# PREDICTIVE MAINTENANCE

– how Artificial Intelligence minimizes risk and costs.

**The world is changing. Modern business models are evolving. Something unimaginable some time ago is becoming a fact of life – what used to be a "purchasable product" is more often becoming a "service". The very popular phrase "I have" has turned into "I am using".**

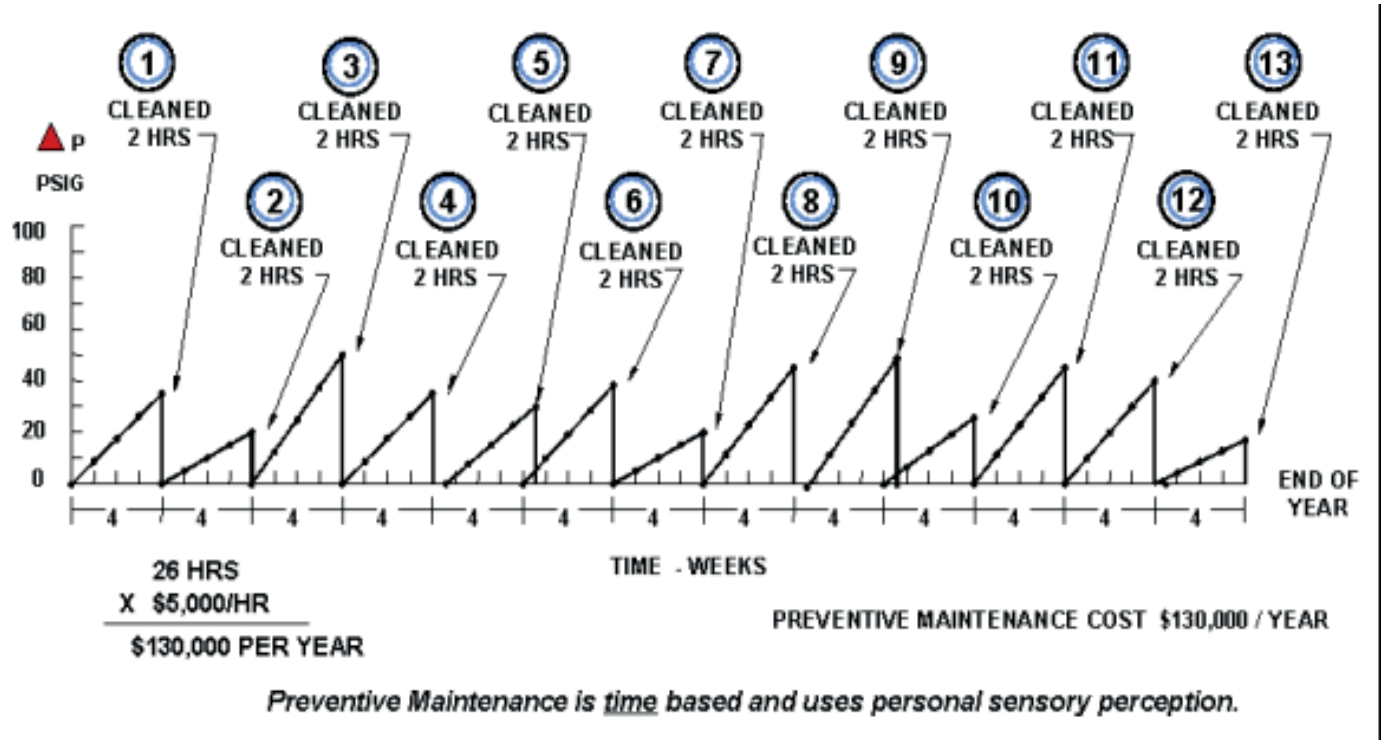
The precursor of this trend is the real estate market (with its popular in the western countries rentals vs possessions), but it can be seen in much more traditional product business. Sold cars can be leased – not to mention "minute rentals". The biggest aviation companies offer their engines to airlines in these models. The more you use, the more you pay. When you don't use – you don't pay. What more – the engine supplier could compensate for when their engines are not fit for use. In such scenarios, controlling the necessary cost to run your business reaches a whole new level. Those, who can control their maintenance costs most effectively, out beat the competition. This is where Artificial Intelligence comes in handy when it comes to asset monitoring.

## Predictive Maintenance – what is it?

Let's imagine, that the owner of some critical equipment (ex. an industrial machine tool for wind turbines) is trying to keep high-cost effectiveness. The machine tools begin to malfunction because they are heavily exploited 24/7. They need servicing which is very costly. An irresponsible owner will fix the machine after it's broken down (Emergency Based Maintenance model). This means additional costs and production interruptions at least expected times, delays caused by waiting for spare parts and paying employees while waiting to fix the problem.

