



UNIVERSITY OF
CAMBRIDGE

Cambridge Service Alliance

Executive Briefing

ENGINEERING ASSET MANAGEMENT: ISSUES AND CHALLENGES

Delivering business objectives by extracting value from assets



Conclusions of the 2012 Cambridge Service Week workshop
on the future of Asset Management

The Cambridge Service Alliance

The Cambridge Service Alliance is a unique global partnership between businesses and universities. It brings together the world's leading firms and academics, all of whom are devoted to delivering today the tools, education and insights needed for the complex service solutions of tomorrow.

About the Cambridge Service Alliance

Founded in 2010 by BAE Systems, IBM and the University of Cambridge's Institute for Manufacturing and Judge Business School, the Cambridge Service Alliance brings together world-leading organisations with an interest in complex service systems to:

- ⇒ Conduct insightful, yet practical research to improve the design and deployment of high-performance complex service systems.
- ⇒ Create and develop industrially applicable tools and techniques that deliver competitive advantage.
- ⇒ Provide an unparalleled network of academics and industrialists that share experience, knowledge and insight in how better to design and deploy high performance complex service systems.
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The Cambridge Service Alliance will bring together up to six further companies prepared to make significant and long-term contributions to support the Alliance. Benefits of joining include:

- Challenging yet practical insights into the design and delivery of high-performance complex service solutions.
- Practical tools, techniques and methodologies.
- Education and training to enhance capabilities in service and support.
- A stimulating international network of the world's best talent engaged in solving problems associated with complex service solutions.

Academic members

The Alliance draws on members from across the University of Cambridge, initially from the Institute for Manufacturing and the Judge Business School.

Internationally leading researchers and educators will be invited to join the Cambridge Service Alliance to meet specific research requirements and the needs of industrial members.

Further information

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Executive Summary

What is Asset Management?

Asset Management is the coordinated activities of an organisation to realise value from the physical assets it owns and uses. While Asset Management is not new, new approaches to, and the new profession of, Asset Management, are required to meet the demands of operators, shareholders and customers.

Owners are demanding greater value, for less overall cost, from their assets. New technologies enable higher performance and greater safety, but at a price. Initial purchase costs are rising, leading to longer periods in service. Maintenance requires a more highly skilled, and so more expensive, workforce.

New Approaches

Asset operators are adopting new approaches to Asset Management. Increasingly they are owning, and maintaining, fewer assets and increasingly relying on complex organisational structures to provide them. Much greater coordination and sharing of data and resources, across multiple organisations is required, to make decisions to the benefit of all those involved in owning, using and benefiting from the assets.

In September 2012 the Cambridge Service Alliance brought together leading industry practitioners to discuss the challenges and opportunities that Asset Management must face over the next

five to ten years. These experts identified the barriers and enablers to efficient Asset Management, and discussed the challenges that must be overcome to make better use of scarce and expensive assets.

Improving Asset Management practice

The group identified four key areas that must be adopted or utilized more effectively to improve Asset Management practice:

- ⇒ Effective decision making. Improving decision making across the organisation, through better use of longer term financial, and non-financial, metrics to deliver value for all involved in managing assets.
- ⇒ Organisational changes. Organisations must evolve to enable better decision making and share knowledge and skills, breaking down silos and boundaries resulting from functional specialism and multiple cost centres.
- ⇒ Data capture, sharing and standards. Improving the quality and availability of the information available for decision making.
- ⇒ Predictive analytics. New information technologies are available to improve Asset Management, but several barriers prevent their effective use. ■



Introduction

Asset Management is a comparatively young discipline, but is an increasingly important organisational competence. But what is Asset Management? The ISO draft definition states that Asset Management is: “the coordinated activities of an organisation to realise value from assets”. In turn, an asset is “something that has potential or actual value to an organisation”. Clearly this encompasses a huge range of assets including property, infrastructure, facilities, physical equipment and plant, and many others.

These definitions reflect the remarks of David McKeown, CEO of the Institute of Asset Management, in a December 2011 interview. When asked how he saw the future of Asset Management changing, he made the following comment.

“There are two ways of looking at that. I think there are the actual changes within Asset Management and I think there’s the increasing and encouraging awareness that’s developing. I’d probably suggest that it’s going to be much more senior in most organisations as chief officers realise that actually they have direct accountability and I think that means that people are beginning to understand that it’s business driven. It’s not really about managing assets; it’s more about actually delivering the business objectives by extracting value from assets.”

