Understanding the History, Foundations and Benefits of Asset Management

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Precedents

Asset management is a decades-old function that is taking on new meaning as it moves from the boiler room to the boardroom, and as it evolves from a limited set of tactics to become a significant contributor to business strategy.

Asset management provides a new perspective on an organization and a basis for innovative organizational development. There are many advantages to organizations that adopt this view and it is likely to be a differentiator in periods of resource constraint. There are many supporters of asset management, from blue-collar operations and maintenance personnel, to CEOs and Boards of Directors. Each has their own reasons for support, and their numbers have grown as the concept has matured.

Current developments in asset management include: a burgeoning of literature and educational opportunities, a rapid gain in attention by societies and organizations, an increase of conferences and meetings on this topic, and the expansion and maturation of consultants and service providers.

In September of 2012, the International Organization for Standardization (ISO) released the Draft International Standard 55000 for Asset Management. It will be ready in final form in late 2013. This standard has widespread support in many countries and economic sectors.

The high-level question is: How can physical assets be best used to meet organizational objectives? The answer requires a fresh look at what the organization owns, why it was acquired, what condition it is in, where it is located, and what opportunities it provides or risks it entails. This process will uncover synergies among assets and among actions on these assets. It will also provide an additional method of measuring organizational performance through asset performance.

This approach is well supported by advances in the breadth, depth, and quality of asset data available, and in the tools for data management, analysis, and decision-making. It is also supported by advances in business process, control, and automation, which allow for efficient implementation of asset management decisions.

In this new view, the perspective changes from the management of an asset to the management of the contribution it makes and the value it provides in cooperation with other assets. It also broadens from a single life cycle stage, such as operations or maintenance, to a whole life view, including creation and disposal. The same is true when transitioning from an individual assets perspective to asset systems and systems of systems.

The shift in point of view, which underlies this paradigm, is quite straightforward at the conceptual level but is more profound as users uncover the details. Conceptually they are moving the management of physical assets from the periphery toward the center, and toward equality with the management of intellectual, information, human, and financial assets. Along the way, their organizations are developing a comprehensive and long-term view of how these asset classes complement each other across time and function.

A New Paradigm

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2ROA (return on assets) is already measured and reported in some asset intensive industries, such as oil and gas. It is discussed in ISO 55000 and is becoming more widely used in other sectors.
What is Asset Management?

The term “Asset Management” may have different meanings, depending on the context in which the term is used. In this white paper, asset management is portrayed as an organizational paradigm. However, it is also a discipline (or field of study) and a professional competence. In an organizational context, it is a management function that oversees the development, deployment, use, and retirement of physical assets.

A useful and often quoted definition of asset management comes from the text of the British Standards Institute Publicly Available Specification (PAS) 55: Optimal Management of Physical Assets. It defines asset management as the “systematic and coordinated activities and practices through which an organization optimally and sustainably manages its assets and asset systems, their associated performance, risks and expenditures over their life cycles for the purpose of achieving its organizational strategic plan.” This definition is intentionally broad and is meant to apply to variety of organizations and industries. Each of these industries may have its own view of asset management, depending on its history and the nature of the assets it manages.

Requirements of Asset Management

Asset management is best served by a management systems approach. The elements of this management system are defined in the ISO Draft International Standard and are similar to the elements of other management systems.

- Organizational commitment
- Leadership direction
- Planning
- Support services
- Operations
- Performance evaluations
- Improvements

The Business Case for Asset Management

The traditional business case for asset management focuses on cost savings through reduced operations and maintenance costs, along with improved productivity through increased reliability and availability. However, there is much more to asset management potential than is captured in these traditional measures. For example:

- Effective management of risk and liability is a part of the standard business case. A firm handle on assets can improve stakeholder confidence and increase investor interest.
- Assets contribute to the image of an organization, just as they contribute to its operation. Assets are often the front door to the enterprise, as in hospitality and retail, and improved design contributes directly to increased visits.
- Asset management provides a natural focus for understanding and managing hundreds of asset-related codes, standards, and guidelines that confront an organization.
- Mergers and acquisitions require a re-shuffling of assets. Asset data management facilitates a more reliable process and provides added leverage in negotiations.
- Asset management allows large organizations to standardize and simplify plants and equipment, reducing costs for spares and supplies, as well as for training and support.
- Carefully managed production and distribution assets provide assurance of supply to critical clients.
- Balancing of conflicting goals for energy, environment, safety, health, security, and profitability requires reliable data on asset capabilities and performance.
- Security programs require current asset knowledge.
The management of outsourced services is more effective when an asset management program is in place to support negotiations and to support performance assessment.

