

Buyer's Guide: Asset Performance Management Software

JULY 2021

BY VICTOR VOULGAROPOULOS
WITH MALAVIKA TOHANI



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 18 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.

TABLE OF CONTENTS

Asset Performance Management Solutions Buyer's Guide 2021	4
The Market For APM Solutions Is Booming	
Four Core Functionalities Underpin APM Solutions	
Solution Providers Offer Products With Similar Capabilities But Have Varying Levels Of Industry Expertise	
APM Product Strategies Are Aimed At Ease Of Integration, Mobility And Digital Twins	
Prospective Customers Should Apply Six Criteria To Shortlist Best-Fit APM Solution Providers	
Inclusion Criteria For The 2021 Asset Performance Management Solutions Buyer's Guide	16
GE Digital Fuses Solid APM Functionality With Expert Implementation To Spur Customer Success	

TABLE OF FIGURES

Figure 1. Common User Groups And Functionality Requirements Of APM Solutions	6
Figure 2. APM Vendor Landscape: Example Solution Providers Based on Background	8
Figure 3. Product, Industry Focus And Capabilities Of Representative APM Solution Providers	9
Figure 4. APM Customers And Revenue By Region Of Representative APM Solution Providers	10
Figure 5-1. APM Dealflow: Acquisitions, Investments And IPOs	12
Figure 5-2. APM Dealflow: Acquisitions, Investments And IPOs	13
Figure 6. Six Criteria Prospective Customers Should Apply When Selecting An APM Solution Provider	14
Figure 7. Evaluation Criteria For Asset Management Software Applications	15
Figure 8. GE Digital's Asset Performance Management Solution Overview	18

