Industry 4.0 Technologies for Maintenance Management

The Role of IoT in Predictive Maintenance

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Table of Contents

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Industry 4.0 Technologies for Maintenance Management

Predictive maintenance is more than just a trend in the field of maintenance—it is one of the core components of Industry 4.0, and is strongly linked to the Internet of Things (IoT), as well as AI and Big Data.

In this white paper, we will examine the possibilities of connected factories and sensor-based maintenance management. Using the example of a successful pilot programme on predictive maintenance, we will see typical milestones in the transformation. We will also look more closely at how predictive maintenance works and how it can benefit you, especially compared to more traditional maintenance options.

In this white paper, you will learn:

- exactly what the fourth industrial revolution is all about
- what IoT sensors are useful for
- the role Industry 4.0 is already playing worldwide, and
- how you can easily make relevant information about the condition and status of equipment available to your employees

We will also introduce you to some of the features of our Timly maintenance management software. Through our partnership with a leading sensor manufacturer, our maintenance management solutions can offer IoT-based functionality, while continuing to offer all of the important inventory management features you expect from Timly.

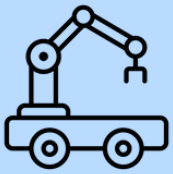
> Only by collecting meaningful data on system usage and conditions can digital analytics predict optimised maintenance times and thus achieve reduced system downtime.

Fourth Industrial Revolution

Current and emerging changes in industry which lead to data-driven, AI-supported and networked factories are referred to as the fourth industrial revolution. The term Industry 4.0 was coined in the 2010s, and covers planning, production, manufacturing and maintenance. Virtual tests before production, for example, are intended to bring better products to market more quickly. A core idea behind the Industry 4.0 is the "Internet of Things and Services".

Intelligent Factories

The Industry 4.0 concept is being applied in smart factories. Tools and systems use data to make production more efficient and flexible, and the networking of production capabilities across company boundaries is a particularly promising practise in how it can allow agile reaction to changes in orders or dynamic market conditions. In general, production in a “smart” factory can be realised with minimal human intervention. When smart factories are integrated into larger systems, machines can be used very efficiently, requiring fewer resources and reducing costs.



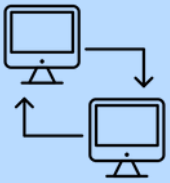
Autonomous Systems

As part of the integration of digitalisation into traditional industrial processes, many production lines will have a modular structure in the future, enabling them to manufacture different variants of a product at low cost and thus satisfy individual customer requirements.

One advantage for smart factory operators is that newly generated data can be deployed very quickly - assuming stable and powerful networks and devices that can process and pass on data in real time. If the services and devices involved are scalable, and equipped with IP addresses to exchange information with each other, they can make their own decentralised decisions - that is, they operate in the Internet of Things.

Internet of Things (IoT)

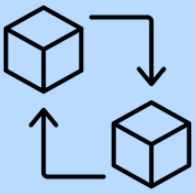
In a smart factory, machines exchange information independently via a wireless network. This shared data might include information on the quality or availability of production materials, or on production errors that have already occurred and those to be avoided in the future. The large amount of information generated in networked factories is referred to as Big Data. It can be combined and analysed in order to derive and utilise new service solutions. The introduction of the 5G mobile communications protocol should accelerate networking via the Internet of Things.



Networked Systems

When physical or virtual assets are connected to digital systems and exchange information with each other in a meaningful way, this ultimately brings added value for the user, because the goods are able to expand their original range of services. Networked systems can include products (smart products), services (smart services) and/or factories (smart factories).

Deploying algorithms in logistics can allow for optimised supply chains if the goods involved are digitally networked. Warehouse systems and machines automatically report missing production resources, and so can deliver finished products faster. In such a networked production environment, machines control themselves by communicating with each other, and with production resources, via sensors.



Digital Twin

Supply chains, machines or factories can be digitally copied 1 to 1, as can intangible elements and processes from the real world. The creation of these digital twins does require the availability of sufficient data.

These digital twins can be used to monitor production or system status in real-time, and can also run simulations which can be used to determine how to optimise production processes without cost-intensive interruptions to actual production.

