With over 69,000 professionals in 40 countries, CGI fosters local accountability for client success while bringing global delivery capabilities to clients' front doors. Founded in 1976, CGI applies a disciplined delivery approach that has achieved an industry-leading track record of on-time, on-budget projects. Our high-quality business consulting, systems integration and outsourcing services help clients leverage current investments while adopting new technology and business strategies that achieve top and bottom line results. As a demonstration of our commitment, our average client satisfaction score for the past 10 years has measured consistently higher than 9 out of 10.

We've been instrumental in every major Utilities industry change since 1990. We provide the systems for energy markets in Britain and globally to work effectively. We understand the unique challenges faced by Utilities in Britain. Our knowledge will help the market reap the benefits of investment in the information and communication infrastructure created by deploying smart metering.

CGI, have invested in smart solutions which support eight British Utility companies with their domestic smart meter programmes. We are continuing to invest in the British Utilities industry and bring the commitment, financial security and deep experience of complex systems to enable the low carbon British economy of the future.
Implementing Enterprise Asset Management FOR DUMMIES

by Paul McKeon, CGI and Darren Ramshaw, EDF Energy

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Have you ever wondered how modern society would function without the machinery, equipment and infrastructure that surrounds it? How would life be without new apps for your iPAD, no running water, no reliable electric lighting? How would society get by without planes, trains, road networks, shipping and haulage, pressurised water supply, telecommunications, cloud-computing, electricity, pressurised gas supply, sewerage services, mass-manufacture and refining and processing plants? Life would certainly be very different.

The reality is that wherever, as a society, we have created a reliance on machinery, equipment and infrastructure to deliver advances for humankind, we’ve also created a need for the effective management of these physical assets. As the number of mobile phone users globally reached the six billion mark in 2011, and with the investment of governments and motor manufacturers in electric cars, the reliance on further new technologies still shows no sign of slowing.

As a direct consequence of this reliance, Enterprise Asset Management is a central concern for many enterprises and government policy makers today.

So what’s new? Surely we’ve been managing assets for thousands of years? The Romans built aqueducts, roads and viaducts that have lasted for millennia. Many of the other essentials of modern life – electricity, gas supply, manufacturing, sewerage and so on – have been around for at least a century. So what’s different from how we’ve been managing and maintaining these assets?

Unlike the Romans who could afford immense overdesign on their equipment or the builders of the Brooklyn Bridge in the late 19th century who designed suspension cables to be six times greater than needed, our safety margins are fractional today. We’ve stripped our planet of readily available
resources and have to pay a premium price for what remains. More humans are alive today than have ever lived since the dawn of time, which makes the demand for resources ever greater – for example, we’re close to running out of infrastructure for power generation to meet the needs of all these resources. This situation places further importance on the management of the assets that bring those resources to us. As a result, assets need to do more for less investment over a longer time period.

And finally, while we don’t yet live in towering vertical mega-cities (in case you think we’re joking, search online for ‘arcologies’), the interdependence of assets on one another is already very complex in our society. Just consider smart grids, smart meters, fly-by-wire airline navigation and so on. As an example, think how complicated it is to dig a hole in the ground in London, a city that has been rebuilt many times since it was razed to the ground by Boudicca almost 2,000 years ago. Therefore, the effects of poor asset management grow rapidly over time.

With many governments struggling with the recession and many businesses trying to ride out the economic storm, the last thing you need is for unexpected losses and costs related to machinery, equipment and infrastructure failures. To weather economic cycles of growth and recession, asset-intensive organisations are best placed to succeed when their asset outcomes (performance, reliability and cost-effectiveness) are superior to their rivals.

The modern asset manager needs to achieve more challenging asset outcomes against a backdrop of ever-increasing regulation and financial constraint. To reach this goal, the implementation of Enterprise Asset Management (EAM) needs to be designed to gain the most synergies across the enterprise. Implementation means challenging age-old practices and pulling together resources to get greater efficiencies with better operational performance and financial transparency. Like the design of your complex assets, much of the lifetime run costs of Enterprise Asset Management within your organisation are baked in from the start, so getting it wrong isn’t much of an option.
About This Book

This book offers answers to today’s challenges. For those of you familiar with Smart Metering For Dummies, Smart Grids For Dummies and New Nuclear Power For Dummies, you know what to expect: namely a concise primer to get you rapidly up to speed with business context, terminology, impacts and issues related to the implementation of Enterprise Asset Management.

The topic of asset management is vast, so this book relates to Enterprise Asset Management, addressing a slightly narrower subset of organisations than wider asset management does. The book focuses only on large asset-intensive enterprises rather than all organisations. For this reason, while we refer to standards in asset management throughout the book, we only mean within this smaller group of large enterprises – hence the term Enterprise Asset Management.

Asset management is also an area where thinking is moving on quickly with global collaboration being driven by organisations like the Global Forum on Maintenance and Asset Management (GFMAM), the Asset Management Council (AMC) and the Institute of Asset Management (IAM). There’s also convergence of thinking through PAS 55 and ISO 55000. You may be surprised to realise that PAS 55 has been in existence only since 2004. Therefore, this book aims to function as a signpost and handy guide on the topic of the emergence and implementation of Enterprise Asset Management.

Foolish Assumptions

In writing this book, we made some assumptions about you, the reader. We assume that:

✔ You work in an asset-intensive industry and understand the need for implementing good EAM practice to achieve improved asset outcomes.

✔ You’re interested in management of physical assets (including the financial aspect) as opposed to the management of purely financial assets (such as derivatives, bonds and so on).
✓ You appreciate the difference between implementing Enterprise Asset Management and implementing an EAM IT system. This book focuses on implementing Enterprise Asset Management to meet your overall business needs, although we do reference IT system considerations.

✓ You want to know more about the techniques and approaches for EAM implementation taken by other successful asset managers.

✓ You want to know how you can tune your EAM implementation to achieve, track, maintain and improve compliance with standards and external bodies (both regulatory and statutory).

✓ You’re interested in harnessing the efforts of previously disconnected groups across your enterprise towards the achievement of better asset management.

✓ You understand some asset management jargon (but don’t worry – we include a glossary at the back of the book, just in case).

How This Book is Organised

Implementing Enterprise Asset Management For Dummies is divided into five informative parts:

✓ Part I – Defining Enterprise Asset Management (EAM): We explain what we mean by Enterprise Asset Management, why you should implement EAM and what good EAM looks like.

✓ Part II – Finding the Right EAM Approach: We describe the key ingredients of an EAM strategy, including defining appropriate asset policy, marshalling the right people, process and system resources and discussing how you can measure your progress along the pathway to success.

✓ Part III – Designing Your EAM Vision: We examine the measures necessary to embed the vision in your people and build the foundation, including effective leadership, integrated processes, the holistic mindset, suitable systems and a one-team mentality.
Part IV – Implementing EAM: We explain the measures necessary for EAM implementation (with continuous improvement) programmes, including performance tracking, organisational (re)design points and important implementation behaviours and activities.

Part V – Top Ten Implementation Points to Remember: If you read nothing else, this part lists the essential things to bear in mind when discussing EAM implementation.

Icons Used in This Book

To make navigation to particular information even easier, these icons highlight key text:

- The knotted string highlights important information to bear in mind.

- The For Dummies man indicates a real-life example to illustrate a point.

- This icon marks the place where technical matters are highlighted and where you might need to think a little more carefully about something.

Where to Go from Here

As with all For Dummies books, you can dip in and out of this book at any point you like or read it from cover to cover – it won’t take you long!

Use the headings to guide you to the information you need. If you require more information, feel free to contact us at energyandutilities.uk@cgi.com.
In this chapter, we tell you exactly what we mean by Enterprise Asset Management. We look at the component parts of EAM and then look at the overall scope of Enterprise Asset Management.

**Figuring Out What EAM Should Do**

You probably know what the words *enterprise, asset* and *management* mean, but you may wonder what they mean when used together.

So what is an asset? Ask yourself: do you need to inspect it, maintain it, attribute costs to it or need to know how it’s performing? If yes, then you can probably consider it an asset.

In this book, *assets* refer to physical objects, such as roads, rail tracks, plants, gas pipelines, water mains, buses, aircraft, trains, buildings and all subtypes of plant and equipment.
For more detailed definitions of asset management, please see the websites of the Institute of Asset Management (IAM; www.theiam.org) and the European Federation of National Maintenance Societies (EFNMS; www.efnms.org).

Enterprises are any big organisations that depend on large amounts of physical equipment or assets. We call these companies asset-intensive organisations.

For our purposes, asset management is the set of activities that an organisation performs in order to achieve the optimum performance of their assets in line with its objectives. This includes procurement, design, finance, risk management, human resources, operations and maintenance.

Enterprise Asset Management is the focusing of enterprise-wide time, effort and resources to achieve optimal total business impact through the performance of its assets.

The IAM in particular, through BSI PAS 55: 2008, provides the requirements for asset management. These requirements are regularly used across asset-intensive industries to audit an organisation’s asset management practices.

**Examining the Scope of EAM**

EAM balances the many disciplines (for example, engineering, finance, risk and so on) that lead to optimum performance of our assets. For example, having the best performing assets doesn’t do you much good if you can’t use them because they’re always being maintained; likewise, having a lot of unexpected failures due to lack of maintenance means that your assets aren’t as reliable as they should be. As Figure 1-1 shows, the aim is to strike a balance between operation of your assets and the costs of maintenance.

In Figure 1-1, the arrow shows asset operation and maintenance balanced for best business impact. To the left, maintenance is too low leading to high operational losses due to failure of the assets. To the right, maintenance is too high leading to high operational losses due to unavailability of the assets.
The preceding example focuses only on the operational life-phase of your assets. However, Enterprise Asset Management takes into account the whole lifecycle, including:

- Design
- Procurement and construction
- Commissioning
- Operation
- Decommission and disposal

The objectives of each phase can have detrimental effects on the other phases – for example, if two metres of clearance is needed to maintain an asset when it’s designed, but in the rush to complete construction, the building has less than one metre clearance, then maintenance costs are higher.

