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CytroConnect Solutions

FACTS

More than **70 PLANTS** worldwide

Operations in **39 countries**

High sampling rate of up to **1000 Hz**

12 million measurements/day at a plant

Up to **50%** faster **maintenance**

Up to **30%** **savings** on follow-up costs

15 plants currently **ONLINE**

67 **sensor packages**

PREDICTIVE MAINTENANCE

The world is developing at an extremely fast pace. New products and technologies are required at ever shorter intervals, and with them improved and more efficient production processes. Things that seemed impossible only yesterday are in fact possible today. It used to be the case that a production plant had to suffer a breakdown before repairs would be carried out, but nowadays smart systems can detect a fault before it even occurres. Bosch Rexroth offers three different cloud-based packages that allow you to do just that: rule- and data-based CytroConnect Solutions.
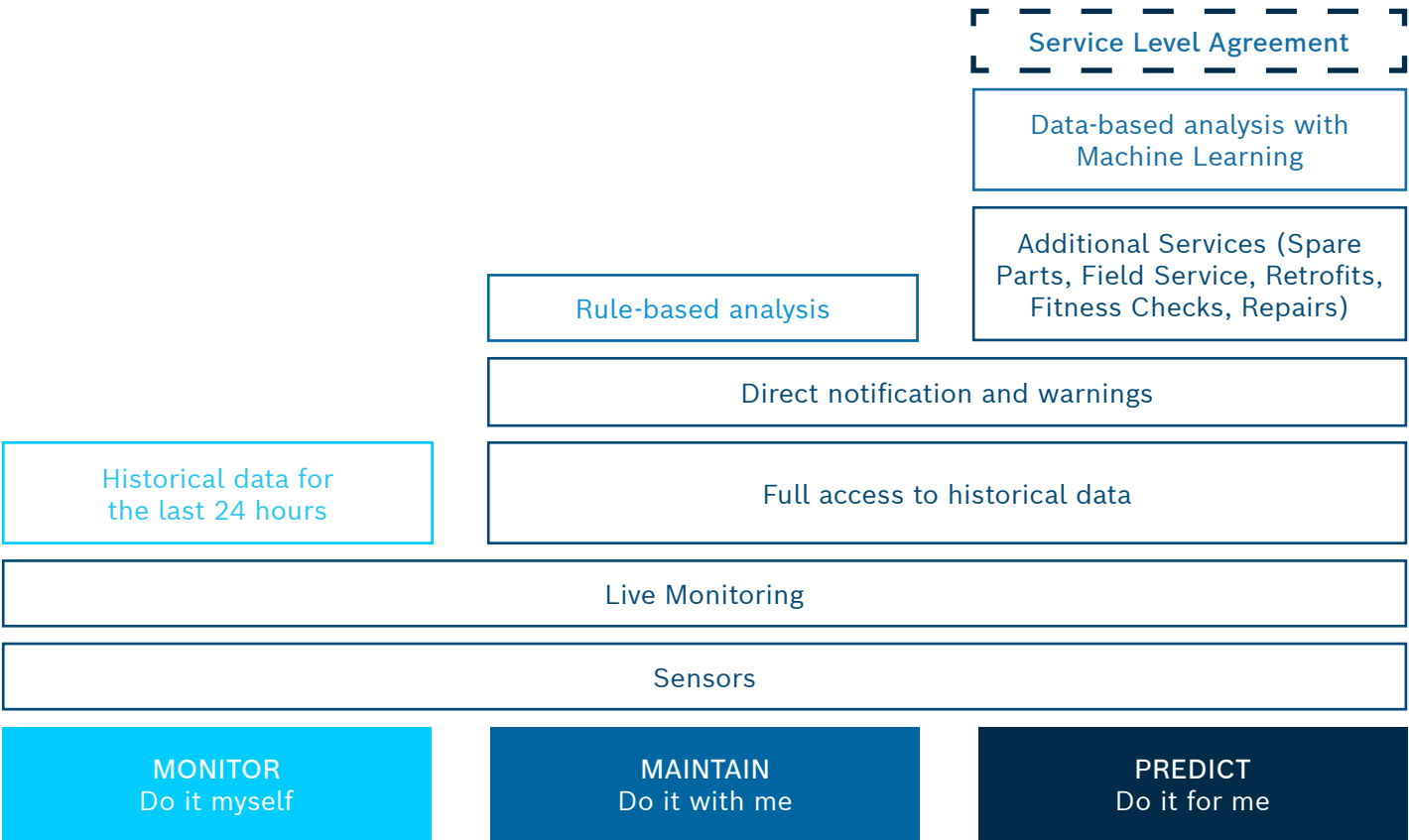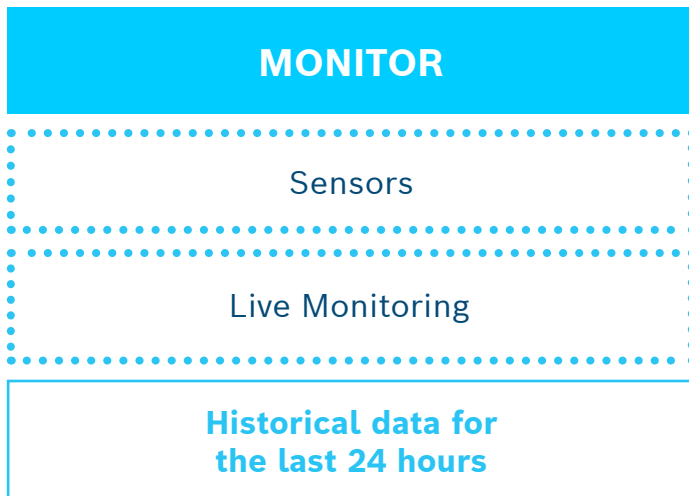
CytroConnect Solutions

