



# THE VALUE OF DIGITAL ASSISTANCE

**Samuli Bergman, NAPCON, Finland,** explains how machine learning can aid operators of oil refineries and petrochemical facilities.

**M**achine learning has the capacity to be a very efficient tool for oil refinery and petrochemical facility operators, where the requirements of end products can change at short notice, and the quality of feedstock can vary widely. Because information is constantly gathered from different stages of the process, there are millions of process values – historical and ongoing – that can be compiled into a machine learning model that predicts process behaviour and provides accurate operation suggestions to operators.

An oil refinery operates constantly, and though the process is highly-automised, there are many process variables for operators to supervise at the

different process steps. This task is particularly challenging, as product quality requirements can vary with short intervals, which in turn requires a lot of changed process parameters.

A human operator is simply not able to carefully watch every monitor and follow all important process variables simultaneously, which means that digital assistance makes it possible to operate a process with increased efficiency. To address this problem, Neste Engineering Solutions began to develop an AI-based solution built on a machine learning model that demonstrates what happens chemically and physically inside reactors, pipes and columns. The model also covers the automation's effects on the factory.



## Making changes

At all chemical processing plants, huge amounts of data are constantly collected regarding flow, temperature, pressure, and other process variables. In addition, there are large amounts of historical data that has been collected over a long period that can be used to teach the machine learning model what a well-functioning process should look like.

The core of machine learning is that the more material that is fed into the system, the more the AI learns about how the factory behaves under different circumstances. When fully trained, the digital assistant can predict how the process will behave during certain hours, for example. Operators can also consult the digital assistant if help with the settings is required. The next development step could be a verbal interface such as Siri, Google Assistant or Alexa, but the fully-developed system is yet to be completed.

Within chemical processes, there are both slowly changing phenomena (such as when the process equipment wears and gets dirty on the inside or when the catalysts in the reactor slowly fade) and fast events (such as when new batches of



**Figure 1.** The Advisor and/or Phenomena Indicator create dynamic models of an oil refinery process or a petrochemicals unit to optimise process conditions, meet production objectives, or detect malfunctions.

feedstock are fed into the process, which must be changed accordingly). Process units must adapt to these changes, and it is here that a digital assistant could shine, as it can be used to calculate how the process could be optimised, and instruct operators as to how to reach the goal.

## Prolonged service intervals

Because a digital assistant carries out the calculations continuously, the machine learning model is constantly changing and evolving. The advice applies mainly to factors such as temperature and pressure, and the idea is that the operator implements the advice by changing the set points in the process control system.

Of course, it is the operator's normal job to handle these factors, but by using the digital assistant's advice, the measures can be scheduled more precisely in difficult situations. It is also more likely that the setting values are correct, as the AI model can sort out enormous amounts of data in a fraction of a second, and apply this wisdom to aid the operator.

AI can also be used to extend the lifetime of the process equipment, which can result in prolonged service intervals and smoother running processes. If, for example, the wrong temperature or pressure is used, the components of the plant wear faster, but for a digital assistant, it is not difficult to always find the optimal value at different stages of the process. This could mean that a production shutdown for service can be postponed, which in turn corresponds to better earnings.

The digital advisor's situation-specific optimisation also helps to reach the true limits of a plant, whether there is a need to reduce carbon emissions, optimise utilities, or maximise certain yields.

## Inside information

Neste is the one of world's largest producers of renewable diesel, but the company also has a subdivision, Neste Engineering Solutions, which implements Neste's innovations on an industrial-scale; carries out major industrial investment projects; and helps its customers in the process industry to continuously develop their production and to optimise their processes. One of Neste Engineering's units,

NAPCON, specialises in the development of solutions to help companies in the process industry to streamline their processes.

Many of NAPCON's solutions are tried and tested at Neste's refinery in Porvoo, Finland, but the company also sells its expertise to third parties that want to have better control over their processes. The digital assistant, NAPCON Advisor, and the soft sensor,



**Figure 2.** A digital operator assistant predicts the dynamic behaviour of process variables; creates what-if scenarios to allow operators to test various operative scenarios; and suggests what changes should be made in order to meet operation objectives.

