

Asset Management: A Risk-Based Approach Energy & Resources Benchmark Survey



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Foreword

The objective of this survey is twofold; first of all, it gathers information on the overall maturity level of a company's risk-based asset management activities, and secondly, it helps to identify new challenges, critical issues and risks Energy & Resources companies are facing today.

Organizations in the Energy & Resources industry are typically asset-intensive. Their daily operations depend strongly on the performance of their physical assets. As a result, these organizations strive continuously to optimize their asset performance. At the same time, they are frequently faced with ageing assets, along with environmental, safety and regulatory compliancy requirements that are becoming more and more stringent, adverse weather conditions and environmental threats, emerging technologies and other challenges associated with asset ownership and operation. To add to this, there is the ongoing pressure to reduce costs in combination with shrinking budgets. This gives Asset Managers the huge challenge of allocating their scarce budget in the most optimal way to their assets.

The emerging discipline of a risk-based approach to managing assets has increased significantly in the last decade. Risk-based asset management has shown to be effective for asset-intensive systems, not necessarily by reducing risk, but by using risk to balance the operational performance of the assets against the asset life-cycle cost. Expenditure on assets is rationalized by using an assessment of what risk exposure is acceptable by the different stakeholders, maximizing overall wealth for the organization and society. For this reason, risk management has been widely incorporated into industry best practice for asset management, such as the ISO55000 series of standards.

In 2013, Deloitte Touche Tohmatsu Limited (DTTL) launched a second edition of the Energy & Resources Enterprise Risk Management (ERM) Benchmark Survey, in which a separate section was dedicated to Asset Risk Management (ARM).

The objective of this survey is twofold; first of all, it gathers information on the overall maturity level of a company's risk-based asset management activities, and secondly, it helps to identify new challenges, critical issues and risks Energy & Resources companies are facing today. The results of this survey may allow companies to benchmark and assess their current asset risk management activities against industry leading practices.

This document summarizes the responses of almost 40 participants worldwide on the Asset Risk Management section of the ERM Survey, covering almost all geographical regions along with the different sectors of the Energy & Resources industry.

Exhibit

Asset Management can be defined as a process to generate maximum value from a physical asset base – for the business and for society – by balancing the operational performance of the asset against the asset life-cycle cost and its risk profile for all relevant stakeholders.

Executive summary

Risk management has become an integral part of good asset management practice

The survey results show that the vast majority (95%) of participants have fully or at least partially integrated risk management into their asset management processes. The remaining 5% are planning to incorporate risk management in their asset management practice in the future.

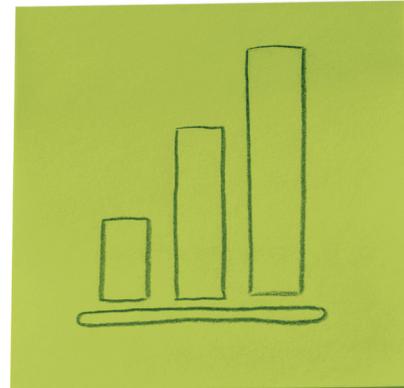
If we compare these results with the previous survey conducted by DTTL in 2009, we see a clear shift towards more incorporation and more interest in doing so at a later date. In 2009, more than 20% of respondents had no intention of incorporating risk management into their asset management processes at all.

This is reaffirmed by the trend towards industry leading practices and standards that have emerged. With ISO55000, asset management now has its own International Standard, which can be seen as a real milestone in the recognition of asset management as a fully-fledged discipline. Within this ISO55000 standard, risk management is seen as an indispensable aspect of asset management. Amongst others, the execution of risk assessments; implementation of risk mitigation plans; and the alignment of asset risk management to the enterprise's risk management approach are an integral part of the ISO55000 standard.

The incorporation of risk management into asset management processes, as described in these different guidelines and standards, reflects the maturity level organizations give themselves when it comes to asset risk management. Organizations describe themselves as being in the middle of a cultural change, where asset risks are dealt with in a proactive way with rapid escalation procedures in place and no distinction between industry segments or size of the organization.

As the level of complexity and therefore required specialization increases, dedicated Asset Risk Managers are appointed to manage the myriad and diversity of risks to which assets are exposed

Along the asset life cycle, ranging from design, build, maintain, operate to divestiture, a host of business, operational, financial, legal, tax, regulatory, security, safety, health and environmental risks need to be managed. Taking all of these dimensions into account and managing them in a balanced way to optimize the value contribution of the assets to the business is a complex task. Therefore, half of the surveyed companies appointed a dedicated Asset Risk Manager, coordinating asset risk management activities across individuals, functions and even organizational entities.



Companies recognize the importance of asset risk management for their organization, though only half of them measure and report the benefits

Risk-based asset management helps to ensure companies that budget spend on their asset base are maximizing business value. Key business values used to drive asset management decisions are legal and regulatory compliance, safety, finance, quality, environment and reputation. Risk-based asset management helps asset-intensive companies to understand the risk they run related to business value in a cost effective way. By supplementing risk with a value-based system, overall wealth for the organization and society is optimized. This benefit is widely recognized, though surprisingly, only half of the respondents quantify these benefits and report them. Moving from risk-based asset management as "the right thing to do" to a management tool that quantifies business benefits that is incorporated into the decision making process, is still a hurdle to take for many companies. The most effective companies are expanding the application of a variety of tools and techniques that allow them to quantify risk and integrate risk and value calculations into the decision-making process.

Asset risk management is mainly used to prioritize investments

Risk management is for the most part fully, or at least partially, incorporated within the key asset management processes throughout the whole asset life cycle. Predominately, it is used for the prioritization of investment decisions, which can be explained by the fact that the gradual deterioration/ageing of assets has been indicated as being the top risk in owning and operating assets.

The aging of assets is one of the major risks in the industry. Calculating residual lifetime and performing life cycle costing analysis are used to manage this risk

The aging of assets and the related risk of failure have been indicated as one of the major risks faced by the industry. In order to adequately respond to this risk, companies calculate the estimated remaining lifetime complemented by life cycle costing analysis in order to take the most appropriate action over the course of the assets' lifecycle.

The full potential of quantitative risk assessment is not yet explored although it can bring huge benefits to an organization

At the onset of asset risk management, organizations primarily rely on qualitative self-assessments. As maturity grows, organizations tend to invest in quantitative techniques to complement qualitative assessment. Surprisingly, predictive risk analytics are not widely used in practice, despite the huge benefits it can potentially bring to an organization. Exploring the vast amount of asset data is an area that companies need to investigate further to better assess root causes and take preventive action. Not unexpectedly, quantitative risk analysis is a driver for preventive maintenance and companies leading in this field spend less time on reactive maintenance.

Qualitative asset data is key to mature asset risk management, though many companies still struggle with it

It is clear that asset risk management benefits from sound asset information management systems being in place. More, and above all, better information on the condition and performance of assets results in better founded asset management decision-making.

Based on the survey findings, we still see huge potential for increasing asset information management within organizations. Depending on the type of data (static, dynamic, financial and environmental), we observed considerable differences in the completeness and quality of data collected. In particular with respect to environmental data, big opportunities for improvement are present. Several cases demonstrate the enormous impact environmental conditions may have on asset performance. Therefore, capturing this data can significantly enhance the understanding of the asset's behavior and its failure modes, which in turn will allow further customization of the asset management policy to the needs of the asset.

We see, however, that companies using more advanced data capturing techniques, like incident or condition monitoring systems, are in general performing better when it comes to harvesting the different types of asset data (static, dynamic, environmental and financial data). Survey findings indicate that the use of hand held devices for incident logging doesn't increase the data quality level that is experienced by the company. This suggests that whilst technology may help to capture data, a strong culture around qualitative asset data needs to be in place. This is still a huge challenge for many companies.

IT tools which support asset risk management have low market penetration and limited integration with other IT tools

Half of the respondents do not have a specific IT tool to support asset risk management. Most of the organizations which do have one, developed it in-house and primarily use it for documenting risks, logging incidents, action tracking and risk assessments.

Most of these tools are only partially integrated with ERM-, ERP (Enterprise Resource Planning)- or GIS (Geographical Information Systems)-tools.

The survey results show that the vast majority (95%) of participants have fully or at least partially integrated risk management into their asset management processes.

About this survey

Objective of the survey

The objective of this survey is twofold; first of all, it gathers information on the overall maturity level of a company's risk-based asset management activities, and secondly, it helps to identify new challenges, critical issues and risks Energy & Resources companies are facing today. The results of this survey may allow companies to benchmark and assess their current asset risk management activities against industry leading practices.

This survey is based on self-assessment. Self-assessment, by definition, entails an unknown degree of subjectivity and DTTL did not attempt to validate the responses. In addition, there is no statistical significance to the responses – they are merely the opinions held at the time by those who responded. It is also important to emphasize that prevailing practice is not necessarily "leading practice".

Approach

The benchmark survey, from which the findings are taken for the basis of this report, was conducted online and using an electronic questionnaire.

Respondents information

Geographical coverage

The majority of the organizations surveyed have operations in Europe and/or North-America, followed by Asia and Oceania. A small number of the respondents were from South America, Africa or the Middle East.

Figure 1. Geographical visualization of participants' origin

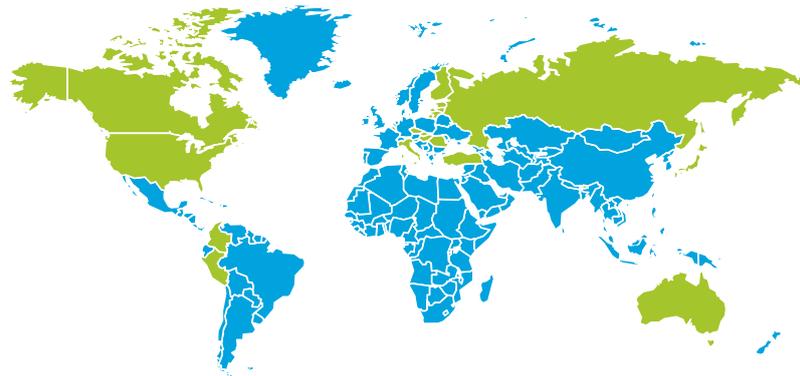


Table 1. Regions represented in the survey

Region	%
Europe	32%
North-America	27%
Asia	19%
Oceania	11%
South-America	8%
Africa	0%
Middle East	3%

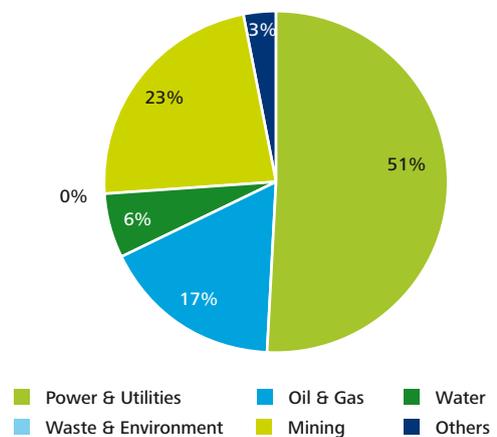
Industry breakdown

A wide variety of different sectors from the Energy & Resources industry are represented, with the largest concentration by far in Power & Utilities (51%), followed by mining with 23%.

