# Merging the Digital, Physical and Human Elements of Asset Management

## Trends Shaping the Future of Asset Management

# A better, CONNECTED world, through INNOVATIVE and EFFICIENT asset solutions.

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# Message from Adriaan Scheeres, Founder and CEO of Pragma

Thank you for taking the time to read this.

At Pragma, we strongly believe that we should be investing to support and accelerate your work. We would love to further engage with you to share some interesting views on how digital transformation will impact asset management - especially in the mining industry - and to discuss why physical asset management should be a strategic imperative for you and your company.

At Pragma our mission is to help you save lives.  We achieve this by mitigating high accident risks and potential loss of life with our effective asset management.

We also strive to save you money, and improve your Return on Investment (ROI). We increase your profit with a relentless focus on your physical assets, driving enterprise asset performance.

I am particularly proud of what we've achieved in the last 33 years since I co-founded Pragma. We now have more than 400 colleagues - most of whom are engineers - dedicated to improving the performance of assets at enterprises across the globe.

In these three decades of working with many international clients, we have yet to come across another company that has consistently achieved the above.

I think the time to create a solid foundation from which to adapt and reposition your company is now.

I would go so far as to say … stop most of your other initiatives until you are clear about where you are in terms of your asset management capability and where you need to be.

Think about your first steps to make physical asset management a strategic imperative for your company.

I would highly recommend that the first step you take is to contact us.

Kind regards

***-Adriaan***
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# Continued Focus on Digital Twins



## Continued Focus on Digital Twins

Digital twin simulations of assets offer a wide use of cases to drive the success of operational excellence initiatives. Implementing a digital twin solution includes benefits such as better budgeting and engineering of asset-intensive capital projects, enhanced performance and safety of operations and maintenance, and the ability to forecast demand capacity through what-if simulations. It also contributes to optimising production without increasing maintenance costs, monitoring and improving asset health, and realising sustainability goals within operations by new design concepts.

## Why are we taking notice?

Despite the fast-growing adoption of digital twins, the market still needs to show value for investment. Stakeholders should refrain from jumping on the digital twin bandwagon without fully reflecting on the requirements they need to meet and the objective they want to achieve. A threshold of digital maturity is required before embarking on a digital twin journey that primarily correlates with the sophistication level of the digital twin being implemented. To understand which digital twin is possible and suitable, organisations must consistently assess their digital maturity across their assets, data collection systems, project and operations workflows, and future business strategy and culture.

## Pragma's Response

Asset registers and libraries are the building blocks of an asset management strategy for any industrial firm and are also the building blocks of a digital twin. These registers and libraries include information about an asset's location, condition and owner, status, maintenance plans, procurement date, failure and maintenance history. We will continue to perform our role as the "stewards of asset information".

## Key Points

- Digital twins provide opportunities for performance gains, better planning and risk reduction using an integrated digital model of asset systems.
- Integrating design, operational and maintenance data in advanced systems promises additional benefits.
- Where digital maturity is relatively low, the benefits of asset-level data collection, spare parts forecasting, and work history are becoming easier to realise.

# The Demand for Cybersecurity

## The Demand for Cybersecurity

Technologies used in the digital transformation of asset management – and other business processes – offer excellent opportunities to create value and gain efficiencies by exploiting underlying data to drive automated decision-making and follow-up actions. Constant connectivity and data sharing significantly amplify the opportunity for data and/or automated processes to be deliberately compromised. Organisations' increased reliance on connected digital solutions and several high-profile examples of cyberattacks will continue to increase the demand for more sophisticated cybersecurity measures.

## Why are we taking notice?

Asset management business processes play an increasingly critical role in organisations' daily and long-term sustainable operations, and any disruption through a cyberattack could have catastrophic consequences. The increased digitisation of asset management processes broadens the attack surface for cybercrimes and places a growing responsibility on the asset management fraternity to contribute to organisational cybersecurity. Demand for and the effort required to ensure cybersecurity could suppress agility, extend project timelines, and increase implementation costs. The impact of cybersecurity on long-term performance, cost and risk of assets should thus be well understood and considered in all future asset management projects.

## Pragma's Response

Cybersecurity practices and performance are continuously refined and governed through our Cybersecurity Risk committee that meets monthly to monitor all aspects - from secure development practices to vendor selection activities. Staff are trained to increase awareness and monitored through various technologies to ensure comprehension of and compliance with policies. We are giving more prominence to cybersecurity in our updated Asset Management Improvement Planning framework, which forms the basis for all consulting and service interventions.