So the scope of Enterprise Asset Management encompasses all the lifecycle of the asset.

**Asset Management Comes of Age**

Only recently, an international consensus on asset management has been reached. This has laid the foundation for a new ISO 55000 standard for asset management replacing PAS 55.
The consensus is presented as a convergence of the disciplines mentioned in the preceding section with a core of 39 subjects – see www.theiam.org for details.

While we don’t attempt to deal with these topics in detail, we do refer to them throughout this book.

**Understanding the Scale and Objectives of EAM**

Assets may range from small discrete assets in remote locations to larger complex plant-type assets. Enterprise Asset Management aims to provide the appropriate regime for the best management of the asset in accordance with its value and the importance of its role to the organisation.

In addition to balancing an asset’s maintenance cost and operational availability, we need to look at how the decision to invest in an asset kicks into motion a whole sequence of interdependent activities over the asset lifecycle. This relationship is shown in Figure 1-2.

*Figure 1-2: Enterprise-wide dependencies in asset management.*
Figure 1-3 lists the individual dependencies from Figure 1-2.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Influence</th>
<th>Impacted component</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Asset Design, Manufacture, Installation, Commissioning</td>
<td>determines</td>
<td>Asset functions</td>
</tr>
<tr>
<td>2</td>
<td>Asset Functions</td>
<td>possesses</td>
<td>Maintenance</td>
</tr>
<tr>
<td>3</td>
<td>Asset Functions</td>
<td>performs</td>
<td>Operation</td>
</tr>
<tr>
<td>4</td>
<td>Operation</td>
<td>affects</td>
<td>Equipment integrity</td>
</tr>
<tr>
<td>5</td>
<td>Equipment Integrity</td>
<td>affects</td>
<td>Operation</td>
</tr>
<tr>
<td>6</td>
<td>Equipment Integration</td>
<td>generates</td>
<td>Safety</td>
</tr>
<tr>
<td>7</td>
<td>Criticality</td>
<td>determines</td>
<td>Maintenance</td>
</tr>
<tr>
<td>8</td>
<td>Maintenance</td>
<td>affects</td>
<td>Safety</td>
</tr>
<tr>
<td>9</td>
<td>Competence-Reliability</td>
<td>determines</td>
<td>Safety</td>
</tr>
<tr>
<td>10</td>
<td>Maintenance</td>
<td>affects</td>
<td>Safety</td>
</tr>
<tr>
<td>11</td>
<td>Asset Functions</td>
<td>affects</td>
<td>Maintenance</td>
</tr>
<tr>
<td>12</td>
<td>Equipment Integrity</td>
<td>affects</td>
<td>Tasks</td>
</tr>
<tr>
<td>13</td>
<td>Safety</td>
<td>affects</td>
<td>Maintenance</td>
</tr>
<tr>
<td>14</td>
<td>Maintenance</td>
<td>affects</td>
<td>Tasks</td>
</tr>
<tr>
<td>15</td>
<td>Maintenance</td>
<td>affects</td>
<td>Operation</td>
</tr>
<tr>
<td>16</td>
<td>Tasks</td>
<td>affects</td>
<td>Maintenance</td>
</tr>
<tr>
<td>17</td>
<td>Maintenance Quality</td>
<td>affects</td>
<td>Operation</td>
</tr>
<tr>
<td>18</td>
<td>Maintenance Quality</td>
<td>affects</td>
<td>Equipment integrity</td>
</tr>
</tbody>
</table>

**Figure 1-3: Table of dependencies in asset management.**
Everything’s related

When you consider the scale of Enterprise Asset Management, you also need to think about the whole lifecycle, as well as the dependencies between lifecycle activities.

The scale of asset management therefore depends on the asset to be managed, its criticality when supporting operations, its lifecycle and the consequences of its failure.

You need to make many key decisions during an asset’s life, and these decisions all have downstream impacts. For example:

✔ The design of the asset determines its physical shape, which determines how easy or hard it is to maintain, which affects the cost to maintain.
✔ Profit (or regulatory funding) finances all support activities relating to asset management.

Choosing smart objectives

Choosing the right objectives is essential when defining how performance is to be measured.

In his book *Strategic Asset Management* (Troubadour Publishing Limited), Clive Deadman surveyed a number of UK-based asset-intensive organisations and presents his findings, which demonstrate current practices. These findings illustrate setting objectives in asset-intensive organisations and led to the development of a strategic hierarchy of asset management activities, which is depicted in Figure 1-4.

An organisation that has correct asset management objectives will have all the business pulling in the right direction.
Objectives need to flow down through the organisation, as shown in Table 1-1.

**Table 1-1  Example of How Objectives Should Flow through an Organisation**

<table>
<thead>
<tr>
<th>Objective Level</th>
<th>Objective Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 objective</td>
<td>Maximise plant production.</td>
</tr>
<tr>
<td>Level 2 objective</td>
<td>Reduce business impact of asset failure by prioritising care of critical assets.</td>
</tr>
<tr>
<td>Level 3 objective</td>
<td>Protect asset reliability with appropriate maintenance strategies OR Improve asset reliability by designing out flaws.</td>
</tr>
<tr>
<td>Level 4 objective</td>
<td>Prioritise preventative work to ensure maintenance strategy is achieved.</td>
</tr>
</tbody>
</table>
Knowing the Benefits of Implementing EAM

You have several good reasons to consider implementing EAM because it:

✓ Promotes cost-effective business management.
✓ Reduces risk of critical asset failure and therefore overall organisational risk.
✓ Provides workers with a safer work environment.
✓ Gives workers a safer set of processes to work with.
✓ Promotes environmental, regulatory and statutory compliance as standard practice.

The fundamental reason why organisations implement asset management is because it makes good business sense. All asset-intensive organisations need an ordered, structured, disciplined way of controlling assets.

Identifying Good EAM

The measures of good EAM are tied to the measures of good business performance. For some organisations, Overall Equipment Effectiveness (OEE) may be a useful measure. OEE multiplies equipment Availability × Performance × Quality to give an OEE score.

Other organisations may measure their EAM performance in terms of their customers’ experience, which is based on their asset performance. The actual measures are specific to the industry and business type. For example, failure of glass windows on commuter buses is an inconvenience, while failure of glass windows on planes may be catastrophic.

Therefore, each organisation should look to benchmark its EAM behaviours against its peers first and then against organisations where EAM is more critical to its existence. Analyst reports such as Gartner, Forrester, Ovum and Aberdeen Group can be useful in this area.

Ultimately, good EAM practices are common across industries, even though specific measures may differ.
Berneslai Homes monitors continuous improvement

Berneslai Homes is a small housing management and maintenance organisation affiliated to Barnsley Council in the UK. In 2002, it identified that regulatory improvements were needed in the management of 21,000 houses, and the organisation embarked on the implementation of EAM. CGI helped Berneslai Homes with the organisational change, process changes and implementation of new systems both in the back-office and for field workers. Berneslai Homes measured the improvements from 2005 onwards (when the initiatives started to go live), and these measurements provided hard facts on the success of its implementation.

![Berneslai Homes KPI improvement chart]

These hard facts (as well as providing indisputable proof for the benefits for implementation of Enterprise Asset Management) helped justify the continuation of the programme for ongoing improvements.

The project referenced in this example, and all examples in this book, was delivered by Logica which CGI acquired in August 2012.

Steps to success

You can strategise all you like, but if you don’t have a plan to get from A to B, then you won’t get any improvement in asset outcomes. This book provides guidance in this area.

When an organisation is trying to move its asset management performance from laggard (below industry-average) to industry-average or industry-average to best-in-class, certain actions, shown in Table 1-2, can help spur the necessary performance improvements.

<table>
<thead>
<tr>
<th>Laggard Steps to Success</th>
<th>Industry-Average Steps to Success</th>
<th>Best-in-Class Steps to Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish executive focus for asset management</td>
<td>Establish a risk-management strategy for predictive decision-making</td>
<td>Utilise energy consumption for operational decision-making</td>
</tr>
<tr>
<td>Provide real-time and historical asset data to employees</td>
<td>Align goals and metrics across maintenance and production teams</td>
<td>Synchronise asset performance to corporate performance</td>
</tr>
<tr>
<td>Invest in analytics</td>
<td>Establish integration between EAM and the plant floor as well as business systems</td>
<td>Implement reliability centred maintenance as a primary maintenance approach</td>
</tr>
</tbody>
</table>

**What good EAM looks like**

Good Enterprise Asset Management manifests itself in many ways:

- Management of risk associated with assets is built into everything a high-performing, asset-intensive organisation does.
- The organisation makes focused, holistic use of resources to optimise asset performance.
- A culture is created where the entire business understands how driving more from assets helps achieve success.
A learning organisation results where the understanding of the root causes of failures is continually fed back into processes and procedures for higher performance assets with reduced unexpected failures.

Cost-effective, efficient compliance occurs with statutory, mandatory and regulatory standards.

An organisation is created where planned maintenance takes priority and reactivity is resisted.

An organisation effectively prioritises emerging work.

An organisation maintains strategy conformance and high asset performance, and a low cost of asset management when compared with its peers.

Good EAM isn’t easily distinguishable from good business management because best practice EAM is part of the day-to-day activities of the best-run organisation.
Finding the Right EAM Approach

In This Part
▶ Getting your EAM approach in sync with your business strategy
▶ Knowing where to begin

In this chapter, we look at getting the right EAM approach in place for the organisation. In doing so, we assume the use of PAS 55 as a specification for Enterprise Asset Management good practice. Therefore, you may want to refer to PAS 55 for more detailed information. (See the nearby sidebar for information on PAS 55.)