Within the Power & Utilities sector, Distribution System Operators are the major sub-sector, representing 27% of the total respondent population.

Figure 2. Sector representation

Sub-industries/segments



Operating revenue

Organizations with a turnover of more than \$1,000 million (56%) and a head count of more than 1,000 employed full time equivalents (80%) had the highest number of respondents. The majority of organizations which took part are active in less than five countries (77%).

Figure 3. Operating revenues (million USD)

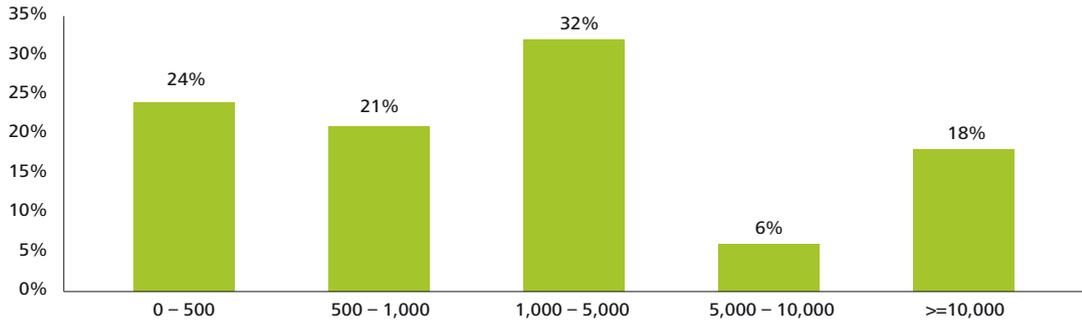


Figure 4. Number of FTEs employed

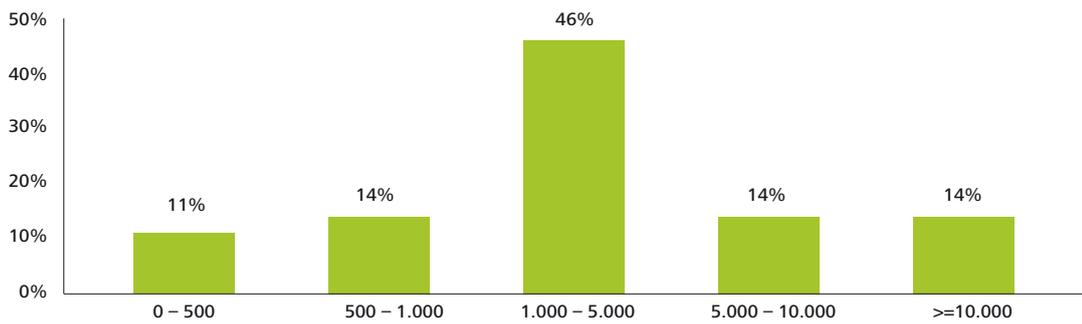
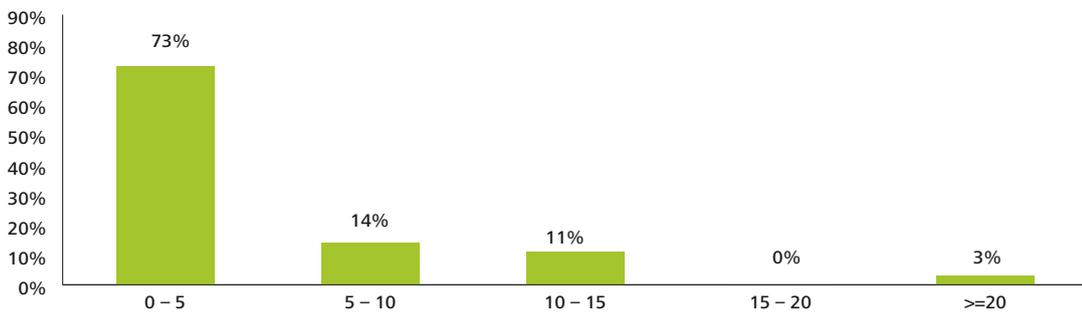


Figure 5. Number of countries in which the organization operates



Detailed survey findings

Asset Risk Management

Governance

Nearly half of the organizations surveyed have (a) dedicated Asset Risk Manager(s)

43% of respondents have (a) dedicated risk manager(s) responsible for managing the risks related to their assets.

Within this group of organizations, which indicated that they have dedicated Asset Risk Managers, about 38% of them have only 1 FTE, while about 50% have between 2 and 5 FTEs in place. In some exceptional cases, there are less than 1 or more than 5 FTEs and this is represented graphically Figure 7.

Figure 6. Organizations employing a Dedicated Asset Risk Manager(s)

Do you have (a) dedicated risk manager(s) responsible for Asset Risk Management?

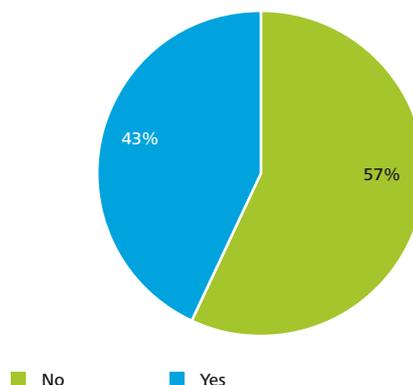
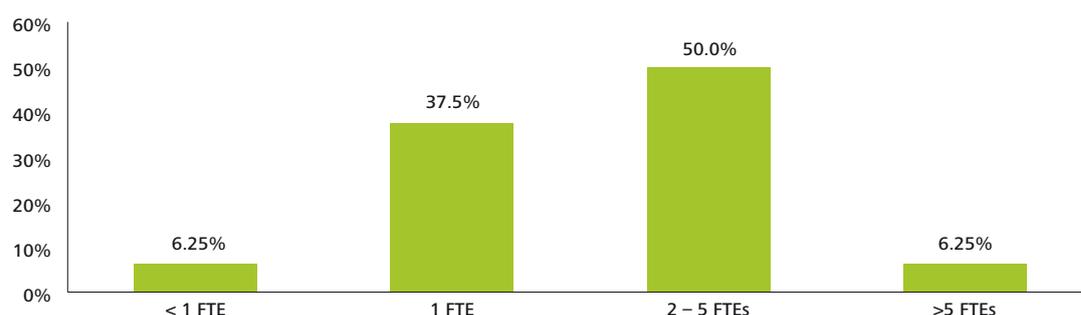


Figure 7. FTEs dedicated to asset risk management, if any

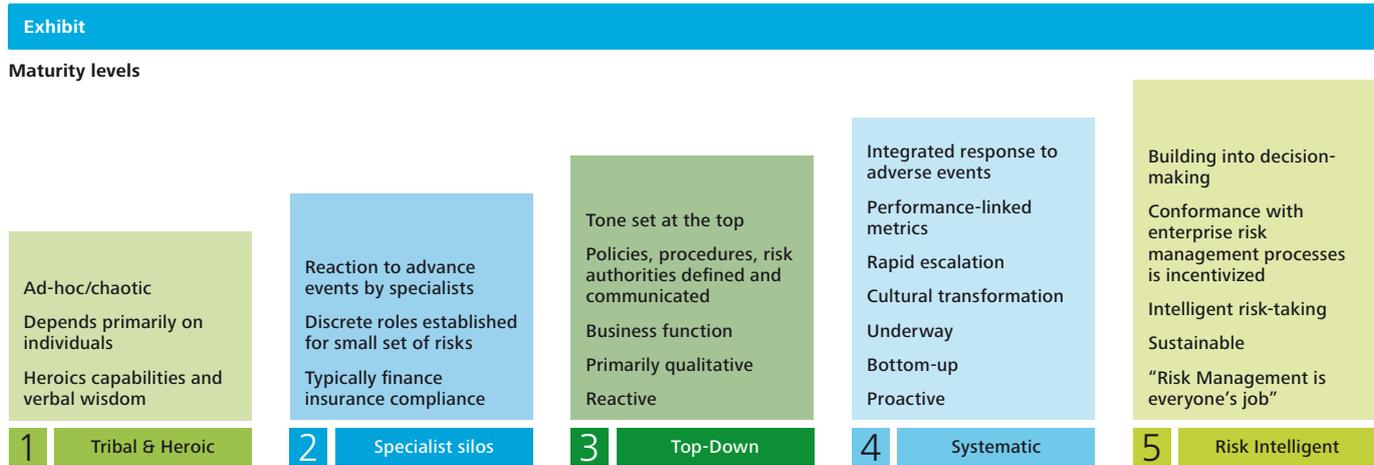


We did not observe a link between the number of Asset Risk Managers in place and company size, with size being measured either by the number of FTEs in the company or net book value of the asset base. Nor did we observe a link with the industry sector in which the company operates.

Asset risk management is at different levels of maturity amongst respondents

Companies were asked to assess their maturity level with respect to asset risk management on a scale from 1 to 5. Different maturity levels were defined as shown in Figure 8.