## Key Points

- Increased levels of digitisation also increase the risk associated with cybercrime.
- Increased connectivity and data-sharing levels amplify the opportunity for these processes to be compromised.
- Implementing cybersecurity risk frameworks, supported by the appropriate technology and governance, will be crucial but could introduce project delays.

# Increased Use of Realtime Asset Monitoring



## Increased Use of Realtime Asset Monitoring

Realtime asset monitoring is made possible by integrated software platforms that aggregate data from industrial internet of things (IIoT) devices attached to assets and workers. The relevant data are then analysed to give realtime insights and prescribe steps to be taken to either maximise the opportunity or minimise risk.

## Why are we taking notice?

Realtime asset monitoring and prescriptive maintenance form the cornerstone of achieving a fully automated plant. Prescriptive analytics helps organisations get ahead of critical issues that could cause asset failures or performance inefficiencies, and it tells them which specific actions to take to remediate developing problems. This minimises risk, improves asset reliability and, thus, business operations, and saves costs. The increased analytics capability in edge devices can power innovation to improve quality and enhance the value of realtime asset monitoring of remote assets or assets that require realtime intervention.

## Pragma's Response

Remote and realtime condition monitoring is shaping the future of asset and maintenance management. Advising on strategies and optimising asset reliability tactics of our clients is the core focus of our condition monitoring and advisory divisions. Pragma's technology capabilities will continue to evolve to ensure the integration of asset data and condition-based decision-making as part of the maintenance process.

## Key Points

- Many asset owners are introducing automated production assets.
- For these to operate successfully, realtime asset monitoring and prescriptive maintenance are required to identify critical issues and prevent asset failure.
- Realtime asset monitoring enables this through a variety of IIoT devices, edge processing and advanced analytics for each asset type.

# Improving Data Utilisation with AI and ML



## Improving Data Utilisation with AI and ML

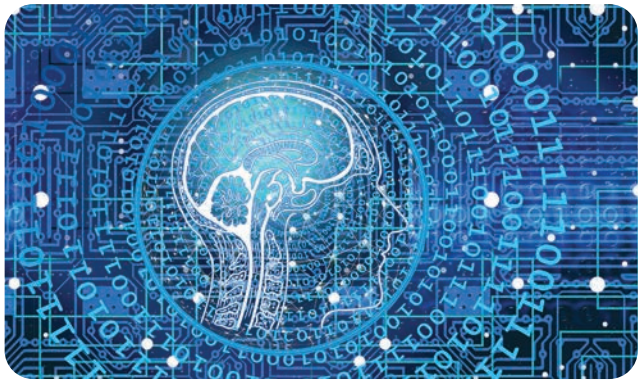
Digital transformation initiatives and the ability to transport and store massive volumes of data cost-effectively continuously increase the opportunity for data-driven decision-making. This, combined with significant usability simplifications of infrastructure and supporting tools required to implement machine learning and artificial intelligence solutions, is putting the gainful implementation of these technologies within reach of a much larger user base. Wider adoption is driving down costs but also increasing the importance of exploiting these technologies to gain and maintain a competitive advantage in all aspects of a business.

## Why are we taking notice?

Asset management relies heavily on collecting, analysing, and interpreting asset and process data before applying accumulated knowledge and reasoning to predict future behaviour. Understanding the influence of expected behaviour on future outcomes is used to make asset design or process adjustments to ensure that desired outcomes are achieved. The increased availability of digitised data that gives context to and describes historical events, combined with cheaper and more powerful digital processing capacity, will continue to increase the viability of machine learning and artificial intelligence technologies to take over asset management business processes autonomously. Faster and more accurate decision-making through machine learning and artificial intelligence is becoming a key differentiator in modern organisations, and asset management practitioners must continuously seek opportunities to incorporate this in digital transformation initiatives.

## Pragma's Response

Pragma is building up internal capacity and working with partners to use machine learning in asset management business processes. We focus on measurement-based use cases such as usage meter forecasts and remaining useful life forecasts for physical assets. Detection of work order transaction anomalies also presents good cost-saving opportunities. A current project focuses on flagging contractor expense anomalies to halt payments, thereby avoiding inefficient reactive recovery processes.