Predictive Maintenance

With predictive maintenance, sensors are integrated into machines and devices, and the collected data helps to evaluate when maintenance procedures make the most sense, and carry them out accordingly. The aim here is to execute parts replacement, repair or other maintenance services before an asset breaks down or becomes unusable, as opposed to more traditional approaches like preventive and prescriptive maintenance.

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Excursus: Historical Industrial Revolutions

Excursus: Historical Industrial Revolutions

The first industrial revolution, from around 1760 to 1840 (Industry 1.0), was characterised by mechanisation, which was triggered by the invention of the steam engine and the construction of the first railroad lines.

The second industrial revolution (Industry 2.0) is the era of mass production, which began in the late 19th to early 20th century with the introduction of electricity and the assembly line. Since each employee concentrated on just one work unit, production became faster and more efficient.

Finally, the rise of automation, from the 1960s through the 1990s, is referred to as the third industrial revolution (Industry 3.0). The main drivers of this new era were the development of semiconductors and mainframe computers, and later personal computers and the internet.

Classic maintenance variants

The subject of maintenance management is relevant in almost every company. It consists of the sub-areas of maintenance, repair, inspection and improvement. By 'maintenance' we specifically mean preventative care measures for mechanical machinery, technical equipment and production facilities.

The optimal operating condition (target condition) of equipment is maintained by carrying out maintenance at the right time. Correctly performed maintenance prevents or delays wear and tear on machines, equipment, vehicles or systems. Maintenance can also help ensure warranty claims, as well as extend the life and increase the resale value of assets. Typical maintenance work includes cleaning, adjusting, lubricating, changing batteries, checking fill levels and more.

In many companies, what is referred to as reactive maintenance is still carried out: a machine is only maintained when something is actually worn, empty or not functioning optimally. With this rather spontaneous approach, the planning effort is minimal, but either spare parts and specialised personnel must be readily on hand, or downtimes must be accepted.

Preventive maintenance is a popular alternative: planned, regular maintenance services are scheduled and adhered to in order to prevent breakdowns. This reduces downtimes, but labour and material costs are higher.

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Predictive Maintenance

The principles of predictive maintenance

1. Predictive maintenance does not follow a rigid schedule.

2. Predictive maintenance is based on current smart factory data in combination with artificial intelligence (AI) algorithms.

3. These algorithms analyse when malfunctions or failures are likely to occur and indicate how and when appropriate maintenance measures should be initiated.

How you benefit from predictive maintenance

By carrying out maintenance proactively, according to sensor data and artificial intelligence predictions, you avoid disruptive production slowdowns and stoppages and the significant associated costs.

Predictive maintenance can also reduce labour and related costs, because fewer manual checks are required. Thanks to IoT sensors, continuously available data on the status and condition of devices makes it possible to dispense with regularly scheduled inspections.

Preventative maintenance can also ensure that unnecessary or untimely maintenance work is avoided. If information about the condition of a part or component is available and monitored, you can be confident that it does not need to be replaced as a precautionary measure, but can be used until the end of its actual service life. This too means less working time as well as savings in material costs.

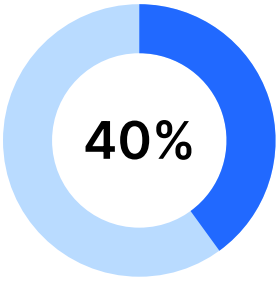
How does predictive maintenance work?

With traditional maintenance options, there is often an experienced employee who has already carried out a particular maintenance task many times. They therefore know how to diagnose noises, vibrations, heat development and the like. Through observation, they can make a relatively accurate assessment of the current condition of a part that is subject to wear and tear, or any other component or mechanism generally requiring regular maintenance.

A well-trained AI system for predictive maintenance works in a similar way. To ensure that predictive maintenance works properly and reliably, any variables or other signs that might indicate the need for maintenance or the possibility of failure, and that can be measured and recorded, must be identified at the outset. In most machines, many different measured variables need to be identified in order to predict when maintenance will be necessary.

In order to train the AI, the course of these measured variables is then recorded over the entire lifecycle of the part or component in question. By learning the early indications of necessary maintenance, the AI system develops the skills of an experienced diagnostician, but can work more cost-effectively than a human employee, and can also process more detailed information.

