SENSEYE PREDICTIVE MAINTENANCE

Connecting asset data
at scale

How Industry 4.0 and smart maintenance can save the world's largest
metals and mining organizations up to $25 billion a year.

Find out more: **siemens.com/senseye-predictive-maintenance**

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Introduction

Companies worldwide understand the need to haul their aging operations into the era of automation and achieve digital transformation at scale to drive more efficient and more sustainable operations.

The world's largest metals and mining firms are at the forefront of Industry 4.0 and play a leading role in the smart industry movement.

Data is fundamental to this change.

Enhanced data architectures and sensor-based condition monitoring – capabilities originally introduced for safety, compliance and control purposes – have become ubiquitous among major metals and mining organizations.

These initial infrastructure investments put these organizations in an excellent place to achieve additional benefits through advanced maintenance practices (powered by Predictive Maintenance) and AI decision-making.

All of the businesses we studied see digitization as a key strategy initiative. These technologies are being trialled by the majority of the metals and mining sector's top 50 companies, and many have started to roll them out at scale.

Throughout this report we will refer to all Industry 4.0, smart industry and digital transformation initiatives under the generic term: Industry 4.0.

This report explores the appetite for and adoption of two key Industry 4.0 technologies – smart Predictive Maintenance and AI.

In providing an up-to-date picture of the metals and mining industry, Senseye Predictive Maintenance has identified a tipping point in the digitization efforts of the biggest companies. These firms are improving the efficiency of their operations and overall equipment effectiveness (OEE) with new Industry 4.0 technologies.

Collectively, they are at the precipice of saving billions of dollars, every year, through operations and maintenance efficiencies – by reducing downtime, operating costs, and running more precise, sustainable, maintenance strategies and operations.

This report explores the appetite for and adoption of two key Industry 4.0 technologies – smart Predictive Maintenance and AI decision-systems – across the sector's leading firms. It seeks to understand:

• How are the most prominent metals and mining organizations preparing their operations for advanced technologies?

• Have they got the data architectures and condition-monitoring capabilities to improve operational decision making?

• How many of the top 50 companies are trialling advanced digital technologies in their businesses?

• How many of the largest firms have started rolling out these advanced technologies and tools across their operations?

Executive Summary

Getting data organized, connected and delivering key business insights has been a fundamental first part of any metal or mining company's digitization efforts for decades now.

• 94% of the leading firms have already established a centralized data hub.

• 90% of companies are collecting condition-monitoring data.

• 84% of the top 50 firms are engaged in digital operations and maintenance skills training.

Industry 4.0 technologies – data-powered, digitally-connected tools that allow for smarter, automated operational control – are now well within the mainstream. Most of the top 50 companies have moved to trial AI and Predictive Maintenance in their operations.

• 80% of the companies studied are trialling a form of AI-driven decision making in at least one business area.

• 58% of businesses showed evidence of trialling smart Predictive Maintenance processes supported by analytical technologies.

One contingent is going further, having seen the success of their trials, and have started to roll out these tools and techniques across their business.

- 32% of businesses have moved beyond trials and are rolling out smart Predictive Maintenance solutions that use advanced analytics across their operations.

- 46% of firms have deployed a wider range of AI-powered decision making capabilities at scale across their organizations.

The impact of digital investment on maintenance costs, downtime and OEE is already evident.

- Collectively, the top 50 firms spent an estimated $62.5 billion on plant and equipment maintenance in their last reported financial years.

- Maintenance costs typically represent 1% – 3% of these firms' total annual revenues.

- A leading steel firm reported a 2.5% reduction in annual maintenance costs after implementing real-time monitoring across key assets.

- An Australian organization currently trialling smart Predictive Maintenance solutions at an ore operation has cut lost production time on ore crushers by 94%.

- One aggregates producer has improved operational efficiency by between 15% and 20% by rolling out a digital transformation scheme including Predictive Maintenance as part of its smart factory initiative.

How the top 50 metals and mining companies are tackling **digital transformation**

Data is almost always the initial raw product of these digitization efforts:

94%　Almost all firms (94%) have established robust data infrastructure and 90% now collect conditionmonitoring data. These are two critical steps for realizing the potential of the Internet of Things (IoT) in industrial environments.