What is PAS 55?

BSI PAS 55: 2008 comprises:
✔ Definition of terms in asset management
✔ Requirements specification for good practice
✔ Guidance for the implementation of such good practice

PAS 55 provides objectivity across 28 aspects of good asset management, from lifecycle strategy to everyday maintenance (cost / risk / performance). It enables the integration of all aspects of the asset lifecycle: from the first recognition of a need through to design, acquisition, construction, commissioning, utilisation or operation, maintenance, renewal, modification and/or ultimate disposal.
Aligning Your EAM Approach with Your Overall Business Strategy

Your vision for how the organisation will run its EAM is based on driving towards achieving the good EAM attributes identified in Part I. Therefore, you can start to set in motion the actions necessary to achieve good EAM by defining your approach.

Align your EAM approach to the overall business strategy. In accordance with PAS 55, ‘The organisation’s top management shall authorise an overall asset management policy’ that is aligned with ‘the organisational strategic plan’.

Establishing policies

To optimise business performance against the backdrop of customer demands, a strong focus on risk associated with EAM is essential. Management of risk associated with assets is central to everything a high-performing organisation does and is reflected strongly in its asset management policy.

The establishment of the asset management policy is important because it:

- Is aligned with business strategy and confirms the organisation’s commitments related to its assets.
- Ensures that the organisation’s asset management policy is aligned with wider organisational policies, including risk management, environment health and safety and regulatory, legislation and statutory compliance.
- Provides the foundation for the asset strategy, objectives and plans.
- Commits to continual improvement in asset management and asset management performance.

As the key definition document, it’s essential that the asset policy is controlled, communicated and reviewed as appropriate. This may include internal and external stakeholders, such as the Health and Safety Executive (HSE).
Conforming to standards

EAM documentation needs to cross-reference PAS 55 to ensure active compliance. PAS 55 prescribes the definition of an asset management policy and an associated strategy.

The following is an example of an asset management policy that illustrates the things that may be contained in a working EAM policy. (This list will vary by organisation, and we provide it here simply for illustrative purposes.)

- Designing, constructing, operating, maintaining and disposing of enterprise assets to ensure compliance to applicable legislative requirements and high standards of health, safety, environmental and commercial performance throughout their complete life.

- Ensuring that the enterprise’s total supply chain risks are identified and that relevant policies and procedures are in place to mitigate identified risks.

- Measuring and improving the effectiveness of the enterprise’s approach to asset management by continuous review and adjustment as required.

- Enabling employees to have the competencies necessary to effectively deliver asset policies and procedures.

- Communicating all necessary information to the relevant stakeholders to enable delivery of asset management policy and procedures.

- Identifying the risks inherent in assets that may prevent the delivery of stakeholder needs and develop optimum asset strategies to mitigate identified risks.

- Managing all the enterprise assets in a way that optimises whole life costs.

- Developing short- and long-term performance targets for assets that optimise the use of resources.

- Developing and maintaining an approach to data management that can underpin asset decision-making by promoting cooperation, consultation and communication of knowledge.

- Developing and maintaining asset plans that enable the asset policy objectives to be delivered.
After the policy is defined, the asset manager is required to derive a strategy leading to plans and objectives to define how the organisation will perform asset management.

The nearby sidebar shows an example of an asset management strategy (this strategy will vary by organisation).

The important thing is that the strategy and policy works for today’s organisation. And this is where the fun starts . . .

Defining the objectives of the asset management initiative is all very well, but it’s an entirely different thing knowing how to get there.

However, PAS 55 isn’t the only standard. Other standards include ISO 9001 (Quality), ISO 14001 (Environmental), OHSAS 18001 (Health and Safety) as well as a host of engineering and financial standards, such as Generally Accepted Accounting Practices (GAAP).

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**An asset management strategy**

Enterprise Asset Management Strategy example:

**Objectives**

**Achieve World Class Asset Management with:**

- Streamlined RCM maintenance philosophy
- Predictive maintenance through condition based maintenance triggers
- Efficient, cost effective operational running (KPIs to track)
- Industry accreditation PAS 55, ISO 9000, ISO 14000, ISO 18000 and PAS 99

**Gain best use of a single integrated IT system for full EAM,** including finance, management accounting, procurement, stores, HR, asset management, work management, document management, incident and accident reporting

**Exert control over data model and end-to-end processes through:**

- Clear stewardship of asset data
- Integration with plant systems (process historian, operator rounds, inspection rounds, advanced condition monitoring, calibration and vibration analysis)
- Integration with the permit system, including effective monitoring and review
To help navigate through standards compliance, consider using PAS 99, which helps organisations achieve benefits by consolidating the common requirements in all management system standards/specifications.

**Figuring Out Where to Start**

Good EAM looks the same no matter what the industry or asset types. This consistency helps with benchmarking, defining objectives and measuring outcomes. Each EAM implementation is likely to start with a different set of challenges (see Figure 2-1).

**Defining the right approach**

Defining the right approach needs to take into account:

- **The start position:** How well is the start position understood? Does the start position need to be investigated extensively?

- **The business case:** The sponsorship and appetite for improvement within the organisation needs to be directly related to a sound business case. A sound business case delivers tangible business performance improvement; often, doing nothing represents an unacceptable level of risk.

- **How challenging the objective is:** How much change is needed for the organisation to achieve benefits? The sponsor needs to know that the objective is achievable.

- **Complexity of change:** Change complexity refers to how complicated executing change within the organisation is. Organisations with many or all of the high-complexity characteristics in Figure 2-1 face many challenges during an EAM implementation. Therefore, the ability to design a pragmatic EAM implementation with a systematic, believable roadmap for change is essential (and especially so where confidence is low due to failed initiatives in the past).

- **External factors:** Regulatory or market influences affect the organisation’s appetite for risk and capacity for change, which an EAM implementation would bring.
## Characteristics of Assets, Enterprises within Enterprises Seeking to Implement Enterprise Asset Management

<table>
<thead>
<tr>
<th>EAM Implementation Complexity</th>
<th>Asset Age</th>
<th>Asset Complexity</th>
<th>Asset Location</th>
<th>Enterprise Type</th>
<th>Operating Environment</th>
<th>Number of Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>New-build</td>
<td>Low – low value, discrete plant and equipment</td>
<td>Single site</td>
<td>Small single site or region</td>
<td>Private enterprise such as small scale manufacturing, airport, local authority</td>
<td>&lt;1000</td>
</tr>
<tr>
<td>Medium</td>
<td>New and ageing assets</td>
<td>Medium – low value, some interconnected plant and equipment</td>
<td>Multi-site</td>
<td>National multi-site</td>
<td>Regulated industry such as utilities or rail</td>
<td>1000-10000</td>
</tr>
<tr>
<td>High</td>
<td>New and ageing assets linked in asset networks</td>
<td>Medium – high tech, highly interconnected plant and equipment</td>
<td>Multi-site linked with network assets</td>
<td>International multi-site</td>
<td>Multinational, multi-site</td>
<td>&gt;10,000</td>
</tr>
</tbody>
</table>
IT systems: Is the landscape that supports asset management up-to-date and modern, or does it need a lot of expensive investment? At some stage in every organisation, the need for process, consistency, acceleration and repeatability necessitates appropriate IT system support.

Figure 2-2 is an example of how an organisation tied together its business objectives with its people and technology requirements for an EAM implementation that was baselined and measured over five years.

Figure 2-2: Alignment of business, people and technology objectives.

Identifying a good design

So what does a good design look like?

- Baselined: To justify the initiative financially, the start position needs to be baselined so that improvements can be measured.
- Holistic: Draws from processes and strengths that stretch across the organisation.
- Inclusive: Brings the organisation together.
- Sponsored: Strongly backed philosophically and financially by management.
- Linked: Linked with enterprise objectives.
✓ **Controlled:** Governance needs appropriate leadership.

✓ **Accountable:** Empowered benefit owners.

✓ **Achievable:** The roadmap is possible.

✓ **Staged:** Benefits released throughout.

✓ **Measurable:** Clearly defined benefits.

✓ **Relevant:** A catalogue of business requirements.
Part III

Designing Your EAM Vision

In This Part
▶ Building your team and embedding the culture
▶ Using systems to amplify the best processes
▶ Gluing all the pieces together with a plan

In this part, we define an Enterprise Asset Management design that can give you the optimum performance from your assets throughout their lifecycle.

Embedding the Vision: The Holistic Mindset

The distinctive characteristic of Enterprise Asset Management is that it’s holistic, which requires a single view of standards. Figure 3-1 shows how PAS 99 helps bring together the requirements of multiple management system standards/specifications.

Figure 3-1: How standards can help.
To achieve a truly holistic management system, the processes, the people and the data need to be aligned. This holistic set-up enables people to run the right processes, which use and enrich good quality data for improved asset management outcomes.

**Building the Right Team**

An EAM system, in its simplest form, is a focused set of organisational activities carried out by people and aided by technology designed to get the best performance from a set of assets. This means that people have a central role to play.

To define the role that people have to play, you must first determine the activities that you need to do. To make this list of activities, you need to understand what your assets are expected to do. Then you can decide how to ensure that your people keep the assets doing what they should be doing.

**Determining your asset’s function and maintenance**

What you expect the asset to do is known as the *function* of the asset. An important part of asset management is preserving the asset’s ability to perform its function as long as possible. Maintaining the function is known as *maintenance*. Maintenance usually costs money and consumes time and effort.

Not doing maintenance has consequences. Failure of some assets to function can be expensive and can harm both people and the environment and stop the business from running. Failure of other assets may be less serious. Therefore, no easy answer exists when deciding what you need to do with your assets.

