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Buyer's Guide: Asset Performance Management Software

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OPERATIONAL EXCELLENCE

Buyer's Guide: Asset Performance Management Software

This report provides executives at industrial facilities responsible for selecting, implementing and managing software or services for performance and maintenance optimization with an up-to-date analysis of 27 prominent asset performance management (APM) solutions on the market. This report updates and extends our analysis of solutions provided through the Green Quadrant: APM Solutions published in June 2020. The analysis of this report also leverages data collected from 19 APM solution providers via questionnaires and software demonstrations over the last three months. It also uses insights into buyer requirements collected via our annual global surveys of executives in operations, maintenance, engineering and process safety roles. Buyers should use this guide to support them in their search for APM software applications and services that fit their requirements.

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ORGANIZATIONS MENTIONED

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Asset Performance Management Solutions Buyer's Guide 2021

This report provides executives at industrial facilities responsible for selecting, implementing and managing software or services for performance and maintenance optimization with an up-to-date analysis of 27 prominent asset performance management (APM) solutions on the market. This report extends our analysis of solutions provided through the Verdantix benchmark of APM solutions published in June 2020 (see Verdantix Green Quadrant: Asset Performance Management Solutions 2020).

This report leverages data collected over the last three months from 18 APM solution providers via questionnaires and software demonstrations, namely from Augury, AVEVA, Bentley Systems, Bently Nevada (including ARMS Reliability), Cenosco, Cognite, Endevor, GE Digital, Hitachi-ABB Power Grids (HAPG), Honeywell, IBM, Itus Digital, Lloyd's Register, Pragma, Seeq, Senseye, Symphony Industrial AI (SIAI) and Uptake.

The study also uses insights into buyer requirements collected via our annual global survey with 259 executives in operations, maintenance, engineering and process safety roles (see Verdantix Global Corporate Survey 2020: Operational Excellence Budgets, Priorities & Tech Preferences). Buyers should use this guide to support their search for APM software applications and services that fit their requirements. Buyers should also leverage other Verdantix reports to support them in developing a more complete digital asset performance and maintenance strategy as well as software implementation plan (for example, see Verdantix Best Practices For Digitizing Industrial Asset Management).

The Market For APM Solutions Is Booming

The APM solutions market has exhibited resiliency to the COVID-19 pandemic, with operations and maintenance leaders turning to digital solutions to help optimize asset performance and intervention strategies to counteract demand shocks and supply chain disruptions. The APM solutions market is currently sized at $2.7 billion and has a promising forecast – it is expected to grow by 12% year over year to $4.4 billion in 2025 (see Verdantix Market Size And Forecast: Asset Performance Management Solutions 2019-2025). Verdantix analysis attributes this growth to:

- **Intensifying efforts to reduce asset-related OPEX and CAPEX.**
  APM solution uptake is primarily triggered by cost-cutting programmes, aiming to reduce operations and maintenance costs through predictive maintenance capabilities as well as optimize CAPEX for asset replacement based on analysis of an asset's remaining useful life (RUL). A US-based pharmaceuticals firm was replacing a seal on a bead mill every eight batches to avoid costly production losses. By employing Aspen Mtell APM software by AspenTech, the firm was able to detect seal failure with a two-day lead time, reducing the frequency of seal replacements to only when needed (approximately three times less frequently). The pharma firm was able to reduce lifecycle maintenance costs by 60%, increase production capacity and save $10 million in CAPEX.

- **Minimizing unplanned downtime and increasing operations reliability.**
  APM solutions are playing a key role in ensuring reliable operations and minimizing outages, which have substantial financial, legal and safety implications in critical industries such as utilities. Inner Mongolia Power Company (IMPC), one of China's power utilities serving 14 million customers, was using a time-based maintenance plan: conducting minor maintenance every three years and major maintenance every five years. By using HAPG's APM solution on its transformers and high-voltage circuit breakers, IMPC moved from schedule-based maintenance to condition-based maintenance, witnessing enhanced safety, reliability and quality of its operations.

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- **Maturing of IT/OT infrastructure across key markets.**
  Consolidation of information technology (IT) and operational technology (OT) is a prerequisite for most digital technology solutions, and APM is no exception. Successful APM software deployments require a maintenance scheduling and execution system as well as an asset information management infrastructure. The increasing maturity of organizations on asset management technologies creates a digital ecosystem that will contribute to the growth in APM spending. More than 40% of the 259 executives interviewed in the 2020 Verdantix Global Corporate Survey mentioned using enterprise asset management (EAM) software widely or at multiple facilities, compared to 15% for APM software. As the market matures, we expect APM software implementations to reach similar levels to current EAM software over the next five to ten years.

- **Coronavirus-induced digital acceleration.**
  The COVID-19 pandemic and the associated lockdowns and travel restrictions are having a profound impact on industrial firms, which must rapidly adopt digital technologies and morph their operations models to allow for business continuity. Digitally enabled automation and remote operations are now a high priority across all industries. This trend has established fertile ground for APM solution implementation, as it has created an inherent demand for upgrading legacy infrastructure and encouraged a mindset change across all levels of an organization, from technicians and engineers to directors and executives. In the 2020 Verdantix Global Corporate Survey, 80% of the respondents stated that they are going to invest in digitizing operational excellence initiatives in their organizations over the next two years.

Four Core Functionalities Underpin APM Solutions

Demand for APM solutions is on the rise as industrial organizations are seeking to increase profit margins while improving the reliability and safety of their operations. APM solution requirements can vary by user group (see **Figure 1**). Typically, APM software applications and associated services are used to:

- **Collect and centralize asset health data.**
  APM solution providers are following different strategies for asset health monitoring, which includes functionality for the effective collection, consolidation, analysis and action on instrument data. Augury, Amazon Web Services (AWS) and Symphony Industrial AI deploy proprietary sensing capabilities to directly collect vibration, magnetic and temperature data for critical rotating industrial and manufacturing equipment. Bently Nevada, Seeq and Senseye are decoupling their analytics implementation from their data strategies by directly connecting to sensors to expedite implementation. Other providers such as AVEVA, Bentley Systems and GE Digital are following the traditional route of connecting to process historians and enterprise systems to enable scalability and a holistic approach to asset health monitoring.