In many organizations, the need to allocate expenditures effectively across units and divisions is also an important driver. Asset management takes this allocation out of the realm of internal politics and moves it into quantitative management.

Growing Interest in Asset Management

Asset management is increasingly gaining attention as a core concept within organizational strategy. Internet searches on the British Standard PAS 55 have been growing exponentially since 2004, when the standard was introduced. The rise in interest in the proposed ISO Standard 55000 is even more dramatic.5

Academic literature on asset management, as shown by Google Scholar, is growing by more than 10,000 articles per year.6 Most operation and maintenance oriented conferences and meetings have added sessions on asset management, as have the conferences on utilities and infrastructure. The list of consultants, software, and services in this area is also growing rapidly, and a Global Forum on Maintenance and Asset Management has been established.7 All major Enterprise Resource Planning systems (ERPs) now accommodate asset management and many are selling it as a major feature. The Institute of Asset Management, a U.K. based organization with an international membership, is experiencing exponential growth in membership and activity.8

Who Wants Asset Management?

Asset management has gained momentum because of proven needs and proven benefits to many industries and economic sectors. In any individual organization, there are supporters of asset management at all levels:

- Boards of Directors will use it as a tool for accountability.
- CEOs find it to be a powerful tool in resolving conflicts among divisions over resource allocation.
- COOs see it as a lever to improve integration and performance.
- CFOs will use it as a source of data to reduce risk and improve opportunity in mergers and acquisitions.
- Public Relations officers expect to use it as a way to reduce or deflect exposure from incidents.
- Asset managers see it as way to improve their influence and budget.
- Operations and maintenance workers expect it to help them improve working conditions and job satisfaction.
- Customers are looking for improved service and for accountability.
- The majority of all employees favor sound environmental policies and practices related to assets.

History

The modern strategic approach to asset management builds upon substantial roots in public infrastructure management. The 1988 report “Fragile Foundations,” by the

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7 http://gfmam.org
National Council on Public Works, described health, safety, and productivity concerns caused by deteriorating infrastructure. Stakeholders recognized the need for large expenditures to catch up with deterioration, and the concept and practice of asset management came into play as a method to prioritize and manage these expenditures, as well as a way to avoid future problems.

Similar needs have emerged in other sectors:

- Publicity of large-scale industrial failures has increased public concern and organizational emphasis on asset risk and reliability.
- Growth in the size of organizations has increased discontinuities and conflicts among divisions, leading to competition for assets.
- Accountability and care for substantial moveable assets requires special attention in the defense, transportation, and public sectors.
- Outsourcing of many asset management responsibilities requires increased emphasis on effective goal setting and contract management.
- Economic recessions put pressure on organizations to control costs and make effective use of all resources, including physical assets.
- Societal emphasis on recycling and reuse supports a life-cycle approach, which is inherent in asset management.

As these needs were recognized, the extraction industries, heavy manufacturing, government services, private utilities, and regulated industries began to build their own asset management practices.

Recently, asset management has become an issue for the Department of Homeland Security, which lists 15 critical sectors in its National Infrastructure Protection Plan. These sectors include banking and finance, commercial facilities, and the more traditional infrastructure categories.