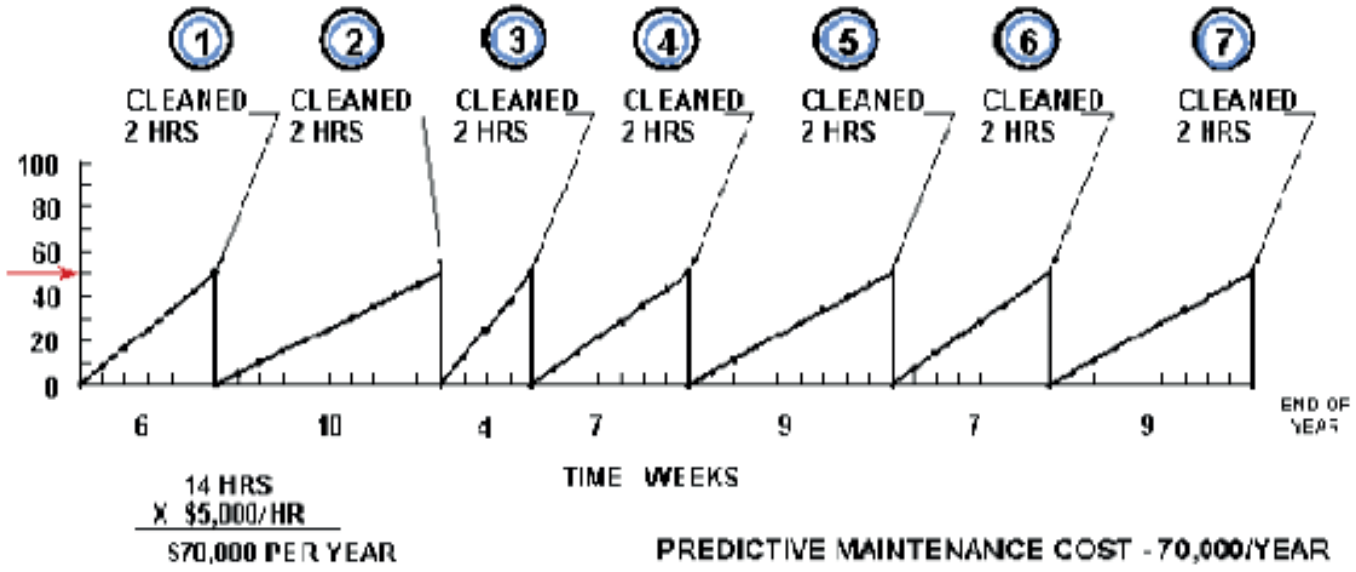

Pic. 1 Maintenance Costs in "Emergency Based Maintenance" model

In a traditional business model ("Preventive Maintenance") the risk of machine failure is adequately calculated (ex. a foreseeable breakdown is expected every 3 months), and any maintenance activities are scheduled ahead of the malfunction – ex. replacement of critical parts every 2,5 months during low exploitation times (service windows). Everything seems to be working fine, but is that effective? Not really – you need to buy and maintain various spare parts in stock, not to mention that parts, that could stay on the tool longer are being replaced.




Picture 2. Maintenance costs in a "Preventive Maintenance" model

What if there could be a crystal ball, that could foresee a malfunction with appropriate due notice? Then one could order the necessary spare parts, perform maintenance activities often enough (or rather rarely enough) and avoid the extra costs of unexpected failures.