- **Predict asset failures.**
  The value proposition of asset failure prediction increases with the ability to predict failures as early as possible, but also with the ability to prescribe corrective actions once the failure is predicted. Large industrial automation providers such as AVEVA, Bentley Systems, Emerson, GE Digital, Honeywell and IBM use a combination of statistical methods, including artificial intelligence (AI)/machine learning (ML) and physics-based asset class-specific failure mode libraries, to predict when an asset will fail but also to understand why and offer recommendations and corrective actions. Over the last decade, the market has also seen the launch of a flurry of smaller (less than 200 employees) predictive maintenance software providers, such as Ada Mode, Predikto, Presenso, Seeq and Senseye, which primarily use statistical and ML-driven methods to predict asset failure (see Verdantix Smart Innovators: Maintenance Analytics For Heavy Asset Industries).

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FIGURE 1

Common User Groups And Functionality Requirements Of APM Solutions

User Groups	Common Solution Requirements	Example Deployments
Maintenance Supervisors	• Asset health monitoring and failure prediction functionality • Asset maintenance strategy optimizer, including maintenance planning and risk-based inspections • Integrations with CMMS, EAM and FSM software to execute maintenance plan	• Bord Gáis Energy adopted GE Digital's APM (Advanced Controls and Predix) platform featuring 141 sensors throughout the plant for condition monitoring, resulting in savings of $1.5m of forced outage costs in the first year and an additional $1.4m in O&M cost avoidance • Salt River Project (SRP) provides water and power to central Arizona and used DNV's APM solution (Cascade) to manage maintenance work orders and to build its operations budgets with the forecasting tool, ultimately saving tens of work orders in a month and gaining more efficient resource planning capability
Reliability Engineers	• Asset health monitoring and failure prediction functionality • Failure mode, probability of failure and RUL • Root-cause analysis and FMEA • Reliability-centred and prescriptive maintenance • Reliability, availability, maintainability and safety (RAMS) analysis	• EPCOR, a Canadian power distribution supplier, used Bentley System's AssetWise to assign asset health indices and identify at-risk assets through real-time data. Being able to define a precise likelihood of failure, EPCOR optimized asset budgeting and reduced defective equipment outages by 43% within 2 years • Swiss Federal Railways (SBB) powered an RCM approach with SAP's Intelligent Asset Management, and was able to auto-generate maintenance work orders, achieve higher customer satisfaction, and transcend costly 'run-to-failure' strategies
Operation Heads	• Asset performance strategy optimizer, including overall equipment effectiveness, production optimization and what-if simulations (e.g., plant overfiring analysis) • Business intelligence and analytics • Dashboards and visualizations, including GIS integration, interactive P&ID, PFD and 3D asset/plant models • Integrations with EAM and ERP software	• Abu Dhabi National Oil Company (ADNOC) used AVEVA's solutions, including Predictive Asset Analytics, to create a real-time data visualization centre. ADNOC was able to save over $60m through optimizing operations by monitoring over 10 million tags across over 120 dashboards and by integrating with ERP as well as business and IT applications • Itus Digital offers OEMs purpose-built APM and asset-level digital twin models to enhance design, operation and performance of the OEM's equipment through a centralized diagnostic and customer support portal
Data Analysts/ Scientists	• Open platforms that can integrate with satellite enterprise systems • Configurable APM software that allows creating use-case-specific workflows • Integrations with time-series data bases and historians, data management and IIoT platforms, cloud data services, and asset lifecycle information management systems	• Senseye offers the PdM Enterprise platform, which, through its open architecture, enables clients to leverage their own IT teams and in-house developed expertise to tailor the maintenance solutions • Covestro used Seeq's self-service analytics in its polymer-producing plants to optimize extrusion process performance, develop specific workflows to benchmark process parameters with past product runs and develop custom recommendation analytics by configuring them in Python script

Note: this list is not exhaustive
Source: Verdantix research and analysis

- **Optimize asset maintenance planning.**
  While maintenance optimization is typically done in EAM systems, APM solutions can significantly complement them, with functionality and tools to optimize which maintenance tasks are performed and in what order to maximize asset reliability and minimize cost and risk. APM solutions can also enhance maintenance planning for longer term maintenance strategies, such as those running for over a year. Salt River Project (SRP), Arizona's electric and water utility implemented DNV's Cascade utility asset

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management software to streamline its maintenance work orders and keep track of corrective maintenance undertaken at all of its substations, saving the firm tens of work orders each month, contributing to more efficient resource planning and providing the ability to input critical field data directly into the system.

- **Enhance asset performance strategies.**
  APM solutions can also enhance performance optimization strategies by analysing overall equipment effectiveness (OEE) and running what-if simulations to optimize production capacity without damaging the assets or increasing OPEX. Baosteel, one of the world's biggest steel manufacturer, analysed 6,000 welding sessions with a combination of AI and predictive modelling using Honeywell Forge enterprise performance management software to actively monitor the health and efficiency of its welding machines, evaluate and maintain weld quality, and predict how to set welding machines for their next operation. Baosteel cut labour costs by $450,000 per year as well as increased operator accuracy by 96.4% and reduced stoppages by 90%.

Solution Providers Offer Products With Similar Capabilities But Have Varying Levels Of Industry Expertise

Functionality for APM solutions consists of four primary capabilities: collecting and centralizing asset health data, predicting asset failures, optimizing asset maintenance plans and enhancing asset performance strategies. Currently, the APM solutions market is fragmented, populated by providers who:

- **Come from five distinct backgrounds.**
  There are multiple providers in the market offering APM solutions, but with different market positioning and approaches (see **Figure 2**). The five core categories of providers existing in the APM solutions market, segmented based on their primary focus, are: (i) large industrial automation technology providers such as AVEVA, GE Digital and Emerson that leverage their wealth in digitization and automation expertise; (ii) EAM software suppliers such as Endevor, iOFFICE and Pragma, innovating from solely time/usage-based maintenance to predictive maintenance strategies and beyond; (iii) APM and predictive maintenance specialists that typically rely on AI/ML-based predictive approaches; (iv) sensor and instrumentation manufacturers that extend engineering and process control expertise to optimize asset performance; and (v) system integrators and digital service providers that have experience in asset management digitization projects.