Changing Definitions of Asset Management

As the field has broadened, the definitions have changed. The U.S. Environmental Protection Agency (EPA) definition, which was developed in response to the infrastructure crisis, provides a tactical definition focused on service:

"Asset management is maintaining a desired level of service for what you want your assets to provide at the lowest life cycle cost. Lowest life cycle cost refers to the best appropriate cost for rehabilitating, repairing or replacing an asset. Asset management is implemented through an asset management program and typically includes a written asset management plan."\(^9\)

The current ISO Draft International Standard 55000 provides a strategic definition, focused on value:

"The coordinated activities of an organisation to realise life cycle value from its assets in delivery of its objectives." (Kings English left intact)\(^12\)

This is a refined version of the definition from PAS 55 quoted earlier. The ISO Standard is devoted to explaining and enforcing strategic and comprehensive asset management. It avoids the use of the term “optimization,” and focuses on balancing objectives and expenditures though a very broad systems approach. This approach opens the door to a new level of management, involving all asset types and all asset classes, and introduces non-asset solutions.

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Foundations of Asset Management

Effective asset management is goal-oriented, comprehensive, and data-driven.

Goal-oriented

It is important to match the asset management strategy to the organizational strategy for a number of reasons [Figure 4].

- Move the economic analysis of assets, which spans decades, from a first-cost/annual-cost basis to a lifetime basis.
- Support the management of asset systems in terms of their contribution to top-level goals.
- Recognize that assets form a part of the customer interface, and effective management is often a key component of customer satisfaction.
- Facilitate top-level engagement in asset management activities, including effective investment, operation, and maintenance.
- Effectively integrate organizational objectives related to quality, security, energy, and environment into the management of physical assets.

Goals imply objectives, which must be measurable. A few examples can be helpful in understanding how this works in asset management.

Infrastructure goals are typically stated in terms of the desired level of service. The goal of asset management is to meet these service levels in the most cost-effective way possible.

- In a water utility, service level objectives might be stated in terms of water quality, water flow and pressure, and interruptions.
- In manufacturing, asset management objectives are often phrased in terms of equipment reliability and uptime, as well as cost of operation.

Leadership direction and support is a requirement of asset management. Many discussions of asset management systems refer to the need for a two-way “line-of-sight,” from the executive level to the level where assets are employed, to ensure consistency with high-level organizational objectives.

Organizational culture also plays a role. Asset management involves millions of small decisions and actions. These decisions cannot all be scripted but are made on the basis of values. There are many examples, both good and bad, where decisions about asset operation and maintenance were based on organizational culture and values (sometimes unstated) rather than on explicit processes and protocols.¹⁴

Comprehensive

Asset management is comprehensive in three dimensions:

- Length: lifetime of the asset system
- Breadth: span of the asset system
- Depth: individual components of the asset system

These dimensions are described briefly in Figure 5, and together they provide the scope of an asset management plan.

The diagram shows four generic stages in the lifetime of an asset. Many organizations will use eight or more stages, introducing analysis, design and construction details, and additional information on repair and refurbishing stages. A key activity in managing the lifetime of an asset is a life cycle cost analysis. This is a well-known procedure, which allows two points of view: the owner’s view, (now commonly expressed as “total cost of ownership,”)¹⁵ and the

asset's view (the whole life of the asset). This whole life view may be theoretical or pragmatic, but it is universally recognized that the acquisition stage (often approximately 20 percent of the life cycle cost) determines much of the later stages.\textsuperscript{16} Modern theories of sustainability often require that the asset developer and initial owner have some responsibility for the asset through the end of its life, whether they continue to own it or not.

Defining the span of asset management is an important decision. Will an insurance company include all of its small claims centers, or just its headquarters and regional offices? Will a retail establishment include all of its stores or just those above a certain threshold in size or amount of sales?

Assets can be managed as individual units, as systems, or as systems of systems. As an example, consider a boiler inside of a larger system: a boiler > a hot-water system > the whole HVAC system > the building > the campus. A broad view of asset management requires an understanding of nested systems and management of interactions across systems.

The depth to which assets are managed may stop at the unit level (e.g. a single escalator), may go down to the component level (e.g. motors, controls, and hardware), or may go up to the systems level (e.g. all conveyances or even the whole building). Increasing depth requires increasing data collection and analysis to support more fine-grained decision-making. The record for a single electric motor, for instance, may include six to ten parameters. Like breadth, depth is often incrementally increased as asset management capabilities mature.

