# PRIMO PERSPECTIVES
# PREDICTIVE MAINTENANCE

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*Primo Climate*

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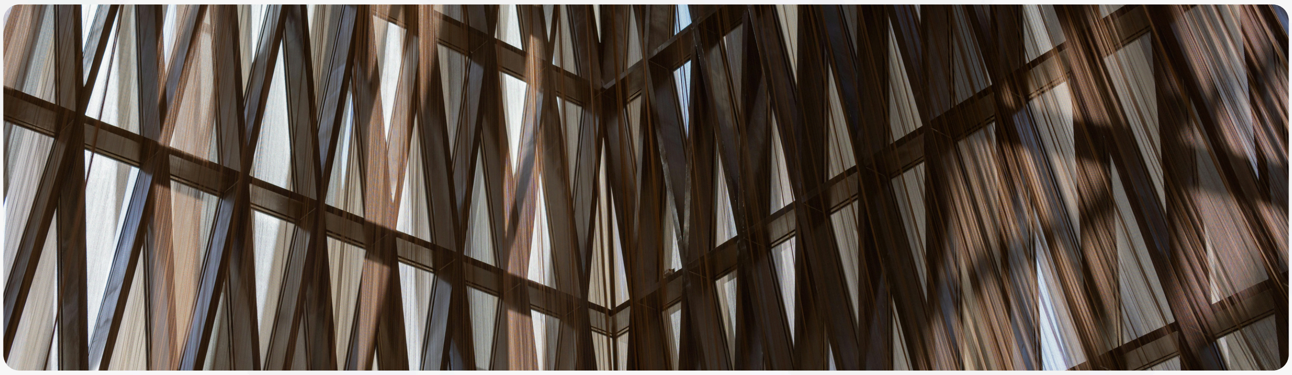
# INDEX





# OPPORTUNITIES FROM THE 4th INDUSTRIAL REVOLUTION

The Fourth Industrial Revolution introduced innovations such as advanced sensors, high-performance computing, automation and robotics, and autonomous decision-making systems, with Industry 4.0 technologies estimated to create up to **USD 3.7 trillion in value** for manufacturers and suppliers by 2025 (World Economic Forum & McKinsey & Company, 2018).

Out of the various different novelties of the I4.0 paradigm, **Predictive Maintenance Software** (PdM) emerged as the perfect union of hardware and AI/ML powered software.

In a world where **value chains** heavily rely on the functioning of **industrial machines** that are automatically operated, **interconnected** with each others and governed by data collected by advanced sensors, **down time** has become an unaffordable **cost** to be avoided. This is where **advanced monitoring** and **maintenance systems** come into play.

This report will frame the issue of machine downtime, deep diving into its main causes and analysing related recent trends.

It will examine the systems that are currently in place that allow for industrial automation and interconnectedness of machines, and how AI/ML systems can be integrated with such existing infrastructure to achieve maintenance efficiency.
It will then review how companies are differentiating themselves with respect to their approaches, and how different modalities are serving different types of customers.

In the last paragraph the report investigates how venture capital has moved with respect to PdM, which companies were able to raise capital and their respective value propositions. The objective is to comprehend which models are more suitable for VC-like risk/return profile to better orient investments in the field.

# MARKET OVERVIEW

## The Root of the Problem

Equipment downtime resulting from maintenance activities around the globe has become a major concern. **Conventional maintenance** methods are today **inadequate** in addressing production interruptions and guaranteeing operational efficiency.

The 500 largest companies in the world **lose** approximately **$1,400 billion per year** due to unplanned machine downtime, equal to 11% of total revenues.

***A single minute of unplanned downtime can cost up to €10,000***

in time sensitive and energy consuming sectors.