Take the time to understand the importance of your assets in your operations and understand the cost and consequence of their failure so that you can understand the most effective mitigating actions to preserve their functions. You can then decide the next techniques or strategies to manage your assets.
We make some sweeping assumptions here. We assume that:

- You have the skills to understand your asset needs.
- You’ll apply consistency to the way you assess your asset needs.
- Everything in your organisation is focused towards managing your assets in the best way possible.

Therefore, you may have a potential problem and need to ask yourself the following questions:

- Do you have the right skills to understand what your assets need to retain their functions?
- Do you have the right skills to prioritise management of the right assets at the expense of other less important assets?
- Does your organisation have the right set-up to empower people to do these activities in the first place?

**Finding the right skill set in your organisation**

Before you implement EAM, you need to consider whether your organisation has the right skills to understand asset needs, manage asset knowledge and skill sets and put in place organisational structures to make asset management effective and efficient.

Training, developing and managing people is a key part of asset management. Without a strong focus on people from the outset, your asset management initiatives can fail. You may find yourself wrestling with competing demands on your resources and unable to make the right decisions for your assets and ultimately for your enterprise, which makes your job as asset manager very difficult.

The challenge of ensuring that you have the right skills is variously described as human capital management, human factors and organisational design and culture. To implement an effective EAM system, you must invest a lot of time and effort in your people.
Getting the most out of your assets

You have people who can define an appropriate set of activities needed to get the most from your assets; these activities are your maintenance and Enterprise Asset Management processes.

You also have people who can define which assets are functionally important – your critical assets. These people are able to define the criticality of each asset and rank them based on a set of factors, including:

- Importance to the business
- Consequence of failure (safety, environmental, cost, disruption and public perception)
- How these assets are used
- The environment they’re operating in

Your people can prioritise some of your asset processes and work out which approaches will yield the best results. Your people can look across your organisation and understand the consequences of their decisions on the rest of the business. For example:

- Does your asset strategy best use the resources you consume to deliver enterprise asset management, such as training, recruitment, materials and contractors, purchasing, budgeting and planning?
- Do your decisions on Enterprise Asset Management enable the company to most efficiently achieve its mission?
- Does your approach lead to the manufacture of a high-quality product cheaply and consistently?
- Have you got an infrastructure that reliably delivers a highly available and profitable service?

Establishing Leadership

The asset policy and strategy can guide the range and scope of asset management activities you undertake within your organisation (see Part II). This approach only works, however,
provided an appropriate vision holder is in place to define the asset management vision and drive it to completion.

Leadership in this area isn’t a role to be taken lightly. It’s all encompassing. The asset management leader must be empowered by the enterprise to make decisions to implement an Enterprise Asset Management system.

The Enterprise Asset Manager doesn’t need to be the programme director of the EAM initiatives. He or she does need to be the senior user of the initiative in programme governance terms. Having this independence is important as a balance can be achieved between limitless business needs and the single-mindedness of a programme director to deliver a scope to time, cost and quality. We discuss the execution of the implementation in more detail in Part IV.

In making the vital selection of the Enterprise Asset Manager, consider the following:

- An asset management qualification.
- Proven asset management track record.
- Proven leadership.
- A successful track record with implementation of quality systems and managing the continuous review and audit process.
- Strong communication skills to ensure that the entire organisation demonstrates an understanding of the asset management policy and strategy.

In the past, an asset management qualification hasn’t been common, but with the Institute of Asset Management endorsed trainer programme, qualified people are more frequent. Qualification is essential to identify best practices.

People

Once the appropriate asset management leader is in place, appropriate skilling and staffing is needed. A close alignment with Human Resources’ activities is needed. Dependent on the start point, a baselining activity may be required to understand available skills and identify any skills gaps.
It’s essential that your staff understand the demands and challenges that are important in each asset lifecycle stage. They also need to be both empowered to execute the processes assigned to them as well as understand the significance of what they’re asked to do.

**Systems**

Systems enable the automation of processes and the consequent efficiencies from automation. In the ‘Predicts 2012: Economy and Energy Sustainability Guide Energy Utility Agenda’ (Nov 2011), Gartner suggests that utilities are striving for better equipment reliability, and this, in turn, is driving utility IT departments to get as much intelligence as possible from their Enterprise Asset Management systems. Because this need for knowledge requires more comprehensive data feeds and the data for the physical plant and equipment is locked away in the operational technology (OT), having interfaces to extract OT data will be a high priority.

This means that the *wall* (lack of links and lack of desire for links) between IT and OT needs to be broken down to deliver greater benefit.

**IT systems**

As record systems, IT systems are immensely scalable and allow easy cross-referencing and analysis compared to paper filing. Many of the shortfalls of the paper record systems still persist – for example, the need for data quality management. However, you can cross-reference IT systems with OT systems to promote better alignment with the physical asset estate.

IT systems are also used for design and reporting on assets. The implementation of an IT system to manage assets can be a complex undertaking. Fortunately, many vendors exist with decades of experience with asset management. These vendors offer packages of functionality that support different EAM processes. As many of these IT systems were designed for multiple industries, they usually offer process support for a wide range of business scenarios – usually wider than is needed for any given implementation in an asset-intensive organisation. This is called the functionality of the IT system.
Enterprise Asset Management IT

In the past 20 years, many early CMMS IT systems have added on Enterprise Resource Planning (ERP) functionality, and some ERP systems have added on Asset Management functionality. These IT systems are known as Enterprise Asset Management IT.

This systems development has offered many exciting possibilities for asset managers. The optimisation of EAM processes to address asset needs holistically becomes more easily achievable in a system that contains all of an organisation’s key business data. This means that all the process-related data for an asset is now available in one place.

Industry analyst Gartner predicts that OT integrations will be used increasingly to intelligently feed predictive data into EAM IT systems. This alerts the asset manager to potential failures, allowing effective intervention before the asset fails. This promises significant improvement in asset performance and availability to operate in the near future.

A number of organisations already offer systems that straddle IT and OT, providing more sophistication in the way that these systems can be used to manage assets. These are known as asset performance management systems.

The complexity of EAM system implementations can be profound. Effective asset management is largely dependent on the skills of the asset managers and the quality of the processes. Only when these two factors are managed effectively and when the organisation provides its best asset managers to lead the initiatives (both EAM system and IT systems) can many of the benefits of EAM systems and IT be unlocked.

Linking People, Processes and Systems

You need a holistic mindset that links people, processes and systems. This mindset enables people to run the right processes that use and enrich good quality data for improved asset management outcomes.
A general objective of Enterprise Asset Management is to maintain control over the information flows that inform understanding of assets, their whole life costs and risks throughout their lifecycle. Your ability to make asset decisions is dependent on having the right information. Identifying a way to enable people, process and systems to deliver the right information makes a successful design. Then you need to put the right information into the hands of the right people at the right time to make the best decisions.

Gathering information

Information is a critical enabler for Enterprise Asset Management. An effective, enterprise-wide asset management implementation needs to have data and decision needs at the heart of its design.

You can help define what information is needed by using techniques such as the following from the Institute of Asset Management. Figure 3-2 helps you understand the importance of some factors:

- You need to know what you'll use the data for and what decisions you'll make, and then build that into your data design.
- You need to know the cost to capture and maintain quality asset information so that you can right-size the data requirement.
- You need to realise how low data confidence breeds negative behaviours, so you need to build confidence and a sense of value and ownership for the data for all stages (except design) of the asset cycle.
- You need practical, cost-effective data governance and management processes, as well as data update tools to make those processes easy to implement.
Looking at asset distribution

Being practical, you also need to consider the distribution of the assets. Some assets are conveniently located in one building or on one site, making it easier to monitor their performance. Some organisations have their assets distributed over large geographies, in inaccessible locations, or moving – even at high speeds in outer space! When putting in operational technology systems, you need to think about how they assist the observation and monitoring of geographically dispersed assets (for example, making them as visible as assets conveniently located in one building on one site).

Ultimately, information flows are going to be best mastered throughout the lifecycle of the asset using integrated and connected IT systems with clear stewardship of asset data.

Multiple systems are needed because asset management IT systems provide very different functionality with different views of the asset. Examples include:

- **Enterprise Asset Management IT systems**: Used for all asset mastering and processes.
- **Geographical Information Systems (GIS)**: Used to geographically identify widely dispersed assets in their terrain.
✓ **Computer Aided Design (CAD) systems:** Used to depict the local, geometric shape of the asset and its immediate operating environment.

✓ **Asset Performance Management systems:** Function as a hub for the IT and OT where both sets of information meet.

Figure 3-3 shows flows of information that you need to control throughout the lifecycle of an asset. You need a holistic view so that sufficient understanding of the asset is retained to optimise business decision-making.

The number of flows shows the opportunities for capture of important intelligence on the performance of the asset infrastructure. Ensuring that these information-flows function efficiently is a challenging task that’s unfortunately not often achieved. This means that end-to-end processes throughout the lifecycle of the asset are less efficient and more expensive than they need to be. IT systems, designed to accelerate and simplify EAM processes, are often blamed for many of these inefficiencies as the symptom is a set of silos of stranded asset data. In reality, the problem is probably more correctly attributed to poor planning of the part that IT systems will play in the asset lifecycle to avoid silos and data stranding.
For large turn-key asset construction, Figure 3-4 shows a generalised depiction of the problems with turnover to operations with an emphasis on systems.