Extracting the maximum value from an asset requires a broad range of expertise, whether that is business and financial know-how, or engineering and operations capabilities. These skills may be required at different stages of an asset’s life, when acquiring, utilising and maintaining the asset, for example. They are also needed to make decisions about how to best combine factors such as costs, risks, and performance.

In 2014, the International Organization for Standardisation is due to publish the ISO55000/1/2 family of standards relating to Asset Management. The publication of these standards, currently under development through ISO Committee PC251, with 28 countries participating, will be a significant event for the Asset Management discipline.

While ISO 55000 is still in development, the existing PAS55 British Standards Institute specification shows what “good” Asset Management practice looks like. In particular, that Asset Management should be: integrated; optimal; risk-based; systems-oriented; systematic; multi-disciplinary; and sustainable. The Institute of Asset Management have identified the core subjects that make up the Asset Management Landscape and practitioners should be familiar with. However, many questions remain unanswered relating to the main objective of Asset Management – how to extract maximum value from the use of assets.

With the objectives of Asset Management becoming clearer, Asset Management gaining recognition as a discipline and ISO 55000 well underway, we feel it is the right time to explore the future.

In September 2012, the Cambridge Service Alliance brought together leading Asset Management practitioners as part of the annual Cambridge Service Week. The group identified some of the trends and drivers shaping the development of the profession. It then examined in greater detail those enablers that will help maximise the value extracted from assets and the associated challenges. In doing so, we hope to locate those problem areas where stakeholders, including both practitioners and academics, can most profitably focus their resources on finding solutions. ■



Trends and Drivers

Asset Management is evolving to adapt to the changing needs of asset owners, operators, and end-users. There are a number of different trends and drivers shaping the way in which organisations think about the provision of complex services and, as part of that, Asset Management. Many of these overlap to some extent, or interact with each other.

Economic and competitive pressures

Difficult global and regional economic conditions, and highly competitive markets, mean that companies and their customers are increasingly focused on trying to be more efficient and drive down costs, including the total cost of ownership of assets. At the same time, they hope to improve the performance of their assets, where possible, and to create and capture greater value. The objective is to do more with less.

Organisations also seek to become more flexible and agile in order to respond quickly to market opportunities and to threats to their business, as well as becoming more resilient, so that they are able to endure adverse economic conditions.

These trends lead to changing behaviours, both at an individual and organisational level.

Less emphasis on ownership

Increasingly there is recognition that asset ownership is not necessarily the most effective way of meeting objectives. An increasing number of companies, across different industry sectors, are moving towards asset-sharing or asset-leasing models of operation. The UK rail industry is a classic example of this where railway engines and carriages are owned and maintained by Rolling Stock Operating Companies (ROSCO), which lease stock to Train Operating Companies (TOC) which provide passenger/freight services.

Finance

Insurers and investors are less willing to provide insurance, or invest, if they are not satisfied that an organisation has good Asset Management practices in place. Thus organisations that do not keep up with current good practice may find it increasingly difficult to get insurance – and have to pay much higher premiums – or to attract investment.

New methods of assessing the value, costs and risks of a contract are opening up new opportunities, particularly the ability to take a through life view of value. Real Options and other novel techniques provides a subtle but importantly different perspective, allowing decision makers greater certainty when they compare different approaches or investment options, or factor in softer measures. However short-term cash flow and reporting requirements often prevent investments that well established techniques such as Net Present Value calculations demonstrate are worthwhile.

New business models

These different trends have prompted organisations to re-evaluate their business models, and the way that their value creation chain is structured. It may involve creating new business models, applying business models that already exist in small pockets, but that are not widely accepted, or reworking elements of existing business models.

At a basic level, for example, organisations traditionally viewed as product manufacturers and suppliers are now contracting to offer services, as part of a process known as servitization. At a more detailed level, this might involve, for example, contracting on the basis of providing an outcome, such as the availability of an asset, or assuring a capability for the customer.

Growing complexity

The world is rapidly becoming a much more complicated place. The move to develop different business models both adds to and reflects a general trend of increased complexity. Greater complexity is evident in many areas of organisational operations and has a significant impact on approaches to Asset Management.

For example, almost every asset is becoming more complex. The growth of electronic sensors and control systems in equipment such as diesel trucks leads to greater performance and efficiency, but makes them much more difficult to maintain. New technical requirements for systems and equipment, such as those around signalling control centres, to name one example, also add to the complexity.