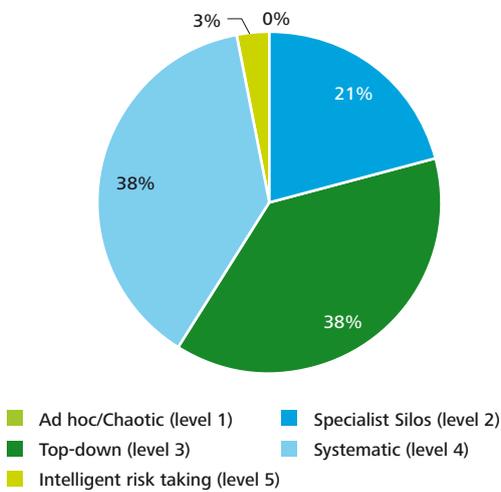
Figure 8 Deloitte Risk Intelligence Maturity Model



Source: Deloitte Risk Intelligence Maturity model™

The figure above illustrates the five maturity steps from the least mature stage (Tribal and Heroic) at the left to the most mature stage (Risk Intelligent) at the right. The same maturity levels are represented in the diagram above representing the results of the maturity assessments, ranging from the least mature stage in the center, to the most mature stage on the outside. The questions asked are represented on the various axes of the figure. At each extremity, reference was made to a summarized version of the question.

Figure 9. Maturity level of the respondents' asset risk management capabilities



21% of respondents indicated that they practice asset risk management on a specialist silo level (2 on a scale of 5), while most participants indicated being in the top down (3 on a scale of 5), or even a systematic (4 on a scale of 5) maturity phase, both represented by 38%. 3% stated that they are at the highest maturity level, being risk intelligent, enabling them to build asset risk management into the decision-making process and including all employees of the organization.

There is no relationship between the ARM maturity level of the company, the industry sector in which the company operates, or the size of the company.

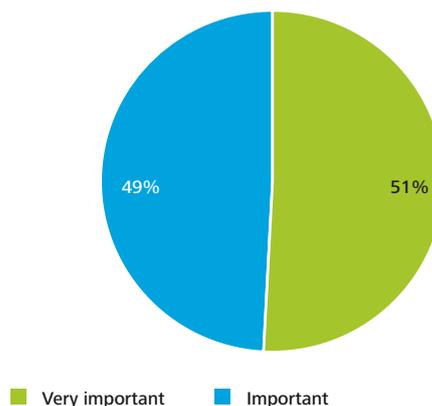
The importance of asset risk management is recognized as a means of creating major value for the business in the future

In order to be effective, a top-down corporate culture – which supports asset risk management – is needed.

More than half of the companies surveyed (51%) indicate that asset risk management is considered to be a very important area of focus for their company today. The remaining 49% also see its importance, but to a lesser extent. None of the respondents indicated ARM to be only of slight, or even no, importance at all.

Figure 10. Importance attributed to asset risk management within the organization

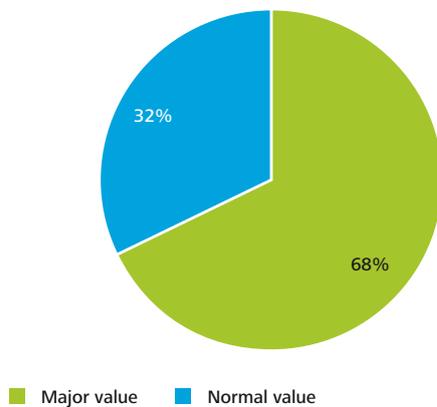
How important is asset risk management for your company today?



Looking ahead, 68% of respondents believe asset risk management can be a significant value driver for their company in the future, whilst 32% think it will bring moderate value. No respondents believe that ARM brings little to no value in the future.

Figure 11. Estimated value asset risk management can bring to the organization

How much value do you think asset risk management can bring for your business in the future?



Of the organizations who indicate asset management as being very important today, 95% also believe it can bring significant value to the organization in the future.

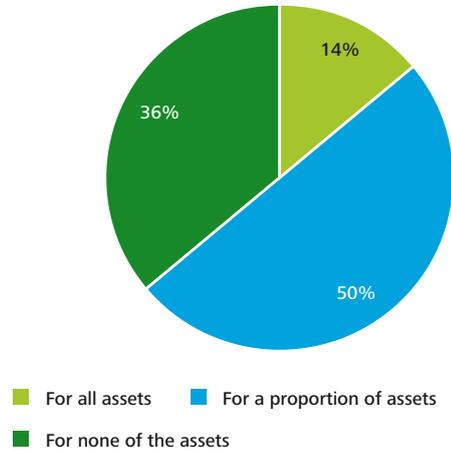
19% of the organizations surveyed believe that the importance of ARM will continue to grow in the future, whilst only 3% believe it will decrease.

Only half of the companies surveyed measure and report the benefits of asset risk management

One out of two participants measure and report the benefits of asset risk management for a proportion of their assets, whilst 14% of respondents report for their entire asset base. Possible measurable benefits may include increased availability, a reduction in incidents or in maintenance costs, and an increase in utilization of capital.

Figure 12. Reporting of asset risk management benefits

Do you measure and report benefits of asset risk management?



It is surprising to see that 36% of participants do not measure or report the benefits of ARM. Herein lies an important opportunity; through quantifying benefits, an Asset Risk Manager can demonstrate that ARM is not simply ‘the right thing to do’, but that it can strongly support effective decision-making. The most effective companies are expanding the application of a variety of tools and techniques that allow them to quantify risk and integrate risk and value calculations into the decision-making process.

Asset risk management methodology is only partially incorporated into ERM methodology

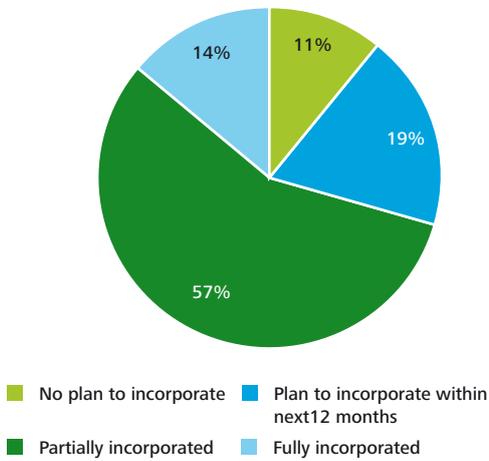
It is important for Asset Risk Management to form part of the overall ERM practice within the organization. Integration of asset risk practices within the company-wide risk management methodology can help to link asset management risk to the strategic risks managed and reported at Board level. In addition, it offers a holistic view on the company’s risk exposure, including those affecting the company’s critical assets, which is indispensable for asset-intensive companies. When budgets and resources are allocated to manage the company’s most prominent risks, this can ensure that asset risks will be allocated their fair share.

Integration of ARM with ERM methodology appears to vary. ERM methodologies are often well suited to the management of strategic and process risks, but are less so for more technical and operational risk management activities. As such, a different set of methodologies, tools and techniques may be required to properly manage asset risks. Nevertheless, both practices should integrate, with the possibility to “roll-up” more lower level, technical asset risks into higher level, enterprise wide risks. As a result, both methodologies are rather complementary, with a touch point where both join and exchange information.

For the majority of respondents (57%), asset risk management methodology is only partially incorporated within the corporate-wide ERM methodology. However, 14% have fully incorporated it within ERM, and 19% plan to incorporate it within the next 12 months. Only a small minority (11%) have no intention to incorporate asset risk management methodology into the ERM methodology.

Figure 13. Incorporation of asset risk management into ERM

Incorporation of ARM methodology within the ERM methodology



Most respondents expect to invest in asset risk management within the next two years, predominantly on the process dimension

The majority of respondents (57%) state that they expect to invest in asset risk management within the next two years. Most of them (32%) plan to do so through their business processes, meaning that they will review them in order to better identify and/or mitigate asset-related risks. Other planned investments in asset risk management concern IT tools (27%) and talent capabilities (22%).

Figure 14. ARM investment forecasts

Do you expect to invest in asset risk management within the next 2 years?

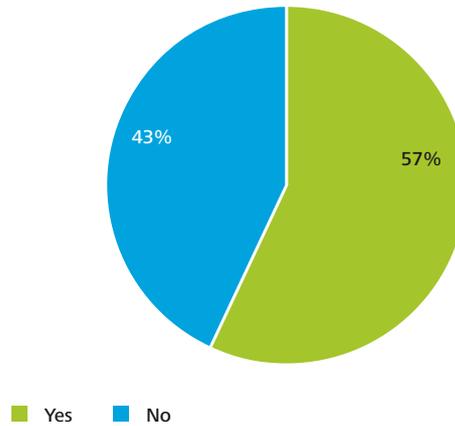
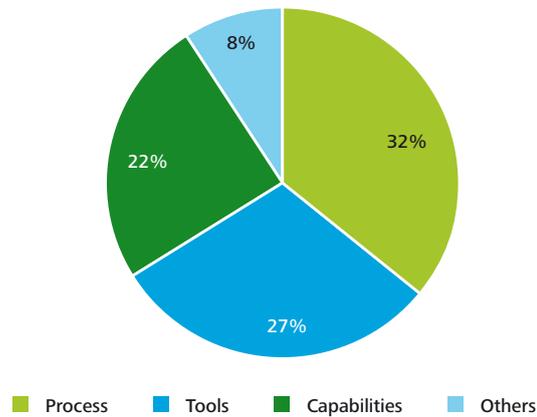


Figure 15. ARM investment forecasts per domain

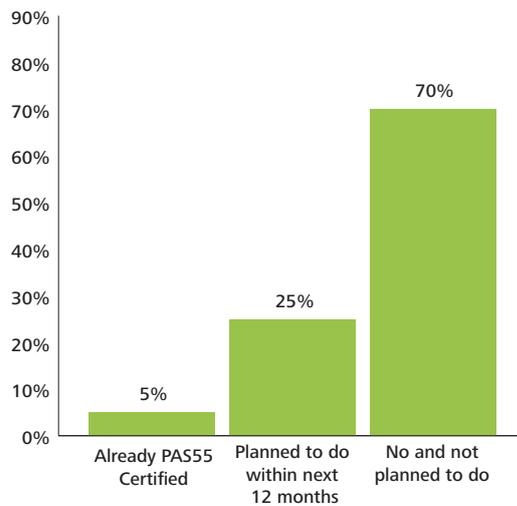
How do you plan to invest in asset risk management?



ISO55000 seems to generate limited interest

When considering ISO55000 accreditation, only 25% of respondents indicated that they plan to aim for certification within the next 12 months. A small minority (5%) are already PAS55 certified and may 'upgrade' to the new ISO55000, however this remains uncertain. 70% of respondents however, have no particular interest in gaining this certification.