58%　Advanced Predictive Maintenance use cases are apparent in over half (58%) of businesses.

80%　More than 80% of the organization analyzed are trialling AI-based decisioning systems.

The industry is reaching a tipping point in how firms are using these tools at scale across their organizations:

- A third (32%) of the organizations studied are now acting on these tools' proven benefits to their operations. 32% of firms are rolling out smart Predictive Maintenance to multiple business areas, and 46% have installed AIdecisioning capabilities at more than one site.

- The leading firms in the metals and mining sector have proven the value and viability of these tools at scale, and three examples of best practice are provided later in this report.

To provide a clear understanding of digitization at these organizations, Senseye Predictive Maintenance has developed a 'digitization pyramid' showing three levels of sophistication:

Transformation at scale:

Businesses at the top level have seen the benefits of their trials and are now rolling out these technologies to more areas of the businesses

- 46% are deploying AI-powered decision making at multiple sites

- 32% are rolling out smart Predictive Maintenance tools across their operations

Trialing innovative technologies:

Businesses at this level are putting their data to use trials of innovative IoT technologies

- 58% are trialing smart Predictive Maintenance tools

- 80% are trialing a form of AI-driven decision making

Laying the foundation:

Businesses at this level are making a concentrated effort to collect, manage and store plant and asset data from their daily operations

- 94% have established robust data systems

- 90% are collecting condition monitoring data

Level 1 Laying the foundation

Advanced data infrastructure and sensor-based condition monitoring are all but universal in the top 50 companies. Senseye Predictive Maintenance research indicates that 9 in 10 have reached or exceeded the first layer of the digitization pyramid.
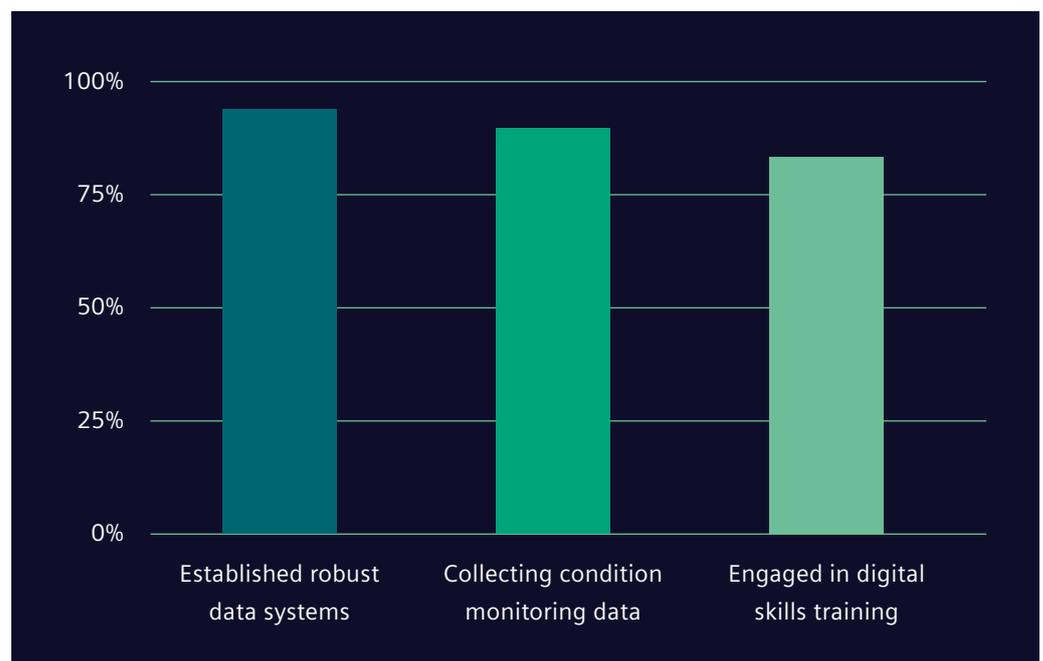
What are the leading firms saying?

- Companies pointed to several motivations for developing their data architecture: more accurate decision-making, building more resilient IT infrastructure, or pursuing a 'culture of agility'.