There is increasing complexity in the relationships organisations are forming to create value. In sectors such as pharmaceuticals, for example, organisations are looking beyond their boundaries for input into their innovation processes. Broader organisational trends,



such as open innovation, have been very influential on business practices. Collaborative practices within industries are becoming more commonplace.

In complex services this is evident from a greater willingness for asset owners, operators and users, to cooperate and collaborate with other organisations in the production and delivery of services. There are more joint ventures, more privatisations. Competitors with a pragmatic mindset may work together in “co-opetition” and share in service delivery if the alternative is to increase costs or lose business. Indeed this may be the case even though elsewhere in their businesses the same organisations are in dispute.

Complicated stakeholder relationships create a number of challenges, such as determining who actually owns the asset. A firm may operate a concession in a terminal, for example, where the Government owns the concession but it is leased for a period. Trying to satisfy commercial objectives, with different stakeholder objectives becomes more difficult.

There are also challenges relating to the sharing of proprietary knowledge. It is a challenge already encountered by organisations that are outsourcing core capability. If an organisation outsources service provision, how much knowledge is ceded to the asset owner, or long term asset operator, and how much is retained by the service provider?

Increasing asset and contract lifetimes

Other complexities also emerge from dealing with outcome- or capability-based contracts running over long time periods. Many organisations, with a strategy of procuring their assets to the peak that they work at, have equipment pools that are aged, over-utilised and under-maintained or neglected. These organisations are constantly trying to find the optimum amount of equipment to do the task at hand. A lot of built infrastructure is also getting old, and likely to require greater attention, from a maintenance or replacement perspective.

Different combinations of product lifecycles for different equipment also complicate matters. An organisation might have prime assets on a 50 year plus product lifecycle, IT systems with a lifecycle of four years, and a means of production that has a life cycle of ten years. How does it get those lifecycles to work together in an Asset Management context, so that it still has the means of production,

means of supply, and means of sustainment out to fifty years when nothing is stable and everything has different lifecycles?

Customer awareness

While there are many trends and drivers supporting new approaches to Asset Management, at the same time many organisations have not adopted these developments. For many organisations adopting an integrated Asset Management strategy requires a complete rethink of the way that the organisation is structured and run.

Effective Asset Management requires tight integration, through the whole of the asset life, irrespective of where people sit in stakeholder organisations. It crosses traditional internal organisational structures, and moves outside of the organisation into the supply chain, across traditional organisational boundaries and contractual relationships. Organisational inertia must be overcome to gain benefit from a better understanding of Asset Management, and new career routes must be created for asset managers.

Human resource capability is a major issue. There is a significant skills gap in Asset Management, with very few specialised training and development programmes, or professional qualifications, for asset managers. The Institute of Asset Management formally launched both its IAM Certificate and Diploma qualifications in June 2012. However, it will be some time before the first generation of true commercial asset managers start reaching senior positions.

Industry specific issues

Some industries have experienced specific trends that impact asset use. For example, in the defence industry there is a long term trend to reduce the size of full-time, uniformed forces and concentrate them on front line activities, rather than do-everything policies that the military have previously employed. This has led to increasing dependence on private sector contractors and the consequent increase of industry and public sector influence on military operations.

Unlike many Asset Management systems, military systems must cope with both regular use and short-term surges. For example, the Royal Air Force must guarantee the availability of assets to meet the long term requirements for training and ongoing commitments such as Operation Herrick in Afghanistan, simultaneously maintaining the readiness of equipment for short-term (and short



notice) operations like Operation Ellamy, the recent intervention in Libya.

Historically, the military dealt with readiness by being asset rich, with large fleets of equipment in reserve or under-utilised. Having a big fleet ensures readiness, as you can always generate the assets needed from that fleet, in extremis by using the rest of the fleet as a source of spare parts. However, with budgetary constraints, the ability to be asset rich is diminished. That same readiness must be generated from a smaller asset pool. Thus in the defence industry, service models are about having the right asset at the right place, ready to do a mission when it is needed from a smaller asset pool.

In built infrastructure other factors are particularly relevant. These include changes in the motorway programme, the changes in the way that we pay for water, and the increasing importance of Building Information Management systems, for example. Faster and cleverer ways of preparing and maintaining built infrastructure are emerging as we become more overloaded and congested.