- **Focus on specific industries and asset classes.**
  Industry and asset class expertise is critical for APM, as technical expertise and asset libraries with industry-specific failure modes and protections as well as maintenance strategies are required to enable more accurate asset failure prediction and more effective asset maintenance and performance strategies (see **Figure 3**).

- **Cater mostly to digitally mature geographies.**
  Due to the technology stack required to deliver a successful APM software implementation project, the digitally mature North American and European regions are seeing most APM action (see **Figure 4**). Thirteen out of the 27 APM solution providers analysed acquire over half of their revenue from North America or Europe. Interestingly, due to its oil and gas focus, Honeywell gains more than 20% of its revenue from the Middle East, while Pragma has found commercial success with APM projects in Africa.

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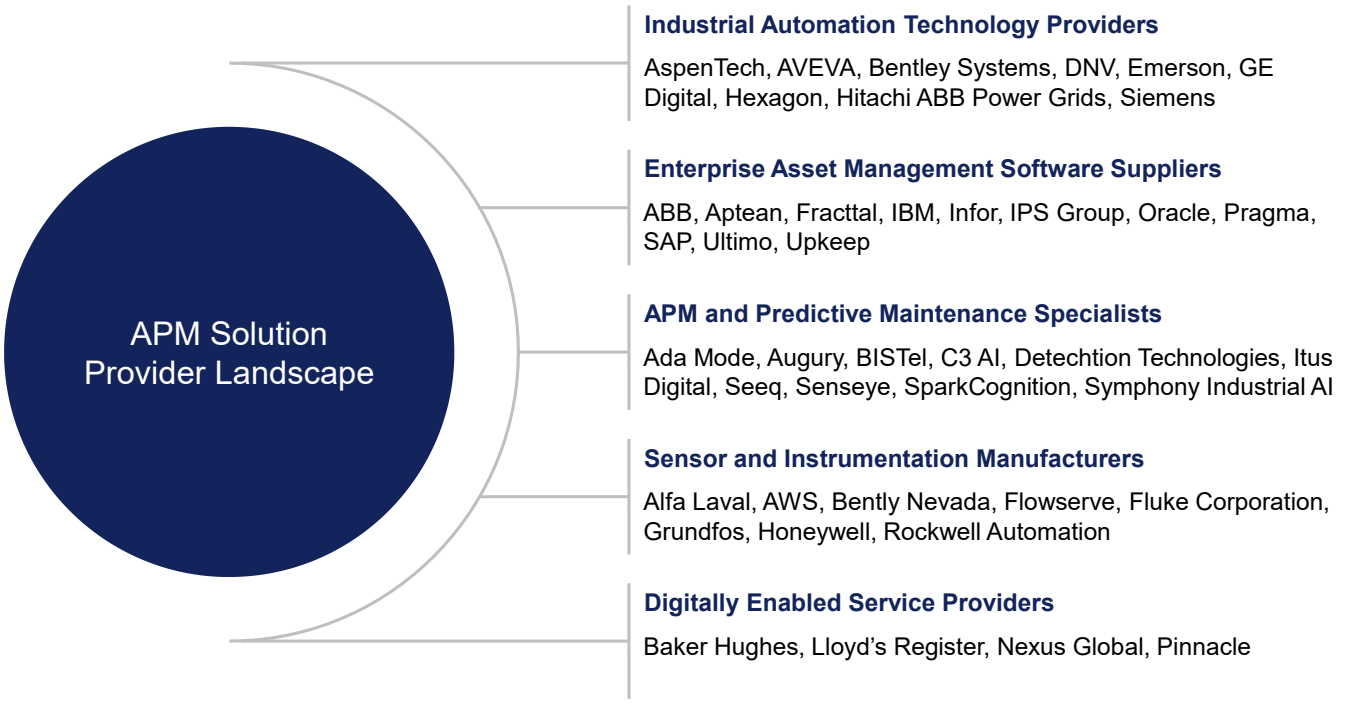
FIGURE 2

APM Vendor Landscape: Example Solution Providers Based On Background



Note: this list is not exhaustive
Source: Verdantix research and analysis

- **Provide both on-premises and cloud deployment options.**
  In the 2020 Verdantix Global Corporate Survey, cloud availability was a more important evaluation criterion than on-premises availability for asset management software applications. Most APM software providers do offer cloud (both hosted single instance and multi-tenant) and on-premises options. From the available deployment data and corporate survey, it becomes clear that cloud-based deployments are increasing, but the dominant delivery method for APM continues to be on-premises systems. We do expect the scale to shift towards the cloud over the next five to ten years, but demand for some on-premises solutions will remain.

- **Deliver most projects via in-house implementations.**
  Providers offer both in-house and external support for APM implementations, depending on customer needs. Most APM software suppliers are currently implementing the majority of projects themselves, which aligns with the 2020 Verdantix Global Corporate Survey on brand perception of the types of providers delivering asset management digitization projects. Asset management software providers had the highest preference, followed by EPC consultancies, professional services firms and IT services firms. Certain APM players have shown an increased interest in services, with GE Digital introducing three new managed services for the power generation industry in June 2021, and Bentley Systems launching in July 2020 The Cohesive Companies subsidiary to act as its digital integrator.