**General systems usage in larger asset lifecycles**

<table>
<thead>
<tr>
<th>Design</th>
<th>Procure and build</th>
<th>Commission</th>
<th>Operation</th>
<th>Decommission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAM Database system</td>
<td>Business as usual project management system</td>
<td>Business as usual project management system</td>
<td>Business as usual project management system</td>
<td>Business as usual project management system</td>
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<tr>
<td>CAD/3D CAD drawing system</td>
<td>Business as usual financial system</td>
<td>Business as usual financial system</td>
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<td>Project management system</td>
<td>Business as usual supply chain system</td>
<td>Business as usual supply chain system</td>
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<td>Business as usual human resource system</td>
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<td>Project financial system</td>
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<td>Project human resource system</td>
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<tr>
<td>Project Contract Management system</td>
<td>Asset management system</td>
<td>Asset management system</td>
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<tr>
<td>Project &quot;management of change&quot; leg</td>
<td>Work management system</td>
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<td>Project Safety reporting system</td>
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<td>Project quality management system</td>
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<td>BAU quality management systems</td>
<td>BAU quality management systems</td>
<td>BAU quality management systems</td>
</tr>
</tbody>
</table>

**Figure 3-4:** The part that systems play (or don’t play) in preserving asset lifecycle information flows.

### Considering IT strategy

The enterprise asset manager needs to build understanding within the IT services function to ensure that the most appropriate systems strategy is in place. This is the first of many relationships that the asset manager needs in order to knit together the appropriate end-to-end processes of the strategy.

Some useful points to note when considering IT systems strategy:

- Information flows are key. Early definition of these is vital.
- Early information stewardship is essential. Owners and processes are needed for this task.
- Avoid functional duplication across departments.
- Select systems with an established roadmap and commitment to integrated asset management.
✓ Minimise systems while maximising functional coverage. These systems include support functions, such as Finance, Procurement, Inventory Management, HR and Safety, Health and Environment Management (SHE).

✓ Understand the cost of building and maintaining system interfaces.

In practice, multiple systems will probably hold asset management data. For example, these systems may interface directly with the assets for monitoring and control, bring information from remote sites into the enterprise and describe the spatial aspects of assets.

There’s a high dependency between asset operation, maintenance activities and equipment reliability for the most profitable lifetime performance of assets. These have the most touch points, as depicted in Figures 3-5 and 3-6.

**Figure 3-5:** The hot spots for inter-dependency in asset intensive organisations.
It’s time to consider how to put in place an Enterprise Asset Management design for each lifecycle stage. This approach should optimise understanding of your assets and their whole life costs and risks. This design must also not compromise the individual objectives of each lifecycle stage – for example, there’s no point in an asset being ten years late just to give it the lowest whole lifecycle cost.
When examining small groups of assets, this model is ideal as it enables you to identify clearly the flows of information that you need to protect. When considering the lifecycle of individual assets, the limitation is that it suggests that all assets are in the same phase at the same time. Unfortunately, the situation is more complex because most asset populations have assets in every one of the phases at any one time. It’s more helpful to represent the lifecycle processes as interconnected as depicted in Figure 3-7.

![Figure 3-7: Interaction of asset processes across lifecycle stages.](image-url)

We use this high-level process model, but make reference to the individual lifecycle stages throughout for an individual asset.

This model takes the lifecycle of the asset from design and construction through operation and maintenance (including decommission) to the continuous improvement cycle. It also places equipment strategy at the centre of the lifecycle processes. Furthermore, irrespective of which model is preferred, the key phase level objectives, activities and data are identified in Figure 3-8.
## Design

**Objectives**
- License to build
- Consent to proceed

**Key information elements**
- 3D or 2D schematic
- Equipment Spec, ratings, size etc.
- Related Data I/O points etc.
- Isolation Points
- Function
- System Hierarchy
- Location
- QA & Safety
- Hazards
- Asset criticality
- Asset policy & strategy
- Define PM Schedule
- Training Requirements

## Procure & Build

**Objectives**
- Best Economic package
- Best construction plan

**Key information elements**
- Supplier Data
- Manufacturer
- Model
- Replacement Cost
- Warranty / Guarantee
- Manufacturer Drawings
- Manufacturer 3D model
- Standard Work Instructions
- Recommended Work Schedule
- Spare Part requirements
- Bills of Material

## Commission

**Objectives**
- Transfer to Operations
- Complete Build project

**Key information elements**
- As-Built Design Changes
- Snagging list
- Implement PM Schedule
- Model Work
- Materials Catalogue
- Model Permits
- Stores Holding
- Deliver Training
- Training – Material
- Verify the As-Built Design

## Operation

**Objectives**
- Maximise availability
- Cost effective safe running

**Key information elements**
- Operate process needs all data collected & verified
- Permits
- Criticality
- Planned Maintenance
- Predictive Maintenance
- Document Management
- Work Orders
- Work prioritisation
- Component Health
- Ops. Measurement Data
- Operational Exp.
- Design Change
- Management of change

## Decommission

**Objectives**
- License to decommission
- Low-cost safe decommission

**Key information elements**
- Operate process needs all data collected & verified
- Permits
- Criticality
- Planned Maintenance
- Predictive Maintenance
- Document Management
- Work Orders
- Work prioritisation
- Component Health
- Ops. Measurement Data
- Operational Exp.
- Design Change
- Management of change
Examining each stage

To help inform this design, first look at each stage to understand its key activities.

You can look at the lifecycle of an asset in a number of different ways. For large plant installations, this is considered in a linear way; see Figure 3-9.

We discuss this concept in more detail in Part IV.

In Figure 3-9, we identify a number of items with arrows. Usually, these elements are considered during commission, but, as part of gaining maximum value from your Enterprise Asset Management, you need to consider them during design.

Figure 3-9: Lifecycle of an asset with management of change impacts.

Looking at maintainability

In Part I we explain that the asset shape affects maintainability, which affects maintenance. Figure 3-10 shows a reminder. So, for cost-effective running of the asset, the maintainability needs to be optimised during asset design.
Reliability, availability and maintainability analysis has been well established in safety-critical industries, such as aerospace, transport and nuclear power. The demand on greater asset performance is pushing this approach into other asset-intensive industries, within capital project execution methodologies that have gated transitions from one phase to the next. A subpart of the design phase called Front-End Engineering Design (known as FEED) is now commonly used. It includes RAM (Reliability, Availability, Maintainability) modelling studies as key deliverables of the early design stage.

Although reliability in design is well understood, the implementation of processes and systems to support this across the asset lifecycle isn’t. Addressing this as part of the implementation brings benefits throughout the asset lifecycle.

**Embedding the Vision: The Measures to Include**

In Part II, we laid out our approach through the asset management policy with its associated strategy, plans and objectives. In this section, we look at the key enablers that will help you to deliver your asset management vision. We give important guidelines on being realistic and key considerations when defining the right EAM implementation approach.

We summarise these guidelines as follows:

- The start position
- The business case
- How challenging the objective is
In the following sections, we expand on these guidelines to show how the appropriate design is achieved.

**Understanding the start position**

In order to improve asset management practices, an organisation must understand exactly where it is. To measure achievement, you need to measure baseline.

No standard international benchmark exists for asset management. However, some reference and maturity models provide a useful framework. The Institute of Asset Management is also working to address the issue of consistency (see Part I).

Current practice is to create a bottom-up map of existing (also known as ‘as-is’) asset management processes to define the start point. You can create this map through facilitated workshops with the business users. These workshops also capture challenges with existing processes. However, these exercises often have too little focus on data quality and the use of systems. In particular, asset management initiatives tend to be limited to maintenance or to disciplines within maintenance, such as reliability.

This limitation can be off-putting because a lot of investment is often needed to map these processes before even defining improvements. Often, organisations may wait until a drastic reason for change occurs.

The skills to perform the evaluation of as-is processes may not reside within the organisation, and it may need external help. In those cases, take care to retain internal leadership and ownership.

It’s critical to ensure that the start position is well understood as it’s the baseline for your EAM implementation. Your start position ensures that requirements are captured and delivered effectively with buy-in across the enterprise.
Defining the business case

After you understand the current position, the case for change begins to emerge through a further set of the target (also known as ‘to-be’) process and organisational design exercises. The benefits emerge from streamlining existing processes, moving towards a more planned approach to maintenance, redefining work prioritisation, improving asset data quality and delivering greater asset availability. These benefits can be reduced by the costs of the activities required to achieve them. It’s essential to select a set of measures that are tempered against their deliverability.

Ownership of the benefits needs to be embedded within any resulting initiative. You can embed ownership by linking benefits to the enablers (changes defined within the EAM implementation) and by making appropriate people within the business responsible and accountable for the realisation of these benefits.

How challenging the objective is

An organisation can perform many initiatives to improve its asset management practices. You need to deliver a successful programme rather than one that overreaches itself. Realism needs to be at the core of the initiative definition.

For example, without an executive focus on asset management, aiming for reliability-centred maintenance as your primary maintenance approach is pointless. Rather, it would be much better to aim for this goal in the long term and choose a more realistic interim objective for the EAM implementation. You can see further examples in Figure 3-11.

<table>
<thead>
<tr>
<th>Laggard steps to success</th>
<th>Industry average steps to success</th>
<th>Best-in-class steps to success</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish executive focus for asset management</td>
<td>Establish a risk-management strategy</td>
<td>Utilise energy consumption for operational decision making</td>
</tr>
<tr>
<td>Provide real-time and historical asset data to employees</td>
<td>Align maintenance and production teams</td>
<td>Synchronise asset performance to corporate performance</td>
</tr>
<tr>
<td>Invest in analytics</td>
<td>Establish integration between EAM and the plant floor as well as business systems</td>
<td>Implement Reliability Centred maintenance as a primary maintenance approach</td>
</tr>
</tbody>
</table>

Figure 3-11: Realistic and un-realistic objectives.
It’s always easier to do nothing and explain away the problems or say that change is too hard. For this reason, your roadmap needs to be realistic if you want to drive through change, especially where change is linked to an event such as new government regulations.