- All 20 Chinese firms noted that the research and developments targets established in the Chinese Communist Party's 'Made in China 2025' and 'Fourteenth Plan' industrial policies were driving increased investment into digital transformation.

- These strategies call for the uptake of AI, IoT, and other smart technologies across several core industries. All but two of these initiatives were launched or supported by Chinese-based data science and analytics organizations.

- One leading steel firm acknowledged a 2.5% reduction in annual maintenance costs after implementing real-time condition monitoring across key assets.

- Using big data, one manufacturer was able to improve the accuracy rate for predicting steel coil width by over 98% in its rolled steel production.

- One firm saw the "interconnection and intelligent monitoring of workshop equipment" reduce unplanned downtime accidents by 10% and increase the output of nickel products by 30%.

Case Study: Cameco – The power of bringing your data together

Cameco is a Canadian energy firm that started its digital transformation in earnest in 2019. Its longest-running initiatives are in operations management, where it seeks to improve operational decision-making, safety management, and sustainability.

A key element in these initiatives is asset maintenance, representing approximately 25% of Cameco's overall operating costs at its various mining operations. Improving asset management began with automating data collection.

Cameco had struggled to analyze multiple streams of condition monitoring data from assets in the past. As a result, the company found it hard to understand what went wrong in the event of asset failure.

Senseye Predictive Maintenance, using data collected by existing sensors, now gives Cameco a continuous stream of information on the condition and predicted future condition of its machines. This will lead to improved sustainability, efficiency and a reduction in downtime.

Using the technique of multivariate analysis, Cameco is poised to make better operational decisions across the business:

• Better data collection means a clearer understanding of what went wrong and stronger insight to avoid repeated issues in the future.

• Importantly, it gives a clearer understanding of where and what you should be monitoring to find the best insights on asset health .

• Continuous data collection reveals which forms of condition data are relevant for measuring asset health – and how the relationship between data points can show an upcoming fault.

• It provides an opportunity to change operating regimes before they lead to equipment failure. The sooner you know, the sooner you can plan interventions and take advantage of windows in your schedule to apply a maintenance intervention without compromising production.

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Quicker access to data gives you the best chance to make early, effective interventions that keep your operations on track."

Brad Owen, a senior specialist in asset health management at Cameco,
discusses how automated data collection is the first step towards smarter operational management.

Level 2 Trialling innovative technologies

Advanced data infrastructure and sensor-based condition monitoring are all but universal in the top 50 companies. Senseye Predictive Maintenance research indicates that 9 in 10 have reached or exceeded the first layer of the digitization pyramid.
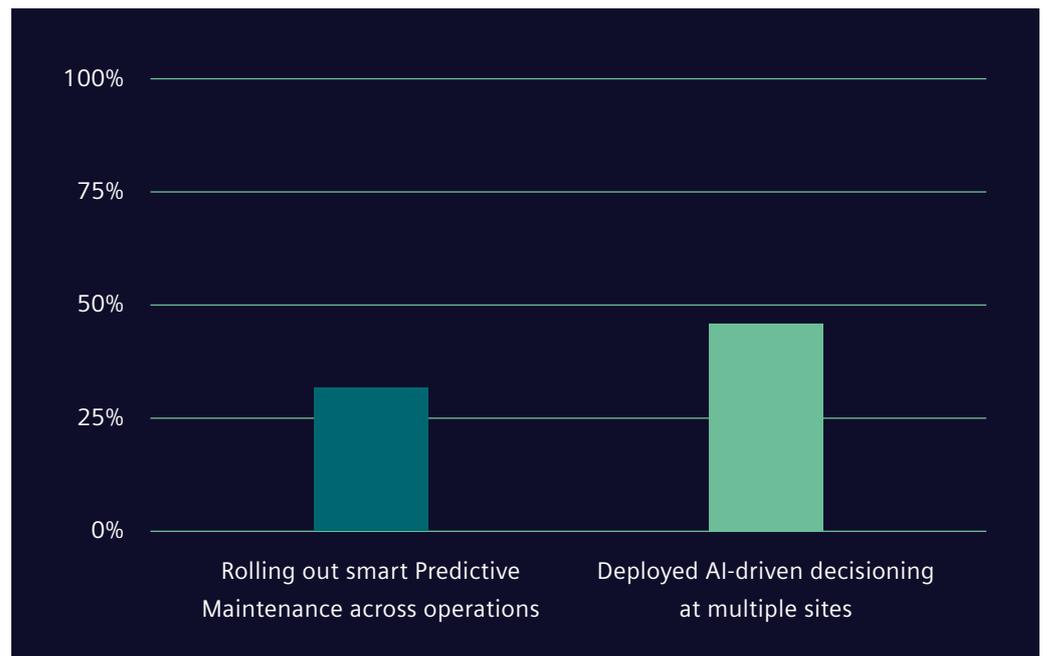