Sudden machine breakdowns, unplanned, costly maintenance work, and pre-defined maintenance cycles. Digital solutions help to support maintenance activities and give insights into the current machine status. Bosch Rexroth is an expert in the fields of hydraulics and combines that with Industrial IoT expertise to offer you reliable digital maintenance solutions. Our modular approach starts with a data visualization solution of the current status that can be upgraded to a rule-based condition monitoring solution or even a predictive analytics service to conduct predictive maintenance. If you have a lack of hydraulic know-how, have high downtime costs and do not have much time because you are facing problems of long-distance applications, then we have right solutions for you.

We pay attention to problems of our customers and try to solve them. CytroConnect Solutions includes three different packages that offer rule- and data-based monitoring solutions applicable to different hydraulic systems. The different applications collect and stream sensor data to a cloud interface.

- Reduction of downtime costs
- Increase in efficiency and product quality
- Optimized maintenance planning

Service Level Agreement

Data-based analysis with Machine Learning

Additional Services (Spare Parts, Field Service, Retrofits, Fitness Checks, Repairs)

Rule-based analysis

Direct notification and warnings

Historical data for the last 24 hours

Full access to historical data

Live Monitoring

Sensors

MONITOR	MAINTAIN	PREDICT
Do it myself	Do it with me	Do it for me

CytroConnect MONITOR

MONITOR
Sensors
Live Monitoring
Historical data for the last 24 hours

The MONITOR package collects data and visualizes it clearly on a dashboard for a quick insight into users' machines. MONITOR offers all data available in the last 24 hours. This allows you to detect changes at an early stage and intervene immediately if they deviate from the normal state.
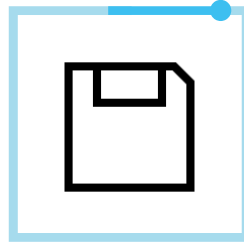
The data can be viewed anytime on a dashboard via a web browser, on a phone or any other devices on demand. This service can be easily implemented in any existing hydraulic powered asset/machine. Users can decide with the help of a Rexroth expert on which components should be monitored.

MONITOR is a good entry in the field of condition monitoring. If users want to take a step further to automize their monitoring, they can easily upgrade to the CytroConnect MAINTAIN package.
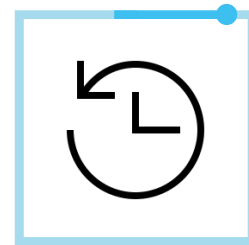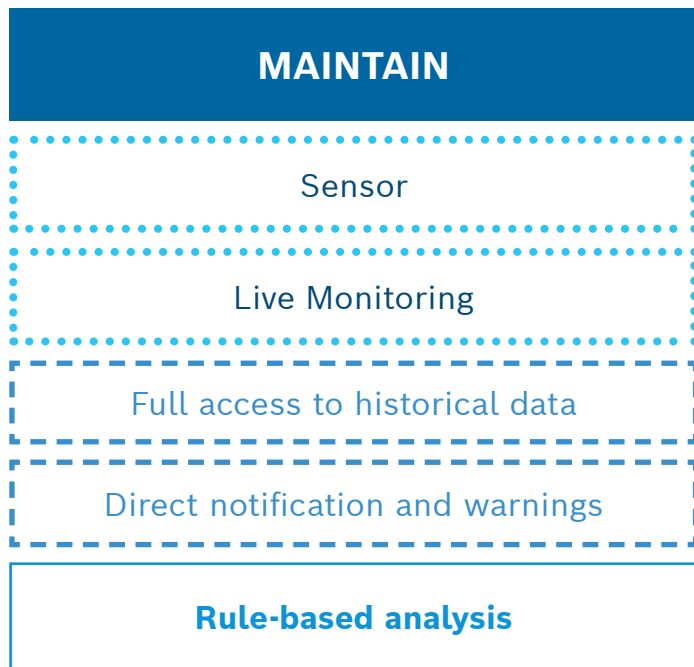
THE BENEFITS:

Web based

All data at a glance

Data from the last 24 hours

CytroConnect MAINTAIN

MAINTAIN
Sensor
Live Monitoring
Full access to historical data
Direct notification and warnings
Rule-based analysis

Besides MONITOR, there is MAINTAIN package. As the MONITOR package, MAINTAIN informs customers about current status of the components via the dashboard. MAINTAIN works in the background so that you do not have to check your machine insights regularly.

Predefined rules monitor the condition of components and show if something is not running according to the rules. The rules are defined by experts and adapted exactly to your machine. MAINTAIN can work with limits but also relate values of different components.
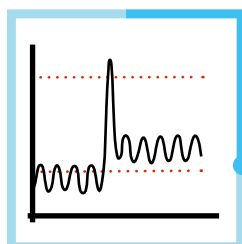
The advantage of these rules is that they relieve you of the work. The structure of the plant and the components to be monitored become more complex. It is more difficult to understand visually (via the graphs) the relationship between different values.

MAINTAIN is a rudimentary segment of AI algorithm. In case of an anomaly, a push notification on problems will be shown and users have their own decisions on how to proceed. Therefore, the available unlimited historical date can be used. This gives users the ability to react quickly, even in unmanned shifts and avoid downtime, while also enabling user to optimize their maintenance strategy with our regular performance and usage report.

THE BENEFITS:

Unlimited historical data   Predefined rules   Push notification

CytroConnect PREDICT

PREDICT
Sensor
Live Monitoring
Full access to historical data
Direct notification and warnings
Additional Services (Spare Parts, Field Service, Retrofits, Fitness Checks, Repairs)
Data-based analysis with Machine Learning
Service Level Agreement

The third package is PREDICT. This package offers an individual service level agreement in addition to predictive analytics, based on self-learning algorithms. Our experts are available to answer your questions. A detailed quarterly report informs you regularly about the status of your application.

The aim of PREDICT is to prevent unscheduled downtime and hence minimize any related maintenance costs, all of which can be accomplished with predictive analytics. Self-learning Algorithms scan the data for abnormalities, whereupon one of our service expert evaluates them and recommend a course of action in the event of an anomaly. On top of the optimization of maintenance planning, a predictive maintenance service ensures maximum availability and simplified spare parts.
This could mean replacing a hydraulic pump at the weekend, for example, giving users sufficient time to purchase the spare part and minimizing any disruption to production.
Such a system reacts more quickly than a human, who needs significantly longer to analyze these volumes of data.

In order to achieve this, suitable data from the system are first of all collected via the sensor technology, securely transferred to the cloud, and stored there.

THE BENEFITS:

Daily monitoring and expert recommendations

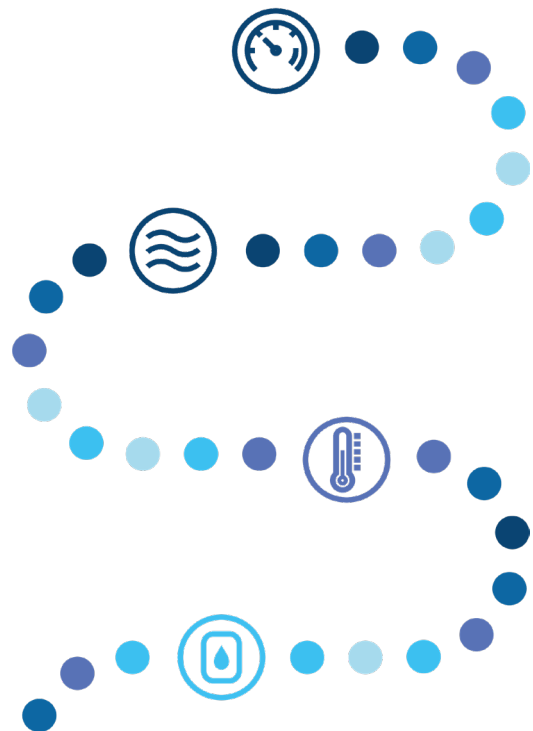Faster and more precise analysis of the data base

Quarterly reports

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Hardware Components – Sensor Technology and IoT Gateway

As a smart solution for Industry 4.0, CytroConnect Solutions requires various different software and hardware components in order to be able to collect, process and analyze data. The sensor technology and in particular the DAQ unit (DAQ = data acquisition) are crucial for the collection of data.