ORGANIZATIONS MENTIONED

ABB, Abbott Nutrition, Abu Dhabi National Oil Company (ADNOC), Accel, Accenture, Ada Mode, ADLINK, AG Solution, Aladon Network, Albemarle, Alcoa, Alfa Laval, Alluvium, Altira Group, Amazon Web Services (AWS), Ameren Illinois, AMI Global, AmSty, Apteon, Arauco, ARMS Reliability, Ascend Performance Materials, AspenTech, Asset Performance Technologies (APT), AT&T, Atonix Digital, Atos, Augury, AVEVA, Axilor, Azima Global, Baillie Gifford, Baker Hughes, Baosteel, Bentley Systems, Bently Nevada, BHE Renewables, BISTel, Black & Veatch, Bord Gáis Energy, Boston Consulting Group (BCG), Boston Dynamics, Bouvet, BP, Brandenburg Kapital, Bruce Power, C3 AI, Camo Analytics, Canadian National Railway, Capgemini, Capital Power, Carrier, Cassantec, Caterpillar Ventures, Cenosco, CMS Asset Management, Cognite, Cognizant, Cohesive Solutions, Colgate-Palmolive, Covestro, Cygnet Infotech, DataStax, Dell Boomi, Deloitte, Detectchion Technologies, Detect Technologies, DNV, Docker, DSV, DTE Energy, Duke Energy, eMaint, Emerson, Endeavor, endiio, EnerPure, Ensemble Energy, Ensign Energy Services, EPCOR, Epiroc, Essity, Everactive, exida, Exxaro, ExxonMobil, Falkonry, FANUC, Feelit, Flowserve, Flexo, Fluke Corporation, Formosa Plastics Corporation, Fortino Capital Partners, Fractal, Frito-Lay, FutureOn, GE Digital, General Electric, General Motors, Geotab, GILL, Google, Grafana, GreatPoint Ventures, Grundfos, GSE TrueNorth, HashiCorp, Henkel, Hexagon, Hitachi, Hitachi ABB Power Grids (HAPG), Hitachi Vantara, Honeywell, Iberdrola, IBI Webfocus, IBM, IBM Global Business Services, ICL, Idhammar Systems, ifm, Industrial Analytics (IA), Infinite Uptime, InfluxDB, Infor, Inmation Software, Inner Mongolia Power Company (IMPC), Insight Partners, Institute of Electrical and Electronics Engineers (IEEE), International Council on Large Electric Systems (CIGRE), International Electrotechnical Commission (IEC), iOFFICE, IoT.nxt, IPS Group, Italtipresse Gauss, Itera, Itus Digital, JFrog, Kinectrics, Kubernetes, L'Oréal, Lanxess, LCG Consulting, Life Cycle Engineering, Lloyd's Register, Logan Aluminum, Lonza, Lundin, Ma'aden Gold & Base Metals Company, Maana, MachineMetrics, Maintenance Connection, Marathon Petroleum Corporation (MPC), March Capital, MaxGrip, McKinsey & Company, Merck, Meridium, Methanex, Microsoft, MidAmerican Energy, Mitsubishi Heavy Industries, Mnubo, MODEC, MOVUS, Munich RE, National Petroleum Refiners of SA, nextAPM, Nexus Global, Nissan, Nova Scotia Power, NRG Energy, NTT DOCOMO Ventures, Omron, OMV, Oncor, Oniqua, Ontracks Consulting, OPC Foundation, Open Systems International (OSI), Oracle, OSISOFT, OutSystems, Pepsi Bottling Ventures, PepsiCo, PETRONAS, PGS, Permasense, Pinnacle, pi Ventures, Praelexis, Pragma, Predikto, Presenso, Progea Group, Project Jupyter, Prüftechnik, PTC, PwC, Qlik, Quartic.ai, Quest, Qumra Capital, Red Hat, Red Technical Services, Reliability Center Inc. (RCI), Revolution, Rockwell Automation, SABIC, Sabisu, Salt River Project (SRP), SAP, SAS, Saudi Aramco, Savigent, Schneider Electric, SCOR, ScyllaDB, Seeq, Senovo, sensemetrics, Senseye, SFK, Shell, ShookIoT, SIBUR, Siemens, SKF, SMRT, Smurfit Kappa, Snowflake, SOCAR, Sony Innovation Fund, SparkCognition, SRO Solutions, Stattnet, Stork, Swiss Federal Railways (SBB), SwitchOn, SymphonyAI Group, Symphony AzimaAI, Symphony Industrial AI (SIAI), Talend, Tata Consultancy Services (TCS), Tata Power, Tata Steel, TasWater, TCV, Teradyne, Tetra Pak, The Cohesive Companies, The Navigator Company, TimescaleDB, Total, Trane, Trimble, Turbulent Flux, Tyk, UK Power Networks Services, Ultimo, United Road, UpKeep, Uptake Technologies, UptimeAI, Uptime Consultant, US Army, Ventureeast, WRVI Capital, Verizon, Visma bWise, Vista Data Vision, VMware, Vysus Group, Western Virginia Water Authority, Wintershall Dea, Wipro, Wood, Worley, Yara, YourNest Venture Capital, YPF.

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, Bentley Nevada (including ARMS Reliability), Cenosco, Cognite, Endeavor, 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.

- **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](#)).

FIGURE 1

Common User Groups And Functionality Requirements Of APM Solutions

User Groups	Common Solution Requirements	Example Deployments
Maintenance Supervisors	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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