What are the leading firms saying?

- $7 million was saved by one steel manufacturer achieved through reduced use of energy and spare parts by trialling an AI temperature control system on its North American electric arc furnaces.

- At one Korean firm, AI control technologies have reduced the average processing time of a small-lot production batch from 12 hours to 4 hours.

- One Australian firm, currently trialling smart Predictive Maintenance solutions at one ore operation, has reduced lost production time on ore crushers by 94%.

Level 3 Transformation at scale

Senseye Predictive Maintenance's research suggests that just under a third (32%) of the top 50 firms have moved past the trial stage and are starting to roll out advanced technologies to other areas of operation. These firms are optimizing operational decision-making by connecting asset data at scale.

A majority of the businesses that trialled automated Predictive Maintenance have already seen the value it brings to uptime and OOE, with 58% rolling this capability out to other areas of their operations.

At least two of the top 50 metals and mining organizations run sites featured in the World Economic Forum's 2021 'Global Lighthouse Network'. This is a network of world-leading businesses in adopting and integrating cutting-edge, Industry 4.0 technologies.

What are the leading firms saying?

- As part of its smart factory initiative, one building materials firm improved operational efficiency gains by 15% to 20% after rolling out a comprehensive digital transformation scheme including Predictive Maintenance.

- One US firm is using AI to maximize ore recovery in mines across North and South America, a development forecast to increase production by 5% or 90,000 tonnes a year.

- Robotic process automation was deployed across more than 40 new use cases at one nickel producer. More than seventy initiatives, driven by the company's 'Digital Lab', have delivered in value between 2018–2020 over USD $9 million.

Case Study: Alcoa –
# Improving productivity with
Predictive Maintenance

Alcoa is an American industrial firm and leading producer of aluminum. The business increased its focus on digital transformation in 2017 and 2018 to improve the tools and processes used in machine asset management.

• Alcoa's plants are running around the clock, so stability is crucial to efficiency, productivity, and the bottom line.

• Improving asset uptime is also essential for meeting customer expectations and ensuring downtime doesn't affect deliveries.

• Finally, Alcoa operates out of large, complex plants with interconnected machinery. Asset failures have the potential to impact large parts of its operations.

Alcoa sought to improve this area of operations through condition monitoring and improved operational management. It has a long history of traditional preventative and Predictive Maintenance, and data collection was integral to operations for a long time.

The firm had struggled to tap the data for insights as manually analyzing the data from thousands of assets was never viable. Alcoa turned to Senseye Predictive Maintenance to begin utilizing the data it was collecting at scale.

Automated analysis of condition monitoring data has allowed Alcoa to interrogate increasingly large and varied data points for insights into asset health. By understanding any machines' problems early, the business can resolve them quicker, in optimum operational windows.

