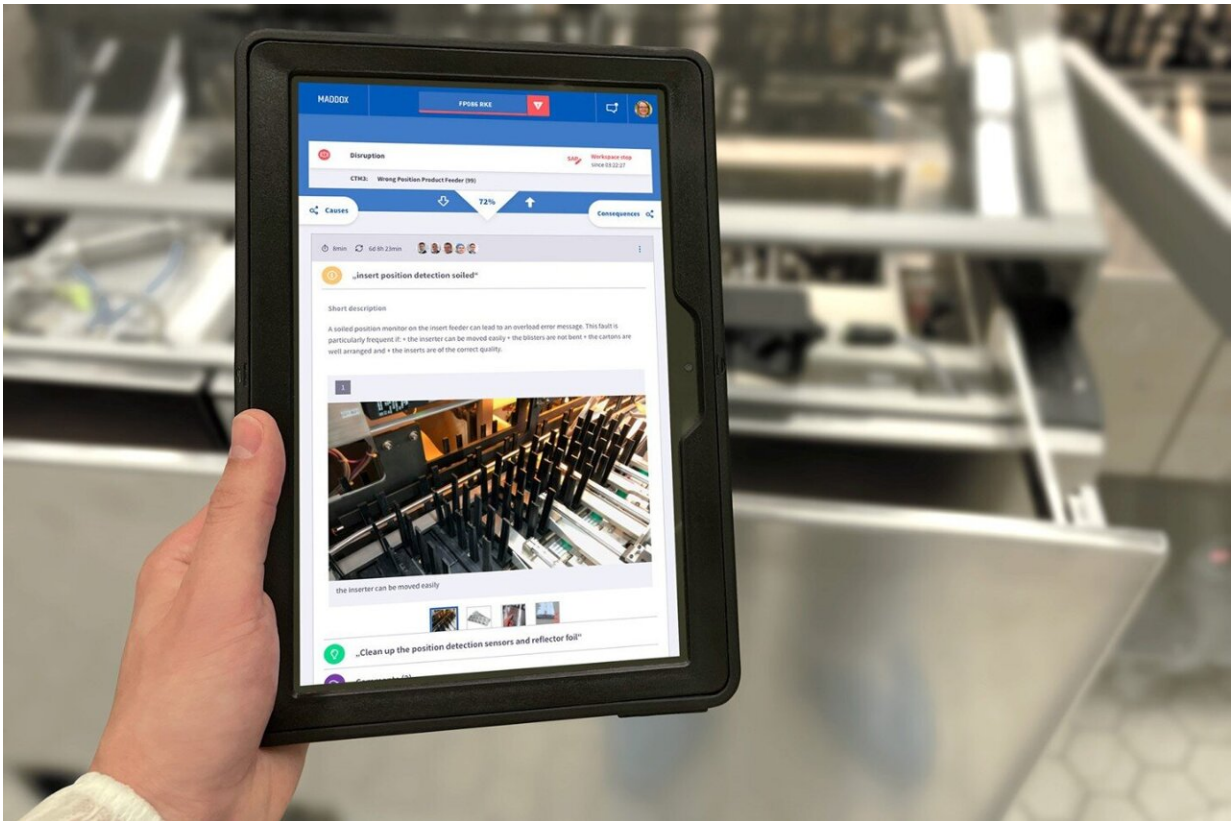# A smart self-learning assistance system for the manufacturing industry

March 1 2022

MADDOX displays the knowledge maps with help information on faults and solutions on a tablet. Credit: Peerox GmbH

Efficiency rates for production machinery frequently fall far below what technology could achieve. The common reason is experienced employees

are not always available when a failure occurs while other employees lack the experience to solve the actual cause. That is where MADDOX comes in. A smart and self-learning assistance system that uses machine learning methods to analyze machine and process data. Via pattern recognition it also searches for similarities in failures and downtimes that occurred in the past. The system was developed by Peerox GmbH, a spin-off of the Fraunhofer Institute for Process Engineering and Packaging IVV.