Parameters such as pressure, temperature, tank level, oil cleanliness, flow and current can be measured with the help of our customized, application-specific sensor package. The sensors are connected to the unit being monitored capture the necessary data and send them to the IOT gateway. Therefore, there are different sampling rates - from low to high samplings up to 1 kHz. Due to the large number of sensors, the DAQ is kept very flexible and simple. Pre-processing is carried out in the IoT gateway whereupon the data is sent to the cloud e.g. an external router.

Once the data has arrived, it can be analyzed and assessed by our experts.

System-Structure

A major advantage of predictive analytics is the early detection of changes in the condition of a machine. But how does it work with CytroConnect Solutions?
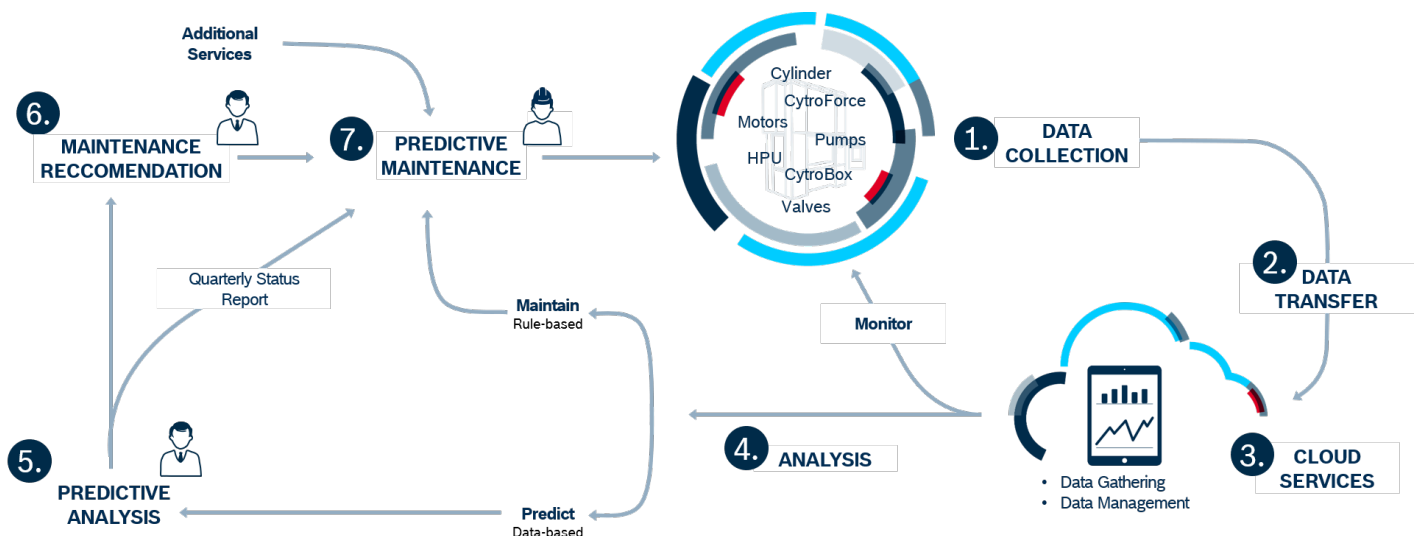
MONITOR and MAINTAIN (rule-based system) give access to all relevant indicators via the browser-based dashboard - whether using your laptop or mobile device - to speed up troubleshooting and maintenance.
PREDICT is a cloud-based service which comprises analysis via the Online Diagnostic platform, operation of the user interface (account), monitoring, support with reporting, and the provision of advice and expert recommendations.

HOW DOES OUR SYSTEM WORK?

First of all, each component's condition is captured and recorded via sensors in a system and transferred to the cloud via an IoT gateway with the help of a mobile communications router equipped with a pre-configured SIM card. With the MONITOR package, you now have all

the data from the last 24 hours at a glance on any devices. With MAINTAIN, the data is analyzed according to predefined rules and push notifications are sent in case of an anomaly. Afterwards, you can plan your maintenance and order the needed spare parts. For PREDICT, the collected machine data is analyzed for anomalies with the help of our Online Diagnostic Network, whereupon our experts conduct an assessment and then draw up a status report and provide a maintenance recommendation. Potential failure patterns are monitored and detected early on with predictive analytics. You are informed in advance so that you can determine the best time for the maintenance work to be carried out and can ensure that it is executed out more efficiently. Combining one package with other Bosch Rexroth service contracts will increase machine availability tremendously.

