NAPCON - DIGITALIZATION AT PROCESS INDUSTRY

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OPERATIONAL INTELLIGENCE WITH PROCESS INDUSTRY PRODUCTION DIGITALIZATION

Digitalization in the process industry has reached production facilities. The future, dominated by AI, will be realized by putting the data management in order first into data-based applications. Digitalization should be started always from the most profitable applications. In many cases, it means amplifying the real-time visibility to the production with dashboards before AI applications.

Recently, technological advances in industrial automation, especially in the areas of IoT, data analytics, and machine learning, have been significant. The opportunities brought by new technology, are constantly shaping production optimization and business opportunities. They put new pressure on companies to deliver services and products to customers in a more flexible, efficient and environmentally sustainable and carbon-neutral way. The key to this can be seen as digitalization, which means not only acquiring new systems to replace the existing ones, but also a comprehensive rethinking, reorganizing and innovating the company's operations. Main emphasis must always be in listening to internal and external end users. Industry has recognized the importance of involving whole workforce in change; in a rapidly changing operating environment, the adopters of team intelligence will succeed the best. Above all, it is about how we learn to perceive and take advantage of the ever-accelerating change in a new way.

In the transition of the process industry, [1] for example in the European process industry can be seen transition with other global trends towards cleaner, resource-wise and especially carbon-neutral production. Additional challenges are posed by the continuous development of employee skills and ensuring information security. These are strongly related to new digitalization solutions, and thus trust and privacy. To ensure competitiveness, digitalization, AI and company-wide optimization of logistics, supply chains and production should be become mainstream policy. Due to the constant development of technology, intensifying global competition and the pressures of climate crisis, the process industry must be able to meet increased efficiency, productivity and sustainability requirements while simultaneously moving to a circular economy and carbon-neutral production.

Base level in the digitalization of production systems is ensuring real-time production information in a secure and cost-effective manner to serve future AI applications. Those solutions will refine knowledge from the data to increase operational intelligence in production. This is done by utilizing machine learning and artificial intelligence to help daily operative decision making and streamline and optimize operations.
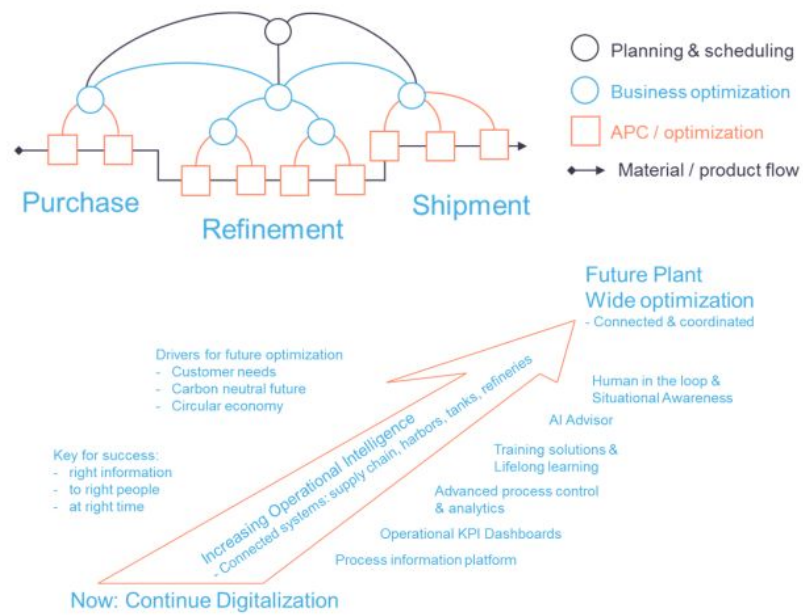
Picture 1: Progression of the digitalization of production plants in the process industry step by step at different operational levels towards operational intelligence and comprehensive optimization of production. This article focuses on the basis of the digitalization of production, i.e. the information platform (Process Information Platform) and real-time KPI visualization dashboards (Operational KPI dashboards).