Notable Predictive Maintenance Statistics



more cost savings versus reactive maintenance and up to 12% more savings versus preventive maintenance

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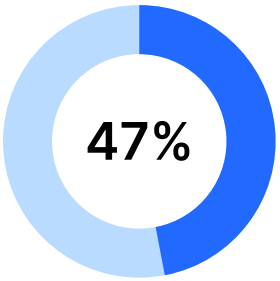

of global manufacturers already use predictive maintenance technologies to reduce operational costs

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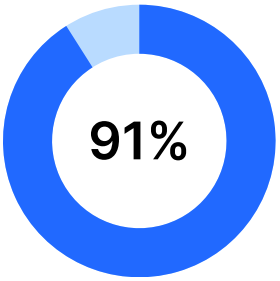

of businesses see a reduction in repair time and unplanned downtime after implementing predictive maintenance

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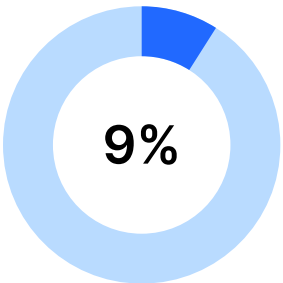

increase in operational uptime in companies utilising Predictive Maintenance 4.0

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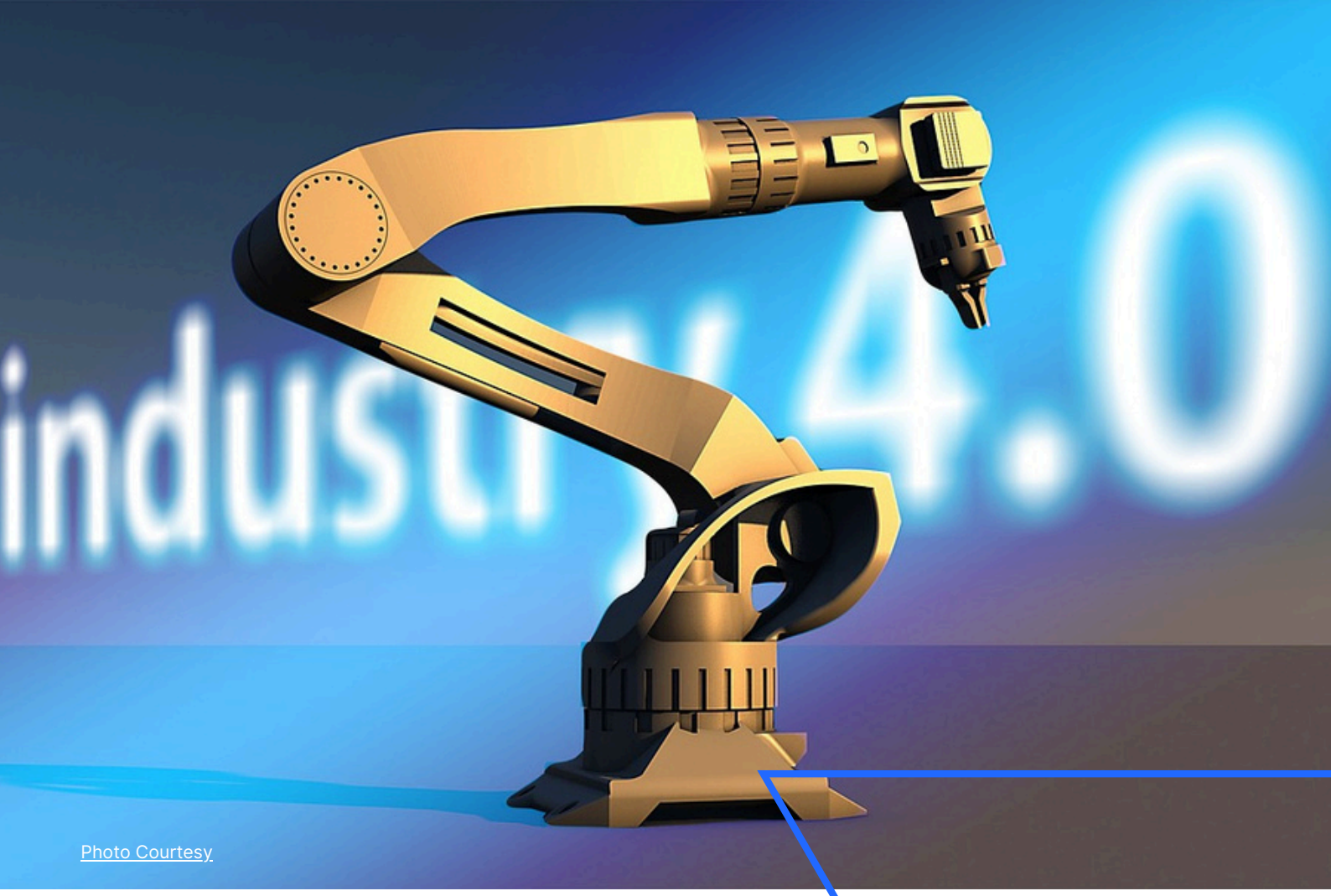