Other external impacts

Beyond increased complexity, a number of other external trends are affecting Asset Management.

Take combatting climate change, for example, with its carbon costing and climate change mitigation measures. People alter their behaviour and travelling patterns to reduce carbon consumption. Climate change also directly impacts on assets such as built infrastructure. Sea level rise, for example, means a much greater flood risk and increased coastal erosion. Organisations engineer and operate assets in accordance with new legislative and regulatory requirements concerning climate change.

Regulation, legislation, and industry standards are important drivers too. The ISO 5500x family of standards due to be introduced in 2014 will set a new International Standard for Asset Management and good Asset Management practices. This is likely to have a significant effect. Potential investors, customers, and collaborative partners are likely to demand organisations meet these standards. Companies that are not certified may be at a significant disadvantage. ■



Key Issues and Challenges

Having identified the trends and drivers affecting how organisations manage their assets, organisations, and Asset Management professionals in particular, must overcome challenges in a range of issues.

EFFECTIVE DECISION MAKING

The overall objective of Asset Management is to ensure assets generate the maximum or optimal value to all the stakeholders. For the owner of the asset, this would involve making decisions throughout the asset's lifecycle aimed at minimising the total cost of ownership of the asset while not compromising safety and performance. To do this, resources must be appropriately allocated across the network of organisations engaged in delivering that service. Risk should be allocated to where it can best be managed. In an ideal world, profits should be optimised on a network wide basis, and apportioned according to the effort provided by, and risk allocated to, the individual companies involved.

Effective decision making is a fundamental part of this process. When supply chains were short, and the manufacturer responsible for all aspects of output, effective decision making was less of an issue. Today, the supply chains involved with the delivery of many asset related services are extremely complex. There are many agents involved in delivering the output contracted for, and this compromises effective decision making.

But if it were possible to capture both the hard financial dimensions and softer dimensions of a decision's impact and allow all those involved in making that decision to see that information, then it should be possible to begin to optimise decision making across the entire system.

There are, however, many challenges to attaining what many might view as an improbably utopian view of service delivery - where costs and profits, are appropriately shared across the network, founded on network wide, optimal decision making.

Challenges

Silo mentality: Where there is a network of organisations delivering a product and associated service, there will be cost and profit centres fragmented across the network. They will be in different silos within the company. There will also be organisations outside the company incurring costs and generating profits. Each silo will be under

pressure to perform on a short-term basis, whether that is weekly, monthly or quarterly. As a result decisions are often made from a local perspective based on short-term objectives, rather than a long-term network wide perspective. Siloed thinking creates tensions across the network and sub-optimal decision making.

Take a company that designs and manufactures heavy plant machinery. In one part of the value chain the design engineers may focus on cost reduction. Trying to design and build it as cheaply as possible, reduces costs to a minimum and helps to improve the individual P&L position. However, if the machinery is then supplied on an availability based contract, it may incur greater maintenance costs and penalties. Once you move into the 'operate and maintain' element of the contract, the service costs climb. Alternatively, the machinery may be designed and built to last as long as possible, which means pushing up costs at a local level. So what makes sense to one function or cost centre has an adverse effect on another, and the overall organisation.

Concentration on 'financial' metrics: Decisions, and the metrics that those decisions are based on, tend to be founded in short-term finance issues. That is not necessarily sufficient information on which to make fully formed decisions. Other soft measures are relevant in assessing the best course of action in maximising value, and distributing it appropriately, including risk, and customer satisfaction, for example.

Information sharing: To enable the optimisation of decision making across the system, information needs to be appropriately shared and in an accessible, accurate, and timely way. Specifically, the information that needs sharing relates to the costs and revenues over time of each of the companies in the network, and each of the P&Ls within those companies. There is also non-financial information that is relevant, such as how the risks are being modelled, and other softer aspects of the service delivery that need to be quantified.

The technology is there to provide the financial information, and much of the technical challenge involved has been overcome. However, other information besides the obvious financial data also needs to be shared. Such information might include how companies are managing their risks, or how productive employees are in different locations across the value creation network. This is information which would not typically appear with the P&L, cash flow and balance sheet data.



It is perfectly feasible to integrate an organisation's financial and enterprise resource planning system, its HR system, and understand the costs it is incurring and the prices it charges. The challenge is to ensure that the appropriate knowledge is collected and distributed across the organisation.