Figure 16. Will you apply for ISO55000 certification

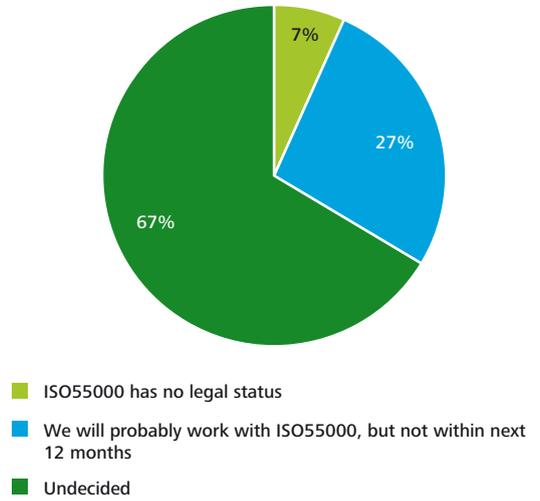


Participating companies list several reasons why there are not planning on applying for ISO55000 certification:

- ISO55000 accreditation does not provide immunity to regulatory obligations (7%).
- The value offered by ISO55000 is uncertain (67%).

Figure 17. Reasons for not getting ISO55000 certified

Why are you not planning to get ISO55000 certified?



When considering ISO55000 accreditation, only 25% of respondents indicated that they plan to aim for certification within the next 12 months.

Processes

Asset risk management is generally incorporated into key asset management processes

As can be seen in Figure 18, the vast majority of participants have (at least partially) incorporated risk management into their asset management processes throughout the whole lifecycle of the assets, from investment planning relating to installation and acceptance, to maintenance until disposal. In this entire lifecycle, we see that between 80% (maintenance planning) up to 89% (investment planning) have at least partially incorporated asset risk management into their asset management processes.

From the few organizations that have not yet incorporated ARM into the asset management processes, almost all of them are planning to do so in the future.

Both facts, clearly demonstrate the value that organizations see in applying ARM.

In supplier and contractor management however, we see a significantly different trend. In this case, only 57% of respondents have (partially) incorporated risk management. The remainder of respondents have no plans to incorporate asset risk management in the future.

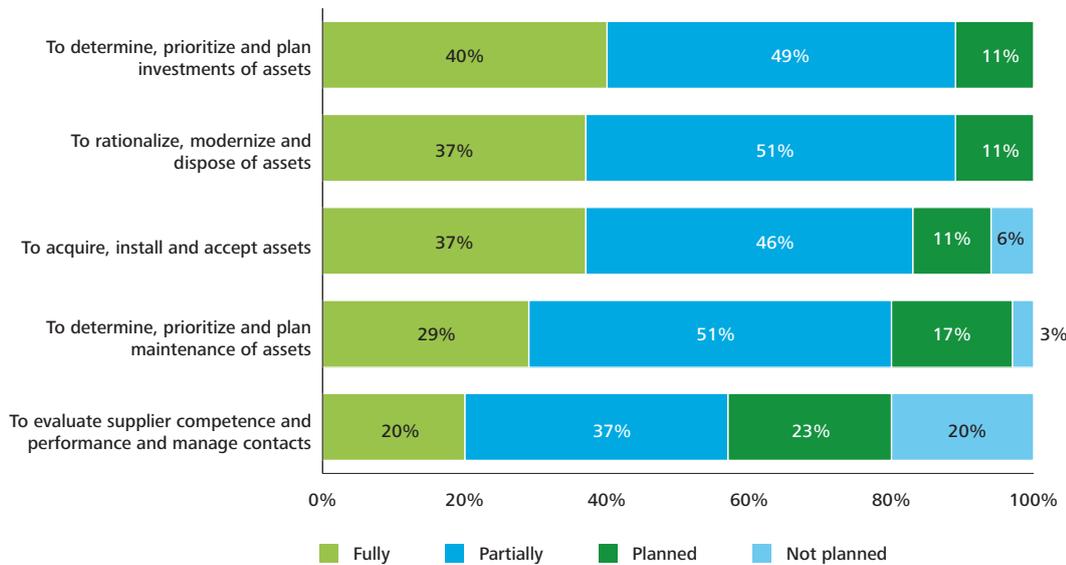
These observations are in positive contrast with the observations from DTTL's 2009 survey where more than 20% of all respondents had no intention to integrate risk management into their asset management decision-making. Four years later, we see that – for most asset management aspects – almost all respondents have (fully or partially) integrated risk management and asset management.

According to survey results, the minority of organizations that have not yet done so are planning to do so in due course. Evaluating supplier competence and performance, and managing contracts are the only exception.

This clearly indicates a strong positive trend in incorporating asset risk management into asset management processes.

Figure 18. Incorporation of asset risk management into asset management processes

To which extent is asset risk management incorporated within your asset management processes?



The main drivers of asset risk management can be found in prioritizing investment decisions and optimizing life cycle costs, or to be compliant with regulations and HS&E requirements

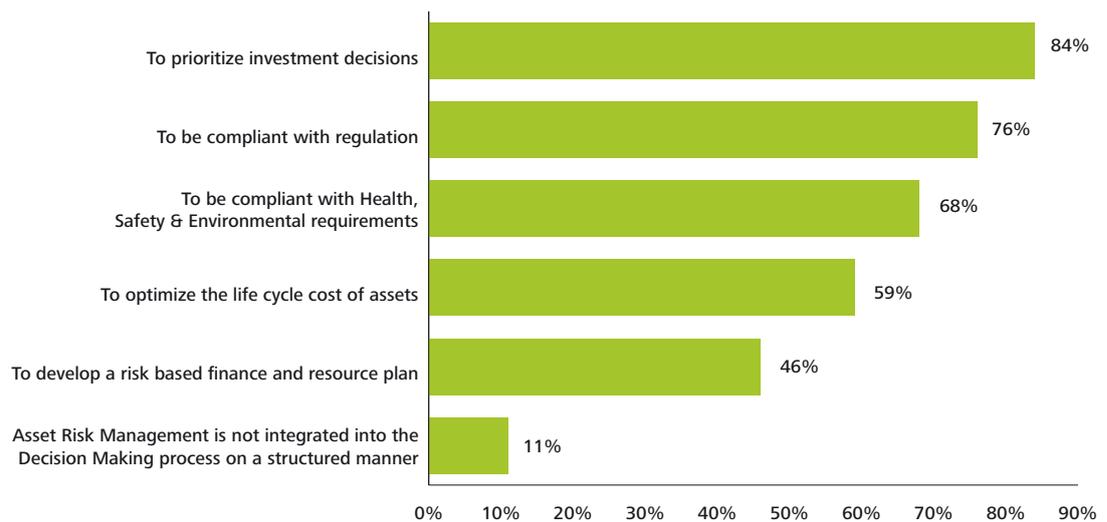
Prioritizing investment decisions (84%) and optimizing asset life cycle costs (59%) are amongst the most common reasons why companies use ARM. This is not surprising, as a risk-based approach helps to rationalize the investment decision process by balancing the operational performance of the assets against the asset life-cycle cost.

Furthermore, regulatory compliance (76%) and compliance with health, safety & environmental (HS&E) requirements (68%) have become major drivers to implement ARM. By incorporating other decision parameters over and above technical performance and costs, such as wider stakeholder requirements like regulatory compliance, safety and environment, risk-based asset management can optimize overall wealth for the organization and society.

Only 11% of companies state that their asset risk management is not integrated into decision-making on a structured level.

Figure 19. Drivers for the use of asset risk management

Drivers for the use of asset risk management



Prioritizing investment decisions (84%) and optimizing asset life cycle costs (59%) are amongst the most common reasons why companies use ARM.

Mechanical breakdown or electrical damage and gradual deterioration are the top risks associated with owning and operating assets

62% of the respondents state that mechanical breakdown or electrical damage and gradual deterioration (ageing) are the major risks associated with owning and operating their assets. A lot of companies in the energy and resources industry own assets that were commissioned in the early fifties or seventies which are now reaching the end of their lives. This results in higher exposure to asset failure and heightened demand for major decommissioning and replacement programs.

Furthermore, for 54% and 43% of the companies respectively, operational safety and regulatory compliance are crucial risks. Recent incidents within the energy and resources industry have pushed operational safety higher up the agenda.

These events have demonstrated not only the immediate and drastic impact one event can have on a company's assets and operations, as well as on the regulatory environment, but have also highlighted the need for energy and resources companies to implement a robust asset risk management system that includes the identification and mitigation of (unknown) low probability/high impact risks.

Since the ageing of assets is identified as the top risk in owning and operating assets, the remaining lifetime is an important consideration. This is confirmed by the survey, revealing that not less than 84% of the respondents calculate the residual life of their assets, either in part (51%) or for the whole portfolio (32%). The remaining 16% of participants do not calculate the residual life at all.

Figure 20. Top risks associated with owning and operating assets

Top risks associated with owning and operating of your assets

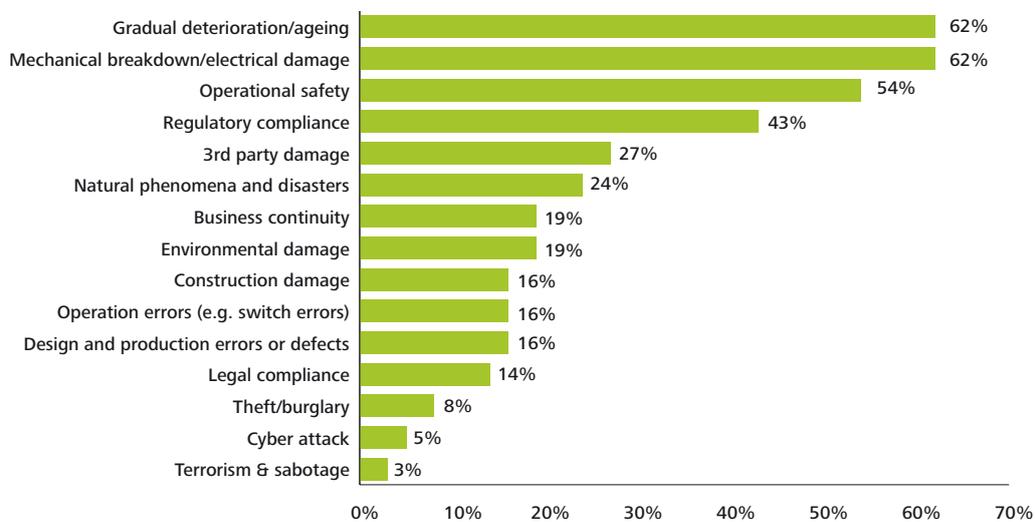


Figure 21. Residual lifetime calculation

Do you calculate residual life of assets?