The process industry has long been reluctant to make investment decisions for digitalization, especially in operations, although the potential of data-driven applications such as predictive maintenance, intelligent real-time analysis, intelligent decision support, machine learning (ML) and artificial intelligence (AI) is enormous. There is thus a large potential user base for clear and value-added solutions to maximize and optimize the operational intelligence of production.

Possibilities of digitalization in the process industry

Stronger operational performance can typically be sought in three different application areas [2]:

1. Customer functions such as sales and marketing,
2. Core activities such as product development, production and logistics; and
3. Support functions such as human resources and financial management.

Digitalization has already been progressing in the process industry, especially in customer operations. Several universal solutions are available in this area and it has been possible to make use of existing cloud tools from large global players. Advanced analytics has been utilized in businesses (Business Intelligence, BI) and maybe in parts of individual

production processes. Solutions for developing cost efficiency, quality and safety exist also in operational technology.

The ongoing production digitalization in line with Industry 4.0 brings entirely new process and technology innovations that make operations transparent in real time, eliminate bottlenecks and improve yields, operational performance and safety. Combining data from production systems, sensors and mobile applications with the company's business systems provides a new kind of information to support the continuous development of operations.

Digitalization as an enabler of operational intelligence in production

In particular, the digitalization of the process industry core production processes has been rather slow, due to the high degree of production customization, the lack of measurements or the lack of industry-specific solutions in the market. The production environment of the process industry, where each plant and unit has been built for its own unique operations, easily accessible analytical and other intelligent applications may not have been easily available in the absence of uniform or sufficiently high quality data. The long lifecycle of the systems and the lack of intelligent actuators or sensors in older units have prevented the use of data-based methods. For a long time, projects in the process industry in machine learning and artificial intelligence have been highly tailored, single-target projects with a long development trajectory but possibly a small increase in the total value of production.

In particular, a new generation of machine learning methods and tools has given new impulse to the digitalization of core functions. Thanks to them, traditionally old-fashioned process industry has started to look at solutions that enable data integration and analytics, which has lowered the threshold for the introduction of intelligent production improvement methods. In particular, new machine learning languages and libraries have become common in recent years and made unified data a significant competitive advantage. This has given totally new opportunities to production digitalization.

Industry 4.0 and OPC UA in the process industry

Advanced digital standards such as Industry 4.0 and the OPC UA used for data transmission bring interoperability, security, extensibility and the necessary boundaries between vendors for the digitalization of production. Since its introduction in 2008, OPC UA has gained widespread support from industrial solution providers and companies. Ensuring that systems used in digitalization support Industry 4.0 and OPC UA guarantees best possible compatibility in the future. As Craig Resnick, Vice President of ARC Advisor Group, notes; "OPC technology has become the de facto standard in global data management from industrial automation to MES / ERP and IT cloud levels." Industry 4.0 and OPC UA in the process industry are described in more detail in [4] and [6].

Digitalization of production - aiming for real-time, predictive decision making support

New opportunities in the process industry are mostly based on machine learning models of processes and phenomena, which can be utilized in, for example, predictive maintenance, process forecasting, logistics optimization and comprehensive production optimization. Digitalization, combined with artificial intelligence, also brings new ways to attract new players to the industry and to maintain and anticipate the lifelong learning of employees by providing real-time information on existing workforce training needs. At the same time, it should be borne in mind that the biggest concrete change by the digitalization is not the new technologies themselves but the entirely new business models they enable, and in particular the benefits of transparency and predictability in production and operations.

The goal of operational intelligence in production can be thought of as enabling real-time visibility to production, increased situational awareness and real-time decision-making support, i.e. assisting operators, production planners and maintenance personnel in their daily activities. Data-driven, machine learning-based intelligent AI solutions play a key role in this transformation.