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Industry 4.0

On the implementation of Industry 4.0

Even though the fourth industrial revolution has been underway for several years, many companies are lagging behind in its practical implementation. Small and medium-sized enterprises in particular often struggle with digital transformation in general, and as a result, many SMEs feel that they are only moderately equipped for the requirements of Industry 4.0. There is a lack of technical expertise and strategic support, and there are still very few strategic implementation models or supporting data for converting to smart factories. As a result, the fourth industrial revolution is not yet part of the corporate strategy at the management levels of many SMEs.

How you benefit from predictive maintenance

Source: Belden

Belden is an American company that develops and manufactures solutions for data transmission, including cables, connectors and active components. The 95-year-old Belden plant in Richmond planned to take a step towards Industry 4.0, with the main goals of:

- avoiding downtime due to unplanned maintenance and hard-to-source parts
- reducing alliance on skilled labour (who are approaching retirement), and
- reliably increasing production through improved connectivity of machines

In the past, the assessment and repair of equipment was routinely scheduled, but the machines, some of which were very old, would occasionally break down unexpectedly, leading to production delays. The company believed that the switch to predictive maintenance would make it possible to procure spare parts in advance based on forecasts from collected data.

To this end, some plant components were modernised and connected to both third-party software and internally developed solutions to gain performance insights. To scale better and connect more machines and their data, Belden turned to local data engineering consultants, who designed a customised network infrastructure, identified operational goals and interviewed plant and facility managers to understand the impact of increased visibility and improved maintenance. Finally, the consultants worked with the plant team to develop a target ROI (return on investment) for the pilot project.

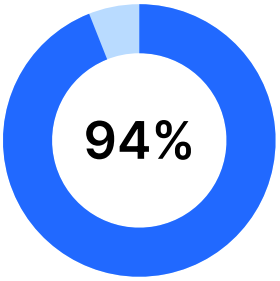
This took place on high-volume, high-margin production lines, with the working assumption that the solution should be easily transferable to other areas of the plant later on. Specifically, the company installed sensors on motors and mechanical devices, collected data for predictive maintenance, identified trends and indicators of out-of-tolerance deviations during data analysis and took preventive measures in the event of indications of impending failures.

The aim was to achieve an overall equipment effectiveness of 56.5 percent, and in the end, the pilot project was so successful that 62 percent was achieved.

The collaboration of employees throughout the company was crucial to the success of this Industry 4.0 pilot project. Within eight months, around 300 GB of data was collected from 150 sensors. In the second phase of the project, the sensor readings were contextualised by a third-party provider to gain further insights.

The project is to be extended to other plants and facilities, including a unified repository for performance and quality for more informed decision-making, which data will be used to develop a system for automating production planning in the long term.

Notable Industry 4.0 Statistics



of business leaders think that AI will be important for business success in the next five years

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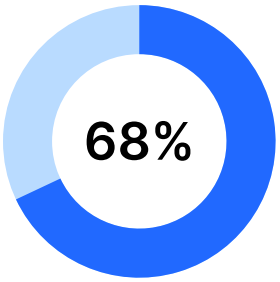

of large companies versus 15% of small companies have adopted at least one AI technology, compared with 34% of SMEs.