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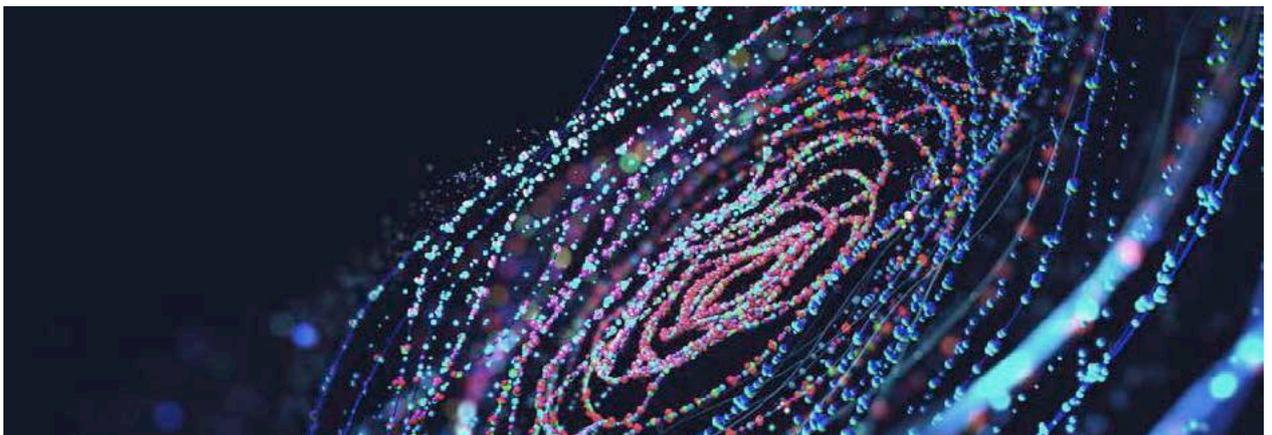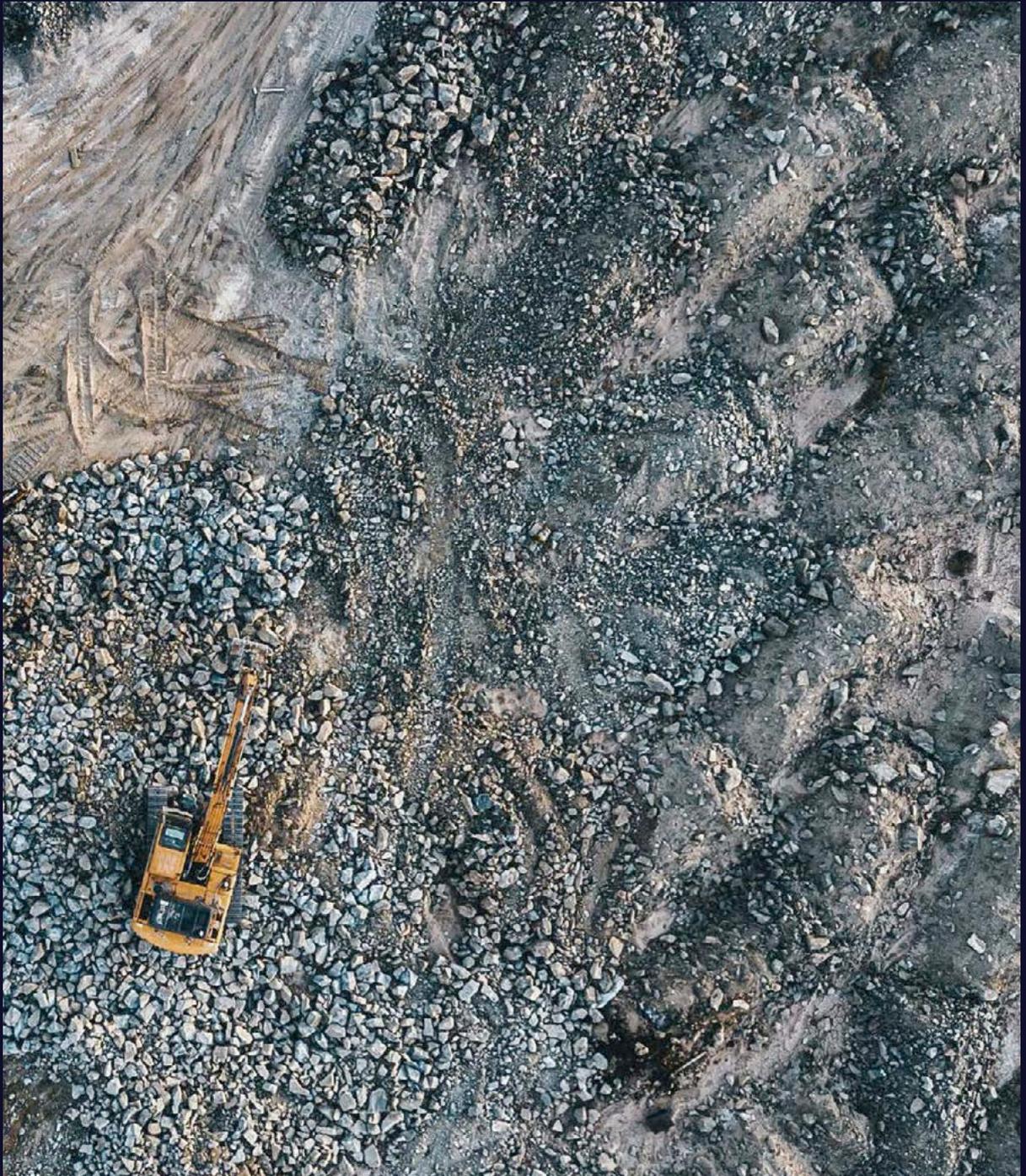
It's a numbers game. The wider the net, the more faults we'll catch early and the more savings will add up."