- **Converge on a tiered pricing model.**
  Pricing models typically depend on the features, scale and usage of the APM solution by the customer, resulting in prices scaling up either with the number of modules purchased, active users, assets

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FIGURE 3

Product, Industry Focus And Capabilities Of Representative APM Solution Providers

Vendor	Products	Industry Focus[1,2]	Asset Health Monitoring	Asset Failure Prediction	Maintenance Optimization	Performance Optimization
ABB	ABB Ability APM	Power generation; Power T&D; Mining and metals; O&G	✓	✓	✓	(✓)
AspenTech	Aspen Mtell, Aspen ProMV, Aspen Event Analytics, Aspen Fidelis, Aspen APM Insights	O&G, chemicals	✓	✓	✓	✓
Augury	Machine Health	F&B and FMCG; Industrial manufacturing; Life sciences	✓	✓	✓	(✓)
AVEVA	AVEVA Asset Strategy Optimization, AVEVA Predictive Analytics; AVEVA Insight; others	Power generation; Power T&D; O&G; F&B and FMCG; Chemicals; Mining and metals	✓	✓	✓	✓
Bentley Systems	AssetWise; PlantSight	Transport; O&G; Power T&D; Power generation	✓	✓	✓	✓
Bently Nevada	Bently Nevada System 1; ARMS Reliability OnePM	O&G; Power generation; Industrial manufacturing	✓	✓	✓	✓
Cenosco	IMS (Integrity Management System)	O&G	✓	✓	✓	
Cognite	Cognite InField; Cognite Data Fusion; Cognite Maintain; Cognite Remote	O&G; Manufacturing; Power generation; Power T&D	(✓)	(✓)	✓	✓
Detechtion Technologies	Enalysis; Enbase	O&G	✓	✓		
DNV	Cascade	Marine; O&G; Power generation; Power T&D	✓	✓	✓	✓
Endevor	ENGAGE: Asset Optimization	Power generation	✓	(✓)	✓	(✓)
GE Digital	GE Digital's Asset Performance Management Suite	Power generation; O&G; Chemicals	✓	✓	✓	✓
Hexagon	HxGN SFx | Asset Management	Industrial manufacturing; Power generation; Automotive; Aerospace	✓	(✓)	(✓)	✓
Hitachi ABB Power Grids	Lumada APM and Equipment Reliability	Power T&D; Power generation	✓	✓	✓	✓
Honeywell	Honeywell Forge APM for Industrial	O&G; Mining and metals; Chemicals	✓	✓	✓	✓
IBM	Maximo Application Suite	Industrial manufacturing; Power T&D; O&G; Mining and metals; Power generation	✓	✓	✓	✓
IPS Group	IPS-SYSTEMS Asset Performance Management	Power T&D; Power generation	✓	✓	✓	
Itus Digital	Itus Digital	O&G; Industrial manufacturing; Life Sciences; Mining and metals	✓	✓	✓	(✓)
Lloyd's Register	AllAssets	O&G; Chemicals	(✓)	(✓)	✓	
Pragma	On Key	F&B and FMCG; Mining and metals; O&G; Industrial manufacturing	✓	(✓)	✓	(✓)
SAP	SAP Asset Strategy and Performance Management; SAP Predictive Maintenance and Service	Power generation; Industrial manufacturing;	✓	✓	✓	
SAS	SAS Asset Performance Analytics	Industrial manufacturing; Automotive; Aerospace; F&B and FMCG	✓	✓	✓	
Seeq	Seeq (inc. Cortex (formerly Server), Workbench, Organizer, and Data Lab)	O&G; Chemicals; Pharmaceuticals	✓	✓	(✓)	(✓)
Senseye	Senseye PdM Complete; Senseye PdM Enterprise	Automotive; F&B and FMCG; Mining and metals	✓	✓	✓	
Siemens	MindSphere; Siemens Asset Performance Management; and others	O&G; Power generation; Power T&D; Chemicals; Mining and metals	✓	✓	✓	✓
Symphony Industrial AI	APM 360; Performance 360	Chemicals; O&G; Power generation; Mining and metals; F&B	✓	✓		✓
Uptake	Uptake (inc. Fusion, Compass, Scout, Radar, and industry-specific modules)	Transport; O&G; Power generation; Mining and metals; Power T&D	✓	✓	✓	(✓)

(✓) Limited or unproven capability ✓ Comprehensive, cross-industry capability

Notes: [1]industries in which the vendor has about 10% or more of its customer base; [2]industry order is ranked based on customer share
Source: vendor questionnaires; secondary research; Verdantix estimates; Verdantix analysis

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FIGURE 4

APM Customers And Revenue By Region Of Representative APM Solution Providers

Vendor	Number of Customers	Number of Users	North America	Europe	APAC	Middle East	Latin America	Africa
ABB	50-100	1,000-5,000						
AspenTech	Not disclosed							
AVEVA	200-500	10,000-50,000						
Augury	200-500	10,000-50,000						
Bentley Systems	200-500	10,000-50,000						
Bently Nevada	>500	>50,000						
Cenosco	25-50	5,000-9,999						
Cognite	50-100	1,000-5,000						
Detechtion Technologies	<25	1,000-5,000						
DNV	50-100	1,000-5,000						
Endevor	<25	<1,000						
GE Digital	200-500	10,000-50,000						
Hexagon	50-100	1,000-5,000						
Hitachi ABB Power Grids	Not disclosed							
Honeywell	100-200	1,000-5,000						
IBM	100-200	5,000-10,000						
IPS Group	<25	1,000-5,000						
Itus Digital	<25	<1,000						
Lloyd's Register	50-100	1,000-5,000						
Pragma	200-500	>50,000						
SAP	100-200	5,000-10,000						
SAS	25-50	1,000-5,000						
Seeq	200-500	10,000-50,000						
Senseye	<25	1,000-5,000						
Siemens	200-500	10,000-50,000						
Symphony Industrial AI	100-200	1,000-5,000						
Uptake	50-100	1,000-5,000						

APM revenue split by customer base in each region:

None | Less than 5% | 5% to 9% | 10% to 19% | 20% to 49% | 50% to 79% | 80% to 100%

Source: vendor questionnaires; secondary research; Verdantix estimates; Verdantix analysis

monitored and sites monitored. This tiered approach, in combination with the offer of subscription licences, gives customers financial flexibility by reducing CAPEX, and enables APM providers to target customers across both the mid and the large enterprise market. We expect the preference for subscription models to increase in line with cloud deployments.