Empirical evidence (MaintainX, 2026) indicates that the **cost** of **equipment downtime** has **increased** year on year, with the main driver being the rising cost of shipping and parts (repair parts take longer to be shipped to the factory, and cost more), followed by the increase of labour and the wear and tear on critical assets. This evidence is aligned with the overall **decrease in manufacturing margins** that happened as a consequence of the last 5/10 years of macro-economic trends and shocks that shaped our economy. High inflation and sharp increases in energy prices are just two examples. Other reports indicate that the current geo-political and economic situation is hindering their budgeting ability, creating a layer of uncertainty that inhibits their ability to plan 5 years ahead.
Maintenance managers indicate that inflation, supply chain disruptions, and **economic uncertainty** make it **difficult to budget for maintenance activities** and capital investments; many organizations are **delaying equipment replacement** and operating aging assets longer because of uncertainty over future spending, making machine breaking more likely.

Now more than ever, companies cannot afford to keep their machinery offline, but at the same time they cannot afford to hire new personnel or invest in additional CAPEX.
These factors, combined with tailwinds regarding sensor price decreases and the availability of AI/ML software pushed companies to **shift their views on maintenance**, going **from a reactive mindset, to a preventive mindset** and ultimately **to a predictive mindset** (Deloitte, 2017).

Further exacerbating the issue of equipment downtime is **the loss of skilled manufacturing labor**, which causes machines to be used improperly, safety procedures not to be followed correctly, and maintenance not to be performed correctly. Moreover, when a machine does break down, the loss of skilled maintenance teams makes the downtime more long-lasting and expensive.

***The manufacturing sector globally could lose nearly 8 million workers within the next few years***

with countries like China and Thailand facing some of the most severe shortfalls as their industrial bases age. Bain & Company's global research found that **150 million jobs will shift to older workers** by 2030 and manufacturing, with its disproportionately older workforce, sits at the center of that shift. Germany's skilled labor shortage rate sits at roughly **82%**, with its manufacturing sector specifically struggling to find industrial mechanics and mechatronics technicians for machine maintenance and automation, while in Japan around 85% of municipalities are actively seeking additional workers just to sustain basic industries amid a rapidly aging population.

The severe effects resulting from the rapid loss of manufacturing expertise are well documented and there are various examples of the catastrophic consequences arising from mass retirement. In the late 1990s, for example, Boeing ran into persistent production crises exactly caused by the 1995 retirement wave with a resulting loss of 1.6bn$.

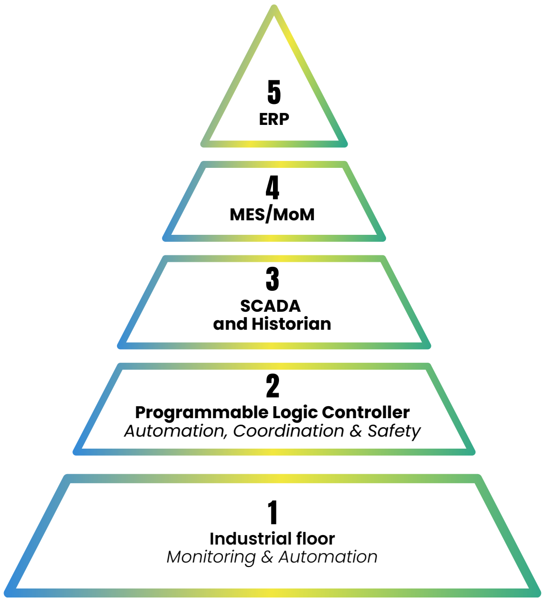
**In 2026, approximately one-quarter of skilled manufacturing workers are over the age of 55**, and younger generations often view manufacturing as unappealing, low-tech, and undesirable compared to other tech-driven sectors, resulting in a lack of much needed blue-collar careers. This creates a structural problem that can only be solved with a targeted reskilling/upskilling effort to educate the workforce. The use of technology such as AI are also emerging as catalyst for change.

## Industrial Equipment Status Quo

To better understand how maintenance can be improved, and how the problem of expensive machine downtime can be tackled, we first have to understand how industrial floors are interconnected, where and how data points are generated and transmitted, and the various layers of decision-making tools that make the data actionable for the company's management.

