



# Maintenance 4.0

Maintenance Management for the  
Future Factory



# Maintenance Management in the age of Industry 4.0

Automation and digital transformation are having a main impact on the factors of production: "capital" (plants/machines) is becoming more and more important whereas the role of "labor" is fading. All major industries rely on robots to enhance their production processes. The number of automated equipment has been rising for a long time and this trend isn't going to lose speed. The charts of the International Federation of Robotics (IFR) point only in one direction – up. According to IFR estimates 2.6 million industrial robots will be used all around the globe in 2019.

Maintenance has always been a strategic factor of success in capital-intensive industries like raw material processing, the chemical and automotive industry. As manual labor is becoming obsolete due to automation in a wide variety of industries, maintenance is pushed to the forefront as a prerequisite for success. Traditional drivers of efficiency in a lean organization are no longer adequate under the rules of Industry 4.0.

The best example is Adidas. Sneakers used to be a product of handwork, literally put together by hand from sometimes up to a hundred parts. Now they are assem-

bled by specialized machines in a largely automated process. As a result, maintaining these machines is now an important driver of profitability for Adidas.

“ Maintenance 4.0 is the determining factor in making tomorrow’s production plants profitable

Maintenance has to improve continuously because new developments in industrial manufacturing demand increased availability, reliability and flexibility of plants and machinery (Fig. 1). Maintenance 4.0 is the technical foundation and the driver of efficiency in the factory of the future.

Another important question: What are the building blocks of a forward-looking asset management? We have sifted through research papers, independent studies and the results of ConMoto's numerous projects. The conclusion: Crucial industrial developments open three main fields of action for maintenance:

- Predictive Maintenance
- Mobile Maintenance
- Asset Innovation/Life Cycle Costing

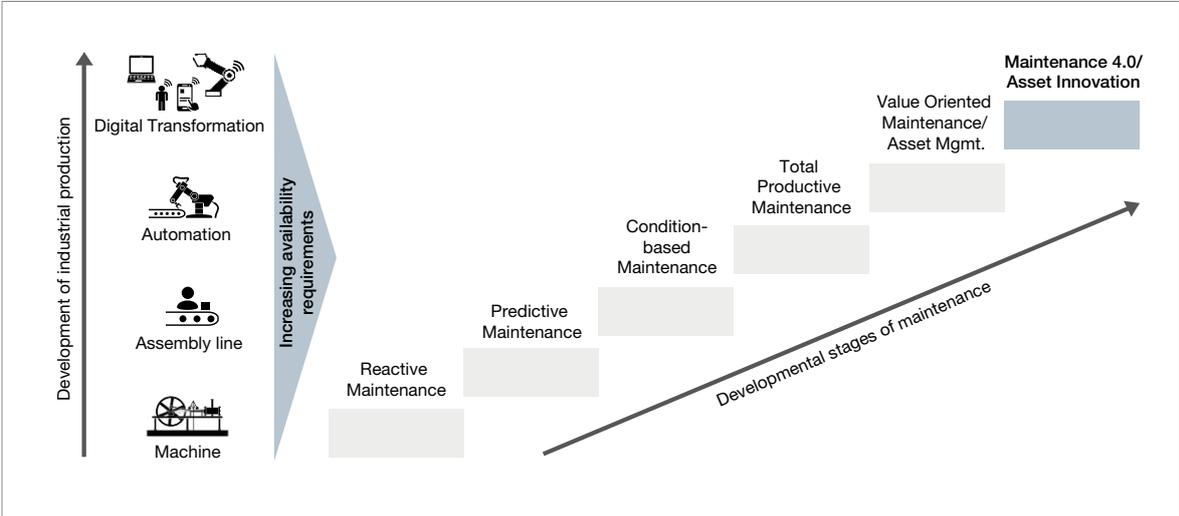


Figure 1: Maintenance – Developmental stages on the way to Maintenance 4.0.

## Predictive Maintenance – Knowing in advance which machines will shut down at which point in time

A sustainable, highly efficient production system requires an optimized Overall Equipment Effectiveness (O.E.E.), focusing on reliability, availability and process stability. Plants and machines have to run dependably. From their own experience, managers in charge know that equipment failure reduces a company's profitability (RONA<sup>1</sup>) as quickly as basically nothing else.

An automated and interconnected production system can be brought to a standstill by a single malfunctioning machine or component. Direct downtime costs (personnel, spare-parts, external services) and – even more important – loss of production costs (production shortfall, delivery failure, reduction in quality) have immediate negative effects on operating income. In our projects we see time and again, that companies suffer intolerable reductions of equipment availability despite substantial maintenance expenditures. Root causes of production loss are:

- Machine breakdown cannot be avoided, because risks of failure are not detected in time.
- Error causes and part-failure curves (P-F curves) are not available.
- Maintenance intervals for critical components are too long or necessary maintenance work is simply not done.
- After a failure, reaction and repair take too much time.
- Repair quality is insufficient causing rework and repeated errors.

Machine availability is reduced not only by unplanned failures, but also by planned downtime. Frequent weak points of industrial production are:

- Maintenance and inspections are scheduled according to time intervals NOT according to machine usage.
- Identical maintenance intervals for similar machines that have strongly differing workloads.
- Maintenance expenditure for un-critical components.
- Poorly executed repairs.