The real barrier to information sharing is not the technical aspect. The commercial, legal and relationship aspects of the information sharing present a much greater barrier. Organisations need to find ways of allowing all the parties involved to be comfortable about how information is shared, so that the sharing of information is as unrestricted as possible.

A question of trust: Pragmatically, negotiating power is not evenly distributed across the network, and so there will inevitably be issues around this. There are a number of examples of a more powerful company entering into a long term relationship with a less powerful company. The less powerful company invests in a joint enterprise. Once that investment is sunk, the dominant company demands price reductions or harsher terms and conditions. The smaller company is left with almost no choice. These smaller companies may be left in positions where they cannot fully contribute to the overall value of the network. This is where trust becomes so important. Any move towards the approach of sharing cost and profit over the long term must be underpinned by long term trust. There needs to be a way, up front, of proving long term commitment, of proving trust up front. This is a challenge.

Trust is built up slowly, over time, and usually between individuals rather than organisations. This leads to breakdowns in trust when people move on to new posts. In modern industries individuals tend to move between roles and organisations frequently, often after only a few years. But many assets and service contracts have lifespans that runs into decades. Relationships must be rebuilt many times during the life of the asset. To date the solutions have been largely commercial and contractual, but this relies on an efficient and effective judiciary and legal system to enforce those contracts, and often the cost of litigation is a deterrent to enforcing rights.

Lack of financial understanding: One of the main challenges from a financial perspective is the trade-off between upfront acquisition costs and through life operating costs. Financial concepts such as Net Present Value, provide a meaningful way of estimating the 'real' time value of money now, and in the future. They allow people to

make more informed decisions about the cost benefits equation, when making commercial decisions.

Among the financial community, certainly, NPV is the, well understood and existing tool for managing the balance between short-term financial measures and long term performance/return on investment and total cost of ownership.

However, those people involved in delivering the contracted service outcome are not always aware of the financial modelling techniques involved in arriving at optimal decisions. Levels of understanding vary. While understanding in the finance function is likely to be more sophisticated, all those involved in the value creation process should have a basic understanding of the financials as it will shape their decision making processes, particularly with respect to short-term versus long term financial understanding.

Broader perspectives: If the aim is for individuals and organisations to be able to make decisions which are in the interest of the whole of the stakeholder network, they need to understand the perspectives of the other participants in the network. Incentives should be in place so that they make decisions that are optimal for the whole system, and have the necessary shared information to form those decisions. However, it may still benefit them to understand why a decision that does not seem optimal from their own P&L perspective, is in fact beneficial to the value creation system, and ultimately to their own organisation's business objectives.

ORGANISATIONAL CHANGE AND SILO BUSTING

Organisational structures are important as they shape the way that assets are managed across the ecosystem and through the life of the asset. A silo mentality obstructs the efficient management of assets, and so silos need to be broken down.

Historically, teams within organisations have been set up in a way that encourages them to adopt a protective mindset about what they do, and who they report to, founded on asset-centric thinking. It is an approach that focuses on the possession of the asset, on owning that asset and maintaining it going forward, without constantly ensuring that the asset is still delivering the organisation's objectives. This is still true of many organisations that have adopted, or are moving towards the provision of outcome driven contracts – they tend to have a silo based, function focused mind set.



However, optimising the creation and delivery of services based around meeting a customer need, (rather than selling equipment, and then contracting to maintain that equipment separately), requires collaboration and the sharing of information across organisational boundaries. It means a change of emphasis towards a focus on business objectives, on how can you help your customer achieve its objectives, rather than on continuing to do operate in the same way as the past, no matter how successful that was.

This in turn requires organisational changes and in particular, the breaking down of those boundaries where organisations have units and teams operating as closed silos. Removing these boundaries should allow the organisation to locate pockets of best practice within the organisation, and within other organisations in the value network.

Many organisations have knowledge that would be useful in one part of the business, which resides in people who work in another part. So, for example, a water utility may have forward planning teams in both the water and waste water parts of its business. Each will be planning its own renewal and maintenance programmes. The water business, may take a proactive approach and have systems to support that approach. However the waste water team may take a more reactive approach, reducing planned maintenance and fixing assets when they break. Breaking down silos enables other parts of the organisations, or other members of the value creation network, to adopt and benefit from the examples of best practice.