The **interconnectedness** of **industrial plants** can be seen as **a five-level pyramid**.

Figure 1 - *Pyramid of Industrial Machinery Interconnectedness*




The first level is the **industrial floor**, where machines are usually fitted with monitoring devices such as sensors that monitor temperature, pressure, vibrations, current and speed, automation devices such as actuators and valves, that can be pneumatic, hydraulic or electronic.

These pieces of hardware communicate with local PLC (**Programmable Logic Controller**) through various protocols, such as Profibus, DeviceNet, CANopen, IO-link, or though Ethernet connection (Profinet, EtherCAT, EtherNET/IP). There are also wireless protocols such as Bluetooth or LoRaWan that are used in confined spaces. The PLC is the brain of the machinery that triggers automations, coordinate work between different machinery and implements safety features; they are the second layer of our pyramid.

Typically PLCs are connected to a SCADA (**Supervisory Control and Data Acquisition**) system that has a human readable interface, and to a Historian that tracks and records historic data. The most common mean of communication for PLC-SCADA is OPC-UA, which is a universal protocol that is hardware-agnostic and works between all the different piece of machinery in the factory. The SCADA is the first data aggregator that can be used by engineers to monitor machines and processes. This is the third layer of the pyramid.

A level above SCADA are MES (**Manufacturing Execution Systems**) or MoM (**Manufacturing Operations Management**) which allow for planification of industrial processes. This further layer makes data much easier to interact with, enabling non-engineers to make decisions regarding operations. This is the fourth layer.

The top of the pyramid of industrial automation is the ERP (**Enterprise Resource Planning**), which is a software layer that managers use as basis for long-term planning and strategic decision-making.

## How maintenance come into play in the status quo

There are various levels of maintenance within an industrial complex:

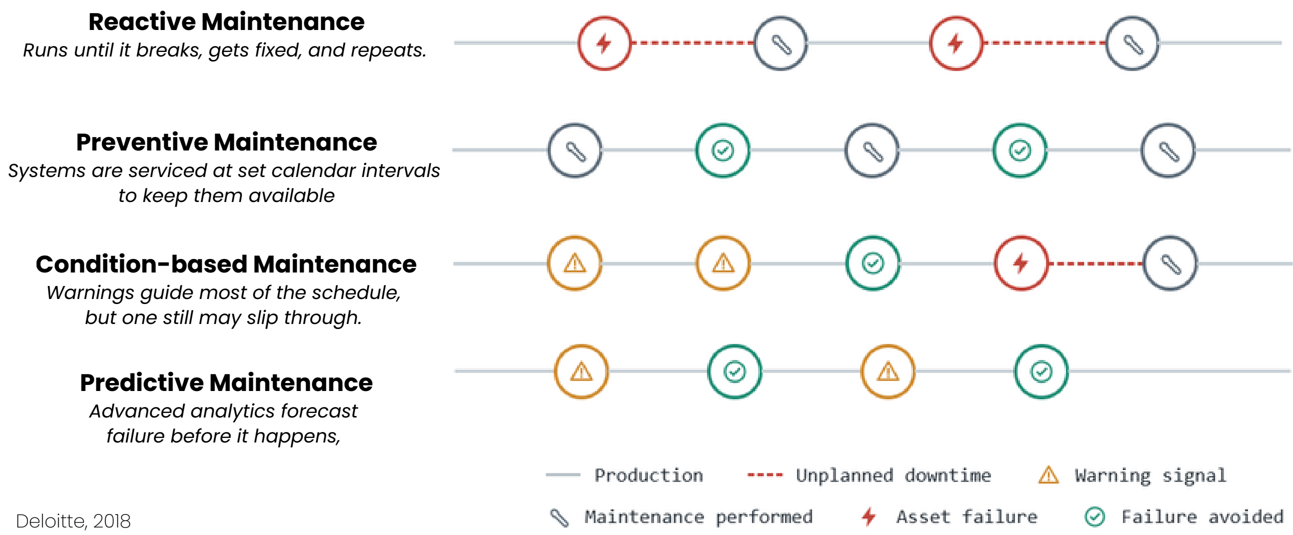
The first level is **Reactive Maintenance:** companies using reactive maintenance let the machines break and then deploy maintenance teams to put the machines back online. This approach is quite expensive since machine downtime is maximized and entire lines might be stalled.