Application Example

The power unit equipped with a complex sensor package is the main element of a hydraulic system. Extensive knowledge of this system is required in order to be able to monitor it effectively.
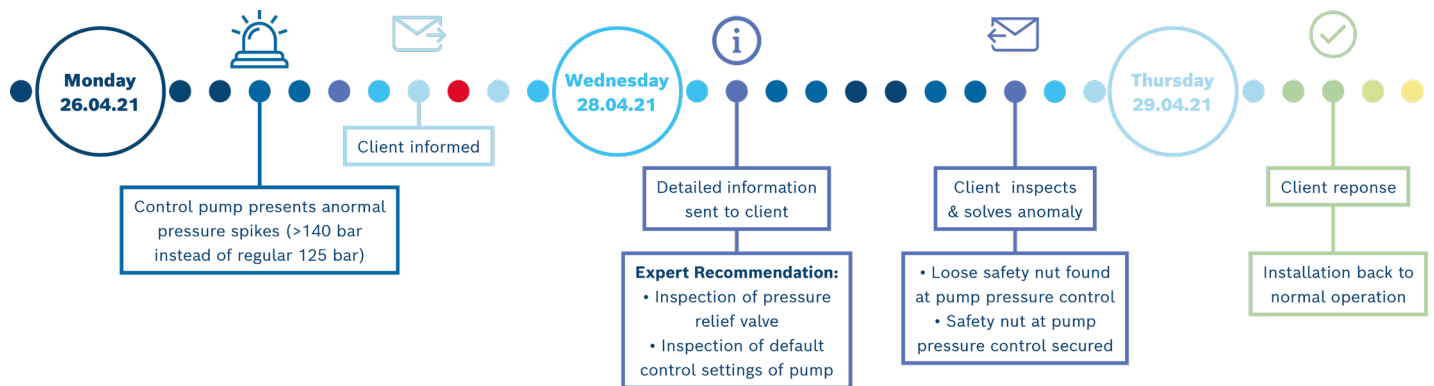
The electric motor, hydraulic pump, tank, oil cleanliness and filter need to be monitored for an informed, qualified statement to be made concerning a power unit's state of health. The cooling and the accumulator can also be included as an option. Bosch Rexroth can provide its own application-specific sensor packages for these components of a hydraulic power unit.

WHICH SENSOR TECHNOLOGY IS USED?

Oil cleanliness
- Particle counter
- Water content sensor
- Oxygen content sensor

EXAMPLE ANOMALY DETECTION WITH PREDICT

Monday 26.04.21

Control pump presents anormal pressure spikes (>140 bar instead of regular 125 bar)

Client informed

Wednesday 28.04.21

Detailed information sent to client

Expert Recommendation:
- Inspection of pressure relief valve
- Inspection of default control settings of pump

Client inspects & solves anomaly

- Loose safety nut found at pump pressure control
- Safety nut at pump pressure control secured

Thursday 29.04.21

Client reponse

Installation back to normal operation

This example is from a client in the metallurgy industry. It shows a real anomaly detection and how the client was able to solve it with the help of Bosch Rexroth.

On a Monday, the control pump 1 showed an abnormal behavior. The pressure, which is normally set at 125 bar, had risen up to 140 bar. The client was informed on the same day. On Wednesday, our experts gave a recommendation on how to proceed. They told the client to check the pressure relief valve as well as the control pump. On the same day, they checked the control pump 1. They found that the safety nut on the control (adjustment) was loose. At its basic setting, the pump was at 132 bar according to the pressure gauge on site. Around 12 pm the adjustment was secured and the problem was solved. On Thursday, the client gave feedback that the plant is back to normal operation.

Implementation: Example of a Hydraulic Press

A hydraulic press system involves several individual machines and components, which cooperate. An important component of this is the power unit of which the electric motor, hydraulic pump, tank, oil cleanliness and filter are monitored.

What are the important factors with regard to the monitoring of an entire press for ensuring that an informed, qualified statement can be made regarding its state of health?

On account of the installation position of the main cylinder of a deep drawing press, maintenance is very time-consuming which means that unscheduled downtime can incur high costs.

Another aspect of the main cylinder is the non-redundant design in the press. It therefore makes sense to monitor the cylinder in order to be able to schedule maintenance for it. As such, the cylinder can be replaced during non-production time, resulting in faster maintenance and lower (consequential) costs.

WHAT IS MONITORED?