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.**

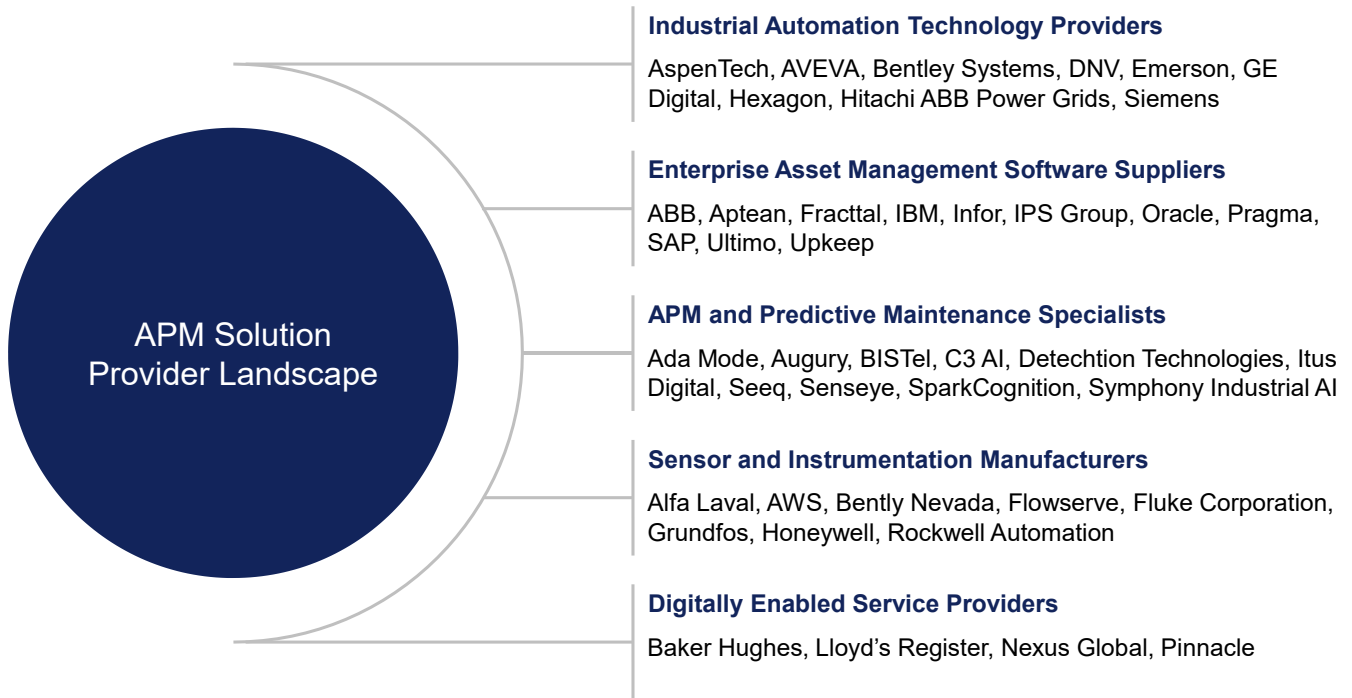
Industry and asset class expertise is critical for APM, as technical expertise and asset libraries with industry-specific failure modes and protections as well as maintenance strategies are required to enable more accurate asset failure prediction and more effective asset maintenance and performance 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.

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

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	aspenONE	Chemicals; O&G; F&B and FMCG; Life sciences; Transportation	✓	✓	✓	✓
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	✓	✓	✓	✓
Bentley Nevada	Bentley 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	(✓)	(✓)	✓	✓
Detection 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: ¹industries in which the vendor has about 10% or more of its customer base; ²industry order is ranked based on customer share

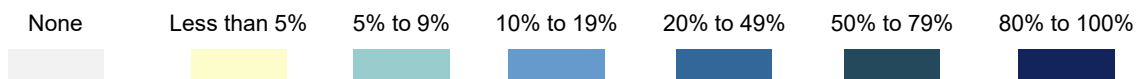
Source: vendor questionnaires; secondary research; Verdantix estimates; Verdantix analysis