Flexible production data collection - production information platform

The basis of the successful and scalable production digitalization is a reliable production information platform that combines production process data to other related sources for the easy further processing [5]. The information platform collects, combines and validates production data from the production assets and merges other data sources to it so that the analytics and machine learning methods can be maximally utilized and data can be generalized to the enterprise-wide use. The production information platform is thus a key element in the production digitalization, because it enables advanced solutions (like AI) usage in production and in business.

The system required to collect a comprehensive amount of production data is affected by the type and age of the plant, the existing systems, but especially the applications for which the data is collected. If the processes include operations where the sampling frequency is high and / or large-scale distributed data collection is required, it is often advisable to do part of the analysis before merging the data (Edge Analytics). Especially this is the case with high-frequency signals that should be analysed locally and used as indicators of change for further use. Often, data are collected specifically for business analytics, in which case required time frequency is low. The time resolution is especially affected by the target application that has a significant effect on how much data need to be transferred. This, in turn, is influenced by the dynamics and scale of the production system; for traditional process industry analytics and operational intelligence, data collection on a scale of seconds and / or minutes is usually sufficient. Predictive maintenance, however, may require a significantly higher sampling frequencies.

Requirement definition for the production information platform is a crucial work step for the success of the implementation, in which it is worth investing resources. Here you should make the most of the company's own experts. The platform needs to be flexible to support new needs and changes that arise later, if possible also automatically. For example, OPC UA supports the automatic connection of new devices and signals to the system, which greatly facilitates system maintenance.

As technical requirements, the production information platform must be compatible with the production systems in use, easily adaptable and extensible, and ensure data security and -reliability. For a solution to be financially secure, it must support existing and future industry-critical standards such as OPC UA. OPC UA enables system vendor independence, configurability, data reconciliation through information models, and the best possible security as built-in for transferring production data over public networks to cloud solutions. OPC UA utilizes proven IT protocols and methods for overall cyber security issues.
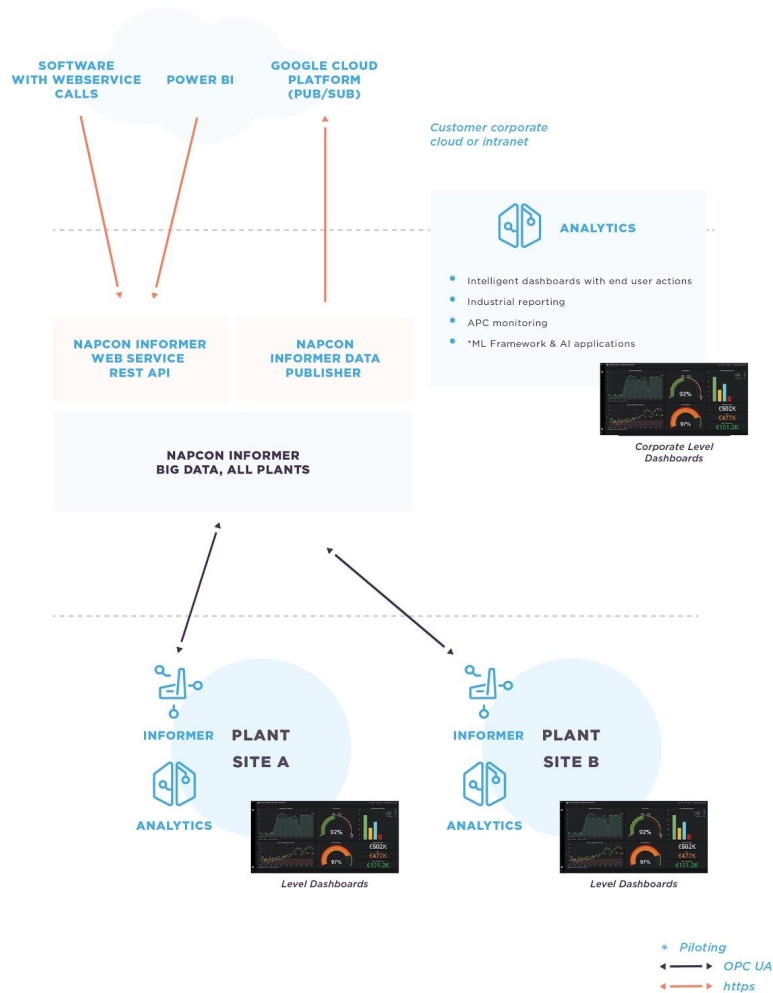
Picture 2: NAPCON Informer can easily be configured to implement different roles of production information platform. Data can be collected and combined from different production facilities and systems and securely transferred to multiple cloud environments using OPC UA and pub/sub connectivity.