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APM Product Strategies Are Aimed At Ease Of Integration, Mobility And Digital Twins

APM solution providers come from different backgrounds and focus on multiple industries, but all converge on solving similar asset maintenance and performance optimization issues for their customers. To gain a competitive edge, APM solution providers are aiming to further accelerate the time to value of their product, increase autonomy and offer a more comprehensive solution that can become the foundation of a firm's digital strategy. To achieve this, APM solution provider product strategies are focused on developing:

- **Open, extensible and customizable solutions that support in-house-developed analytics.**
  APM products are gradually becoming 'enterprise' platforms, allowing customers to extend them and add in-house-developed solutions. Symphony Industrial AI's EurekaAI Industrial Platform allows customers to create custom analytics within a low-code environment. In November 2020, Senseye launched Senseye PdM Enterprise, which can host customer-developed analytics and data modules, while Seeq now enables customer or third-party access to the Seeq Python library to implement their own functions.

- **'Plug-and-play' solutions that readily integrate with sensor and IoT infrastructure.**
  By offering out-of-the-box connectors and interfaces, such as with sensors or with asset information libraries, EAM and asset investment planning (AIP) software, APM software providers can significantly expedite the implementation and scale the value of APM solutions. Sensor integrations have recently been in the spotlight. Since the beginning of 2021, the market witnessed multiple such investments: Alfa Laval investing in AMI Global, Bentley Systems acquiring sensemetrics and Vista Data Vision, Henkel investing in Feelit, Symphony Industrial AI acquiring Savigent, and Uptake investing in ShookIOT (see **Figure 5**). Aligned with this trend, Senseye launched Senseye Ready – a partner ecosystem of compatible products, primarily comprising sensor and IoT solution providers – aiming to expedite deployment and resolve compatibility issues.

- **Holistic digital twin offerings that enhance plant operations.**
  The digital twin technology market is convoluted, as the term is being used to describe different solutions (see Verdantix Smart Innovators: Digital Twins For Industrial Facilities). APM solution providers are at the forefront of digital twin strategies, offering or aiming to offer immersive visualizations and asset-specific digital twin models and libraries. Bentley Systems recently upgraded its iTwin platform for APM, providing enhanced visualization and analytics visibility through digital twin models. In April 2021, GE Digital announced it has added new features to its SmartSignal predictive maintenance software application, including improved visualization and analysis tools and the expansion of its digital twin analytics and content catalogue covering over 300 industrial equipment classes.

- **Mobile applications for field workers.**
  When asked about the significance of digital innovations for their firm's operational excellence initiatives, interviewees in the Verdantix Global Corporate Survey ranked mobile apps for inspection rounds, work orders and permits as the most popular among 10 innovations. While most APM specialists are still developing robust mobile functionality, most EAM software providers are already offering mobile apps to help execute work in the field (see Verdantix Smart Innovators: Field Service Management Software). For example, HAPG's Lumada APM mobile app can be used for monitoring and assessing the condition and risk of failure for assets in the field, while directly integrating with the Lumada FSM app. Pragma offers multiple mobile apps for various use cases, from the condition assessment of assets and analytics to EHS incident logging and work order execution. Aligned with this trend, in February 2021, IBM launched Maximo Mobile, enabling field workers to access diagnostics and asset information on the go.

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FIGURE 5-1

APM Dealflow: Acquisitions, Investments and IPOs (March 2019 - December 2020)

2019	Transaction	Description
March	Acquisition	AVEVA acquires MaxGrip's APM software solutions
April	Investment	Industrial Analytics IA raises $1.8m in Seed funding from Senovo and Brandenburg Kapital (total funding amount to date: $2.2m)
May	Acquisition	SymphonyAI Group acquires machine condition monitoring and reliability solution provider Azima Global
June	Acquisition	AspenTech acquires asset health monitoring software application supplier Mnubo
June	Acquisition	AspenTech acquires asset performance monitoring and visualization software application supplier Sabisu
June	Investment	SwitchOn raises $1m in Seed funding from pi Ventures, Axilor and others (total funding amount to date: $1m)
July	Acquisition	IBM acquires open source enterprise technology supplier Red Hat for $34 billion
July	Acquisition	Fluke acquires asset reliability and predictive maintenance solution provider PRÜFTECHNIK
September	Acquisition	GE Digital acquires APM commercial team and O&G customer accounts from Baker Hughes
October	Acquisition	Pragma acquires physical asset management consultancy CMS Asset Management
October	Acquisition	ABB acquires asset failure prediction solution provider Cassantec
October	Investment	SparkCognition receives $100m in Series C funding led by March Capital (total funding amount to date: $163.6m)
October	Acquisition	SKF acquires industrial AI for machine performance firm Presenso
November	Investment	Quartic.ai raises $5m in Series A funding led by WRVI Capital (total funding amount to date: $10m)
December	Investment	Augury raises $33m in Series C funding led by Insight Partners (total funding amount to date: $59m)