The second level is **Preventive Maintenance**: this approach is based on frequent and regular maintenance interventions. Although the machine seldom breaks, the interventions themselves cause machine downtime, and the system is not optimized.

The third level is **Condition-Based Maintenance**: companies using this approach conduct maintenance once the machine has reached a critical parameter highlighted by the sensors (e.g., the machine is running too hot, pressure is dropping, vibrations are increasing, etc.). Companies using this approach might implement a CMMS (Computerized Maintenance Management System) within their software, a maintenance management application that tracks and optimizes maintenance activities. The CMMS can receive equipment and condition-monitoring data from SCADA systems, historians, and other operational data sources, and it exchanges maintenance information with MES and ERP systems for work-order management, asset tracking, and resource planning.

The fourth level is **Predictive Maintenance**: this approach, often AI based, reacts to subtle changes in machine performance and indicates when it becomes mandatory to intervene in order to avoid a break.

Figure 2 - Types of Maintenance Approaches




Deloitte, 2018

Various surveys (Upkeep, 2026; MaintainX, 2026) conducted worldwide indicate that over 80% - 90% of professionals recognize the value of predictive maintenance, but execution lags far behind; only 25% of respondents have integrated predictive maintenance processes, and two thirds of all maintenance work is outsouced to contractors. This poses a significant **loss of competitive advantage** for industrial plants, given that equipment downtime is higher when maintenance is outsourced, and technical knowledge is not retained, creating further problems down the line.

The data therefore indicates that, although companies are quite keen on adopting new technology, both hardware and software, adoption has been quite lackluster and unsatisfactory; almost 80% of companies experienced the same or more downtime in 2026 compared to previous years. This gap between intention and execution can be pinpointed to two major issues affecting manufacturing companies:

- **Lack of data:** The data readiness gap isn’t about volume, most organizations have years of work order history. The problem is its quality and consistency. AI needs consistent asset identification, accurate failure coding, complete work history, and standardized procedures. These data quality issues are the accumulated result of years of workflow friction, inconsistent processes, and skipped documentation;

- **Lack of skilled workforce**: as previously mentioned, much of the workforce is old, newer generations are not interested in blue collar jobs and most manufacturing companies are facing serious staffing challenges.

What this means, for the purpose of this report, is that there is a huge opportunity to capture an underserved market. Companies operating within the sector have not yet been able to create a solution that captures the clients' needs in their entirety, that is easy to implement, and that creates a measurable impact on daily operations right away. There is space for **new technological solutions** to thrive.

The solution needs to be integrated into the existing flow of data that is widely available on the industrial floor, while not relying on existing IT/OT infrastructure for computing power. It needs to be easy to implement at the operational level, and it must act as a knowledge center that will replace the retiring workforce. Moreover, it must generate an ROI that is measurable and concrete.