A roadmap for change therefore needs to:

- Deliver benefits every step of the way.
- Deliver large change dependencies early to give flexibility later on and early benefits.
- Provide an appropriate timeline to avoid change weariness.

**Change complexity**

Implementing Enterprise Asset Management means changing the way an organisation works, and that’s disruptive. Implementing EAM can be called a lot of things: business process re-engineering, transformation, streamlining and so on. But it is always change.

Change may mean:

- Changing the processes people use.
- Increasing automation in processes.
- Removing unnecessary processes.
- Changing the mix of skills people need.
- Changing the organisational structure to reflect the change in the effort required to execute the new processes.
- Implementing new IT systems to support the new processes.
- Bringing in external systems integration and consultancy to support the changes.
- Communicating the impacts of the changes throughout the organisation.
- Training people on new processes and new systems.

Often, though not always, the organisation may be reducing the number of people who carry out the existing processes –
usually the knowledge that these people possess can be redirected to deliver greater value. Early and close coordination with union representatives can increase the likelihood of successful EAM implementation.

Careful consideration is required to ensure that all the implications of the change are understood and planning is put in place so that the change agents are appropriately equipped and supported.

You must consider factors such as organisational complexity as well as its change track record. You need to learn from previous experiences and case studies.

So where can you find lessons learned? Try here:

- Your carefully recruited people – for example, a team of 20 maintenance employees with an average of 10 years’ experience each, has 200 years’ experience between them.
- Documented lessons learned in your company.
- Independent sources, such as:
  - ISO14224: This International Standard provides a comprehensive basis for the collection of reliability and maintenance (RM) data in a standard format for equipment in all facilities and operations within the petroleum, natural gas and petrochemical industries during the operational life cycle of equipment.
  - The IAM: This learned organisation promotes increased knowledge in asset management. It has valuable guidance material for asset managers at every level.

**External factors**

Many asset-intensive organisations face direct or indirect regulatory control. Utilities (water, gas and power distribution), rail companies, airports, local authorities as well as many others answer to a regulator who controls their performance and even their capital allocations. Furthermore, external factors, including the weather, public perception, taxation, legislative change, cost of capital and the performance of international markets, all affect the timing and scale of your Enterprise Asset Management approach. Factor these items into the plan as well.
Sense checking your approach

After all this explanation of the considerations for implementing the right EAM approach, it’s worth applying some sense checks to ensure that your approach can deliver benefits. It’s good practice to define a set of tests to help weed out non-essential parts of your strategy. Base these tests on existing lessons learned.

Start by looking at the impact of the design phase. The design of the asset determines its shape, which determines its maintainability, which affects maintenance and therefore the cost of maintenance. This significance is represented in the following figure, which shows that approximately 75 per cent of the whole lifecycle cost of operating an asset is pre-defined at design stage.

What does this mean? Well, it means that no matter what the people who operate the plant do, they can affect only 25 per cent of the cost by the time that the asset is handed over to them. Therefore, decisions made during design that make maintenance more difficult or challenging can have considerable cost consequences for maintenance cost and overall profitability during plant operation.

For example, in a recent construction project, a design decision was made to mount fixed (non-retractable) lights on top of 3m high columns on top of cooling towers that were 25m high (see the following figure). These lighting columns were cheaper than retractable lighting columns.
However, the problem came with handover to maintenance. The maintenance team noted that because the lighting columns were too high for normal access and the ground beside the tower wasn’t concrete, an all-terrain elevated working platform would have to be hired to change each light bulb. Therefore the cost of each light bulb change could reach £2,000 per bulb instead of less than £100. Furthermore, and more importantly, workers were exposed to a significant and unnecessary hazard.

What went wrong here?

The design specification required an illuminated access platform for inspection of the cooling tower on a 24-hour basis. No mention was included in the design for safe practical maintenance. The procurement team sourced the lowest cost option against the original design criteria.

The operator and maintainer identified the impact.

You can see that Enterprise Asset Management requires close collaboration across the organisation as well as throughout its lifecycle in order to achieve its objectives.

How will the defined approach prevent this from happening in the future?
**IT systems**

Changing IT systems are disruptive. As EAM is a holistic discipline, IT systems which support EAM are particularly disruptive to the organisations day-to-day work. Conversely, many organisations have realised that this very disruption can provide a really good opportunity to implement organisation and process changes. This can be a very good approach so long as you ensure that the changes are process led. IT systems are powerful enablers but business process shouldn’t be defined to match to IT system restrictions.
Part IV
Implementing EAM

In This Part
▶ Following your design and plan
▶ Tracking your progress
▶ Improving and measuring the outcome benefits

In this part, we look to pool all the information and guidance from the previous parts into some straightforward actions that can help you implement effective Enterprise Asset Management.

Putting Everything Together
As an asset manager you may find yourself in various different stages of the asset lifecycle. More than likely, you’re in the ‘operate and maintain’ phase where you’re looking to improve existing asset management practices. Alternatively, you may find yourself at the beginning or end of the asset lifecycle.

In each case, you may have a compelling business need to invest in better Enterprise Asset Management practice. Yes, even in decommission, you may gain significant savings and improvements by spending some money upfront on improving Enterprise Asset Management practices.

Taking advantage of true leadership
The critical success factor during implementation is the presence of an Enterprise Asset Management leader who holds the holistic vision and can execute on this vision (see Part III).
The business must be able to place its trust in such an individual and follow the change through to realise the improvement. So an important question to ask early on is ‘Is the Enterprise Asset Management leader sufficiently skilled and supported to lead the business through this important change?’

Although help is available from many sources, the only place that true leadership for a successful implementation can come from is within your own organisation. The ownership of the vision rests with your in-house Enterprise Asset Management leader.

Of course, the EAM leader can’t do everything and shouldn’t try. It’s sensible for them to appoint a transformation lead. The transformation requires formal governance to ensure successful delivery. This book doesn’t go into defining what good transformation governance looks like. We do, however, identify these prerequisites for good transformation that are relevant to successful EAM implementation:

- Ownership from the top
- Empowerment for tough business decisions
- Focused steering group (business, finance and IT)
- Transformation programme director
- Committed resources from business
- Clear business vision to focus requirements
- Engagement from business
- Implementation and training plan from the start
- Strong attention to data
- Strong communication channels

**Defining the EAM vision**

After you have the Enterprise Asset Management leader in place, the first activity is to define the Enterprise Asset Management vision that the organisation will implement. After defining your Enterprise Asset Management vision, you’ll be likely to prioritise objectives that align with your general and phase specific objectives. (See Part III for a discussion of the importance of appropriate leadership, process and data
management as well as the significance of the proper use of IT and OT systems to support your processes.)

The Enterprise Asset Management vision needs to be grounded in a well-considered and peer-reviewed business case for improvement. Your organisation will expect at least this vision in order to approve funding. This endorsement is an essential step towards an effective implementation. It’s also a discipline that you should track throughout the lifecycle of the investment because not only is it important to provide rapid ROI, the year-on-year return versus prediction gives an invaluable indicator of how well you know your assets and your business.

Ultimately, the financial governance of the organisation looks for hard, cash benefits from the initiative. Figure 4-1 identifies some of the areas where these opportunities may arise.

![Figure 4-1: Striking the right balance with the pillars of asset management to drive cashable benefits.](image)

The transformation leader, in conjunction with the EAM leader, now needs to define the governance to shepherd the changes through. High-level sponsorship is important to ensure that the initiative doesn’t get bogged down in organisational resistance. The Enterprise Asset Management initiative should be the place to be in the organisation where aspiring asset managers compete to be involved so as to further their careers.
Without the appropriate Enterprise Asset Management leader or appropriate governance, the organisation needs to think very seriously about whether it’s worthwhile investing in the initiative as it’s likely to deliver well below its potential.

Enterprise Asset Management implementations are therefore essentially an initiative, driven from the top, led by a highly skilled and sponsored individual who can execute an enterprise-endorsed asset management vision.

**Shaping the Organisational Design**

The organisational structure needed to execute the new vision is likely to be quite different from the existing model. This structure may require more people initially to gain control of back-log or to define processes. It may or may not require fewer people.

The shape of the new organisation largely comes down to the changes that need to be made to support the new asset management practices. Fundamentally, this shape is related to the processes that the business needs to run and the roles required to execute them.

Proven track-record and experience in Enterprise Asset Management leadership are essential factors required to design the most appropriate processes.

For example, an organisation in the operations and maintenance stage for the bulk of its assets that views its percentage of reactive maintenance work as too high, may want to bring in more people to address backlog, impose planned maintenance rigour and ultimately reduce risk before moving on to a more controlled, steady state of running. Conversely, a new build may require more people in design to ensure that safety and maintainability are properly considered.

Various asset-related factors are relevant when considering resources needed. These include but aren’t limited to:
Complexity of the asset base
✓ Changeable nature of the asset infrastructure (for example, numerous small additions)
✓ Regulatory licensing constraints
✓ Risk mitigation for operation and maintenance

Identification of the key roles to embed the vision is essential. Key actors in the Enterprise Asset Management organisation must understand the holistic vision from the start in order to be able to create an Enterprise Asset Management culture.

Some examples are:

✓ Appointment of a maintenance coordinator responsible for planned maintenance and delivery of high compliance with the planned maintenance schedule. This increases the focus on planned maintenance.

✓ Re-orientation of teams to cover holistic disciplines that encourage cooperation across the organisation.

After the EAM leader has worked to define the appropriate structure, recruitment into the Enterprise Asset Management initiative is required. Recruitment of all parties for the implementation and running of a successful Enterprise Asset Management requires alignment with the vision. This recruitment includes employees, contractors, IT systems integrators, consultants, corporate services and so on. All parties must demonstrate understanding of the importance of effective Enterprise Asset Management for the success of the business as defined by the business sponsor.