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	20% to 49%	10% to 19%	10% to 19%	None	5% to 9%	None
AspenTech	50-100	1,000-5,000	20% to 49%	20% to 49%	10% to 19%	5% to 9%	10% to 19%	5% to 9%
AVEVA	200-500	10,000-50,000	20% to 49%	20% to 49%	20% to 49%	10% to 19%	5% to 9%	5% to 9%
Augury	200-500	10,000-50,000	20% to 49%	20% to 49%	None	10% to 19%	5% to 9%	None
Bentley Systems	200-500	10,000-50,000	20% to 49%	20% to 49%	5% to 9%	5% to 9%	5% to 9%	5% to 9%
Bently Nevada	>500	>50,000	20% to 49%	20% to 49%	20% to 49%	5% to 9%	5% to 9%	5% to 9%
Cenosco	25-50	5,000-9,999	10% to 19%	20% to 49%	10% to 19%	10% to 19%	5% to 9%	10% to 19%
Cognite	50-100	1,000-5,000	5% to 9%	20% to 49%	5% to 9%	10% to 19%	5% to 9%	5% to 9%
Detection Technologies	<25	1,000-5,000	20% to 49%	5% to 9%	10% to 19%	5% to 9%	5% to 9%	5% to 9%
DNV	50-100	1,000-5,000	20% to 49%	20% to 49%	10% to 19%	5% to 9%	5% to 9%	5% to 9%
Endevor	<25	<1,000	20% to 49%	10% to 19%	None	10% to 19%	None	None
GE Digital	200-500	10,000-50,000	20% to 49%	10% to 19%	10% to 19%	10% to 19%	5% to 9%	5% to 9%
Hexagon	50-100	1,000-5,000	20% to 49%	20% to 49%	20% to 49%	5% to 9%	5% to 9%	5% to 9%
Hitachi ABB Power Grids	Not disclosed		20% to 49%	10% to 19%	20% to 49%	5% to 9%	10% to 19%	5% to 9%
Honeywell	100-200	1,000-5,000	20% to 49%	20% to 49%	10% to 19%	20% to 49%	5% to 9%	None
IBM	100-200	5,000-10,000	20% to 49%	20% to 49%	20% to 49%	5% to 9%	5% to 9%	5% to 9%
IPS Group	<25	1,000-5,000	20% to 49%	20% to 49%	20% to 49%	10% to 19%	5% to 9%	5% to 9%
Itus Digital	<25	<1,000	20% to 49%	10% to 19%	20% to 49%	None	None	None
Lloyd's Register	50-100	1,000-5,000	20% to 49%	10% to 19%	20% to 49%	10% to 19%	None	None
Pragma	200-500	>50,000	5% to 9%	10% to 19%	5% to 9%	5% to 9%	5% to 9%	20% to 49%
SAP	100-200	5,000-10,000	10% to 19%	20% to 49%	10% to 19%	10% to 19%	5% to 9%	5% to 9%
SAS	25-50	1,000-5,000	20% to 49%	20% to 49%	20% to 49%	10% to 19%	10% to 19%	5% to 9%
Seeq	200-500	10,000-50,000	20% to 49%	20% to 49%	5% to 9%	5% to 9%	5% to 9%	5% to 9%
Senseye	<25	1,000-5,000	20% to 49%	20% to 49%	5% to 9%	5% to 9%	5% to 9%	5% to 9%
Siemens	200-500	10,000-50,000	5% to 9%	20% to 49%	10% to 19%	5% to 9%	5% to 9%	5% to 9%
Symphony Industrial AI	100-200	1,000-5,000	20% to 49%	10% to 19%	10% to 19%	5% to 9%	None	5% to 9%
Uptake	50-100	1,000-5,000	20% to 49%	5% to 9%	20% to 49%	5% to 9%	5% to 9%	5% to 9%

APM revenue split by customer base in each region:



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.

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.

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 OS!soft for \$5bn
August	Investment	Emerson invests in industrial data management software supplier inmotion 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

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	SparkConignition acquires industrial knowledge management technology provider Maana