There are a number of factors that make the need for organisational change particularly relevant at the moment. The ISO 55000 Standard for Asset Management will drive broader change across the Asset Management sector. There is also pressure, particularly in the current global economy, to deliver solutions with reduced cost, and with the same or fewer resources. There also appears to be a desire on the customers' part to focus on their core business proposition, favouring outcome based service solutions.

Challenges

There are a number of challenges involved in driving the kind of organisational change that will break down silo walls, and create the culture necessary for all parties to benefit from this change.

Impetus for change: There is the question of where the impetus for change comes from. Most people have been involved in a change

programme where agreed changes are implemented but fail to gain traction in the organisation. So who should drive the changes required and the processes to embed those changes? Will it be top down, middle out, or bottom up?

Generally the push for change comes from the top, as this is where the organisation's objectives are set from. Then implementing change and embedding it successfully has a lot to do with winning the hearts and minds of people involved in delivering those objectives, those who are most affected by change, and that is usually from the bottom up. So you need strong leadership to make the change happen and to make it stick, but also bottom up buy-in.

Other factors may also drive organisational change. The regulatory or legislative environment may change, requiring an appropriate response. Or changes may be required by stakeholders or competitors, where they are internal or external.

Understanding of objectives: There will also need to be a very clearly articulated understanding of what the objectives of the various parties involved in delivering an outcome, including those of the customer. The customers' objectives will change over time, and the business objectives of the various parties involved in delivery of the outcome should also change over time to reflect that.

The use of metrics: Metrics play an important role in enabling and exploiting a network wide approach to Asset Management. System wide metrics are needed to create incentives and alignment across the whole organisation and network that deliver the service objectives. And in turn to ensure that those objectives are based on the objectives of service provider and customer.

Many organisations, however, are still grappling with changes connected to what activities are kept in-house and what is outsourced. There has been a move to outsourcing, as it removes costs from the books. However, it also has implications for collaborative decision making, and the creation and use of metrics, as some of the knowledge needed to make these decisions will get transferred as result of the outsourcing process. This may leave the organisation in a position where it needs to go to another organisation for that information or data and pay for it.

Organisations must know what information they can and cannot control. If outsourcing is part of the business model, it is essential to carry out the necessary organisational design to ensure that actors



in the network will have access to the information and knowledge they need to deliver the promised outcome. That access will need to be written into the contract.

Incentivising the right behaviours: Cultural change is often difficult. Especially when it comes to changing deeply entrenched behaviours - in this case a protective and insular approach to the sharing of information. One way of helping to change the silo mindset is by incentivising the desired collaborative behaviour across the network of stakeholders. So, for example, part of a bonus can be might depend on maximising an individual's own P&L and part on whether that individual's peers meet their performance levels – or even other actors in the stakeholder network.

The power of tacit knowledge: Locating and utilising pockets of best practice is not easy. Partly because of the silos that prevent the sharing of information, and partly because knowledge often resides in individuals, and they are required to interact with employees in order to make sense of the best practice information that they possess. It would be helpful if it were possible to construct a software based knowledge exchange that conveyed the tacit or other less easily transferable knowledge, possibly via communities of practice, for example.

The case for action: It is not easy to make the case for organisational change, knowing that it may well be a painful process. One way to make the case for change is to focus on the benefits that accrue from breaking down silos, by separating them out into non-financial and financial, tangible and intangible benefits. So, for example, a benefit that is non-financial and intangible might be the reduction of risk, such as the risk of loss of knowledge, whether that is through aging workforce, as the by-product of outsourcing, or on your ability to provide your service.

DATA CAPTURE, SHARING AND STANDARDS

Data capture, data sharing and data standards have a part to play in driving improvement in the overall performance of an asset. In turn this should increase the overall value available to the stakeholders involved in delivering a service that involves that asset. The effective use of data can inform decisions that then improve asset performance. For example, good use of data allows organisations to understand risk and criticality better, and to avoid surprises and failures. It enables organisations to understand the performance of assets, assess whether performance meets expectations, and take

action to improve the asset lifecycle cost. This not only benefits organisations participating in the value creation network, but also society in general, in many cases.

There has been a focus on data capture and sharing recently for a number of reasons. Organisations are able to collect a lot more data about the equipment they use and the service they are involved in delivering. There are greater expectations about the availability of data. If you adopt an end user, customer point of view there is a general perception, in the world that we live, that access to data should be instantaneous. We are used to having data at our fingertips. Why should that be different for the services that we consume, as asset owners or users?