Recruits may be internal or external depending on the stage of the asset lifecycle. The recruits should be able to identify the importance of the vision as it applies to them within their day-to-day job. The business case should include the costs (including productivity losses and back-fill costs) of releasing the best people for the initiative. Nothing’s quite as demotivating as asking your best employees to execute processes that have been poorly conceived because the only people released to define them weren’t sufficiently experienced.

An excellent source of guidance in this area is the IAM’s competency framework, which you can view in conjunction with your asset management strategy and policy.
Looking at Process Design and Implementation

After your new recruits are on board, you can get down to the detailed process design. This step takes the vision to the next level, ensures that your asset management policy and strategy are clearly defined, organisationally aligned and that the overall business management for your business utilises the combined expertise of your entire team.

It’s vital to engage the new recruits in the definition of new processes that underpin the implementation. Furthermore, the use of the integrated business management specification (PAS 99) can help you efficiently manage the mandated compliance with so many of the standards you must adhere to in your asset-intensive world.

The vision is now shared with a core group of champions who, along with the Enterprise Asset Management leader, champion the definition of all relevant processes.

Defining IT system set-up

Definition of IT system set-up always needs to follow your process leadership. However, be aware that extensive reprogramming of customised, off-the-shelf Enterprise Asset Management software is expensive to implement and extremely expensive to maintain. Selection of enterprise-strength software to cover the breadth and depth of your process needs is very important. It’s worth taking up any opportunities to visit your external peers – especially those you view as leaders in Enterprise Asset Management – to learn from their experiences.

Recent developments in mobile technology smartphones, iPads and other tablets have pushed their way into the workplace. Using this field technology can add more complication to implementing Enterprise Asset Management but can offer significant benefits in worker productivity as well as the essential area of asset management feedback on work completion.

Field-based machine technology (for example, sensors, Remote Telemetry Units [RTUs]) feed essential operational information about asset function. Also, this operational technology allows the operator to remotely operate the plant.
Anglian Water and CGI deliver next-generation mobility

Anglian Water is the largest water and sewerage company by geographical area in the UK. As an asset-intensive business, Anglian Water has a keen focus on asset management for the entirety of its existence. In the past decade, it has continually updated its processes and systems to meet the increasing regulatory and cost challenges within its marketplace. These updates have involved initiatives such as moving systems onto an ERP-EAM platform for management of its assets as well as implementation of a fully mobile field-based asset management system.

The advances in IT and the demands for ever more intuitive and performance IT solutions has driven Anglian Water to innovate further. With CGI, Anglian Water is implementing an even more highly integrated operational technology project to give even better telemetry visibility from thousands of field-based sensors. Furthermore, Logica has helped to bring the next generation of highly intuitive rich user experience to Anglian Water in the form of new mobile applications.

Critical to the application’s success is the ability to serve data from a number of other applications so that they arrive at the engineer’s mobile device in a timely fashion. The application architecture was designed to support the optimal delivery of information. The project team identified the most time-critical data and prioritised this data over others.

This ability has had an immediate impact on worker productivity and data quality, reinforcing Anglian Water’s holistic asset management philosophy. The analyst organisation Pierre Audoin Consulting group commented: ‘For a service engineer to manage all his tasks while on the road [and be managed] in a truly IT integrated way is still quite rare in this world, but a desirable goal with a good business benefit case to be made for quality, productivity and indeed staff motivation.’

Analyst organisation Ovum commented: ‘Representatives of CGI and Anglian Water both highlighted the huge effort put into the design of the application user interface. The goal was to provide staff with an interface with which they were immediately comfortable: something intuitive for users of web-based applications. Anglian Water wanted the application to look like a consumer app, not a corporate one.’

The drive for consumer-style apps within asset-organisations is already changing the way that asset-intensive organisations are viewing usability for geographically dispersed asset management operatives.
The importance of integrating asset management Information Technologies with Operational Technologies is being stressed by analysts such as the Aberdeen Group and Gartner. An elegant and rich way of doing this is through the use of Asset Performance Management (APM) systems, which provide an intelligent hub to drive synergies and increased performance from your assets. Again, look for accelerators such as prebuilt interfaces and independently verifiable references.

Adding people and data to the mix

It goes without saying that processes and systems are nothing without people and data. Preparing both of these components takes particular skill, patience and attention to detail. The existence of your core team to embed the vision is a big help. Your team can ensure rapid growth within the organisation. However, a well-considered and executed change and knowledge transfer plan is essential to ensure that the right knowledge transfer and enablement happens at the right time to the right people to ensure success.

Likewise, for data, you’ll face very particular challenges depending on the asset lifecycle phase. In new builds, you have a great opportunity to get data quality right the first time. However, while you may have more time before operational running, be aware that you’re closely aligned with your build contractors to ensure you get synergies. Nowadays, it’s easy for you to specify the file format you want your data to load into your system of record, so early definition of these formats can save you a lot of time downstream. It’s well worth investing in a data load specialist who can look after data quality for you throughout the course of the implementation.

For assets in the operation and maintenance phase and beyond, the challenge of poor data quality may force you to execute a data acquisition and clean-up exercise even before you start out on your enterprise asset management implementation.

Ultimately, in business process design (including the implementation of appropriate supporting IT systems), the focus on process leadership by the Enterprise Asset Management leader, in line with the vision, should be the guiding force.
Power generator implements new EAM solution in record time

A major power generator decided to build a new gas-fired power station in the UK. This power station went live in May 2012. The challenge for the station management was to start from the ground up to design and implement the Enterprise Asset Management system for the power station in time for the go-live of the power plant.

Building a new power station required a definition of the appropriate business management system for running the power plant with the right organisational structure. The company decided that it needed an integrated holistic approach to Enterprise Asset Management that would enable the organisation to be compliant from the start with PAS 55, ISO 9001, ISO 14001 and OHSAS 18001. PAS 99 compliance was used to assist with this design.

This approach helped determine the appropriate lean organisational structure for the plant, which is now run with just over 40 people. Their recruitment brought together people from multiple industries and multiple backgrounds. These people found themselves being provisioned with very modern tools to assist with their jobs. However, they also found that they were expected to be more joined up with their colleagues in plant-wide processes than ever before, particularly in the areas of asset management. Maintenance and operations technicians found themselves responsible for owning specific classes of assets. In particular, this ownership meant that they were responsible for the quality of data and data collection. These technicians also had to ensure that the plant being built was in line with the system of record.

Safe working practices, good document practice, repeatability and consistency were values that the asset management leadership instilled from the start in the highly inclusive culture that was installed. All staff pooled lessons learned from previous working experiences into the design of the new Enterprise Asset Management system. The team took the opportunity to do high-level criticality assessments of all assets on site and use this information to govern the asset management policy and asset management strategy.

The Enterprise Asset Management leadership selected systems that reflected this inclusive philosophy. The asset management leadership embraced the corporate ERP system (SAP) employed by the company not only as the Finance, HR and Procurement system but also as the Enterprise Asset Management, Document Management and Environmental Health and Safety system. It took a lot of encouragement

(continued)
to get everyone on board, but once this goal was achieved, the benefits of the highly integrated nature of the selected system ensured that the holistic vision took root in the organisation and drove behaviour from day one.

The Enterprise Asset Management leadership, the maintenance and operations employees, and Logica systems integrator led the system design and implementation. All system design was process-led with the power station team defining the key processes in line with the holistic vision and Logica, now part of CGI, advising on the optimal deployment of SAP, EAM and ERP to support this.

The data model was defined as part of this exercise, as was the processes relating to safety, Health, Environment, Asset Management, Finance, Management Accounting, Purchasing, Contract Management, Operations and Human Resources. The use of offline spreadsheets and standalone drives was minimised by the pervasive use of the corporate document management system and the removal of access to shared drives. Stations staff members were given ownership for discrete pieces of data ownership, and progress quality checks were made along the way. International standards were applied where applicable, including ISO 14224 and KKS, which allows benchmarking externally.

Corporate functions were engaged throughout from IS, procurement, HR, finance and safety to ensure that they contributed towards and understood the initiative.

The initiative went live successfully on time and budget, achieved certification against all the preceding standards, and added tight integration with real-time operational technology systems added after the station went live to automate condition monitoring and further mitigate risk.

**Seeking Continuous Improvement**

After you’re live with your newly implemented Enterprise Asset Management, you need to know how you’re performing, and ensure that you can measure this from the start. Based on your asset management strategy, you know what KPIs you need for process health (head to the later section ‘Key Performance Indicators (KPIs)’ for more). Make sure that you use performance and conformance KPIs that are appropriate to the stage of the asset management lifecycle, because for new builds, things are fluid.
There’s no point delivering very high reliability if the cost of so doing is going out of business. Furthermore, the adage is also true: ‘if you don’t like the cost of maintenance, then see if you prefer the cost of catastrophic failure’. Compound measures across the end-to-end business process provide invaluable decision-making insights. Clearly, it’s essential to know where you are so that you can be assured that you’re operating under controlled conditions and that your risk level is understood.

In the absence of a universally accepted quantitative maturity measurement for asset management performance, it’s up to each organisation to define what the key performance indicators are and how performance will be tracked against them. Figure 4-2 shows some of the points where information flow readings should be measured to assess the performance of your Enterprise Asset Management system.

**Figure 4-2:** Points where information flows are measured to assess EAM performance.

The more holistic and joined up your maintenance system is, the more representative and therefore useful your performance indicators will be. The numbers suggest performance measure points.
You can separate reporting and KPIs into different groups:

- Business process reports
- Process compliance reporting
- Key performance indicators (KPIs)

**Business process reports**

*Business process reports* are the most frequently used reports, as they provide day-to-day information as part of a process. They also provide asset performance information to be used in the continuous improvement cycle. These reports are executed in real time, giving the user up-to-date information when carrying out the required steps in a process. Generally, these reports should be available on a user-driven query basis.