2020	Transaction	Description
July	Acquisition	Bentley Systems acquires systems integrator Cohesive Solutions and launches The Cohesive Companies subsidiary
July	Investment	Hitachi buys 80.1% of ABB's Power Grids business for $6.85bn
August	Acquisition	AVEVA acquires industrial operational data management software and service provider OSIsoft for $5bn
August	Investment	Emerson invests in industrial data management software supplier inmation Software
August	Acquisition	Emerson acquires industrial automation software supplier Open Systems International (OSI) for $1.6bn
September	IPO	Bentley Systems launches initial public offering of 10,750,000 shares of its Class B common stock at a price of $22.00 per share
September	Investment	Seeq raises $53m in Series B funding from Altira Group and others (total funding amount to date: $65.2m)
September	Investment	Everactive raises $35m in Series C funding led by Fluke (total funding amount to date: $98.1m)
October	Acquisition	Emerson acquires IIoT and plant analytics software supplier Progea Group
October	Investment	Senseye raises $3.5m in venture funding led by NTT DOCOMO Ventures and Sony Innovation Fund (total funding amount to date: $21m)
October	Investment	Augury raises $55m in Series D funding led by Qumra Capital (total funding amount to date: $114m)
October	Investment	Cognite raises $75m in Series A funding from Accel (total funding amount to date: $75.2m)
November	Investment	AspenTech acquires industrial analytics software provider Camo Analytics
November	Acquisition	The Cohesive Companies acquires IBM Maximo implementer SRO Solutions
December	Investment	Infinite Uptime raises $5.2m in Series B funding led by VenturEast
December	Acquisition	Itus Digital acquires APM service provider nextAPM
December	Investment	Fortino Capital Partners acquired a majority shareholding of Cenosco
December	IPO	C3 AI launches initial public offering of 15,500,000 shares of its Class A common stock at a price of $42.00 per share

Notes: this list is not exhaustive
Source: Verdantix research and analysis

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FIGURE 5-2

APM Dealflow: Acquisitions, Investments and IPOs (January 2021 - July 2021)

2021	Transaction	Description
January	Divestment	Black & Veatch sells industrial data analytics and APM software supplier Atonix Digital to its management team
January	Investment	Alfa Laval invests in IoT and remote monitoring solution provider AMI Global
January	Investment	Henkel invests in sensor technology for predictive maintenance start-up Feelit
February	Acquisition	Uptake acquires industrial data management solution provider ShookIOT
February	Acquisition	Baker Hughes acquires APM solution provider ARMS Reliability
February	Investment	UptimeAI raises $1.5m in Seed funding led by YourNest Venture Capital
March	Acquisition	Symphony Industrial AI acquires manufacturing-focused IIoT software supplier Savigent
March	Acquisition	The Cohesive Companies acquires IBM Maximo implementer Ontracks Consulting
April	Investment	Seeq raises $50m in Series C funding led by Insight Partners (total funding amount to date: $115.2m)
April	Acquisition	Bentley Systems acquires sensor data management solution provider sensemetrics
April	Acquisition	Bentley Systems acquires condition-monitoring software supplier Vista Data Vision
May	Investment	Cognite raises $150m in Series B funding from TCV (total funding amount to date: $225.2m)
May	Acquisition	SparkCognition acquires predictive analytics for asset failure and production optimization software provider Ensemble Energy
June	Investment	MachineMetrics raises $20m in Series B funding led by Teradyne (total funding amount to date: $37.7m)
June	Investment	Detect Technologies raises $12m in Series B funding led by Accel (total funding amount to date: $15.3m)
July	Acquisition	SparkConigition acquires industrial knowledge management technology provider Maana

Notes: this list is not exhaustive
Source: Verdantix research and analysis

Prospective Customers Should Apply Six Criteria To Shortlist Best-Fit APM Solution Providers

Provider product strategies are aimed at expediting the time to value of their products and offering more flexible but also comprehensive products. Providers offer varying breadths and depths of capabilities for APM software and some have developed industry and asset-specific best practice workflows. Prospective customers should consider APM solution providers with (see **Figure 6**):

- **Industry and asset class-specific credentials.**
  Firms should look at the industry focus of the APM software providers listed and choose one with experience in their sector. Asset class expertise is important both for a successful APM implementation and for extracting the most value from the investment. Approximately half of the executives interviewed in the 2020 Verdantix Global Corporate Survey consider embedded libraries of industry-specific asset failure modes as a 'very important' or 'important' criterion when selecting asset management software applications (see **Figure 7**). The need for asset libraries becomes particularly important when customer strategies extend to prescriptive maintenance, focusing on identifying the reasons why assets fail and how to prevent them from failing in the future.

- **Consultative selling capabilities.**
  For a technology project to be successful, a certain degree of change management is required. Prospective customers should connect with the providers to understand the potential use cases of the APM solution, and whether the technology implementation requires new processes or changes to existing

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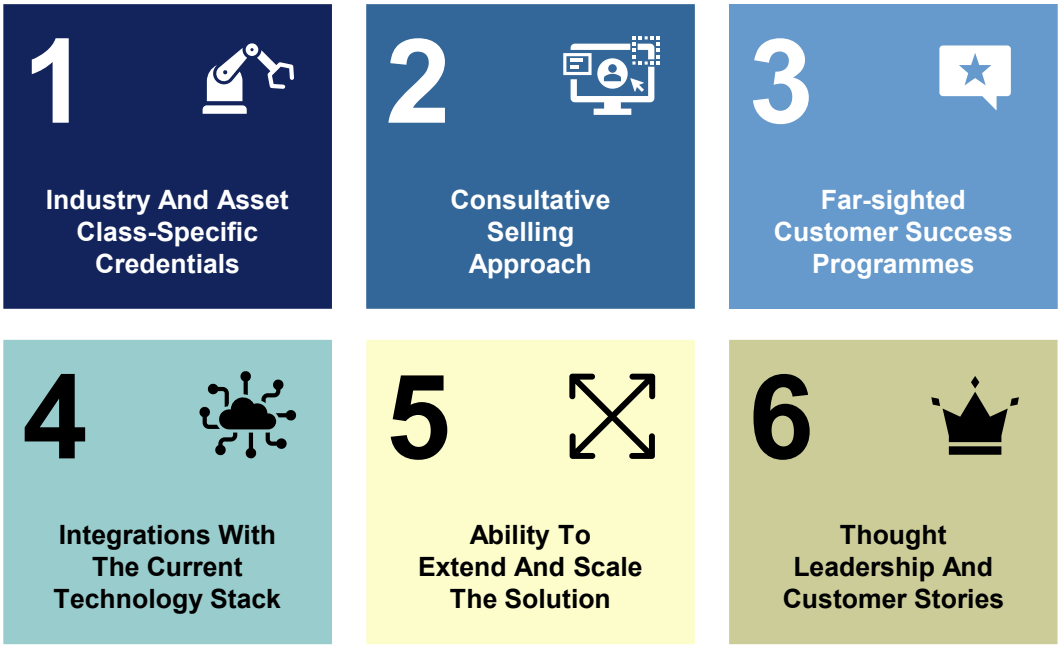
FIGURE 6

Six Criteria Prospective Customers Should Apply When Selecting An APM Solution Provider



Source: Verdantix research and analysis

ones. It is important for the customer to liaise with the provider to understand which people, in what roles, and to what extent will be involved in the final use cases in order to maximize the benefits of the APM solution.