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

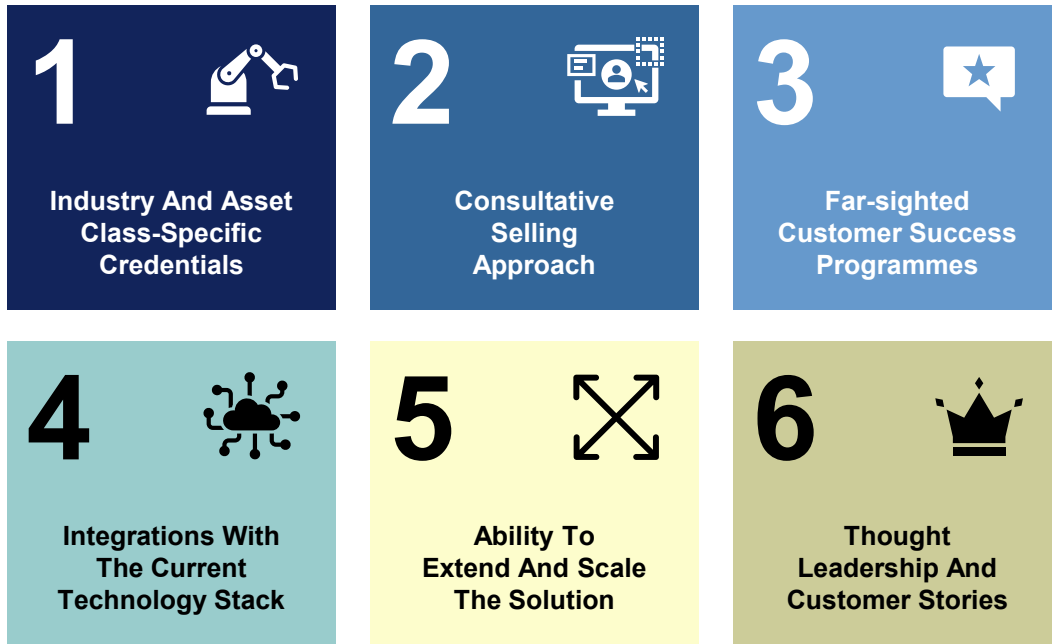
Prospective Customers Should Apply Six Criteria To Shortlist Best-Fit APM Solution Providers

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

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.

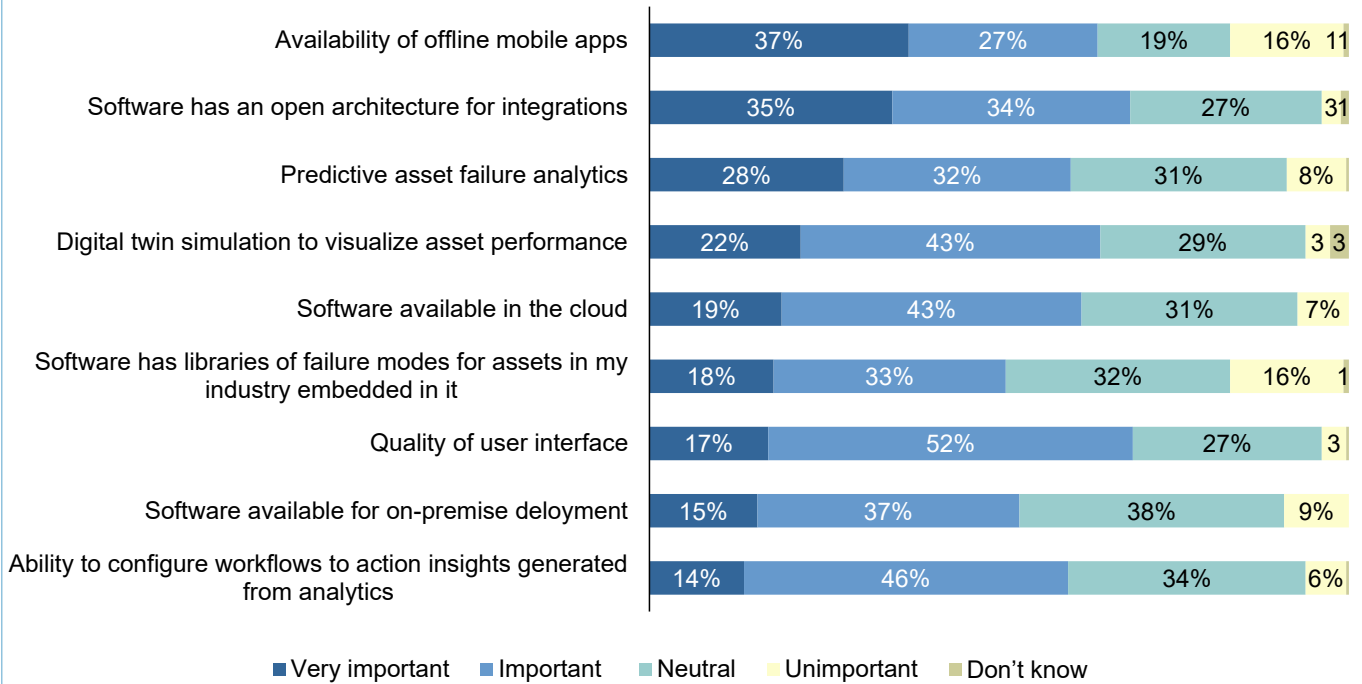
- **Implementation and integration options to make the most of current data.**

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 Bentley Nevada, Endeavor, 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.

