just how we do it. We need to ensure we are doing



the right things in the best possible way. Recognition that change is required is essential and understanding the importance of deliberate and facilitated organizational change management are important first steps. It is only then that we can finalize the new work processes required; define the new metrics that will matter most; and provide the essential training that must go hand in hand with an organizational change management program.

Let's look now at the tactical challenges that are faced in implementing an asset management system.

### **What are the tactical challenges that exist?**

The asset management systems on the market as COTS (commercial off the shelf) are relatively expensive. Even more so if you want to customize them to a particular group of assets and/or integrate them with other systems. Most of them do not correspond to desired outcomes – the performance metrics that we are seeing 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 we see first steps often centered on putting in place a maintenance management system (MMS). While this is far short of what is required for comprehensive asset management we find that owner's implementing a MMS or contacting out maintenance management for the first time are challenged to agreeing on value adding metrics.

Even when an effective MMS has been identified and demonstrated 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.

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 grey at best.

And when it comes to technology - this becomes even greyer. 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 you choose is only as good as the information you have. Brownfield projects have to have the assets surveyed for location and condition for input into the system and 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 doesn't, teams develop work arounds or simply ignore the data. Table 1 summarizes some of the tactical impediments often encountered.

<b>Table 1</b>	
<b>Common Tactical Impediments to Asset Management System Implementation</b>	
Cost/value of COTS	Mapping optimal work processes
Lack of <b>outcomes</b> based performance metrics	User Training
Lack of <b>timeliness</b> 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 provides 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	
Inadequate maintenance records	
Weak data entry protocols	
Data quality and transition	
Limited system users	

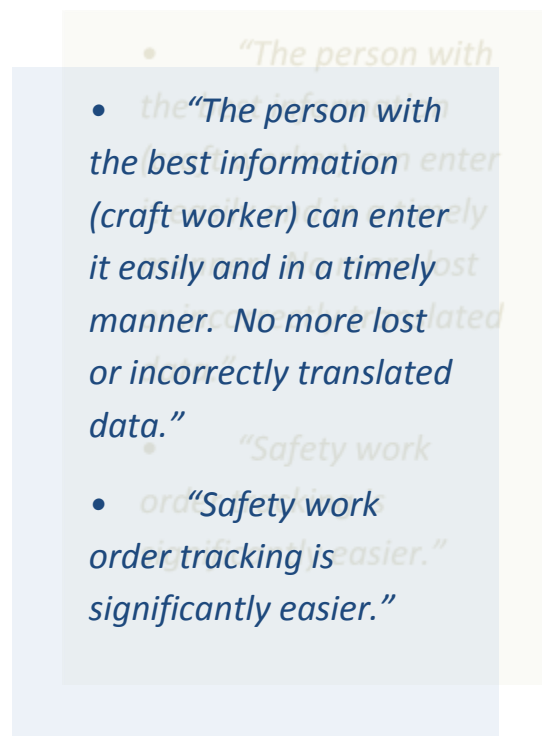
An analysis of private transportation company use of asset management principles and systems highlights several best practices:

- 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, let’s look now at how we define success and importantly, how do we achieve it.

### How do we define and achieve success?

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



Success is achieved by:

- Linking Asset Management to the vision or mission of the agency
- Securing sustained political commitment and leadership from 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 creating an asset management system that is

responsive, adaptive, meeting changing business needs brought about by new technologies or changed regulatory or legislative requirements.

It must build on existing good management systems and in their absence act as a catalyst for their creation. Asset management systems must recognize that we are entering the world of Big



Data and our ability to handle unstructured as well as structured data opens up new insights and new possibilities.

Asset management success is when asset management is part of an agency's daily work function and it is trusted and more importantly its data seen as reliable and importantly relied upon for decision making and driving asset management. We see this today in availability type PPP's where we are compensated for being able to run a train within say a six minute window or 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. They support the case for funding requests in ways not previously possible. As they demonstrate achievement and improvement in outcomes they become fundamental to strategy development, operational management and reinvestment case development.

Asset by asset reports complemented higher level assessments of system resiliency, a growing concern and 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.

They 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 Asset Manager 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:
    - A key goal of 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.
    - Having cost of ownership plans for all significant assets means that 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:
    - Establish short-interval portions of asset plans
    - Establish long-interval portions of asset plans
    - 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:
    - Improve R&R Planning
    - Improve R&R Analysis
    - 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
  - 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 3 goals:
  - Define condition monitoring methods
  - Define condition monitoring program
  - 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:
  - Improve consistency of asset accounting database
  - Improve change management procedures in fixed asset records

Successful asset management programs provide strategic and tactical benefits such as those summarized in the following table.

Strategic	Tactical
● Improved reliability	● Reduced labor costs
● Empowered workforce	● Reduced materials/spare parts costs
● Streamlined organizational structure	● Increased productivity
● Achieved business case for the improvement investment	● Standardized maintenance
● Maximized use of existing assets	● Integration of all software systems
● Best practices identified and made available across asset classes; shared with partners	● More efficient scheduling and execution of work
● Improved asset availability	● Eliminated worker complaints concerning human factors
● Reduced time to market	● Reduction in equipment breakdowns
● Reduced inventory costs and shortened inventory turnover	● Accelerated program development of maintenance craft training materials
● Raised plant capacity and production availability	● Foundation of basic maintenance skills

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

## References

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2. Impediments for Implementing a Sound Asset Management System; Center for Advanced Infrastructure and Transportation; State of Good Repair Summit; March 27, 2013

## About the Author



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