High maintenance expenditure accompanied by a deficit in machine availability is caused by reactive maintenance. This is not only costly, but also fails to solve the problem. Metaphorically speaking maintenance is trying to constantly cope with a burning fire – and even taking pride in putting it out again and again – instead of intelligently investing in fire safety, preventing a fire from breaking out.

With that in mind, how can unnecessary production losses be avoided in order to significantly reduce follow-up costs? In expert circles plant and machinery data is treated as the fourth factor of production complementing land, labor and capital. To put it bluntly: companies that fail to understand that data is the new production factor, will fall out of competition. The solution is simple – predictive maintenance – at least that is what the glossy brochures of management consultancies and IT-experts are telling their clients. Predictive maintenance, they claim, is the measure of all things.

1) Return on Net Assets (RONA) is a key performance indicator that measures a company's profitability. RONA is calculated as net income divided by fixed assets and net working capital.

Well, is it really that simple? And what is Predictive Maintenance? Predictive Maintenance is a concept that uses real-time data of critical components and machines to forecast necessary maintenance measures and determines the ideal point in time to implement them. Predictive Maintenance analyzes a component's state, the degree of wear and tear and calculates a date of expected component failure. A point in time when the wear limit is reached and a component's proper function can no longer be guaranteed.

Today Predictive Maintenance accounts for only 2-3 percent of all maintenance expenditure. This finding is supported by the experience of more than 300 ConMoto projects in Maintenance and Asset Management. In real life, companies in the industrial sector are still reacting, working with time-based models of periodical maintenance and inspection. To put it positively: there is vast potential for improvement. Will Predictive Maintenance be the magic bullet? That is highly questionable.

There is one central benchmark for a reasonable maintenance strategy: cost effectiveness. This simple fact does not change in the new era of Industry 4.0. As sensor technology and the underlying software gets cheaper, Predictive Maintenance becomes

economically more viable. But it's a fallacy to expect that every critical component and every grease fitting can be monitored and fitted into a predictive model – at least for the foreseeable future. This way of thinking is as visionary as it is uneconomical.

“ Predictive Maintenance is no magic bullet, but a concept of enormous potential

Based on risk and profitability analyses ConMoto predicts that the percentage of Predictive Maintenance for machine components will rise, up to circa ten percent within the next five years. In the long run this share will reach 20 percent. "Total Monitoring" is a long way from being practicable, because cost-benefit analysis is king! Predictive Maintenance is not an end in itself.

The bottom line is clear: Predictive Maintenance is a powerful strategy to unlock hidden potentials of a plant's performance. However, for economic reasons Predictive Maintenance is only one option in the maintenance strategy mix. It is no magic bullet.

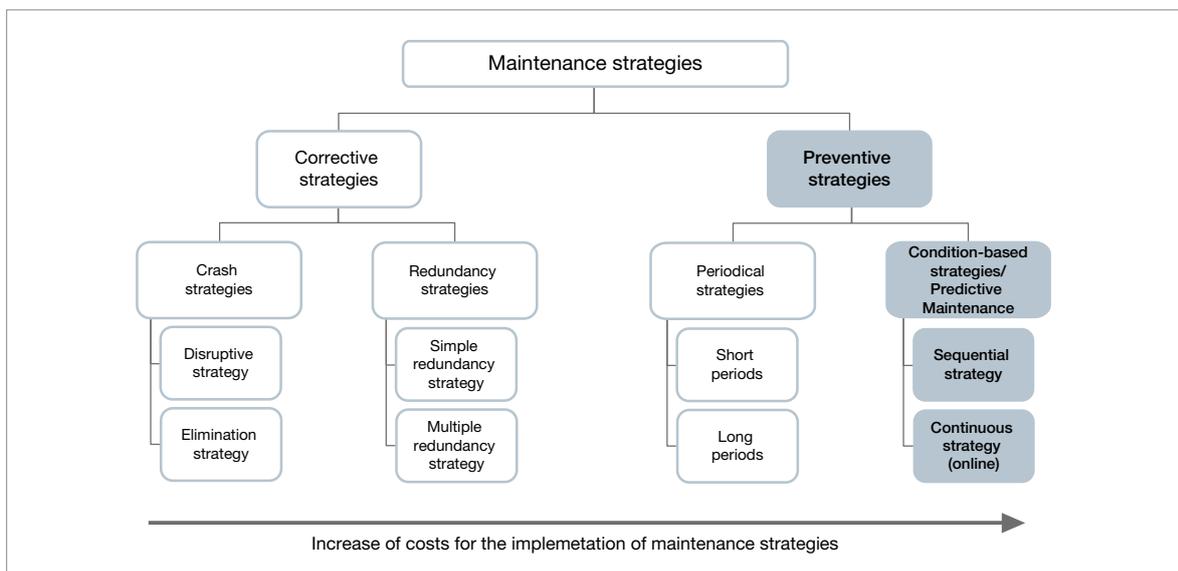


Figure 2: Classifying Predictive Maintenance by basic maintenance strategies

The pages 4 to 11 are not included in this preview.  
Should you be interested in the whole White Paper "Maintenance 4.0 - Maintenance Management for the Future Factory", please contact:

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