There is also considerable competitive pressure in the market, especially during very difficult economic conditions. Thus there is a need to find a competitive edge, and data capture and sharing may contribute to providing that. Finally, another issue is that in many industry sectors a lot of assets are aging and require increasingly costly maintenance or changes to meet new legislation. Good use of data can prioritise which assets should be replaced, or adopt efficient maintenance strategies.

Challenges

There are a number of issues relating to the effective use of data that need addressing.

The “right” data: It is important to understand, where possible, why data is being captured. Data capture should be driven from a “what are you trying to achieve” rather than from a “what can be measure” perspective. Determine what decisions you are trying to affect and then whether you have the data to enable that? If not then go and find it. This helps organisations to capture the “right” data using the most appropriate technology, the data that helps to meet their specific objectives. There is also a question over who decides what the “right” data is to capture.

Data quantity: While it is possible to ascertain what data is required to meet specific known business objectives, there is a broader issue about how much data should be captured. One point of view is that just because it is possible for organisations to collect vast amounts of data that does not mean that they should. In many instances a limited set of data is required to monitor the condition of an asset.

There is also an argument for collecting as much data as possible,



however. Although the usefulness of some of that data may not be immediately apparent, as it is difficult to predict what data might become useful in the future.

Data quality: When capturing and sharing data, quality is an issue. The people best placed to collect that data, for example, may not be the people best placed to interpret it and may not even be within the same organisation.

For example, a team in the UK is monitoring an underwater structure in another country. The UK team has constructed a mathematical model to monitor the condition of the structure. They rely on a local team of divers to inspect the structure and report on any new cracks that have appeared. The divers will not have a sophisticated understanding of the model and so will need precise instructions to capture the data required. The more people there are involved in the chain between decision maker and data capture, the more scope there is for error.

Organisations should think about the quality of the information they need information to be. Perfect data is elusive. Introducing people into the equation increases the risk of having imperfect data. Organisations may be able to make good decisions with less than perfect information. So it is a question of how good does the data need to be to give you adequate information. By thinking this through it may be possible to set a quality/quantity threshold which is more affordable than trying to capture data of quality which is not actually required.

One suggestion relating to the sharing of data is that shared data can be tagged by users with a confidence rating. This means that users are aware of the quality of the data shared, and that information source is able to trace and update that information with more confident better quality information.

Data sharing: The adoption of data sharing standards would, theoretically, enable organisations to share data more willingly and more effectively. It is possible, for example, that an organisation in one part of the asset related value creation network may own data, but an organisation in another part of the value creation network is able to use that data to create value. There may be no apparent incentive for the organisation that owns the data to share it, or even to collect it. Data sharing standards may enforce sharing of that data. If information sharing standards are to be implemented, it must be done in a way that does not compromise commercial standing.

Data costs: Despite the falling costs of computer systems, there are significant costs associated with both the capture and use of data. Those costs must be stacked up against the benefits obtainable through use of that data. If the costs outweigh the benefits, the organisations should reduce the costs of collecting the data, or change the data collected, until a favourable outcome to the cost-benefits equation is obtained. There may be some challenges around assessing the benefits of the data.

There is also the issue of the cost of collecting data which has no apparent usefulness in relation to the delivery of the defined business objectives. This may influence decisions about how much, if any, of this data to capture.

One possible way of reducing costs is by having other organisation in the value creation network can gather information on the assets. For example, data on the state of a railway bridge might be captured by mounting sensors on the trains using it, reducing the need for separate inspections. Data can even be collected by people who are not part of the value creation network, through social media or crowdsourcing, if such behaviour can be suitably incentivised.

PREDICTIVE ANALYTICS

Emerging predictive analytic techniques allow organisations to predict events, or the cause of events, that affect the creation of value by the Asset Management systems, using historical and real time data, and change practice to reduce costs and risks of failure.

Traditionally, attention might focus on maintenance only after the warranty period has expired. The owner would then take a view on the maintenance approach, such as adopting a time based, condition based approach for maintenance, or just repair when the equipment fails.

Predictive analysis goes a step further. It harnesses cutting-edge technology to enable informed decision making based on facts, on data, on information that is going to mitigate risk. So, for example, when a component fails unexpectedly it has a negative impact on the performance of an asset, and thus value creation. The ability to anticipate the failure of that component, to a high degree of probability, allows action to be taken in advance, reducing costs, and potentially increasing performance. Running things to fail is usually not the most efficient strategy, particularly when human safety is compromised.