Main drive:

- Press speed
- Pressure peaks
- Positional accuracy
- Power units
- Cylinder pressures and actual values
- Manifold
- High-response valves
- Servo drives

Valve:

- Command values
- Control values

Values:

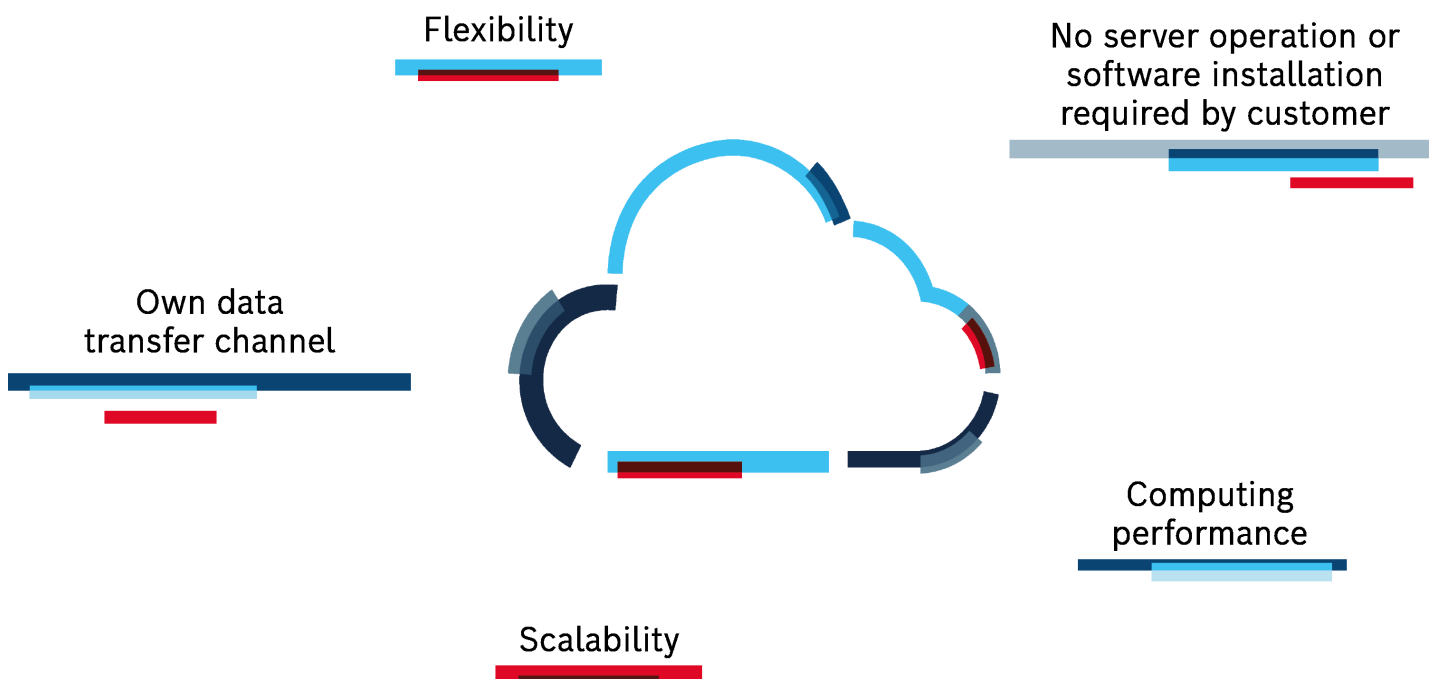- Pressure
- Oil
- Temperature
- Filters

Example hydraulic press

Cloud Services

Nowadays, electronic data processing is increasingly attracting attention on account of digitalization. More and more companies are recognizing the advantages of cloudbased services. Why is this also the best option for CytroConnect Solutions?

Why transfer data to a cloud and store it there? A cloud is always up to date, there is no need to worry about security updates. No remote access is required, as the data is sent directly to the cloud via a secure connection and the analysis results are accessible from anywhere with the help of our web interface. You benefit from high-speed and high-quality analyses and better monitoring.

The security of the data is guaranteed by the transmission of encrypted data, confidential handling, and unidirectional transmission. There is no remote access, every-

thing is working from a cloud. The identification is working via Import ID and Password. Beside this fact, the quality of the analysis results is much better than before. Reason is that Data Packets are "married" in the Cloud ("Data Analysis, Storage, Visualization & Management"). The main benefits of the cloud are shown in the graphic below.