## Key Points

- The increased usability of data and supporting infrastructure and tools have significantly increased the viability of using AI and ML capabilities.
- Good asset management practice makes important historical operating and failure data available to predict the behaviour of critical assets and detect anomalies.
- ML/AI will play an increasingly important role in gaining realtime benefit from large volumes of collected data and will differentiate leaders from the rest.

# Automated Maintenance Planning and Execution



## Automated Maintenance Planning and Execution

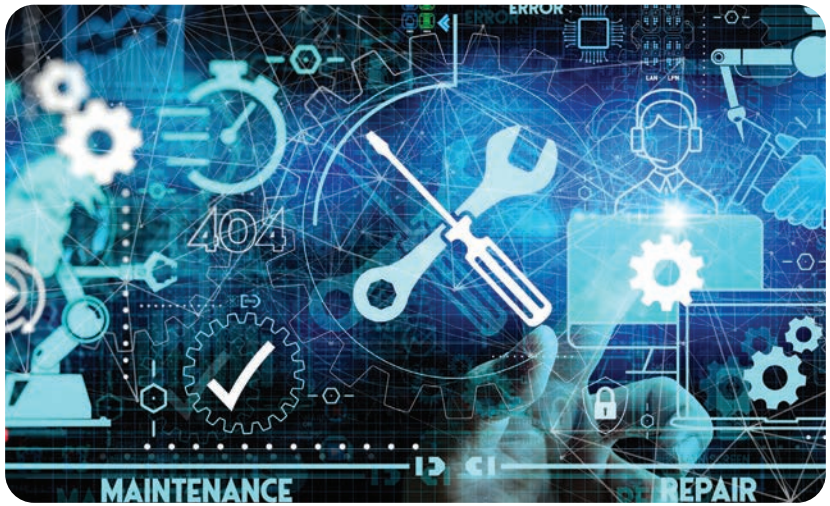
The relentless drop in edge hardware costs, the higher prevalence of artificial intelligence, increased asset connectivity, and the feasibility of deeper system integrations are fuelling the hyper-automation of processes in all business areas. Automation of maintenance planning and execution activities is no exception as industries prepare themselves for “lights-out” factories and “no-operator” processing plants.

## Why are we taking notice?

Automation of maintenance planning and execution activities will require a fresh look at current asset management practices, including but not limited to maintenance strategies and related master data refinement to enable extended periods of operation without human intervention. This trend does not override the fundamental principles of run-to-failure, usage- and condition-based maintenance tactics but will place new demands on the accuracy and completeness of maintenance plans, the agility of supply chains and other support functions required to deal with the higher variability of resource and material requirements introduced by “sensor-driven” (failure and condition detection) maintenance actions. A further ramification of this trend will be the increased criticality of technology solutions and related IT/OT assets that will also require suitable maintenance strategies to ensure reliable operation.

## Pragma's Response

Pragma continues to expand its product suite for and experience in the automation of maintenance planning and execution activities through our product development and asset management services divisions, respectively, that seek efficiency gains through process automation. Our advisory division also has regular exposure to advances in this area as part of asset management improvement and operational readiness projects conducted for large clients.




## Key Points

- As production facilities become automated, engineering teams must reconsider maintenance strategies, asset connectivity, and condition monitoring.
- Pre-planning, accuracy of condition monitoring, use of AI and increased asset connectivity are all required to drive dynamic, automated maintenance planning.
- Increased criticality of asset management technology as processes depend entirely on it.

# Data Integration and Collaboration

## Data Integration and Collaboration

It is becoming increasingly unrealistic for organisations to contain their asset management information needs in a single platform vendor. Unlocking a competitive advantage using best-of-breed solutions and utilising cloud services is becoming standard practice thanks to mature integration technology, API standards, and integration protocols. Data and information sharing across organisational boundaries is the new frontier to uncover new potential.

## Why are we taking notice?

Organisations manage thousands of assets to keep their sites operational, including infrastructure, equipment and the associated spare parts. The exchange of asset-related content across the value chain creates the opportunity to unlock previously hidden value. The most basic information exchange value chain includes the component/spare part providers, original equipment manufacturers (OEM), the Procurement, Engineering, and Construction (EPC) companies, the asset service providers and the asset owners and/or operators. The ambition is for different stakeholders in the information value chain to contribute to a collaborative platform to share asset specifications, maintenance plans, feedback on asset performance, overall equipment efficiency and best practices for maintenance procedures. Having a single consolidated asset information source allows the different stakeholders in the value chain to optimise their operations and planning and identify on-selling or collaboration opportunities.