## COMPETITIVE LANDSCAPE

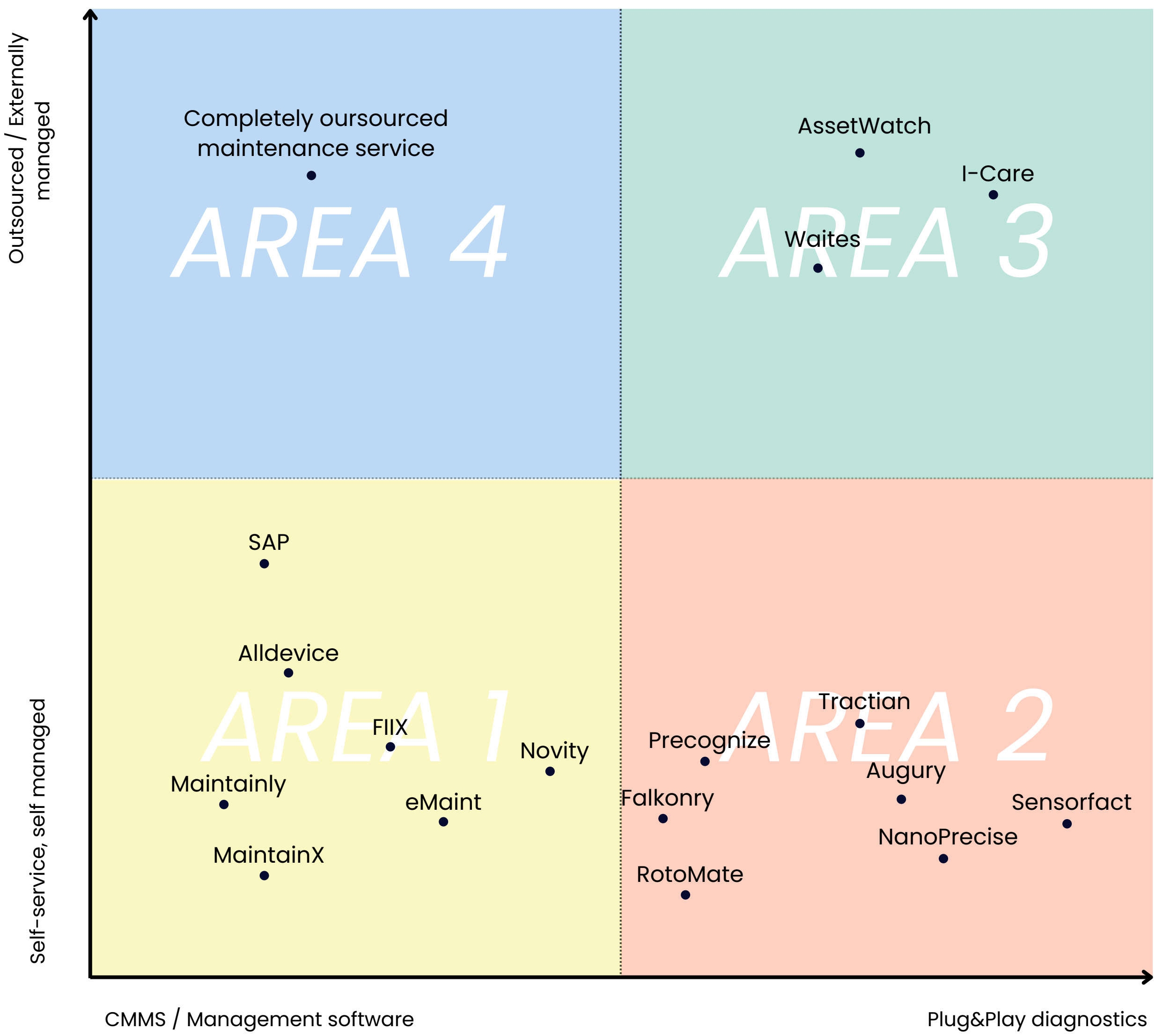
### The Predictive Approach

In this paragraph we will go over the main existing solutions on the market for PdM and segment the market into four main areas:

- **Area 1**: These companies developed CMMS solutions with integrated PdM features. These Saas solutions include a wide array of features, including work order management, preventive maintenance, asset management, inspections and checklists, inventory and spare parts management, reporting and analysis, compliance features, etc. This area also includes “traditional” software companies that design and code specific software for industrial companies. Companies such as SAP, for example, will have much larger costs compared to their digital competitors, but also a much better personalization of the final product.
- **Area 2:** These companies instead developed plug&play solutions that either come with patented/proprietary sensors or that integrate into existing SCADA/historian softwares, to monitor and predict machine downtime. These companies are the most appealing from an investor point of view, because they present a very fast and scalable business model (MaaS, or monitoring as a service) that has a small one-time payment to cover the purchase and installation of sensors, and a strong recurring component based on the number of assets monitored; the price bracket is 20$-200$ per piece of equipment. Most of these companies require an initial “testing” period where the AI/ML algorithm is fed data; this usually lasts about 2 weeks. After the initial beta period, the client will start receiving warnings and alarms when measurements begin deviating substantially from their normal operating ranges.