Flexibility

No server operation or
software installation
required by customer

Own data
transfer channel
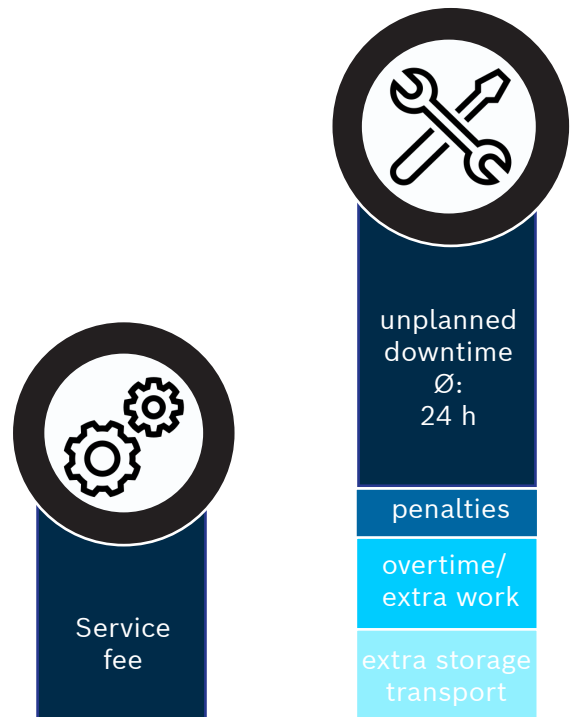
Computing
performance

Scalability

With or without CytroConnect Solutions?

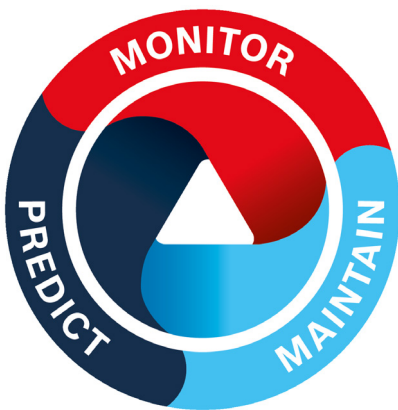## Why CytroConnect Solutions worth it?

One of the most frequently asked questions about Cytro-Connect Solutions is whether it is worth the cost. We can say yes! There is a simple explanation for it. If one of the components have a failure and because of that you have a downtime, the costs for that new component would have to be paid. In addition to the cost of the component, you have incurred downtime costs per hour. Let's assume that the downtime will take around 24 hours because the spare parts have to be ordered and delivered: The total cost for this duration could then be in the five-digit range.

There would be a monthly service fee if you invest in one of our packages. The savings through the use of CytroConnect Solutions would be more than half of what would normally be paid in the event of a failure. In the graphic on the right you can see the total savings per year.

Service fee

unplanned downtime Ø: 24 h

penalties

overtime/ extra work

extra storage transport

The breakdown itself is in most cases not that expensive compared to additional costs, it is those expenses that bring up the price. In the recycling industry, for example, you also have to pay for additional space to store the garbage that you can't continue to process because of the outage. In other industries, you may have extra transports to get the component. On top of that, there are most of the times penalties that have to be paid if products are not ready on time.

Another advantage is that there will be more time for planning the maintenance work because you always know the condition of the machine. Additionally, as already mentioned, downtime is reduced because you know when you need to replace the missing component and can order it while production continues. Furthermore, additional costs can be reduced to a minimum, because you can plan in advance.

MONITOR

MAINTAIN

PREDICT

Conclusion

What's the benefit?