Examples of business process reports include:

- Job requests created in the last 24 hours
- Work orders completed in the last 24 hours
- Assets with gauge/meter points
- Location of all pumps of a certain type or rating
- Orders scheduled today
- A list of all calibration equipment
- A list of all assets with under warranty
- Materials ordered availability

**Process compliance reporting**

*Process compliance reports* measure adherence to a process derived from a policy, law or regulations. This process may be either a physical world process or a system process. It’s usual to set out a procedure to identify what it is that the compliance report relates to and how it should be measured. Process compliance reports are an aid to maintaining both the system and data integrity. As an organisation matures, system compliance becomes custom and practice, so you have less need to measure, and focus can move towards more performance and KPI reports.
Examples of process compliance reporting include:

- Completed work orders without confirmation
- Job reports without Cause and Remedy coding entered
- Outstanding orders by discipline or work centre
- Assets without an object type maintained in the master record
- Overdue calibrations
- Overdue deliveries
- Work not completed to service level agreement
- Number of orders awaiting creation of a safety permit

**Key Performance Indicators (KPIs)**

*Key Performance Indicators (KPIs)* are measurable indicators of performance derived from the strategy and goals of an organisation as an aid to evaluate how successful the organisation is in meeting these goals. Targets are set for KPIs, which are often obtained by benchmarking.

The delivery of processes and their improvement is helped by comparing current performance to the agreed targets. An important success factor associated with the use of KPIs is that they’re communicated and understood. Asset managers should select KPIs that, when used together, provide a cohesive balanced picture of the health of the asset management process.

Here are examples of Key Performance Indicators:

- OEE (Overall Equipment Effectiveness)
- Conformance to maintenance plan
- Conformance to maintenance schedule
- Backlog monitoring
- Breakdown recording
- Percentage of planned work
- Planning effectiveness
✓ Job request processing time
✓ Planned/actual costs
✓ Order status management
✓ Damage/cause analysis

Evaluating improvement

When looking at continual improvement, the following questions are relevant:

✓ How are lessons learned?
✓ Is there an opportunity for learning lessons?
✓ Learning from failure (does the culture shun talking about failure?)
✓ Learning from success (is there the discipline to learn from success?)
✓ Embedding best practice in design (is learning lessons a key part of FEED?)
✓ Closing the loop (is there a fully traceable audit trail from root cause analysis and lessons learned through to implemented changes?)

The holistic EAM design needs to incorporate continuous improvement. For many asset-intensive organisations (particularly those with distributed asset networks), continuous asset build is core business and efficient, and continually improving capital investment is an essential activity. For all asset-intensive organisations, the ability to identify true asset need (with financial payback) for capital-spend is a core requirement, and harnessing hard facts from a holistic enterprise asset management reduces risk of wasted investments.

Use the organisation’s measures and performance to inform continuous improvements with facts. Decisions relating to improvements should therefore have a solid basis in engineering fact tightly coupled with financial payback. New technology (simulations, ‘what-if scenario modelling’) is becoming more and more powerful through advances in computing such as ‘Big-Data In Memory computing’.

Look outwardly to organisations such as the IAM and EFNMS who provide excellent guidance.
Part V

Top Ten Implementation Points to Remember

In This Part
- Learning from the experts
- Engaging everyone

Bear these points in mind as you begin your Enterprise Asset Management journey.

Embrace the EAM Convergence

Enterprise Asset Management is a new discipline that represents the convergence of a number of maintenance, finance, project and engineering disciplines into one common set of good business practices for asset-intensive organisations. Keep current by following, joining and contributing to organisations such as the IAM or the EFNMS who are at the forefront of this convergence.

Engage with the Leading EAM Learned Organisations

The Institute of Asset Management (www.theIAM.org) is helping (in collaboration with other global bodies) to define best practice in asset management with its asset management landscape and 39 subject specific guidelines.
Be Holistic when Implementing EAM

Enterprise Asset Management is holistic. It’s essentially the good business management of an asset-intensive operation. Therefore you need to engage all relevant parties in your organisation, irrespective of their department.

Know the Difference Between EAM and EAM IT Systems

Enterprise Asset Management and Enterprise Asset Management IT systems are two very different things. EAM IT systems help to automate some of the processes in your overall EAM business system.

Prioritise Establishing the Right EAM Leader

Proven enterprise asset management leadership is a key factor in the implementation of Enterprise Asset Management. Prioritise establishing the right EAM leader for your implementation.

Exploit the Guidance Available

Help is at hand to support your EAM implementation. Many standards and benchmarks provide excellent guidance – most notably PAS 55/ISO 55000 as well as the common standards standard PAS 99. Speak with the learned bodies in this area (such as the IAM and the EFNMS).
Choose Process-led Implementation for EAM IT Systems

Enterprise Asset Management processes can be supported by the appropriate use of IT systems. The implementation of such systems should be led by the processes and not the other way around.

Put Effort into Creating an Asset-centric Culture

Successful implementation of Enterprise Asset Management requires the embedding and continuous, rigorous review of an asset-centric culture.

Be Better Informed with Real-time Information

Harnessing intelligence that resides in Operational Technologies (OT) has an important part to play in the holistic enterprise wide decision-making related to assets.

Monitor to Perform

Monitoring and acting on performance of assets and process conformance measures through effective KPIs is an essential part of a continually improving Enterprise Asset Management system. (See Part IV for more on this topic.)
Asset Performance Management (APM): Encompasses all maintenance activities that extend the lifespan of mission-critical assets to ensure that an organisation achieves its strategic goals and objectives.

Capital Programme Management System (CPMS): Refers to the systems available to help building owner/operators, program managers, and construction managers control and manage the information that capital construction projects create.

Computer Aided Design (CAD): The use of computer systems to assist in the creation, modification, analysis or optimisation of a design.

Computerised Maintenance Management Systems (CMMS): A CMMS software package maintains a computer database of information about an organisation’s maintenance operations. This information is intended to help maintenance workers do their jobs more effectively and help management make informed decisions (for example, calculating the cost of machine breakdown repair versus preventive maintenance for each machine, possibly leading to better allocation of resources).

Customer Information System (CIS): Manages all billing and customer support processes.

End-to-End (or E2E) processes: End-to-end theory embraces the philosophy that eliminating as many middle layers or steps as possible will optimise performance and efficiency in any process.

Enterprise Resource Planning (ERP): A system that integrates internal and external management information across an entire organisation, embracing finance, manufacturing, sales and service, customer relationship management and so on. ERP systems automate this activity with an integrated software
application. The purpose of ERP is to facilitate the flow of information between all business functions inside the boundaries of the organisation and manage the connections to outside stakeholders.

**Forrester**: A global research and advisory firm.

**Front-End Engineering Design (FEED)**: The stage of a project beyond conceptual design, but before detailed design. The objective of the FEED study is to define the project’s scope to a degree such that uncertainty and hence cost increases are minimised during the execution phase. A FEED study typically involves preparation of preliminary design documentation, cost estimates, procurement requirements, a project schedule and risk assessment.

**Gartner**: A leading global information technology research and advisory company.

**Geographic Information System (GIS)**: A system designed to capture, store, manipulate, analyse, manage and present all types of geographical data.

**Information Technologies (IT)**: The branch of engineering that deals with the use of computers to store, retrieve and transmit information. The acquisition, processing, storage and dissemination of vocal, pictorial, textual and numerical information.

**Institute of Asset Management (IAM)**: The professional body for whole life management of physical assets.

**ISO 14001**: Standard related to environmental management. Designed to help organisations minimise how their operations negatively affect the environment (for example, cause adverse changes to air, water or land). Also provides guidance on how to comply with applicable laws, regulations and other environmentally oriented requirements.

**ISO 9001**: Standard related to quality management systems and designed to help organisations ensure that they meet the needs of customers and other stakeholders. Published by ISO, the International Organisation for Standardisation.
Mobile Enterprise Application Platform: A comprehensive suite of products and services that enable development of mobile applications. MEAPs address the difficulties of developing mobile software by managing the diversity of devices, networks and user groups at the time of deployment and throughout the mobile solution’s lifecycle.

OHSAS 18001: Standard related to Occupational Health and Safety Management System (OHSMS), designed to create a safer workplace.

Operational technologies (OT): Systems that deal with the actual running of plant and equipment. Devices to ensure physical system integrity and to meet technical constraints. Event-driven and frequently real-time software applications or devices with embedded software.

Ovum: An organisation providing independent and objective analysis enabling its clients to make better business and technology decisions.

PAS 55: Optimal management of physical assets. PAS stands for Publicly Available Specification and is published by the British Standards Institution.

PAS 99: Specification of common management system requirements as a framework for integration. Published by the British Standards Institution.

Programmable Logic Controllers (PLCs): A digital computer used for automation of electromechanical processes, such as control of machinery on factory assembly lines, amusement rides or light fixtures.

Reliability, Availability, Maintainability (RAM): A set of requirements imposed on a system to ensure that it will be ready for use when required. Also ensures that it will successfully perform assigned or designed (intended) functions and can be maintained in its operational state over its specified useful life.

Reliability Centred Maintenance (RCM): A process to ensure that assets continue to do what their users require in their present operating context. It is generally used to achieve
improvements in fields such as the establishment of safe minimum levels of maintenance, changes to operating procedures and strategies and the establishment of capital maintenance regimes and plans. Successful implementation of RCM will lead to increases in cost effectiveness, machine uptime and a greater understanding of the level of risk.

**Supervisory Control and Data Acquisition (SCADA):** A centralised system that monitors and controls entire sites, or complexes of systems spread out over large areas.

**The Aberdeen Group:** An organisation providing research and analysis of information technology companies and products as well as custom consulting services.
## Business

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