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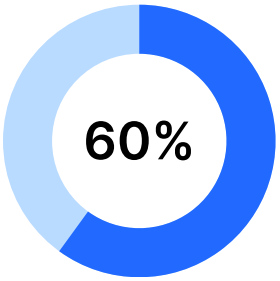


of companies plan to increase their AI investment in the next three years, motivated by AI-related revenue growth.

Source

Projected market size of Industry 4.0

US$482B

by 2032 at a CAGR of 20.7%, up from US$77 billion in 2022.

Source

Notable Industry 4.0 Statistics

Projected growth of the UK AI market

US$1 Trillion

by 2035 from US$ 21 billion at present.

Source

Projected growth of global IoT market

US$650.5B

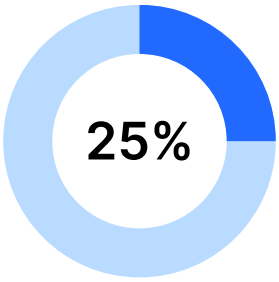
at a CAGR of 16.7% by the end of 2026, from US$ 300.3 billion in 2021.

Source

+319%

increase in the annual funding of startups active in Industry 4.0 from 2011 to 2021.

Source



more business growth rate by implementing the right IoT technology to increase production, reduce waste and improve safety.

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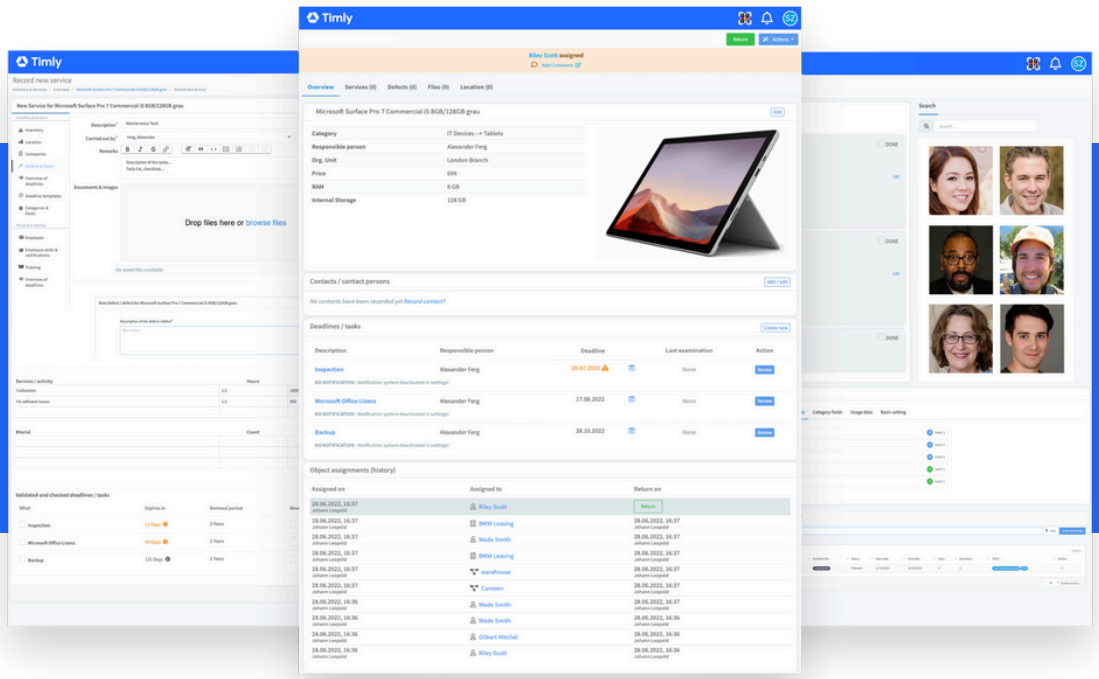

Timly: A robust tool for predictive maintenance

Many companies need a specific digital location for the collected performance and quality data of devices, machines, tools, etc., so that they can make informed decisions in the area of production planning and maintenance. In fact, all sub-areas of maintenance (servicing, repair, inspection and improvement) can be mapped in a single software package, providing authorised employees with comprehensive, up-to-date information on the company's inventory and assets anywhere and at any time.

By using Timly as maintenance planning software, you can track defects and faults via an internal ticketing system. Repair times can be shortened because a repair order reported in this way can already be processed in the administration department while the defective equipment and the reporting person are still on site.