Hydraulics users are confronted with numerous problems: lack of hydraulic know-how, high downtime costs and do not have much time because you are facing the problem of long-distance applications. With our packages that we already introduced, we have shown how those problems can be prevented or minimized.
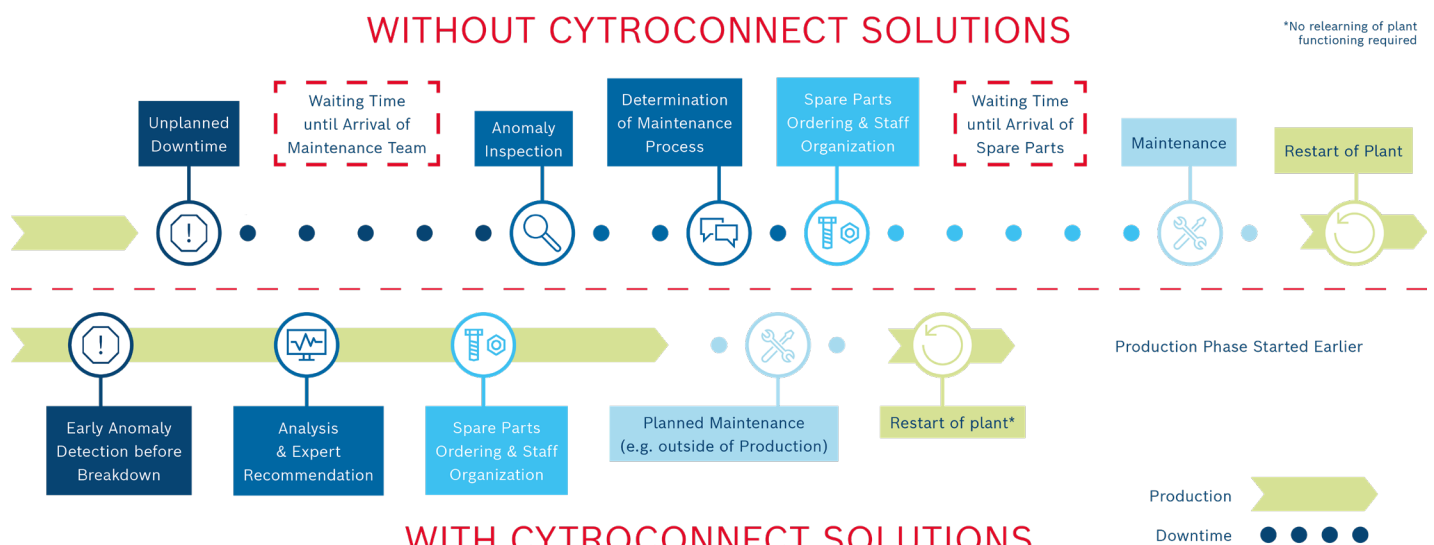
MONITOR provides you with all data from the last 24 hours, this allows you to detect changes at an early stage and intervene immediately if there is a deviation from the normal state. The data can be viewed on demand at any time on a dashboard via a web browser or on other end devices. The service can be easily implemented in any existing hydraulically operated plant/machine.

MAINTAIN makes it possible to react in time before damage or even failures occur, in the case of unmanned shifts. The package offers the possibility to use unlimited historical data. In addition, we provide you with regular performance and usage reports to help you optimize your application.

With PREDICT, our experienced experts evaluate their data from the self-learning algorithm and provide recommendations in the event of an anomaly. Our analysis as well as our experts support you in the monitoring of your machine and result in up to 40% reduced machine downtime due to faster fault detection. Additionally to optimizing maintenance planning, a predictive maintenance service ensures maximum availability and simplified spare parts supply.

The graphic below shows how users can save time, with all our packages. With each package, more time is saved. MAINTAIN gives users a notification if something does not comply with the rules. The time users save with the help of this package is that they can always check the current status of the machine and get a message before a component fails. Because of that, they can react early and do not lose any time searching for problems. PREDICT saves even more time because the CytroConnect Solutions platform detects an anomaly early and our experts give users a recommendation on how to proceed.

WITHOUT CYTROCONNECT SOLUTIONS

*No relearning of plant functioning required

Unplanned Downtime — Waiting Time until Arrival of Maintenance Team — Anomaly Inspection — Determination of Maintenance Process — Spare Parts Ordering & Staff Organization — Waiting Time until Arrival of Spare Parts — Maintenance — Restart of Plant

Early Anomaly Detection before Breakdown — Analysis & Expert Recommendation — Spare Parts Ordering & Staff Organization — Planned Maintenance (e.g. outside of Production) — Restart of plant*

Production Phase Started Earlier

WITH CYTROCONNECT SOLUTIONS

Production

Downtime ● ● ● ●

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Raise your Availability with aditional Services

PREDICT is a complex service with a broad range of options. However, in order to enable you to maximize the availability of your system, we offer optional additional service contracts.

FITNESS CHECKS

With our fitness check, you can discover how "healthy" your system actually is. After this service has been provided, our experts recommend measures to prevent unscheduled downtime. As a result, your production process will be more reliable, and you will be able to plan better for the future. You will also benefit from the best possible introduction to the world of IoT and predictive analytics

SPARE PARTS MANAGEMENT

We can help you to improve your production scheduling. Thanks to our recommended courses of action (in the PREDICT package), you can manage maintenance work, making your production processes more efficient. The right spare parts will be available at the right time thanks to our spare parts management!

FIELD SERVICE

Our field service allows you to always have access to our field service at the right time in order to replace quickly and accurately any defective components. In conjunction with our spare parts management, the field service immediately provides you with the relevant spare parts. Thanks to CytroConnect Solutions, anomalies can be detected early and maintenance work can be scheduled at the best time.

MODERNIZATION

Is your system still not ready for Industry 4.0 or our CytroConnect Solutions, but purchasing a completely new system would be too expensive? Bosch Rexroth provides you with a cost-effective alternative in the form of proficient modernization. We provide you with professional advice on the technical modernization of dated components.