- **Area 3:** These companies have a similar business model to those that populate Area 2, but heavily employ engineers to look into the data before the alert is sent. This means that the quality of the alarm will be better, with less false-alarms getting through, but also that the personnel cost will have a much greater influence on the company's finances. These companies basically act as an outsourced predictive maintenance function.
- **Area 4:** these companies completely outsource all maintenance-related activities. Considering the importance of asset quality, large companies that completely outsource maintenance (including the monitoring and scheduling aspects) are very rare, and constitute a more traditional form of business.

Figure 3 - Competitive Landscape



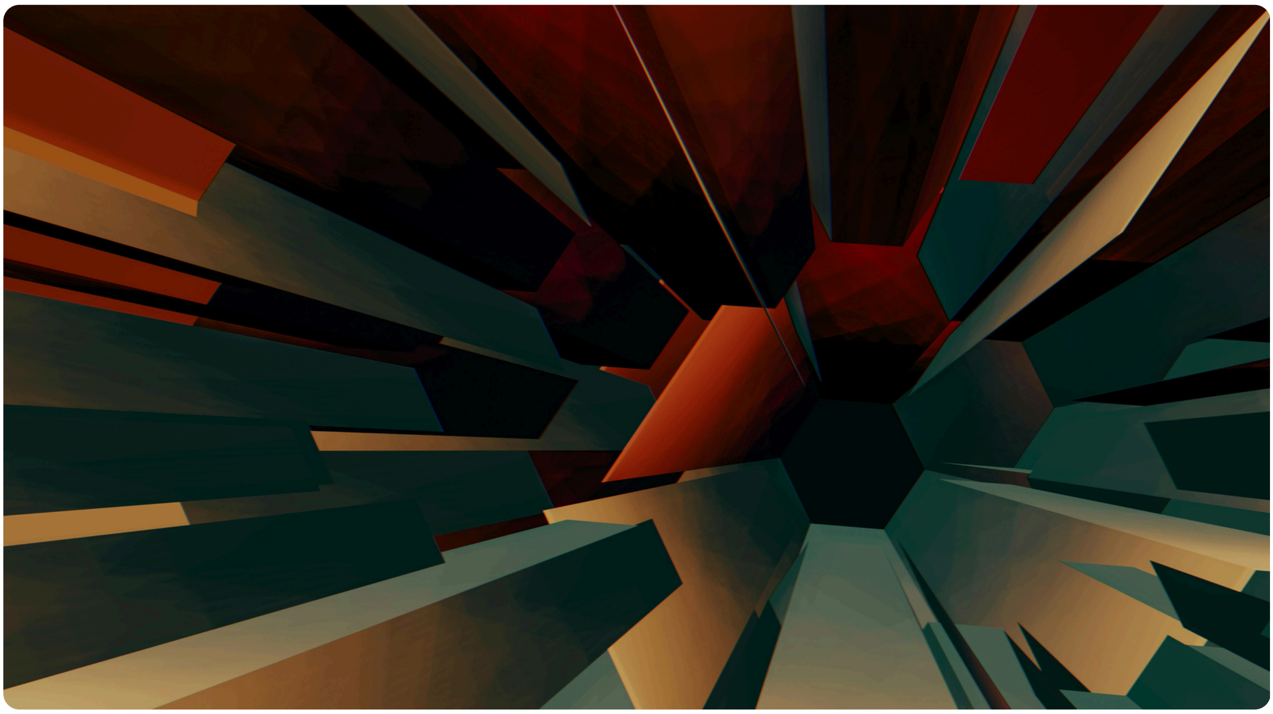
## The Reactive Approach

There is another approach that needs to be considered when it comes to optimizing maintenance processes.