- **Far-sighted customer success and support programmes.**
  In most technology implementations, the level of hand-holding from the tech provider gradually decreases over time, as the customer becomes more experienced in using the solution. However, to ensure that the customer will be in a position to smoothly scale the APM solution to support more assets and use the complete range of APM functionality, working with a provider with a customer support programme that can extend to years can be very beneficial for both parties involved, presenting upselling opportunities for the provider and increased value for the customer.

- **Implementation and integration options to make the most of current data.**
  Implementation and integration needs vary by a firm's digital maturity and in-house IT resources available. Customers and their IT teams should discuss the potential APM solution with the providers to clarify the customer goals, the specific integrations required to the customer ecosystem (including EAM systems, in-house-developed tools and IP network) and any future customizations. Increasingly, APM providers such as Bently Nevada, Endevor, Seeq and Senseye are offering customers the option to plug in their own or third-party tools via APIs, while others such as Cognite and Uptake offer tools to help customers implement a data lake strategy.

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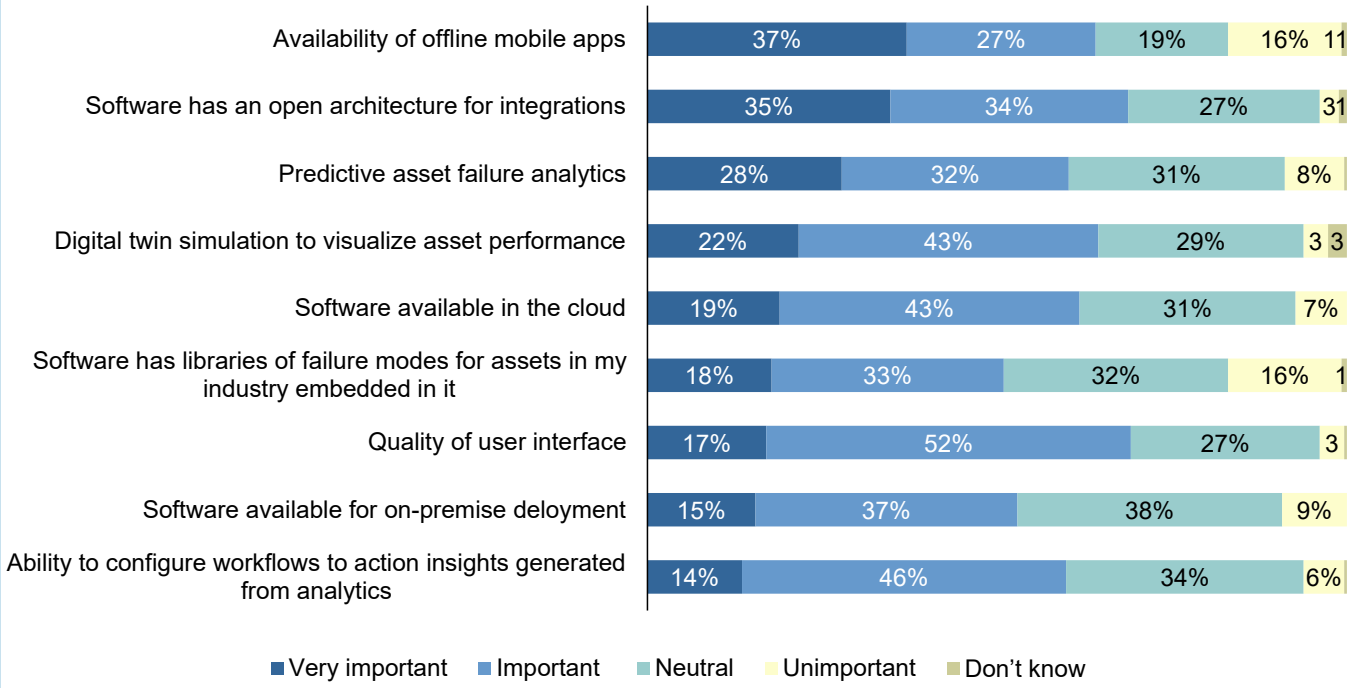
FIGURE 7

Evaluation Criteria For Asset Management Software Applications

"How important are the following criteria when you evaluate software applications for asset management?"



Note: data labels are rounded to zero decimal points; percentages less than 6% have been written as numbers
Source: Verdantix Corporate Survey 2020: Operational Excellence Budgets, Priorities & Tech Preferences

- **Deep functionality and the ability to keep pace with innovations.**
  Firms that are serious about digital transformation should look for a long-term digital partner with deep operational technology expertise. Customers should work with an APM solution provider that offers comprehensive functionality for the use cases that are the customer's current priorities, but the provider should also be able to realize the customer's digital asset management vision. Such visions could encompass scaling and extending the APM solution to a digital twin project by adding more asset classes, robust visualizations, maintenance and performance strategy analytics and connected worker mobile apps.

- **Thought leadership pieces that report on customer success from past projects.**
  Industrial firms should work with APM solution providers that have a proven track record of delivering projects of a similar scale and complexity. As APM programmes tend to be on the advanced side of digital complexity, implementation success relies heavily on the provider's experience. Case studies and success stories serve twin goals; firstly, proving the implementation capabilities of the provider and secondly, managing customer expectations as they help clarify a typical ROI and give a view of the end solution.