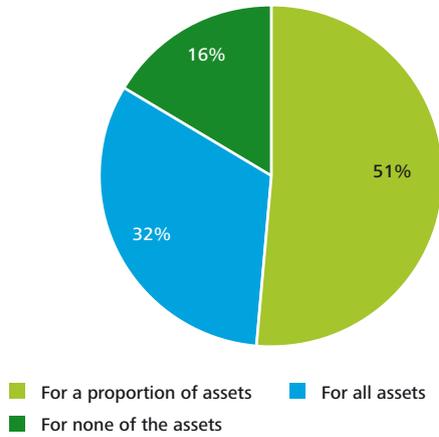
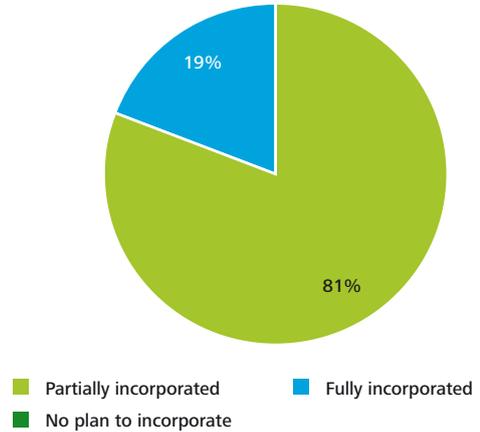


Figure 22. Usage of life-cycle costing to determine asset management strategy

To what extent is life cycle costing for your assets used to determine the appropriate asset management strategy?



Life cycle costing is common practice for companies to determine the appropriate asset management strategy. However, only 19% of respondents incorporate this to its full extent. The majority (81%) only do so on a limited basis. Of particular significance here is that none of the respondents indicated that they are not planning to incorporate asset life cycle costing in order to develop an asset management strategy.

Life cycle costing is common practice for companies to determine the appropriate asset management strategy. However, only 19% of respondents incorporate this to its full extent.

The most popular techniques for risk identification are incident/risk inventory and brainstorming sessions

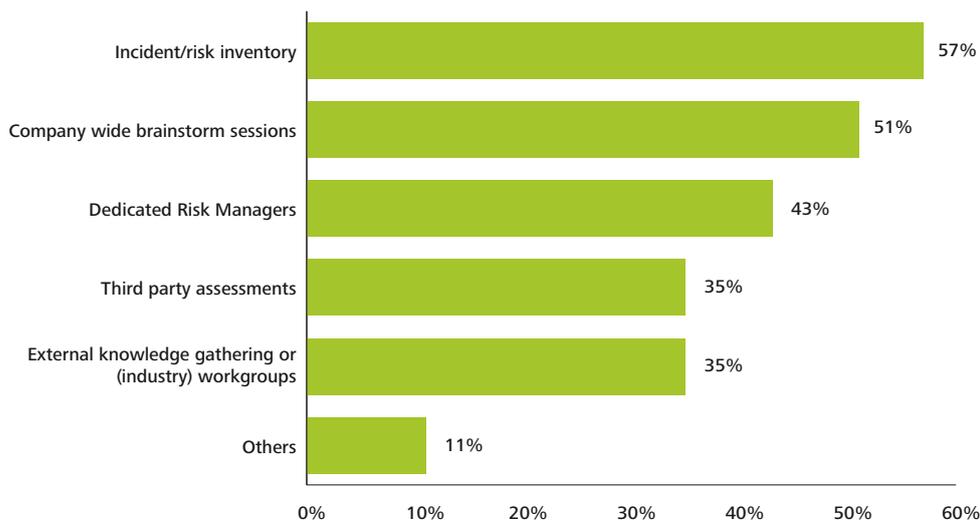
The most popular asset risk identification techniques are incident/risk inventory (57%) and company-wide brainstorming sessions (51%). 43% of respondents use input from dedicated risk managers. Less popular risk analysis techniques include third party assessments and external knowledge gathering or industry workgroups. 'Others' include, for example, analysis performed in conjunction with the business planning process, by site level risk assessments, or by corporate function audits and assessments.

An incident/risk inventory is the pre-eminent source of information, since it is based on in-house experience with occasionally very specific asset risks. However, the disadvantage of this method is that all too often it simply consists of a spreadsheet or database file that employees update on a relatively ad hoc basis with no guarantee as to the completeness and quality of the information captured. More advanced incident and risk inventory systems make use of easy-to-access tooling to log incidents (e.g., field mobile applications), with pre-defined definitions and classifications and geo-localization.

Moreover, we see that the most popular risk analysis techniques are based on in-house information (number 1 – 3), whilst numbers 4 and 5 rely on external sources.

Figure 23. Ways of performing asset risk analysis

Undertaking asset risk identification analysis



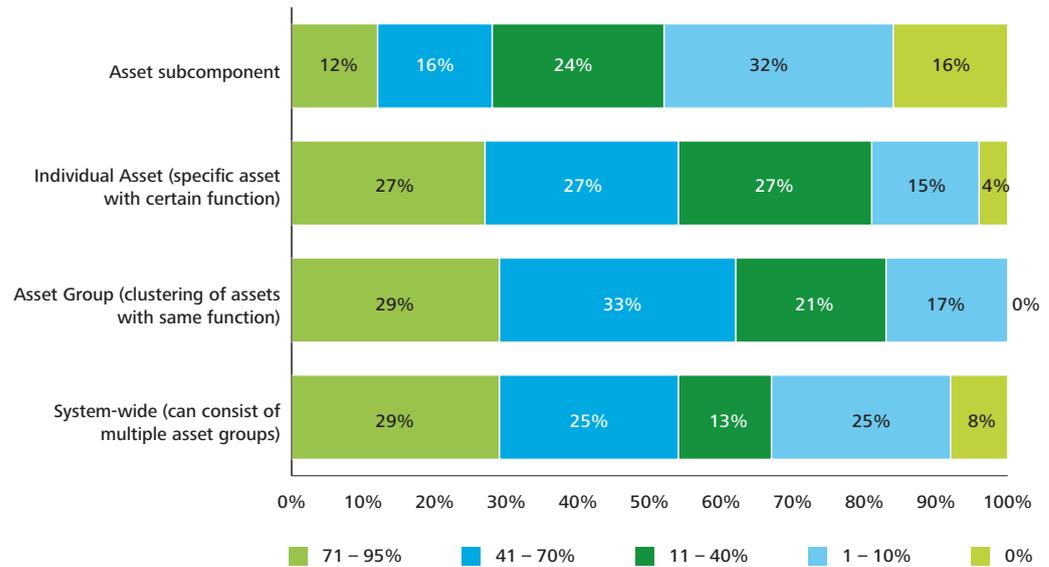
The most complete asset risks assessments are being performed on an asset group level

The asset group level appears to be the most commonly used level of detail for a risk assessment. All respondents take this level into consideration and in general, risk assessments seem to be the most complete as well (29% of respondents' state that they identify more than 70% of all asset risks at this level, and 62% of respondents' state that they identify more than 40% of all asset risks at this level). The asset group level is very closely followed by the adjacent levels, i.e., individual asset level and system-wide level.

The asset subcomponent level is clearly much less commonly used. This can be due to the very high number of subcomponents to assess, resulting in considerably more effort when compared to the others. Another difficulty when assessing risks on asset subcomponent level is aggregating risks to the higher level. When redundant subcomponents are available, the risk for the asset is less than the risk of its subcomponents. On the other hand, subcomponents can also interact in a risk escalating way, meaning that the risk for the asset is higher than the risk for its subcomponents. This may result in a low return-on-effort for this level of risk assessment. 16% of all respondents don't take this level into account at all. However, companies effectively performing these kind of assessments use advanced risk modelling techniques to analyze this level of risk in a cost efficient way.

Figure 24. Proportion of asset risks assessed

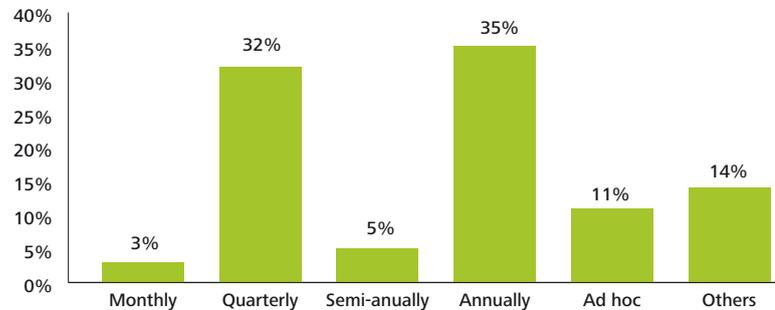
Proportion of asset risks assessed



Asset risk assessments are most commonly conducted annually or quarterly

For the most part, asset risk assessments are conducted on an annual (35%) or quarter-year (32%) basis within a company. Some companies also conduct their assessments on an ad hoc basis (11%), whilst twice a year (5%) or monthly (3%) are less common frequencies to perform assessments. Some companies' frequency of assessments also depends on other assessments (e.g., safety assessments compared to general strategic assessment).

Figure 25. Asset risk assessment frequency



Brainstorming is by far the most commonly used qualitative risk assessment methodology

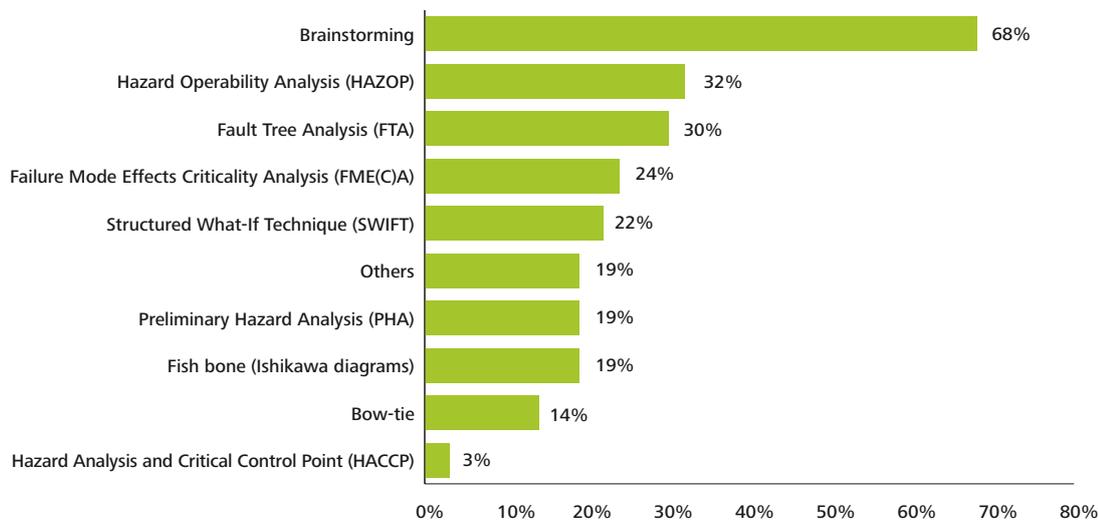
Asset risks can be evaluated based on a qualitative or a quantitative approach.