The statement of scope defines the portfolio of assets to be managed. A multi-stage asset management plan may call for increasing scope at each stage, and that increase may be in depth, breadth, or length. In many cases, an organization will choose a restrained portfolio of assets to begin the program, perhaps one building on a campus or one division of a manufacturing organization. The first step in scope setting is an examination of the organization’s mission, vision, values, and strategic objectives to determine which assets contribute to these objectives and how they will be managed to be most effective. There are many tactics and tools to aid in scope setting. The most common of these are inventories and criticality assessments.

Understanding the dimensions of asset systems is only the first step. Developing a management system to integrate across these dimensions is much more difficult but is also at the heart of effective asset management.

The issue at hand is achieving integration across time. This is a significant challenge because the life cycle stages are often silos, with their own budgets and organizational structures. An effective change-management approach is required.

Integration across systems with overlapping functional impacts has many of the organizational and financial challenges of integrating a single system across time. Lighting systems offer an example. Light levels in a space can affect safety, security, and productivity, as well as heating and air conditioning energy use, and electricity demand. Light levels may be determined by fixture type, placement, and operation, but room colors, textures, flooring, and furnishings also influence light levels. Day lighting may be a primary or secondary consideration, and it is also influenced by window material, design, and placement, as well as internal and external treatments. An organization may well divide responsibility for the building exterior, interior, furnishings, electrical systems, and controls into separate functions. Asset management needs to integrate these functions to achieve its goals, whether they are cost control, productivity, or aesthetics.

Vertical integration within a system is also an issue since different parts of the organization may be responsible for different pieces of a lighting or HVAC system. Systems engineering tools are often employed to support this level of understanding and management.\textsuperscript{17}

At the management systems level, integration is also required across asset types. This includes human resources, information technology, and finance. It may also include intellectual property (the basis of many products and processes), sales, and marketing. When new assets are considered, non-asset solutions must also be part of the analysis.

Data-driven

Being data-driven means that asset performance goals are set, Key Performance Indicators (KPIs) are developed, and data is collected to support these indicators. This data is a combination of asset performance data, such as input, output, and run-time, and organizational performance data, such as occupancy, traffic, and sales.

The idea of being data-driven also applies to the management of the assets themselves through asset condition data, such as wear, or asset operational data, such as temperature and vibration. The term asset data management has emerged as a comprehensive descriptor.\textsuperscript{18} There are two different points of view on asset data management: the view which says that more data is better, and the view that says that data does not equal knowledge.

\textsuperscript{18} DiStefano, Robert S. and Thomas, Stephen J. Asset Data Integrity is Serious Business, 2010, Industrial Press, New York, New York
The first view asserts that increasing availability of large amounts of data on asset condition and performance and the development of tools to manage this data are the key reasons for changing practices in asset management. Organizations are now able to see where their assets are located, how they are allocated, and how they are performing. This data comes from many sources. Initially, it comes from the manufacturer through the supply chain or from the contractor through a Building Information Management (BIM) system. Then it comes through machine self-diagnostics, through metering and monitoring systems, through sensors associated with automatic controls, and through digitized field notes and repair records. Increasingly, it is provided in usable formats that can be incorporated into standard business processes and Enterprise Resource Planning (ERP) systems.

The second view, which is shared by many at the operational level, asserts that there is no shortage of asset data. A modern building may have thousands or tens of thousands of sensor points. Instead, the problem is getting the right data, in the right format, then analyzing and using it effectively. Sensors from different vendors may be set to different parameters and may report into different data formats; integrated use then requires data consolidation. Even basic construction and equipment data is often missing, especially in older facilities.

Both views agree that a major stumbling block is the many separate databases that now exist to support asset management. These include asset inventories, building automation, computerized maintenance management systems (CMMS), spares inventories, supply chain, and ERP systems. The common goal is effective system information through database integration. New technologies and services are coming along to help in this quest, but they are expensive and require management guidance and executive oversight, as well as the participation of the owners of other asset classes.