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.

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, Bentley Nevada (including ARMS Reliability), Cenosco, Cognite, Endeavor, GE Digital, Hitachi ABB Power Grids, Honeywell, IBM, Itus Digital, Lloyd's Register, Pragma, Seeq, Senseye, Symphony Industrial AI and Uptake.

GE Digital Fuses Solid APM Functionality With Expert Implementation To Spur Customer Success

Founded in 2015, GE Digital is a subsidiary of General Electric. The firm is headquartered in California, USA and is the commercial division that owns GE's software assets. One of the core offerings in the GE Digital portfolio is its Asset Performance Management suite, which has grown from the acquisition of Meridium in 2016. GE Digital currently has over 4,000 employees based out of its 48 offices globally and has customers in four asset-heavy industrial segments: power generation, O&G, electric utilities, mining and metals, and chemicals, as well as select manufacturing sectors. GE Digital consolidates a headline position in APM solutions through a focus on customer success; it was recognized as a Market Leader in the 2020 Verdantix APM Solution Green Quadrant benchmark. It has a leading presence, based on the number of customers, in the O&G industry (see [Verdantix Strategic Focus: APM Software Applications For The Oil And Gas Industry](#)). GE Digital is a protagonist in its core vision to connect asset reliability with financial performance metrics and is supported by its well-founded subject matter expertise and comprehensive implementation programme (see [Verdantix GE Digital's APM Software Will Thrive In An Independent Business](#)).

Key Takeaways

Verdantix found that GE Digital and its APM software solution have:

- **Broad and deep asset health monitoring and failure prediction functionality.**
GE Digital's Asset Performance Management suite comprises six rich functional solutions: Predix Essentials provides the foundation to the APM software products with data connectivity, processing and storage functionality; APM Health provides a unified comprehensive view of asset health, featuring performance dashboards; APM Reliability offers built-in workflows for production loss analysis, RCA and statistical reliability analysis and optimization; APM Strategy enables risk-based analysis and optimization at various scales, from individual assets to groups and systems; APM Integrity helps operators and maintenance engineers to manage risk, lower inspection costs and ensure regulatory compliance; and SmartSignal offers predictive maintenance functionality driven by time-to-action forecast analytics. GE Digital achieved perfect scores of 3.0/3.0 for its asset health monitoring and asset failure prediction functionality in the 2020 Verdantix APM Green Quadrant benchmark due to its broad industry capabilities, superior integrations and proven customer success.
- **Implementation and asset class expertise that drives accelerated project success.**
GE Digital's Industrial Managed Services is a consulting services organization designed to sustain continuous customer success after a project's deployment. These services ensure that customers can capitalize on the long-term value of their GE Digital solution by supporting workers with training and process development. Industrial Managed Services monitor thousands of assets globally, has saved customers over \$1.6 billion in operations and maintenance costs and boasts an average ROI on the predictive maintenance managed service of less than 3.5 months. In the Verdantix Green Quadrant benchmark, GE Digital received a joint highest score of 2.7/3.0 for its implementation services, subject matter expertise (it has a collective 1,100 years of APM experience), technical support and customer success programme. This array of positive attributes explains why customers such as ExxonMobil, Marathon Petroleum, PETRONAS, SABIC and Total have implemented GE Digital's APM solution.
- **Comprehensive and use-case specific mobile applications.**
A specific set of modules in the GE Digital Asset Performance Management suite have a dedicated mobile app. The Rounds Data Collection module allows users to perform route-based, recurring tasks such as operator checks, routine maintenance, lubrication tasks and safety inspections. Proactive warnings can be