Considering qualitative approaches in the first instance, the vast majority of respondents (68%) use brainstorming techniques to conduct the evaluation of asset risks. Other qualitative approaches that are used by a number of organizations include Hazard Operability Analysis (32%), Fault Tree Analysis (30%) and Failure Mode Effects Criticality Analysis (24%). 'Other' qualitative approaches may include double triangular distribution, impact/probability/risk velocity, insurer maximum foreseeable loss, probable maximum loss calculations and laboratory tests.

However, over half of the respondents combine more than one qualitative approach to assess risks. On average, participants combine 2-3 assessment techniques. As every method has its advantages and drawbacks, a combination of techniques used in a complementary way, helps to obtain better results.

Figure 26. Representation of different qualitative risk assessment techniques

How are asset risks evaluated? Qualitative approach:



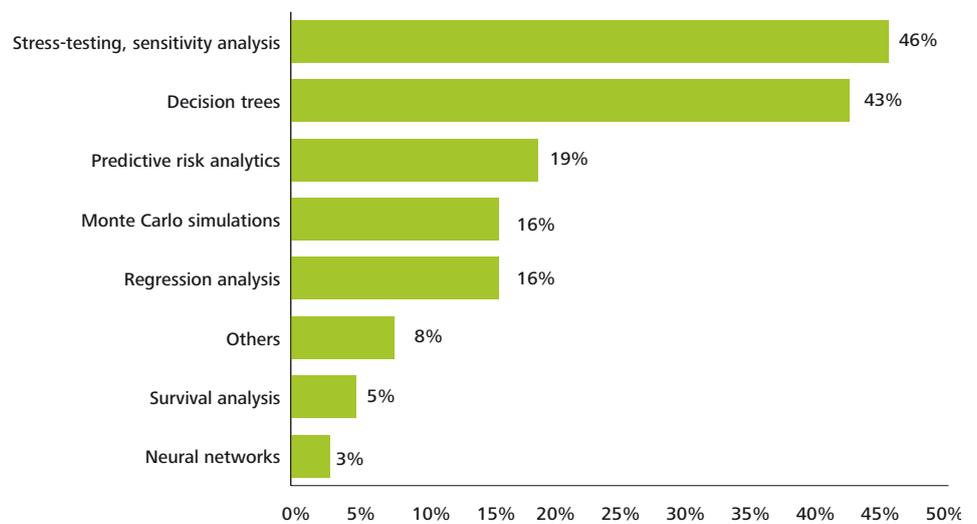
Stress-testing and sensitivity analysis represent almost half of quantitative risk assessments

Considering the quantitative approach on the other hand, stress-testing or sensitivity analysis (46%) and decision trees (43%) are by far most commonly used, followed by predictive risk analytics (19%).

The 'other' classification consists of non-destructive testing or estimated maximum loss scenarios, amongst others. On average, participants combine 1 to 2 quantitative risk assessment techniques.

Figure 27. Representation of different quantitative risk assessment techniques

How are asset risks evaluated? Qualitative approach:



Quantitative modelling is focused for the most part on the intrinsic risks of the assets

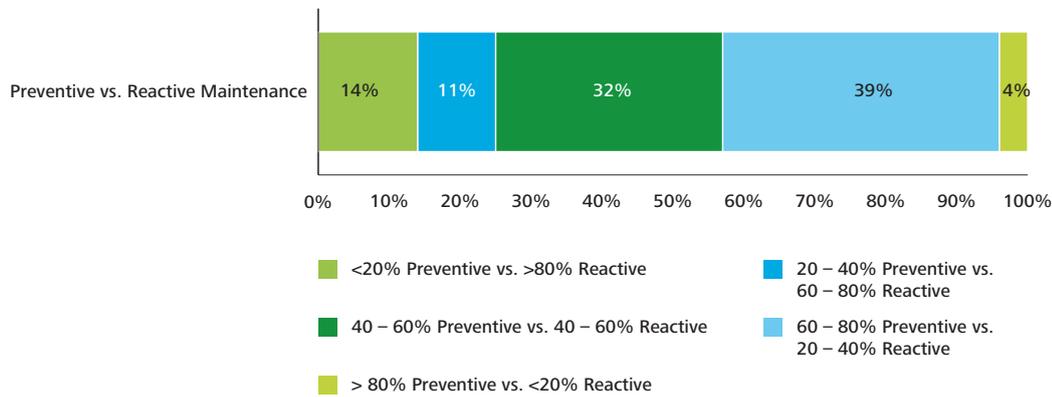
Almost every respondent (95%) models risks inherent or internal to the asset such as ageing or technical failure. 59% of the participating companies also model risks external to the asset, for example weather or third party damages.

39% of the companies divide their effort more or less equally between preventive and reactive maintenance; approximately 43% put more than 60% of their total maintenance effort in preventive maintenance, whilst 25% put more than 60% of their total maintenance effort in reactive maintenance.

An interesting trend to observe is that companies applying quantitative risk analysis techniques on average spend a less significant proportion of their total maintenance effort on reactive maintenance. For companies using predictive risk analysis and survival analysis techniques, this trend is even more prominent.

Figure 28. Preventive versus reactive maintenance effort

Quantitative risk analysis is a driver for preventive maintenance



Companies applying quantitative risk analysis techniques on average spend a less significant proportion of their total maintenance effort on reactive maintenance.

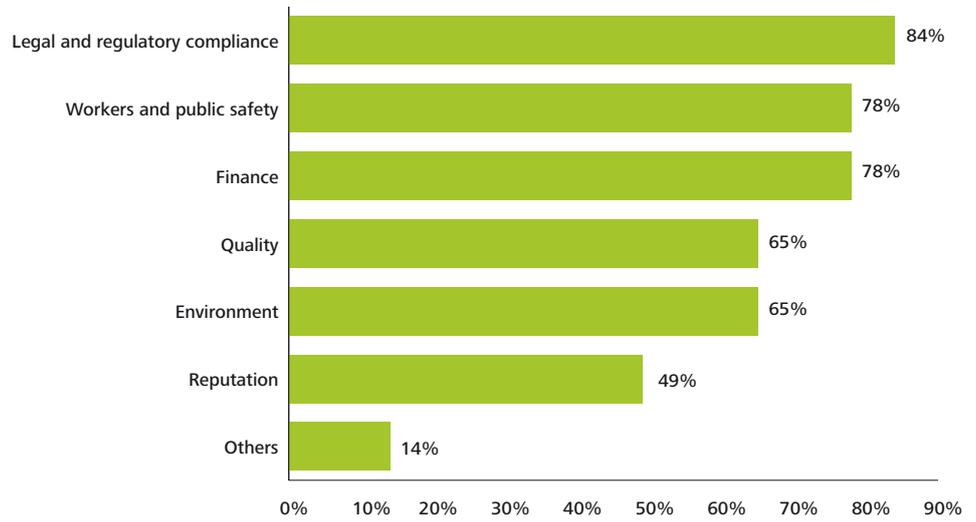
Legal and regulatory compliance are the most common criteria in evaluating asset risks

Asset intensive organizations are confronted with different values (for instance values related to cost, performance, safety, sustainability, legal and regulatory compliance, etc.) of a diverse set of stakeholders. A value-based Asset Management approach tries to balance these values in order to optimize the value of the assets for all of its stakeholders. Decision makers use these values in the asset management decision-making process as criteria to make the right trade-offs.

The survey revealed that legal and regulatory compliance is the main criterion in evaluating asset risks (84%). Employees and public safety (78%), as well as finance (78%), are also commonly used, followed by environment (65%), quality (65%) and reputation (49%). Efficiency, security, geo-political intelligence, nuclear safety, penalties and technical aspects are shown to be used in practice as well; however, this is in the case for a relatively small number of survey respondents (14%).

Figure 29. Asset Risk evaluation criteria

Criteria to evaluate asset risks



Technology

Static asset data is the most captured or registered data type, with the highest associated quality level

Static asset data (or configuration data), define the assets themselves and the normal conditions in which they operate and interact with other assets. This data typically does not change during the asset life cycle. Some examples include a datasheet of certain pieces of equipment, installation data, asset location and the contractor who installed the equipment.

Dynamic asset data is collected during the life cycle of the assets in relation to how the asset is operating and performing, its condition, maintenance and other similar types of data. These data tend to change during the life cycle of the assets, through operation and maintenance. Some examples are the maintenance history of the asset, the failure history, inspection reports and so on.

The availability of this information can play a major role in gaining insight into the performance of the assets, its performance record and its technical or installation characteristics.

Therefore, asset information can be seen as a very valuable resource for asset owners, asset managers and service providers, in order to make better decisions.

The survey revealed that 68% of respondents capture more than 70% of all static data. This type of data is also considered to have the highest level of quality, with 72% of the data having a satisfactory or even high level of quality. This can be explained by the fact that this is the easiest type of data to capture as well.

Dynamic asset data, like asset lifetime and maintenance history for example, are still relatively easy to capture, but need to be gathered continuously whereas static data only requires action once. The increased effort-intensity of this type of data collection is clearly reflected in the survey, with only 46% of respondents indicating that they capture more than 70% of this type of data (compared to 68% for static data). This increased effort-intensity has also a clear impact on data quality. Only 55% of all respondents judge their dynamic asset data to be of a satisfactory to high quality level, whilst this was 72% for static data.

The scoring of these dynamic asset data, both from a quantity and quality perspective, can be increased significantly through enhanced Asset Information Management. This may come with a certain cost, but benefits for the organization can be huge.

