

The factory of the future speaks our language

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Fazel Ansari in the pilot factory of TU Wien. Credit: Vienna University of Technology

The complexity of large industrial production plants is hardly manageable for a single person. In order to maintain, monitor and service an industrial production line, it therefore makes sense to rely on artificial intelligence (AI).

There are different strategies for this. The most obvious would be to equip machines with sensors and to infer the condition of the plant from the [sensor data](#). However, a large part of the information about machines and production [plants](#) is not available in the form of digital measurement data, but in the form of texts written by humans—from machine inspection reports to shift logs pointing out problems. If an [artificial intelligence](#) could use all this data, it would be a huge step forward. This is exactly what scientists are working on now at TU Wien (Vienna), in the research field of "[text mining](#)" and "maintenance 4.0."

The algorithm that can read

"We are probably all familiar with this—you write something, save it somewhere and then forget about it," says Dr. Fazel Ansari from the Institute of Management Sciences at TU Wien. "An audit report might be flicked through briefly, then it disappears in the drawer. To draw the right conclusions from it and initiate the necessary measures, you need a lot of experience."

Human experience is extremely valuable in the industry, and it will probably remain irreplaceable in the future. Fazel Ansari's vision is to make the collaboration between humans and machines more efficient. When humans and machines communicate with each other—what language should they use? The language of [machines](#)—for example in the form of long tables with numerical codes, or in human language?

"If we succeed in making natural human language understandable for artificial [intelligence](#) in industry, then a huge amount of additional

information opens up to us," says Fazel Ansari. "Imagine how much knowledge you can extract and use about a [manufacturing plant](#), from written records of the last ten years—from shift books, logs or final quality control reports." Much more comprehensively and precisely than any human, an artificial intelligence could automatically recognize patterns from large amounts of data—for example, typical problems that are reported again and again before major damage then occurs. In this case, the artificial intelligence could suggest countermeasures.

Tailor-made solutions for every type of plant

However, it is not easy to prepare human texts for artificial intelligence. "You cannot develop a perfect AI that can then be used for any type of manufacturing plant," says Fazel Ansari. "You have to develop customized solutions for each type of plant." Sometimes data are available in the form of handwritten texts—in which case they first have to be digitized. Depending on the type of plant and industry, different technical terms are important, and the AI must first be trained for this.

In order for an artificial intelligence to actually "understand" what the texts are about, it needs to know the overall situation: It needs an understanding of the machine, the processes and even knowledge about the role of the people involved.

Only when the AI has this understanding can texts be correctly classified. This is not only done with statistical analysis, such as detecting the changing frequency with which certain terms occur. Algorithms can also distinguish between positive and negative evaluations—this is called "sentiment analysis." It is possible to examine how subjective evaluations have changed over time; associations between different words are also detected and quantified.

"A lot of research has already been done in this area. To some extent, we

can use existing AI solutions and adapt them to our requirements. But a lot of research is still needed to apply these text mining algorithms in an industrial environment," says Fazel Ansari. "In the Smart and Knowledge-Based Maintenance research group, we have a lot of experience in the field of industrial maintenance; we currently have several research projects running in this topic area. This expertise is very important to be able to apply and optimize the algorithms."

TU Wien's text mining approaches could have particularly disruptive potential in the [insurance industry](#): "For a company that offers insurance for expensive equipment, optimal maintenance is of course very important," says Fazel Ansari. "In this area, you can save a lot of money if you find better methods to detect problems in time."

More information: Fazel Ansari et al, Text mining for AI enhanced failure detection and availability optimization in production systems, *CIRP Annals* (2021). [DOI: 10.1016/j.cirp.2021.04.045](https://doi.org/10.1016/j.cirp.2021.04.045)

Fazel Ansari, Cost-based text understanding to improve maintenance knowledge intelligence in manufacturing enterprises, *Computers & Industrial Engineering* (2020). [DOI: 10.1016/j.cie.2020.106319](https://doi.org/10.1016/j.cie.2020.106319)

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