FIGURE 8

GE Digital's Asset Performance Management Solution Overview

Category	Attributes	Details
Vendor Overview	Vendor name	GE Digital
	HQ	San Ramon, CA USA
	Founded	2015
	Employees	4,083
APM Solution Offering	Solution name	Asset Performance Management Suite
	Pricing model	APM (formerly Meridium): on-premises perpetual or term (billed annually/quarterly), priced per site's size/capacity; SmartSignal: on-premises perpetual or term, priced per monitored assets; tiered subscription for Predix APM, priced per site's size/capacity and per monitored assets; tiered cloud computing and storage services
	Implementation options	80% in-house; 20% partners
	Partners	<ul style="list-style-type: none"> - APM Tech & Integration: exida, Reliability Center - Data Analytics: AWS, DataStax, IBI Webfocus, Project Jupyter, ScyllaDB, Talend - Infrastructure Tech: Docker, HashiCorp, jFrog, Kubernetes, Tyk, VMware; - Public Cloud, hyperscalers for the PaaS/SaaS operations: AWS, Microsoft Azure - Service Providers: Accenture, Pinnacle, Stork, TCS, Wipro, Wood
	Integration & APIs	APIs; connectors for EAM and ERP systems (IBM, SAP), historians (AVEVA, Cygnet Infotech, GE Digital, OSIsoft) and Industrial Gateway Server offering that services multiple data protocols and standards
	Mobile app features/use cases	Rounds Data Collection module (operator checks, routine maintenance, lubrication tasks, safety inspections); Inspection Management module; Mobile Proof Testing module for SIS; integrations with calibration devices; DataLogger and Thickness Monitoring modules
	Additional/Unique features	Digital Inspections product (from mobile devices to drones); Outage Planning and Analytics product for scheduling planned outages; Remote Operations product for remote access to on-site HMIs
APM Customer Footprint	Number of APM customers	200 to 500
	Example named customers	AmSty, ExxonMobil, Nova Scotia Power, PETRONAS, SIBUR, SOCAR, Tata Power, The Navigator Company, Total, YPF
	Deployments	60% on-premises; 40% cloud
	Location of customers	Majority in North America, followed by Europe, APAC and Middle East
	Industry focus	Power generation, O&G, chemicals

Source: GE Digital; Verdantix research and analysis

set up to alert the user and prescribe advisory corrective actions. Data are collected (even when offline) and transferred automatically to the GE Digital APM database when a connection is established and is used in APM workflows. GE Digital further offers the Inspection Management module, which includes support for regulatory pressure equipment inspections, the Mobile Proof Testing module, which customers can use to execute test procedures and collect proof testing data for SIS, and integration capabilities with instrumentation calibration devices to perform calibration tasks on the go .



VERDANTIX CAPABILITIES

RESEARCH, ADVISORY, INSIGHTS & EVENTS

Through our research activities and independent brand positioning we provide clients with:

- Research relationships based on an annual research subscription
- Confidential advisory services such as commercial due diligence
- Thought leadership studies for brand building and lead generation
- Executive summits, roundtables and webinars
- Advisory workshops to rapidly increase your sector knowledge
- Multi-country and complex customer survey projects
- Marketing campaign support with analysts and content

VERDANTIX MARKET COVERAGE

Environment, Health & Safety

Focuses on the software and services markets that enable corporations to improve their performance across environment, health and safety including compliance, risk and performance.

Operational Excellence

Focuses on helping managers in operations, asset reliability, process safety and maintenance roles to leverage technologies which enhance production reliability, asset health and operational safety.

Smart Building Technologies

Focuses on software, intelligent building technologies and consulting services that enable real estate and facilities executives to optimize the value and performance of their building portfolios.

ESG & Sustainability

Focuses on the decisions of investors, tech providers, financial services firms and corporate leaders. Conducting in-depth research on the full range of services and technologies required to succeed with ESG and sustainability strategies.

WHY VERDANTIX?

Verdantix is an independent research and consulting firm with a focus on innovative technologies that optimize business operations. We have expertise in environment, health, safety, quality, operational risk, as well as smart building technologies.

WWW.VERDANTIX.COM