Furthermore, we see that data on the impact/financial loss of incidents, incident data, and root causes for incidents are captured to an even smaller extent.

This may again be explained by the level of effort required for capturing this type of data.

The low scores on proportion of environmental data being captured clearly indicate scope for improvement. Several cases demonstrate the enormous impact that environmental conditions can have on asset performance. Therefore, capturing these data can significantly enhance the understanding of the asset behavior and its failure modes, which in turn can allow you to better customize the maintenance policy to the needs of the asset.

Asset information can be seen as a very valuable resource for asset owners, asset managers and service providers, in order to make better decisions.

Figure 30. Which proportion of asset data is captured/registered with respect to asset risk management.

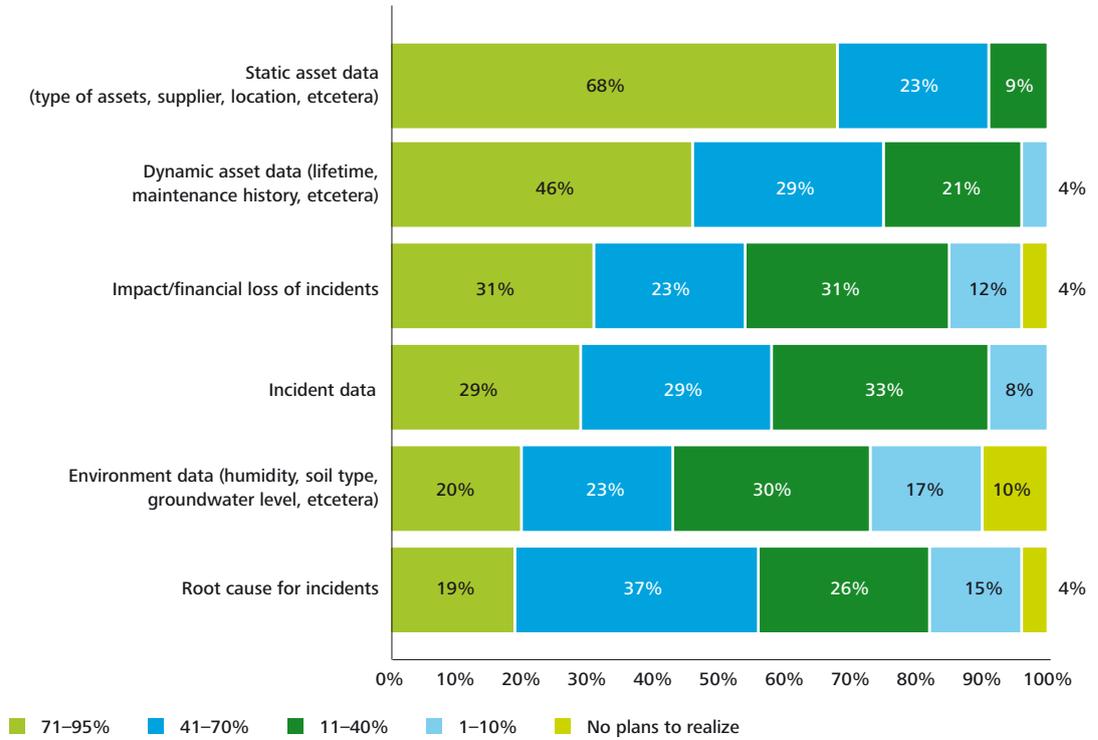
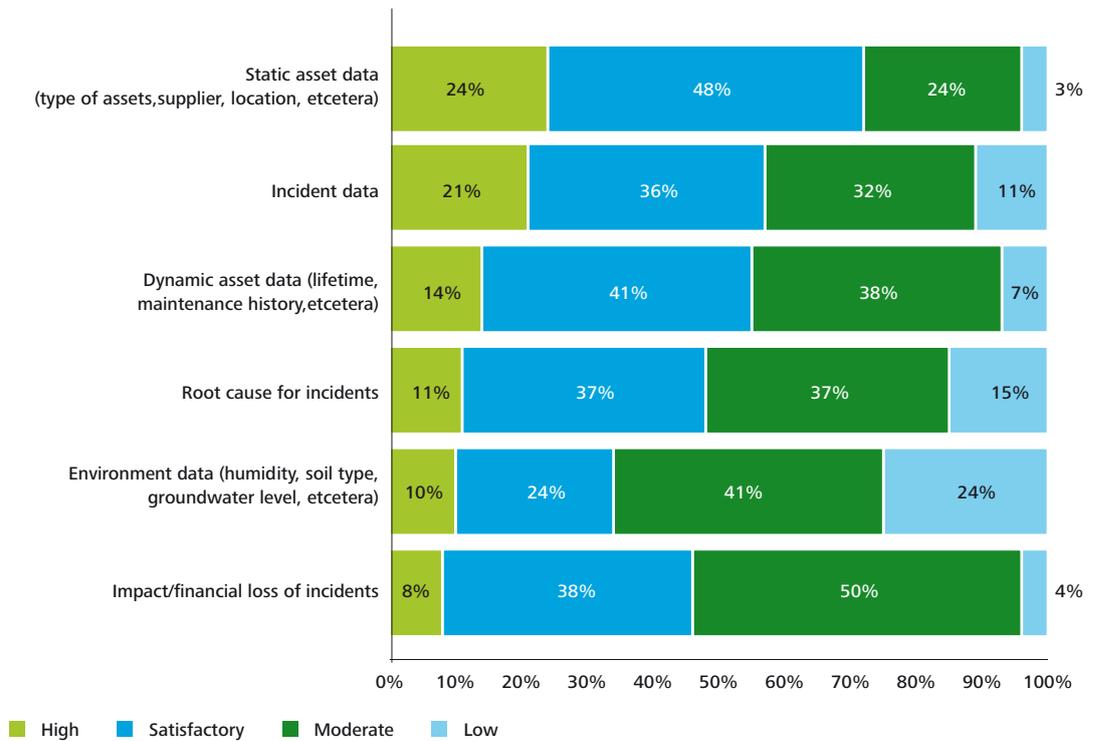


Figure 31. What is the respective quality level of the registered data?



Sector comparisons show that the power and utilities sector plays a leading role when it comes to the amounts of asset data available. The water sector represents the most potential for growth in the amount of available asset data, whilst on the other hand; it has the most qualitative asset data. Quality of asset data is lowest in the oil and gas sector.

The main method used to capture asset data is via incident monitoring systems however a simple paper format is still widely used.

Asset data is captured using a wide range of methods. Survey findings indicate that most commonly used methods include incident monitoring systems (70%), paper (54%) and condition monitoring systems (e.g. telemetrics, intelligent pigging, etc.) (51%).

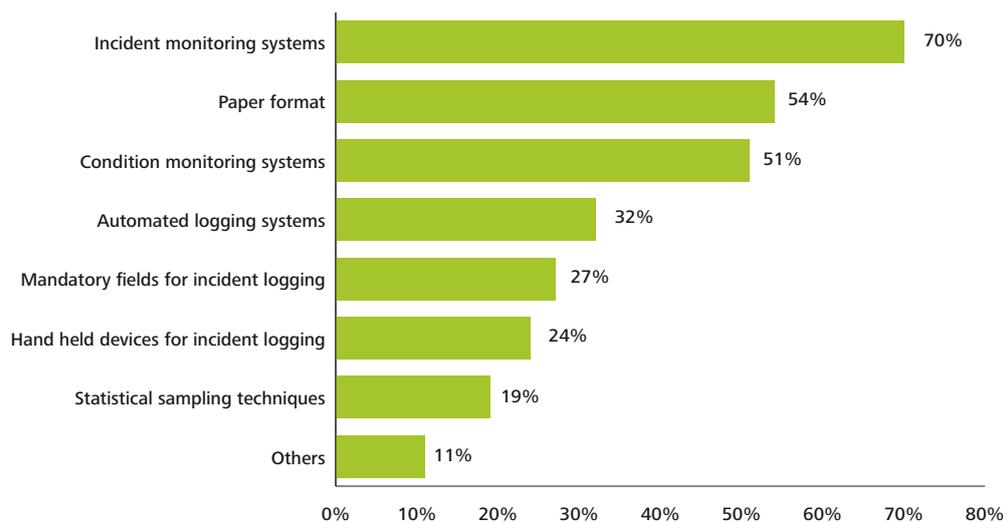
Automated logging systems (32%), hand held devices for incident logging (24%), mandatory fields for incident logging (27%) and statistical sampling techniques (19%) are also frequently used as a means to capture asset data according to respondents. 'Others' may include online packages such as ledger for fixed assets, database and spreadsheet based lists of incidents and maintenance and risk analysis. On average, participants combine 2-3 techniques to capture their asset data.

We see that companies using more advanced data capturing techniques, like incident monitoring systems or condition monitoring systems, are in general performing better when it comes to capturing a range of asset data (static, dynamic, environmental, financial and incidents data).

Survey findings indicate that the use of hand held devices for incident logging doesn't increase the data quality level that is experienced by the company. This suggests that whilst technology may help to capture data, a strong culture around qualitative asset data needs to be in place. This is still a huge challenge for many companies

Figure 32. Asset data capturing techniques

How are asset data captured?

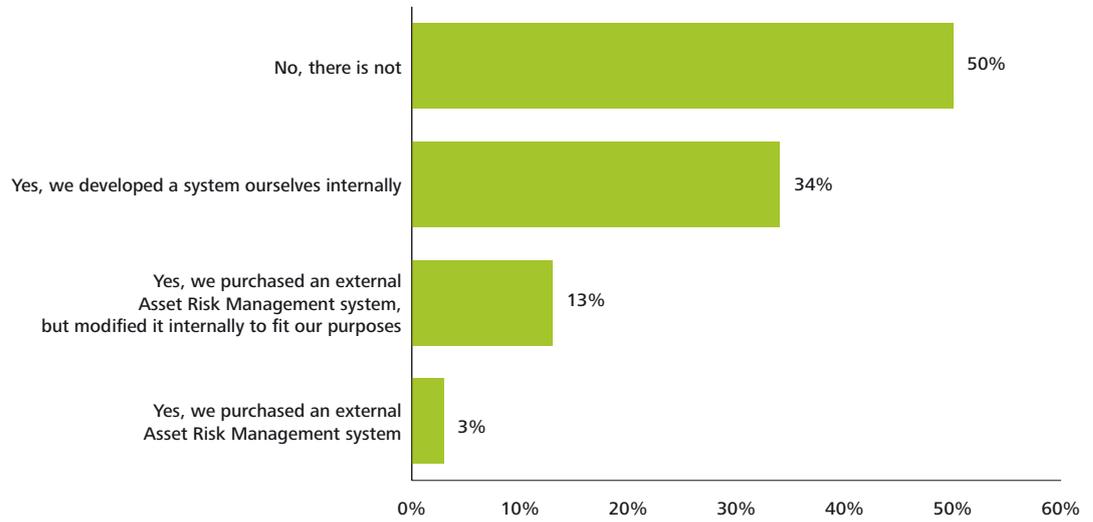


Frequently no asset (risk) management IT systems are available to manage asset related risks

Half of the organizations surveyed do not use an asset (risk) management IT system to manage asset-related risks. 34% of organizations that do use a specific IT system have developed it in-house. The remaining 16% of respondents have acquired an external asset risk management system, of which 13% went on to modify it themselves to meet their needs.