A key step in the management of asset data is the development of the asset taxonomy. This taxonomy may be specified at the industry level, such as in oil and gas, or it may be unique to the organization. It is likely to require considerable effort to develop and deploy, but without taxonomy, data cannot be effectively gathered, stored, or used.

Large datasets provide the information necessary to improve maintenance, operation, and capital investment decision making. Collection of this data is not normally a competitive issue and there are benefits for all. The U.S. Department of Energy supports data sharing through its Commercial Buildings Consortium. Other sectors are considering similar efforts. Support for asset data management is rapidly developing, through associations, societies, and consultancies. As a result of these efforts, asset managers will increasingly face the problems and opportunities of “big data,” and they will need to understand these phenomena.

The final issue is decision making. One of the benefits of asset management is to take asset development and allocation decisions out of the political realm and into the scientific realm. Accurate data that yields accurate information allows but does not guarantee good decisions. Predictive tools are used for maintenance and repair/replacement decisions, while multi-criteria tools are used for asset allocation.

**Perfect Storm**

The current attention to asset management is the result of a confluence of events, a “perfect storm,” representing need and opportunity.

**Need**

- The problems with aging public infrastructure, which received much attention in the 1980’s and 1990’s, have only partially been resolved by standard development and funding on the part of agencies like the EPA and Federal Highway Administration. Failing bridges, crumbling highways, and overloaded sewers still regularly confront society. Recent headlines about industrial accidents in Japan and the Gulf of Mexico add to this unease. Commercial buildings, which make up the core of our urban areas, are on average 40 years old in the Midwest and 65 years old in the Northeast.
- Changing technologies and business patterns have rapidly reduced the need for retail and office space per person. This reduction has led to competition based on features and functions. The collapse of the real estate market led to a reexamination of the core value of many of these assets. The marginal assets have sometimes been abandoned.
- Continued slow growth has increased the economic pressure for productive use of all assets: physical, technological, and intellectual.

ISO Standard 14224 Petroleum and natural gas industries — Collection and exchange of reliability and maintenance data for equipment is the model for most asset management taxonomies. This taxonomy was setup to provide a basis for sharing reliability and maintenance (RM) data among corporations. It supports information on the business, location, function, and equipment attributes of any significant asset.


• A shortage of skilled workers in maintenance and operation requires effective use of their time.

• Energy and environmental pressures contribute to a steady march of regulations, and ever-increasing demand for efficiency, particularly felt in urban areas.

• Homeland security is an increasingly complex issue, involving assets in many sectors.

Opportunity

• Asset data is increasingly available. Sensor technology, network technology, and database management all contribute.

• Data analysis and decision-making tools are growing quickly, along with the capability to use them effectively.

• Automation, especially when integrated with analysis, provides rapidly expanding options for efficiency improvements.

• Industry associations use new data to produce benchmark information.

• Assets are often the face of the enterprise to customers and investors, leading to growing awareness of asset potential.

• Return on asset information is increasingly produced and used by managers and investors.

• Shifts in the technology and geography of manufacturing open up new avenues for the U.S. economy. Some previously lost production is returning.

• Many firms are looking for opportunity to invest their capital, and investments in machinery and automation rank first in activity.

• Educational institutions are expanding curricula in asset management.

• Internal and external consulting services are acquiring new skill and experience in guiding the implementation of asset management.

One result of this “perfect storm” of events is the development of an international standard. The standard will support change by providing common language and international exposure for asset management, leading to increased tools, techniques, products, and services. When the standard is released, many organizations will readily adopt it, adding to the resources, knowledge, and information available.

Next steps

The city of Calgary, Alberta, Canada is a great illustration of the asset management paradigm: goal-oriented, comprehensive, and data-driven. Calgary, a city of more than one million people and over $25 billion in assets, has a corporate asset management department. The department supports integrated decision making on asset investments across the city: police, properties and buildings, emergency medical services, fire, fleet, information technology, parks, roads, transit, waste management, water, and sewer. This department serves as a model for many communities and demonstrates the potential scope and influence of asset management.

The international standard for asset management follows new ISO guidelines for consistency in management standards. The integration of asset management with energy, environment,