Find out more about us here or book a non-binding demo appointment directly.

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Timly: A robust tool for predictive maintenance

When tracking maintenance dates, inspection documents, machines needing maintenance or the staffing of certified personnel become unmanageable, it is time to invest in a scalable inventory software such as Timly for predictive maintenance management.

The advantage of Timly in particular is its wide range of functions. As one example, in addition to the maintenance planning module, Timly can also generate evaluations that give you a clear and historically traceable overview of the performance data of your work equipment.

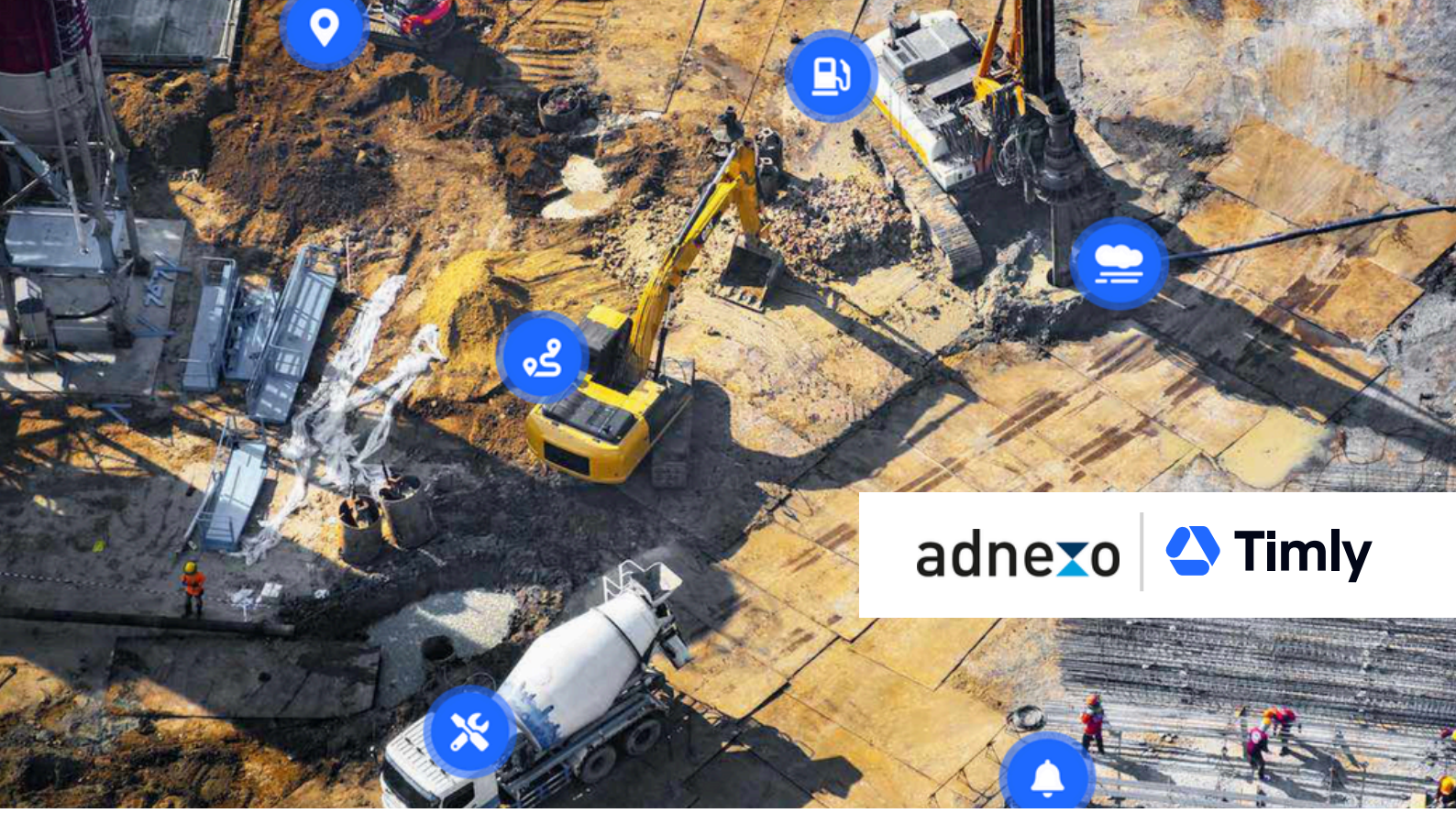
As cloud-based inventory software, Timly can be installed on company tablets and employee smartphones, and by employing scannable QR codes all data can be easily entered into the inventory database, and just as easily accessed - the risk of forgetting documentation or reports or the extra effort of having to go to specific administrative offices is eliminated, and onsite employees can not only see in real-time when the next inspection or maintenance is due, but other data as well, like if the equipment is reserved by another worker or available for use.