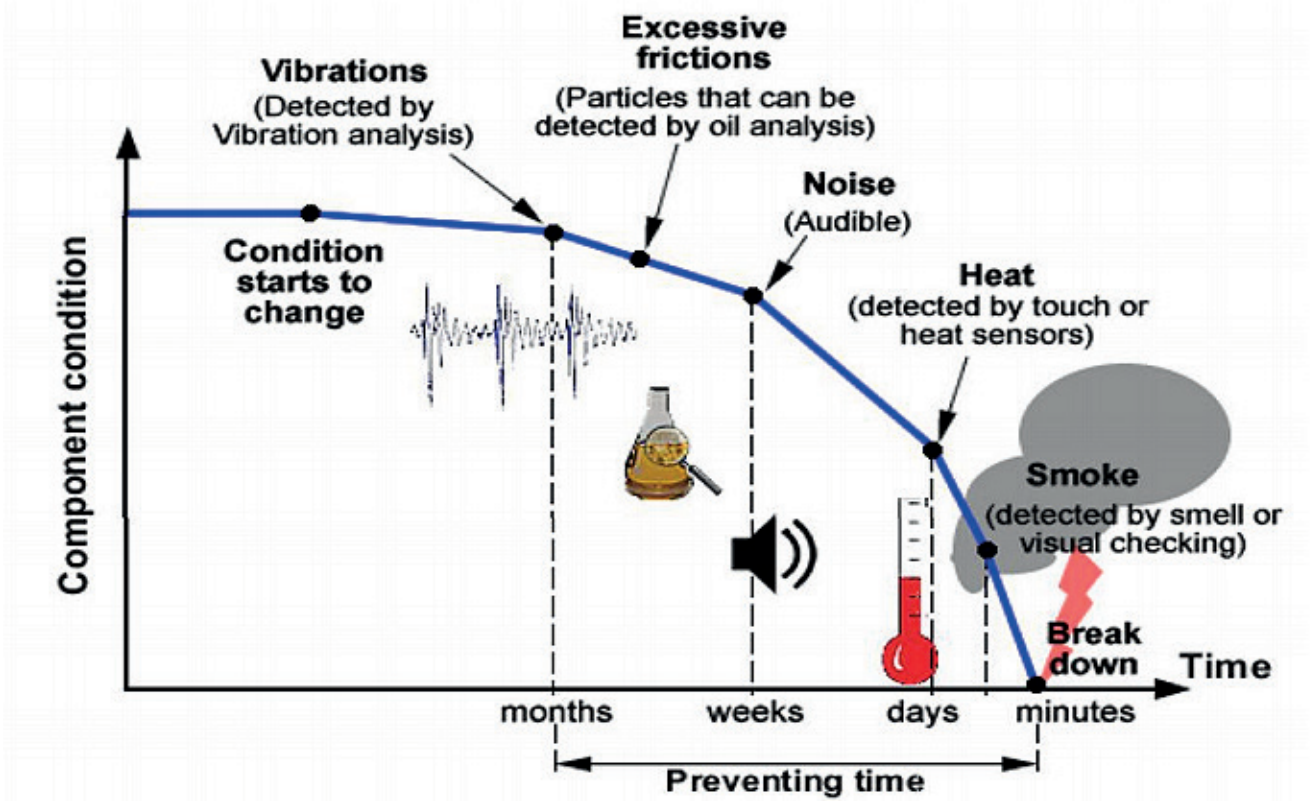



Picture 3. Cost benefits of a "Predictive Maintenance" approach

Yes, this approach is called „Predictive Maintenance" and is far more interesting. But, can something like this be scheduled? The answer is – Yes – this is possible with today's technology. All you need to do is start collecting machine data, in order to use it for "Predictive Maintenance".

## Case Study – how to do this?

In the example above (but also any other one concerning rotating devices) an intelligent "Vibration Analyzer" can be built. Thus, any rotating element is causing vibrations, and in case of a malfunction, it vibrates in unexpected ways. The vibrations can be a symptom of failure. Bearings that can be heard, is nothing more than the effect vibrations – a sound wave generated by vibrations. Except that, once you already hear something, it might be too late. Soon after you can start seeing it (ex. fire, caused by unexpected friction) then it's a critical failure. Noticing anomalies in vibrations soon enough allows avoiding such issues.




Picture 4. Symptoms of upcoming failure and ways to predict is sooner (source: 1)

Ok – but one could say "vibration analysis" is a known topic – paying "big money" to companies who analyze the state of machinery based on their vibration spectrum. Where is the AI? Well, in this case, Artificial Intelligence comes in two areas. First, utilizing Deep Learning, the algorithm can be taught correct and incorrect vibration profiles. Furthermore, incorrect profiles can be classified by diagnosing what will break and when. It's not magic, just enough service data. What more, Artificial Intelligence algorithms can be immune to human error. For example, noise. Vibrations detected from devices mounted in other "vibrating environments" can be confusing for the human ear. AI could effectively learn what is a symptom of an upcoming failure, and what is just noise.

## Next steps

Predictive Maintenance can be successfully applied in other business domains then the one mentioned above. All you need is (start collecting) data and… experiment. It's not hard to imagine algorithms forecasting network failures, ex. in telecom or other than rotating type of devices. Data is most important. Collection (designing flows and big data storages), its correct processing (data analysis) and preparation of intelligent solutions (Machine Learning). Gfi gained its experience by collaborating with one of the largest aircraft engine suppliers in the world. If you have a similar idea or problem, want to build an intelligent "Predictive Maintenance" solution, or simply start gathering data to prepare for ML and AI – we are ready to help.