During a machine downtime it usually takes the knowledge and experience of senior colleagues to fix it. However, they are often absent at these crucial moments, leaving less experienced staff to find the cause themselves to fix it. Even if extensive documentation is provided, it can be a major challenge to find the right information when a failure occurs and puts the staff under unnecessary pressure. As a result, the actual cause of failures is rarely resolved. Instead, they frequently keep reoccurring. These common scenarios in the manufacturing industry are the focus of the Peerox GmbH. Their intelligent and self-learning assistant System MADDOX, helps to increase the efficiency in the manufacturing, reduces waste and contributes to a more economical and ecological production. Examples can be found in the food, cosmetics and pharmaceutical industry. Peerox was founded in the summer of 2019 as a spin-off of Fraunhofer in Dresden by Andre Schult and Markus Windisch with the support of EXIST Transfer of Research, a funding program by the German Federal Ministry of Economic Affairs and Climate Action. Today, the company has a total of 17 employees.

"Many production facilities can barely get their efficiency rate over 60 percent. There is a lot of room for improvement. For the most part, the problem originates by not fixing the actual cause of the failure—for example, an operator cannot tell if the slider is jammed, the vacuum is clogged or if the root of the failure is something completely different," says Andre Schult, CEO of Peerox GmbH. Of course, there are

employees that have the practice and the necessary knowledge but often are unavailable in emergencies. Considering the demographic change, shortage of skilled staff and higher turnover rates, the manufacturing industry becomes more and more dependent on the practice and knowledge of their experienced employees, what causes an increasingly serious problem. Peerox GmbH addresses this issue by digitalizing employees' practical knowledge in MADDOX.

Knowledge cards help to find the cause and solution

"Employees often have no idea what phrase to use when searching for the cause of a failure. For example, if a crushed yogurt container causes the machinery downtime, they could search within the data base for 'belt," 'container," 'strap' or some other keyword. But generally speaking, if they do not find what they are looking for quick enough, they do not see the point in doing some further searching or using the data base at all. MADDOX therefore, is a data driven solution that uses machine data such as pressure curves, temperatures, photoelectric sensor signals or error codes," explains Schult.

The self-learning search algorithm uses machine learning algorithms to analyze machine data and creates categories consisting of similar data patterns. Those are then linked to digital knowledge cards, where employees can use text, images and video to create visual documentation of failures and solutions—similar to a wiki page. If a failure occurs in the machinery, the algorithm analyzes the data patterns, searches for similar categories and displays the relevant knowledge card to the user via a tablet that is not connected to the platform—that is the principle if the smart assistant is in action. If that particular problem (e.g. a dirty nozzle) already occurred four weeks ago, MADDOX will suggest a possible solution that the operator can either reject or confirm, and in return, MADDOX learns what database entries are proven to be helpful in which situation. This trains the algorithm and allowing it to learn

quickly. A specialized preprocessing of data and dimension reduction allows the algorithm to have a rapid learning curve.

Digital assistants with psychological expertise

"Overall, MADDOX acts like a digital colleague that is always there to offer a helping hand," says the engineer. The psychological component also plays an important role. Several features in the Linux-based knowledge management system incorporate human impulses like helpfulness and appreciation. This in return encourages people to use the system frequently, motivating users to confirm, reject, correct and expand the entries, as well as to share their practical knowledge. It was the team's longstanding collaboration with engineering psychologists at TU Dresden that made it possible to integrate these fundamental features into the assistant. "That is the secret what differentiates us from other knowledge management systems. We incorporate the psychological component, that allows us to increase engagement, improve documentation and reduce operating costs," says Schult.

The company currently specializes on the processing and packaging industry. In the long run, they also plan to target other sectors such as the semiconductor, automotive and chemical industry. MADDOX is currently deployed for pharmaceutical packaging at Bayer AG in Leverkusen.

Provided by Fraunhofer-Gesellschaft