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Inclusion Criteria For The 2021 Asset Performance Management Solutions Buyer's Guide

Globally, the APM solutions market is still at a 'land-grab' stage, with large total addressable market opportunities. A wide range of providers are active in this market, offering solutions with varying breadth and depth of functionality. For this reason, Verdantix has provided a detailed profile for 18 APM solution providers that have:

- **APM revenues exceeding $2 million.**
  A minimum threshold of $2 million in revenues from APM solutions was set to ensure all APM solution providers included have a significant customer base.

- **Comprehensive functionality for at least two out of the four areas considered.**
  Asset health monitoring, asset failure prediction, asset maintenance optimization and asset performance optimization are all core functionalities that can effectively transform an organization. Providers must support at least two of these four aspects of APM to be considered in the APM software buyer's guide.

Based on these two criteria, this report includes profiles on: Augury, AVEVA, Bentley Systems, Bently Nevada (including ARMS Reliability), Cenosco, Cognite, Endevor, GE Digital, Hitachi ABB Power Grids, Honeywell, IBM, Itus Digital, Lloyd's Register, Pragma, Seeq, Senseye, Symphony Industrial AI and Uptake.

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AspenTech Combines AI And Simulations To Offer A Robust Prescriptive Maintenance Solution

AspenTech was founded 40 years ago and currently employs 1,800 people with a market capitalization of over $10 billion. It is headquartered in Massachusetts USA and has a global presence with 30 offices around the world. Over the last 40 years, AspenTech has built deep subject matter expertise in process-intensive industries such as O&G, refinery, chemicals, metals and mining, pharmaceuticals, and pulp and paper. Its APM strategy involves organically growing its own process analytics and APM capabilities but also making well-targeted acquisitions — in June 2016 it acquired asset reliability software provider Fidelis Group (now Aspen Fidelis), in September 2016 it acquired multivariate process analytics software suite ProMV from ProSensus (now Aspen ProMV), and in October 2016 it acquired predictive maintenance software provider Mtelligence Corporation (now Aspen Mtell). AspenTech has also invested in developing its industrial data management capabilities, launching in 2018 the Aspen Connect family of solutions, which help optimize data networking and storage (see Verdantix AspenTech Differentiates With Analytics For Asset Optimization).

Key Takeaways

Verdantix found that AspenTech and its APM software solution have:

- **Leading ML-driven asset failure predictive capabilities.**
  Aspen Mtell follows an asset-agnostic data-driven approach to predict asset failure. It employs AI-based algorithms to recognize patterns of abnormal behaviour early in the asset's P-F curve, with dedicated functionality to minimize false alarms, identify 'new normal' operational states and increase accuracy. When imminent failure is identified, AspenTech's APM software application indicates to users the RUL until failure if the equipment continues to be operated at that level. AspenTech was recognized as a Leader in in the 2020 Verdantix APM Green Quadrant benchmark, achieving second highest score (2.8/3.0) for its asset health monitoring and asset failure prediction functionality. AspenTech also achieved the highest score for asset data management (3.0/3.0) in the Green Quadrant benchmark. The November 2020 release of Aspen Maestro bolsters these asset data management capabilities further, as it enables users to standardize and accelerate data pre-processing efforts required to train the Aspen Mtell models.

- **Comprehensive simulation functionality for production and reliability optimization.**
  The Aspen Fidelis simulation tool is designed specifically for the process industries and can evaluate a plant's ability to reliably meet production targets. It can quantify the ramifications of possible actions and support reliability, availability and maintainability (RAM) strategies both on an asset and a system level — substantially enhancing the confidence of decision-makers across maintenance, operations and safety functions. The simulations are based on Monte Carlo discrete event modelling and pull in data about equipment capacities, maintenance approaches and even contextual information such as weather data and geopolitical factors. Users can run a range of what-if scenarios to evaluate the impact of operational, maintenance, logistical and weather conditions in the lifecycle of assets or systems and analyze variances in their performance, criticality, risk and cost.

- **Protagonistic role in the industrial digital twin ecosystem for process industries.**
  Verdantix recently assessed that AspenTech is able to support autonomous digital twin implementations (highest digital twin sophistication level), which is a testament to the breadth and depth of its software portfolio (see Verdantix Smart Innovators: Digital Twins For Industrial Facilities). By combining its strengths in measurement data analytics and engineering simulations, AspenTech has established a leading presence in the industrial digital twins market, especially for EPC firms. AspenTech also has a long-standing partnership with Hexagon PPM to leverage its engineering and design software, while in

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FIGURE 8

AspenTech's Asset Performance Management Solution Overview

Category	Attributes	Details
Vendor Overview	Vendor name	AspenTech
	HQ	Massachusetts, USA
	Founded	1981
	Employees	1,800
APM Solution Offering	Solution name	Aspen Mtell, Aspen ProMV, Aspen Event Analytics, Aspen Fidelis, Aspen APM Insights
	Pricing model	Site-based and per-seat licensing
	Implementation options	In-house; partners
	Partners	- Tech: AWS, Microsoft - Integration: Accenture, RoviSys Company, Wood
	Integration & APIs	APIs; Aspen Connect for connections with edge, IIoT devices, historians, data lakes and other cloud-based systems
	Mobile app features/use cases	Browser-based; all features
	Additional/Unique features	- ML-driven asset failure predictions - Prescriptive diagnostics - What-if simulations for lifecycle analysis, production performance and OEE optimization
APM Customer Footprint	Number of APM customers	Not disclosed
	Example named customers	Dow Chemical, Shell, Teck Metals
	Deployments	On-premises; cloud
	Location of customers	70% North America and Europe with the rest spread globally
	Industry focus	Chemicals, O&G, refining

Source: AspenTech; Verdantix research and analysis

December 2020 it acquired AI-powered 3D engineering design software supplier OptiPlant to further enhance its visualization capabilities.

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