## Pragma's Response

We have identified the establishment of an Asset Collaboration Platform as part of On Key Plus' evolution. The vision is to create a platform and business network for OEMs, service providers, operators, and other contributors to share the best maintenance management practices they have in common. Our deep understanding and capabilities in asset information management position us well to execute this vision.

## Key Points

- The development of best-of-breed solutions is making single-platform solutions increasingly unrealistic.
- Using cross-functional data exchange to collaborate across OEM/EPC, spare parts and AM service providers can unlock previously hidden value.
- Sharing data will help increase effectiveness across the value chain.

# Moving to Predictive Maintenance



## Moving to Predictive Maintenance

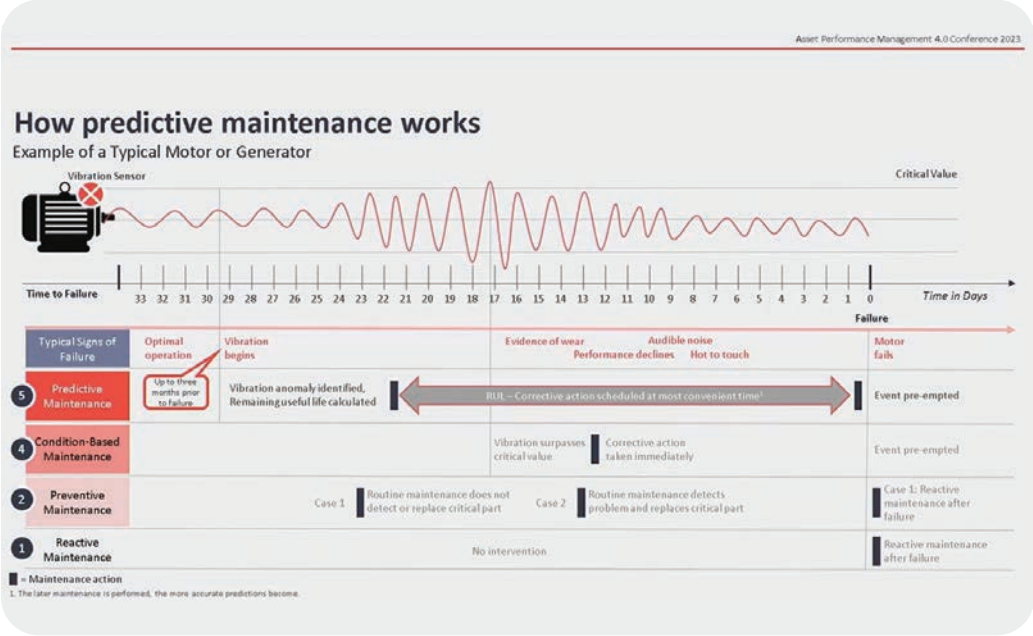
Improved sensors and a more accessible edge-to-cloud technology stack have significantly improved our ability to implement condition-based maintenance strategies based on actual asset condition or use. In addition, the wide adoption of CMMSs provides access to significant amounts of historical failure data for critical assets. Enhancing these capabilities with ML and AI models will allow for the development of predictive models capable of predicting certain failure modes or remaining asset life – significantly improving planning accuracy and reducing operational disruption and cost.

## Why are we taking notice?

The ability to predict and plan for asset failure significantly affects several key production KPIs. It increases original equipment effectiveness, labour efficiency and quality and decreases overall costs. It has also become possible for asset owners to build these analytics tools themselves, creating exciting opportunities to increase maintenance effectiveness and efficiency.

## Pragma's Response

Our technology R&D has already yielded a reliable, integrated edge-to-cloud technology stack with access to cloud-based AI analytics. Creating a maintenance tactics library from all the disparate data sources available has become a top priority. Having easy access to historical failure data for a wide range of critical assets will allow us to combine the appropriate sensor data with failure modes to fast-track the implementation of predictive models as needed.




## Key Points

- All the technology components required to build predictive maintenance solutions already exist and are accessible to most asset owners.
- The potential benefits of predictive models are obvious, but having access to historical failure data and developing the correct combination of data sources to predict those failures remains the key challenge.