Once machines break down, maintenance teams need to consult fragmented data that comes from machines' instruction manuals and plant-wide schematics, that often causes delays and loss of efficiency. As a result, many companies started developing P&IDs (**Piping and Instrumentation Diagrams**) reading tools **to accelerate the job of maintenance teams**, while remaining light on the plant's IT and OT infrastructure. These tools allow maintenance teams to **detect the problem in a deterministic way**, making t**he fix easier and faster**: this is the reactive approach.

Companies in this space have proprietary extraction algorithms that map P&IDs, drawings, CAD files, and technical records with, often with AI/ML models.

These companies show significant growth potential by addressing the widespread and recurring challenge faced by maintenance teams. They also serve as centralized repositories of maintenance knowledge and best practices, which can prove highly valuable in preserving industrial know-how and help overcome the workforce gap. However, they face substantial hurdles, including high churn rates and complex, resource-intensive go-to-market strategies.



## VC FUNDING

Given its substantial financial potential, the abundance of available data, the growing need for AI/ML-driven computing, and its high scalability and applicability across diverse industries and use cases, **PdM** has attracted **significant interest from venture capital** investors.

Corporate acquisitions also took place, highlighting the need from large industrial groups to innovate and integrate PdM in their product offering.

These are the most notable rounds, the latest happened just few weeks ago:

| Company | Date | Round Size | Pre-money Valuation | Lead Investor |
|---|---|---|---|---|
| TRACTIAN | Dec. 2024 | $120M | $600M | Sapphire Ventures |
| UpKeep | May 2026 | Unknown | Unknown | Accel KKR (private equity) |
| AUGURY | Feb. 2025 | $75M | $925M | Lightrock |
| MaintainX | Jul. 2025 | $150M | $2.4B | Bessemer Venture Partners |
| novity | May 2026 | Unknown | Unknown | Acario (Tokyo Gas) |
| falkonry | Nov. 2024 | $3.4M | Unknown | Unknown |
| RotoMate | Jun. 2026 | $2.1M | Unknown | Kvanted Ventures |
| AssetWatch | Apr. 2025 | $75M | $400M | Viking Global Investments |

As it is apparent, all of the companies listed above are **US based** (except for RotoMate, that is based in Australia), and there is **no EU-based champion yet.** This presents a large opportunity, as the **EU market** is still rather underserved.

It is important to point out that there have already been exists in the industry, as Senseye has been acquired by Siemens for an indisclosed amount, and ABB acquired Sensorfact in 2025. Back in 2019, Presenso was acquired by SKF.

## KEY TAKEAWAYS

In the context of the Industry 4.0 paradigm, **predictive maintenance is a largely untapped market** that has nonetheless received strong funding in recent years. Most companies in the space run lean business models built around proprietary data-collection software, fine-tuned AI/ML algorithms, and subscription-based pricing. However, these companies have struggled with execution, due to both exogenous factors (such as thinning industrial margins and a shortage of available workforce) and endogenous ones (inconsistent data quality and sensor coverage, integration friction with legacy OT systems, and ROI claims that have often outpaced what mid-market deployments actually deliver). As a result, **AI adoption for maintenance in industrial complexes remains underdeployed.**

Adding to this, no independent European champion has emerged at scale in this space. The notable players have instead been absorbed into incumbents' portfolios rather than growing into standalone leaders, leaving the market largely defined by traditional industrial conglomerates (Siemens, ABB, Schneider Electric, SKF, Bosch) building or buying their way into the space, rather than by a scaled independent vendor.

Investors, operators and industrial players should be on the lookout for the next predictive maintenance champions to maximizie technical, financial and economic value.

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