Gísli Gylfason, Leading Reliability Engineer at Alcoa's Icelandic site, explains how Alcoa is driving improvements in asset management.

The power of smart Predictive Maintenance in metals and mining

Senseye Predictive Maintenance's analysis of the 50 largest metals and mining companies shows that smart Predictive Maintenance strategies are now achieving mainstream adoption.

More than half (58%) of the organizations studied have identified Predictive Maintenance as a strategic initiative and are trialling in at least one business area.

Predictive Maintenance isn't just driving more efficient industrial operations. It is also delivering:

- Lower maintenance costs: Maintenance costs in the mining industry regularly account for between 30% and 50% of total site operating costs. Studies show that condition monitoring (a key first step for Predictive Maintenance) can improve overall equipment effectiveness, on average, by 6% – reducing company spend on parts and machinery.

- Less downtime: Previous research from Senseye Predictive Maintenance has shown that – across the Fortune Global 500 – heavy industrial companies lose $225 billion collectively per year due to unplanned downtime. A predictive approach to maintenance automates the analysis of machine health, identifies early warning signs of deterioration and directs engineers to where they're needed most. It leads to a more robust, informed asset maintenance strategy where more successful interventions are made and fewer assets run to fail.

- Improved health and safety: The Center for Disease Control and Prevention (CDC) reports that 30% of all injuries and fatalities from underground mining in the US are due to machinery maintenance accidents.

- Predictive maintenance means interventions can be better planned and completed first-time. But a Predictive Maintenance-empowered schedule can also reduce the need for manual inspections by over 50% without sacrificing operational quality. This leads to less over-maintenance and reduces the time employees are at risk.

- A scalable solution: Automating asset health analysis is critical for large firms looking for more comprehensive monitoring across their entire operations.

Smart Predictive Maintenance uses advanced machine learning algorithms to learn the characteristics of each monitored asset automatically, enabling the capability to be rolled out easily at scale. The system automatically provides the critical data needed for engineers to make decisions and gives them more time to focus on maintenance. Nearly all leading firms have got their operational data into a usable format, collected centrally within their organization. And the majority are taking the next step to make better use of that data for driving effective, cost-efficient daily operations.

It is crucial that those who aren't yet at this stage take advantage of a powerful, developing field of AI-enabled tools that integrate quickly and provide immediate value in their operations.

Implementations of more sophisticated Predictive Maintenance by Senseye Predictive Maintenance's clients have demonstrated its ability to deliver:

• 40% reduction in maintenance costs.

• 85% improvement in downtime forecasting accuracy.

• 50% reduction in unplanned machine downtime.

• 55% increase in maintenance-staff productivity.

For the top 50 metals and mining companies, which spent a collective $62.5 billion on maintenance costs in 2020–21, a 40% reduction in maintenance costs would save a total $25 billion a year in maintenance efficiencies.

Methodology

The insights in this report were obtained from a study of the world's 50 largest metals and mining companies (based on revenue in their last financial year). Our analysts looked at publicly available annual reports, Environment Social Governance (ESG) reports, and press statements.