# Virtualisation of Maintenance Activities



## Virtualisation of Maintenance Activities

Adopting connected worker (CW) and augmented reality (AR) solutions is on the upswing as corporates look to overhaul their approaches to improving maintenance worker productivity, safety, and satisfaction through innovative technologies.

## Why are we taking notice?

The industrial AR market has expanded due to the maturation of AR hardware and data connectivity and an increased appetite for industrial wearables capable of remote content delivery. The COVID-19 pandemic has provided the impetus for firms to invest in AR solutions, which will trigger a new phase of growth for the technology. CW and AR technology will impact maintenance activities across the whole asset lifecycle: remote assistance during plant commissioning, remote expertise and oversight to on-site workers while performing inspections and just-in-time training of junior technicians. Benefits include process efficiency improvements, increased knowledge retention, cost reduction in travelling and labour rates and increased worker safety.  AR applications will place an increased demand on the information held in the EAMS (Enterprise Asset Management System), and Pragma will need to seek ways to ensure efficient information availability.

## Pragma's Response

Integrating AR solutions into maintenance schedules yields improvements in operational efficiency. Remote experts clarify techniques to maintain, repair or service machines, expediting planned maintenance. One of Pragma's key contributions is defining and managing the optimum maintenance mix of maintenance tasks for an asset type.


## Key Points

- The adoption of connected worker (CW) and augmented reality (AR) solutions are on the upswing.
- Activities impacted include remote assistance during plant commissioning, remote expertise, overseeing on-site workers, and just-in-time training of junior technicians.
- Benefits include process efficiency improvements, increased knowledge retention, cost reduction in travelling and labour rates, and increased worker safety.

# The Role of Asset Management in Operational Readiness



## The Role of Asset Management in Operational Readiness

Recent high-profile project failures (significant overruns on the timeline, budget and operability metrics) have brought the need for an increased focus on maintenance readiness during project development into sharp focus. Design engineers typically have limited operational experience, resulting in commissioning processes and budgets that are not appropriate for the operational realities of the new assets. Asset owners are beginning to insist that maintenance strategies, criticality analysis, spare parts planning and skills estimates are included much earlier in the asset design process to help ensure a smooth commissioning process.

## Why are we taking notice?

Many large asset owners rely on Engineering, Procurement and Construction (EPC) service providers for design and project management capacity when designing new or significantly upgraded facilities. The EPC companies and the client's own engineering team often do not have the skills or experience to develop maintenance plans, budgets and procedures during the design process. Many responsible asset owners request assistance from asset management specialists early in the design process to help develop maintenance-related operational readiness plans and budgets.

## Pragma's Response

Pragma has developed a detailed maintenance readiness offering to support clients designing green- or brownfields facilities. We work with OEMs and the design team to develop key operational readiness elements such as reliability block diagrams, failure mode assessments, criticality analyses, maintenance tactics and spare parts lists. These inputs are used to develop the maintenance schedules, skills requirements and budgets for the plant maintenance activities before commissioning and are also used to influence equipment design where required.

## Key Points

- Design engineers typically have limited operational experience, resulting in commissioning processes and budgets that are not appropriate for the operational realities of the new assets.
- Asset owners are beginning to insist that maintenance strategies, criticality analysis, spare parts planning and skills estimates are included much earlier in the asset design process to help ensure a smooth commissioning process.

# Driving Sustainability through Responsible Maintenance



## Driving Sustainability through Responsible Maintenance

Clients (and shareholders) are demanding increased transparency from asset owners on issues such as the ethics of their maintenance practices and their environmental impact. Historically, corporate reporting has focused on emissions, with many regulators continuously reviewing legislation and compliance requirements. Recent supply chain disruptions and geopolitical instability have increased client awareness of how asset owners are shaping their maintenance and procurement strategies to consider replacing environmentally taxing equipment, considering fair trade practices when sourcing spare parts and labour, and considering the impact of emissions when selecting source destinations and supply routes. ESG reporting and action from corporates will continue to focus on corporate agendas, and good maintenance practices have an important supporting role.

## Why are we taking notice?

Corporate boards are under increasing pressure from clients and shareholders to be transparent about their operations' ethical and environmental impact. Maintenance is no exception. Asset owners will face increasing demands to show how choices made on maintenance tactics, sourcing and procurement, local content requirements, and technology selection lower the company's environmental impact and avoid potential ethics or exploitation issues. Planning, sourcing, and disposal decisions related to fixed assets will face increasing scrutiny from shareholders, communities, and activists, and they play an essential part in supporting corporate ESG agendas.