Figure 33. Usage of asset risk management IT systems

Is an asset (risk) management IT system used by your organization to manage asset related risks?



Half of the organizations surveyed do not use an asset (risk) management IT system to manage asset-related risks.

Asset (risk) management software is used to perform multiple activities, but predominantly for identification, assessment and monitoring purposes
 Asset (risk) management tools or software are used to perform different asset risk management activities. The respondents most commonly use a specific tool or software package for identifying and documenting risks (38%), assessing risks (35%), mitigating or action tracking (35%) and monitoring and incident logging (35%).

To a lesser extent, asset risk management software is used for modeling purposes, such as statistical modeling, or for monitoring risks such as Key Risk Indicators.

Figure 34. Activities performed using an A(R)M tool

ARM activity(ies) performed using the A(R)M tool(s) or software

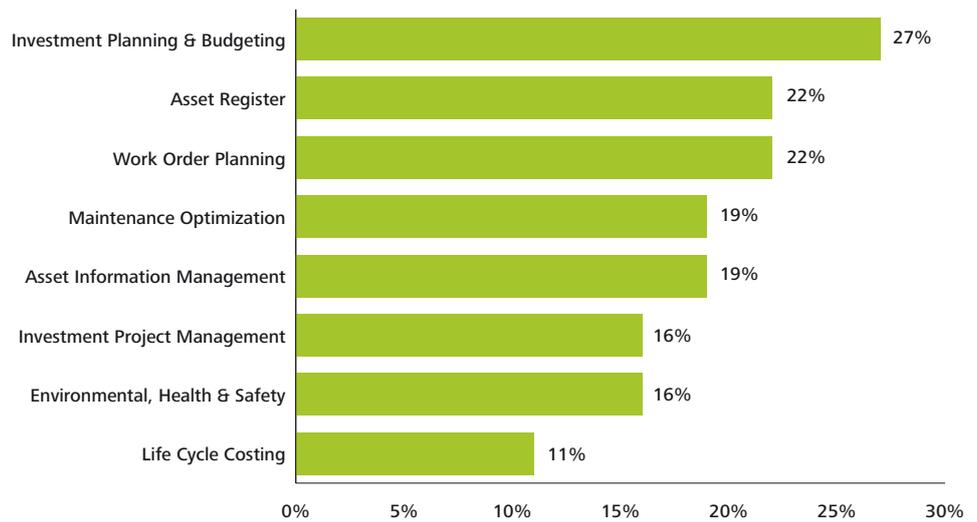


Aside from asset (risk) management purposes, specific software packages support other functionalities such as investment planning and budgeting

Alongside all of the asset (risk) management activities, specific software packages or tools are used for other needs. Investment planning and budgeting (27%), asset register (22%) and work order planning (22%) are the main functions that are supported. 19% of respondents use software or another tool for asset information management or maintenance optimization. Less commonly used or supported functionalities consist of environmental, health and safety (16%), investment project management (16%) and life cycle costing (11%).

Figure 35. Other functionalities supported by the ARM tool

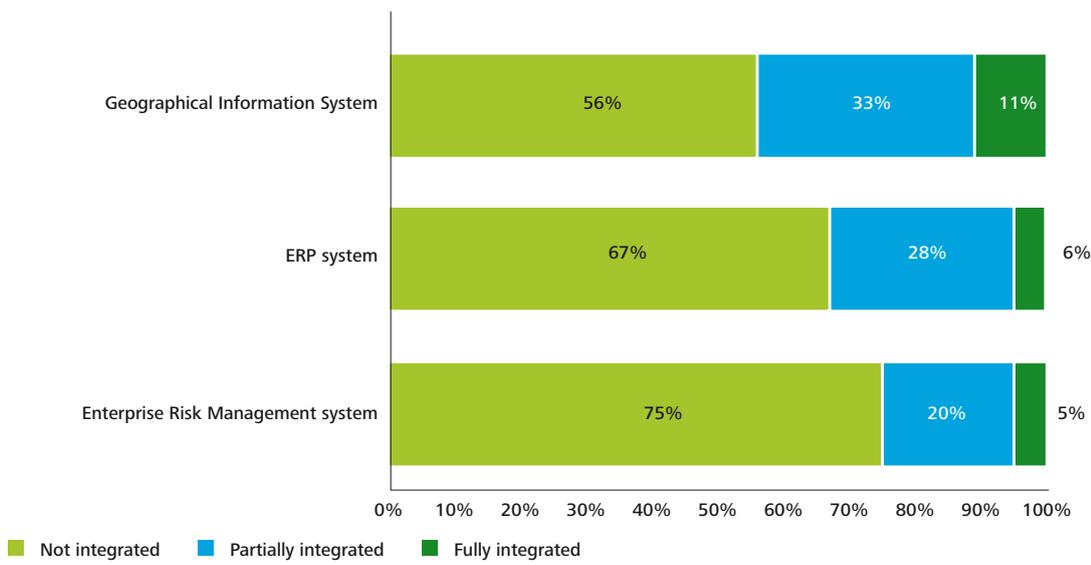
Other functionalities supported by software or tool(s) used for ARM



Asset (risk) management software is rarely integrated with other tools

Asset (risk) management tools or software are, in most cases, not integrated within other tools. Nevertheless, for 44% of respondents, their software is partially or fully integrated within a geographical information system, and in 33% of cases within an ERP system.

Figure 36. To which extent is the A(R)M tool or software integrated within other tools?



Asset (risk) management tools or software are, in most cases, not integrated within other tools.

Way Forward

Most organizations clearly recognize the importance of asset risk management and the value it can bring to their organization today. They even believe that its importance and value will further grow in the future.

Nevertheless, there is still an important development opportunity in the area of **asset information management**. Delivering the required input, asset information is the foundation of sound asset risk management practices in an organization. As such, organizations should start by making sure their asset information management has been correctly put in place. It is only by getting these foundations right, that asset risk management can grow within an organization and deliver its value.

However, we see that many organizations are still struggling with the quality of asset data and capturing this data in an effective and efficient way. Some of the tools used to capture this data, for instance hand held devices, do not always live up to their promises or expectations. This is not due to the technology itself, but as a result of the lack of an appropriate culture around asset data quality in the field. Every single person within the organization who is involved in any asset management process should be aware of the importance of complete and correct asset information. For as long as this is not the case, no tool will deliver the value it is supposed to. This is clearly an area requiring attention by companies investing into these kind of technologies.

But the challenge lies not only in capturing asset data in an effective and efficient way. It is also about having the "right" data to make good decisions. This will help to reduce the effort from low-value information gathering, which heavily frustrates the operators out in the field. Defining the right data to obtain a proper 360° overview of your assets often remains a hurdle to take. In this context, we see that several sources of asset data remain untapped. One of them is the area of environmental data, providing information on the conditions to which the assets are exposed and within which they are operating. Considering most participants indicated that they plan to invest further in asset risk management in the near future, focusing on asset information management might therefore be an intelligent investment to make. By better managing the processes surrounding capturing, collecting and structuring asset data, the foundations upon which to build a better asset risk management system are in place. Quintessential in this is to have the right mixture of engineering and data analytics capabilities in place.

Those organizations which already have sufficient and qualitative asset data available could take a deeper look into how to better explore it. Storing huge amounts of data, saved in databases, is a first step, but translating these data into valuable information for decision-making can be a challenge. By exploring data, past performance and the current state of assets can be evaluated. It can give insight into, for instance, failure patterns, failure behaviour and interacting factors which can explain asset performance. These insights may lead to the better definition of metrics that more accurately **monitor past and current asset performance** from which actions can be derived.

Whilst asset performance monitoring will certainly teach you a lot about the actual status of your assets, imagine what could be possible if you had insight both into past or current state, along with future condition and/or potential failures of your assets. This could elevate your asset risk management to the next level. It is ultimately all about being better informed as to the likelihood of a certain incident occurring, and therefore being better equipped to quantify the asset risks you are facing. This ability to predict asset performance and failure can help you to take preventive action on precisely the assets which need it, and therefore avoid potential unplanned downtime and reactive (and unplanned) interventions. Additionally, it can help you to avoid unnecessary action on healthy assets. In doing so, performance is improved, operational and capital expenses are reduced and surprises are mitigated. Using **Predictive Asset Management** is the means to achieving this heightened level of asset risk management maturity.

The final step in increasing maturity is achieved by implementing fully-fledged asset performance measurement process through a comprehensive and intelligent **Asset Control Centre**. The role of the Asset Control Centre is to provide a real-time view on the current state of your assets. It will track the status of your assets based on historical data and predictions, notify you of new events (e.g. incidents), generate alarms and initiate work orders. With a predictive asset management engine running behind the scenes, it automatically alerts you when a particular asset is in need of an intervention, or when critical limits of certain parameters are about to be exceeded.

The Asset Control Centre gives you a complete overview of what is happening when and where, allowing you to have an up-to-date, real-time overview of your actual asset risks on a permanent basis. Furthermore, it supports decision management, amongst others, enabling you to make informed trade-offs between maintenance and replacement decisions, investment-planning simulations, etc. This enables you to be in the driver's seat of your asset base and define which direction it is going.

Every single stage in the journey from enhanced asset information management to asset performance monitoring and predictive asset management, with the asset control centre as the final piece in the puzzle, gives you increased control over your assets and therefore greater capability to manage the risks that are inherent to your assets.

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