Timly supports maintenance by, among other things:

- Managing responsibilities
- Assigning tasks
- Documenting maintenance and inspections
- Planning processes and deadlines for inventory items

A combination of QR code labels and IoT trackers works well for many companies. The IoT sensors on the machines or other assets transmit real-time data, which is made available to authorised employees on their mobile devices or computers. IoT sensors are not yet very widespread, though, and are usually only used for large, expensive and heavy devices or machines, and so for many other inventory items it makes sense to make maintenance data accessible via QR codes and the Timly app.

A holistic inventory tracking software with extensive maintenance planner functions, Timly is a simple and modern option for providing company employees with relevant information about the condition and location of a device, machine or vehicle at all times.



Cooperation for Live Tracking: Timly and adnexo

In order to offer its customers even more functionalities, Timly is cooperating with established technology partners. As one important example, the professional IoT sensors from adnexo are now available for tracking assets. These can be used as GPS trackers on operating equipment and transmit configured data in real time after activation.

Live data for predictive maintenance

Predictive maintenance is about being able to make predictions for maintenance measures that relate to work equipment with dynamic wear. IoT sensors are able to measure information such as operating hours, locations, mileage, temperatures or fill levels and transmit it wirelessly to Timly's cloud-based software. Through cooperation with adnexo, a manufacturer of IoT sensors for industrial use, Timly users who opt for this feature will be able to view important data on their equipment directly via the software.

Both LoRaWAN (Long Range Wide Area Network) and NB-IoT (Narrowband Internet of Things) protocols are used for data transmission.

Timly can send automated notifications to employees for predefined events, such as when certain low fill levels or high temperatures are reached on the equipment. The asset data can also be tracked in real time via the ax-track platform from adnexo. In most cases, the IoT sensors can be retrofitted to the machines and vehicles, regardless of the type of equipment.

You can find out more about how the use of adnexo sensors helped to manage high-quality rental equipment in this case study.

Timly: More than just maintenance software

More than a comprehensive preventive maintenance solution, Timly asset management software is an excellent choice for companies that want to manage their physical and digital assets - vehicles, equipment, facilities, furniture, tools, employee records and certifications, company records, documentation and warranty certificates and much more - in a clear, comprehensive and efficient manner.

Timly is an all-round inventory management software that can be adapted to the specific needs of your company, providing, among many other things, location, quantity, age, condition and value, usage and use history, scheduling and access, physical descriptions and photographs and other specific attributes of any and all assets or inventory items, which can be made available to all or to specific employees or groups.

In Timly, organisations can store and display all kinds of attachments for an inventory item. For example, the warranty certificate or operating instructions for a device can be uploaded so that they can be viewed via tablet or smartphone as needed - in the warehouse, in the workshop or at the assembly site.

Also very useful are the ability to reserve, schedule usage and assign access of equipment, machinery, tools,vehicles or other valuable company assets, as well as tracking access and usage, making it possible to maintain and view a historical record of what employees used which assets and when, even across different company branches or sites - crucial for long-term strategic planning.

If you purchase the appropriate module, Timly can even link inventory assets to employee qualifications. Skills, certifications and training, among other things, can be easily managed in the digital personnel file, and can be connected to your existing HR systems if desired, and then used to manage the access and usage of specific assets like machinery, tools, vehicles or valuable equipment.

In this way, Timly can answer typical day-to-day company questions at the click of a mouse or a simple smartphone gesture:

- When does any specific employee need to renew her certification?
- Who is authorised to operate this machine?
- How many employees have completed this training?
- Who is qualified to carry out this specific maintenance?

Book a demo now **to find out more about how Timly can help you!**