We also conducted in-depth interviews with three major metals and mining firms based in Canada, USA, and Australia.

Additional insights into Predictive Maintenance benefits were obtained from live Senseye Predictive Maintenance deployments at large manufacturing and industrial organizations globally.
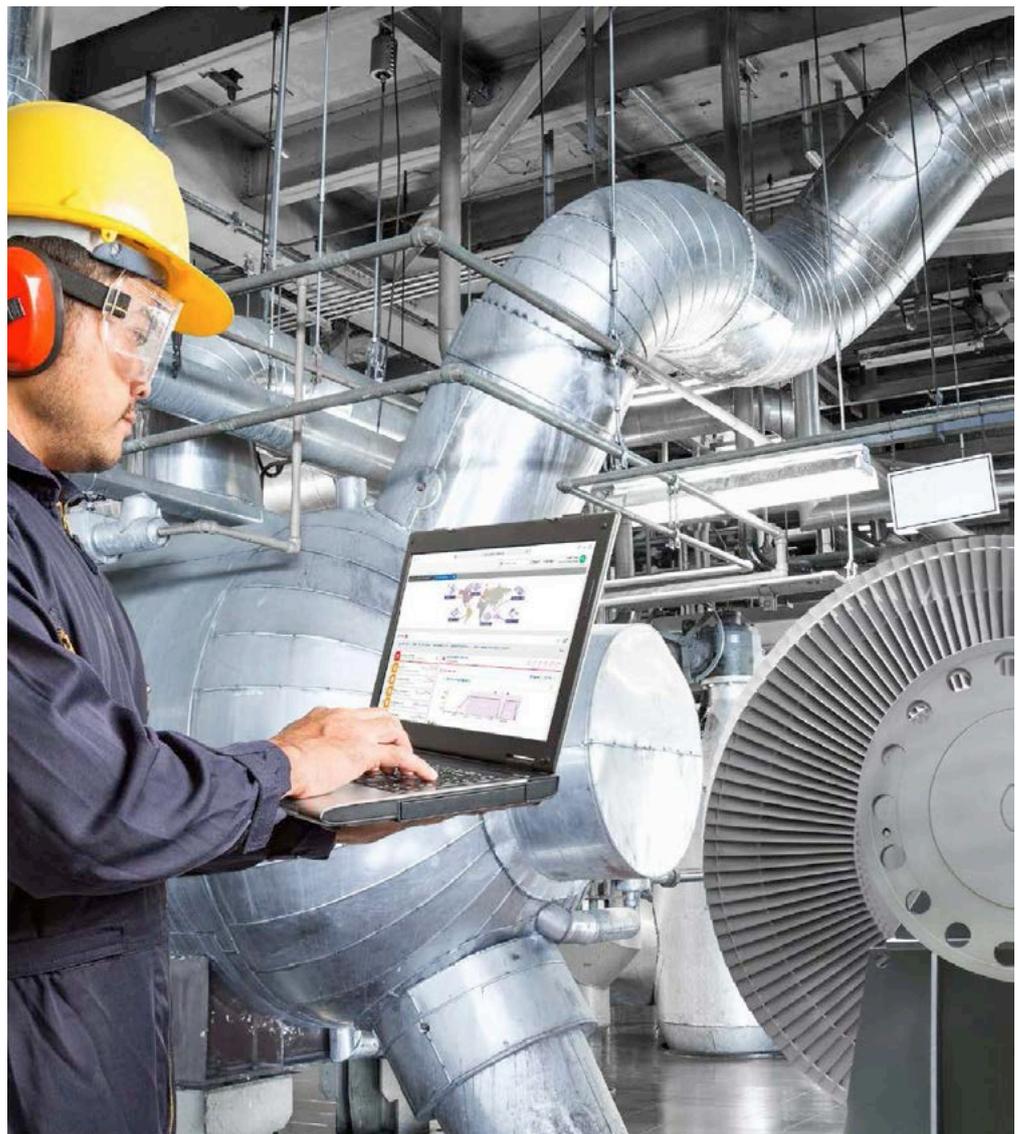
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