

Management Side of *Engineering*



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Artificial Intelligence Poised to Revolutionize Preventive Maintenance

Highly automated applications of pattern recognition technology that can predict machine breakdown events with 80%+ accuracy one week ahead of occurrence offer the promise to soon make the current regimens of routine preventive maintenance obsolete. This is fact, not an exaggeration. These first applications for industrial asset management use the same type of pattern recognition technologies perfected in military scenarios and other mission-critical situations. The methods, or more accurately the combination of methods, have only become possible very recently.

Whether or not the term "pattern recognition technology" is familiar to you, the technology itself certainly is. That spell checker on your word processor is a primitive version of pattern recognition technology. So is the voice recognition software that now allows you to reach many customer service departments by phone. And, if you have ever received a call from your credit card company inquiring as to unusual purchases on your account, it probably was a call enabled by pattern recognition technology. Using pattern recognition technology to predict machine breakdown events is simply a far more complex and sophisticated variation on these distant cousin pattern recognition technologies.

Pattern recognition technology is built on various mathematical methods used to model and interpret data. In essence, pattern recognition technology takes what mathematicians think of as highly dimensional data into one-dimensional space. That one-dimensional space is a single number or representation that can provide a classification or prediction. Machines, being electromechanical systems, have a variety of parameters that can be mathematically mapped. The mapped parameters of functioning machines create certain data clusters, while those of malfunctioning machines create different data clusters.

Pattern recognition technologies then find the partitions between different clusters. When machines with new parameters are mapped, they fall on one side or another of the "discovered" partitions, and meaningful predictions of machine behavior are then made.

Thus, the magic, if you will, is in the math. Sources for such pattern recognition studies do not require you to have any additional hardware or software in your plant. For example, pattern recognition studies do not require you to outfit your equipment with new sensors. In fact, sensor data is only one type of data used in such studies. All of those operating codes—activity logs, error logs, command codes and sensor data—may come into play. Usually, all your plant needs to do is use existing modem or Internet hookups to send such data to a service provider capable of conducting machine behavior studies with highly automated pattern recognition technology.

Distributive computing technology that allows such a highly automated process to proceed does underlie such applications of artificial intelligence techniques, but there is no need for your plant to make extensive and expensive hardware investments. More to the point, your operation can obtain outsourced studies without making the multimillion-dollar and decades-long investment it takes to master the mathematical and programming expertise that underlies pattern recognition technology.

Because these studies predict the behavior of each and every machine in a population with 80%+ accuracy, you no longer need to make or use analyses of trends in machine breakdowns. Routine replacements of parts as part of preventive maintenance can also be minimized, if not eliminated altogether. Instead, you know which parts in which machines will break in the coming week, so you can then schedule replacement part installations accordingly.

A pattern recognition technology-driven inven-

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tory management system delivers parts so that predicted break/fix events are addressed during normal preventive maintenance. With accumulated experience, all break/fix events are predicted early enough to be addressed during preventive maintenance, and ultimately, advance diagnosis of break/fix events eliminates them altogether.

Pattern recognition technology predicts the behavior of each and every machine in a given population. A savvy plant needs to replace parts far less often, because it has insight into which parts really need replacement, and when, for *each* machine.

"Break/fix events are predicted early enough to be addressed during preventive maintenance."

Today, most businesses estimate that they spend 1.5% of gross revenues on service delivery. Studies to predict machine behavior with pattern recognition technology tools, now in their infant stage, promise to dramatically alter this standard.

The revolution, so to speak, is actually a tried-and-true mechanism to bring cutting edge mathematics to bear on everyday problems of plant engineering. For most companies, prepping machine populations for pattern recognition studies can be done in hours or days, not weeks.

More than anything else, the return on investment from this breakthrough technology requires a new way of thinking from plant management.

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