It can be used in two ways, for long term maintenance planning or in real-time. Using historical data the failure of components can be predicted from the asset's condition or use, and a more efficient maintenance schedule adopted.

Alternatively, predictive analysis can be done in real time. Real time data can detect if a failure is imminent and corrective action can be taken, perhaps replacing a component at the end of the current shift or taking immediate action.

Greater confidence of reliability may allow fleet sizes to be decreased, reducing costs and increasing competitiveness. Increased performance and fewer disruptions are likely to lead to better relations with the customer and enhance the supplier's corporate reputation.

Challenges

Recent advances in data analysis means that predictive analytics are an option for many organisations. Major suppliers such as SAP, Oracle and Google provide tools that enable users to manage "big data", the vast quantities of data in organisations are able to collect from a wide range of sources. Firms that are able to collect, process, analyse and, most importantly, utilise this data will have a major competitive advantage. We are still some way from this, and many issues remain.

Capturing the knowledge: Important knowledge often resides with people, not IT systems. It is not always easy to extract this tacit information when it is most needed. An emergency may arise, but a critical piece of information resides with an individual who is off work and not contactable. To enable predictive analytics, therefore, knowledge management systems must capture individuals' knowledge and store it where it can be automatically retrieved. Capturing the knowledge that resides with individuals will not be easy, however.

Mind-set: It is much easier to continue to do things the way that they have always been done, than it is to change. Often, senior management will be working with the methods that have proved successful for some time, and are comfortable with those methodologies. A clearly defined strategy is required to educate senior management to the possibilities suggested by predictive analytics, so that they and others embrace a new mind-set.

Not an analytics department: Expertise in this area needs to be built into the fabric of the organisation, not confined to another corporate function or silo. Wherever predictive analytics expertise resides, it should be available across the network. Are analytics experts required, or should everyone have a degree of knowledge and expertise? There is likely to be competition for this type of talent and efficient use of these scarce resources is essential.

How much data is enough?: This is a question common to other areas of Asset Management. Being selective in the data necessarily limits your ability to predict. But gathering any data has cost implications. One approach, therefore, is to consider the more catastrophic failure modes. Ideally there is an element of redundancy built into the system. Predictive analysis allows an organisation to minimise the level of redundancy required.

Although there may be significant benefits obtainable from collecting as much data as possible, making a business case for collecting and maintaining the data for unknown benefit is difficult.

Usefulness of data: Organisations collect a lot of data about their assets, and much more data is readily available. But while all of the data may be available, not all of it is being used. This may be because it is not in a useful or understandable format, that the use for the data is not clear at the present time, or that people are simply unaware that the data exists. Hence there are challenges relating to producing data in an easily usable format, and making everyone in the value creation network aware that data being collected exists. ■

Conclusions

- ⇒ Efficient management of industrial assets is increasingly seen in companies across different industry sectors such as manufacturing, infrastructure, and services as a critical success factor.
- ⇒ It is clear that the focus of any Asset Management system must be to ensure that the assets generate value throughout its life to different organisations and stakeholders in the value chain.
- ⇒ The critical trends enabling this vision are:
 - ➔ Effective capture, sharing and use of relevant data to decision-makers across the eco-system.
 - ➔ The use of appropriate metrics to improve the performance of assets as well as the Asset Management system.
 - ➔ The use of new and emerging business models, reducing the importance of operators owning the assets they use.
 - ➔ Encouraging the adoption of innovative methods of decision-making, such as predictive analytics.
- ⇒ The four key areas that must be adopted or utilized more effectively to improve Asset Management practice are:
 - ➔ Effective decision making. Improving decision making across the organisation, through better use of longer term financial, and non-financial, metrics to deliver value for all involved in managing assets.
 - ➔ Organisational changes. Organisations must evolve to enable better decision making and share knowledge and skills, breaking down silos and boundaries resulting from functional specialism and multiple cost centres.
 - ➔ Data capture, sharing and standards. Improving the quality and availability of the information available for decision making.
 - ➔ Predictive analytics. New information technologies are available to improve Asset Management, but several barriers prevent their effective use.
- ⇒ Key to success is gaining the commitment from top management to drive change in organisational culture to:
 - ➔ improve the understanding of how good Asset Management contributes to organisational success,
 - ➔ encourage through-life – cross-organisation – systems thinking, and remove the organisational barriers to it. ■



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