## Pragma's Response

A number of our current clients face increasing reporting and transparency requirements. Our focused improvement engineers are assigned to all large contracts to assess and motivate projects and technologies that reduce overall environmental impact. These include conversion to solar energy, reduction of carbon-based fuel use through advanced maintenance work planning and route optimisation and increasing the use of condition-based maintenance tactics and realtime monitoring to reduce the requirement for travel and spare parts use.

## Key Points

- Recent supply chain disruptions and geopolitical instability have increased client awareness of how asset owners shape their maintenance and procurement strategies.
- Asset owners will face increasing demands to show how choices made on maintenance tactics, sourcing and procurement, local content requirements, and technology selection lower the company's environmental impact and avoid potential ethics or exploitation issues.

# Bridging the New Skills Gap

## Bridging the New Skills Gap

For several years, the need for more technical skills, especially in asset management disciplines, has been an issue in both developed and developing markets. The problem is compounded by an ever-increasing gap in digital literacy between the younger people entering the asset management workforce and an older generation more established in traditional maintenance practices. The emergence of new practices and technologies such as predictive analytics, maintenance automation, robotics in manufacturing and virtualisation of maintenance work is creating a whole new category of maintenance skills that traditional organisations need to be equipped to manage.

## Why are we taking notice?

Current supply/demand planning skills are based on the traditional role definitions and learning pathways for areas such as reliability engineering, planning and scheduling, and industrial trades. The level of adoption of new technologies and maintenance practices is rapidly changing the skills requirements within these roles. It creates roles that did not exist in asset management a decade ago. In addition, digital transformation in the asset management space is creating a demand for digital literacy within the existing and future workforce that existing recruiting and learning environments should adapt to, to remain relevant.

## Pragma's Response

Our advisory team is often asked to develop role profiles, competence assessments and organisational structures for clients' asset management units. Our design work for these roles now includes an assessment of the digital maturity of the client, the level of technology adoption within the maintenance environment, and the current level of digital literacy in the workforce. In addition, new "digital native" role descriptions are being developed across all asset management team designs to help client teams attract and develop the right talent as part of their staffing processes.

## Key Points

- The shortage of technical skills has been an issue in both developed and developing markets. An ever-increasing gap in digital literacy is compounding the problem.
- The emergence of new practices and technologies such as predictive analytics, maintenance automation, and robotics in manufacturing is creating a whole new category of maintenance skills requirements that traditional organisations are ill-equipped for.

# Learning Approaches for a New Generation

## Learning Approaches for a New Generation

Millennials will comprise 75% of the workforce by 2025 and are already emerging as leaders in certain fields. This new talent generation wants to work for organisations that foster innovative thinking, develop their skills, and make a positive contribution to society. Traditional approaches to learning and development and the methods currently used to define roles, identify a talent pipeline and develop compelling employee value propositions will all need to adapt to the expectations – or lose the war on talent.

## Why are we taking notice?

Many of today's asset management leaders grew up in a world where a structured curriculum, classroom-based training sessions and practical, on-the-job experience defined the learning journey. Millennials are motivated by different learning drivers – deep-seated curiosity, a need for instant gratification, impatience with the expectation to gain sufficient knowledge and a focus on "what's in it for me"- changing what effective learning looks like. To effectively develop learning environments and pathways for the emerging talent pool, Learning and Development (L&D) teams must focus on understanding this new way of learning – and incorporate learner preferences such as collaboration platforms, different learning styles, a high level of impatience and significant digital literacy expectations.

## Pragma's Response

Pragma's Learning and Development teams continually evaluate new learning methods, instructional design techniques and learning platforms to help shape an engaging learning experience. Elements such as micro-learning, just-in-time content, flexible learning schedules, collaboration communities, mentorship, coaching and openness to function in a disrupted learning environment are all incorporated into a new way of developing our emerging talent.

## Key Points

- Traditional approaches to learning and development and the methods currently used to define roles, identify a talent pipeline and develop compelling employee value propositions will all need to adapt to the expectations – or lose the war on talent.
- Millennials are motivated by different learning drivers. To effectively develop learning environments and pathways for the emerging talent pool, teams must focus on understanding this new way of learning – and incorporate learner preferences such as collaboration platforms, different learning styles, a high level of impatience and significant digital literacy expectations.

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