Flexible Real-time overview of the production performance

Once the company has ensured it has an information platform that brings together data from different production assets and functions (typically to cloud environment), it is possible to start thinking and building applications on it, which will enable the full utilization of digitalization. In the process industry, the first such application is often the visualization of KPIs (Key Performance Indicators) that provide a real-time overview of production. Previously, production performance indicators were obtained from production reports with delay. Same information can now be presented in real time as a basis for decision-making, alongside the production plan for operators, production planners and other stakeholders to use it to optimize operations.

The practical implementation preferably includes dashboards implemented with web technologies, i.e. data visualisations that can be used with several (including mobile) terminals whenever information is needed. The requirements for the solutions are mainly similar than the typical features required of IT solutions, such as high cyber security, usability, and flexibility with regard to systems change. Dashboards can be configured to automatically display information tailored to different user groups within production. This enables the right information to be shared with the right people at the right time, such as a comprehensive operational KPIs snapshot for operators, the results of predictive maintenance for maintenance operators, or upcoming raw materials and customer needs information for production planners.

A key step in building production dashboards is to define the most relevant production performance indicators (KPIs) based on business needs. Here, too, the focus should be on the experience and insight of production experts, as they have the necessary knowledge of the impact and usability of different variables in production control. The mere use of business control variables can lead to target indicators that are unfavourable for the productional aspects and thus to lead to partial optimization or even unwanted phenomena. It is therefore important to openly build and discuss a clear picture of the supply chains of production or services as a whole and to base the metrics on this analysis. An external consultant can also be used as an assistant, as long as you remember that the views of your own staff must be at the heart of the action.

There are numerous tools for visualizing dashboards, the fastest to deploy being cloud-based solutions. It is essential that the visualization tool is easy to deploy and can connect to production systems so that all the necessary data can be securely utilized and that its computing capabilities are comprehensive. Easy configurability and, in particular, industry-specific customization and expertise in the necessary solutions are then features that cannot be found in general tools.
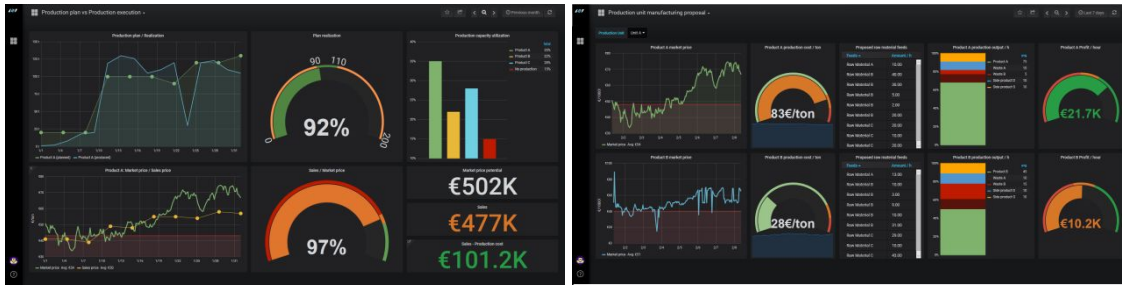
Picture 3: NAPCON Analytics - example dashboards that improve the operational efficiency of production. The current production situation and differences compared to production plans can be easily seen with a quick glance.

NAPCON digitalizes Neste's refineries

Operational Excellence is at the heart of Neste's strategic development and one of Neste's growth enablers. It means world-class performance in safety, reliability, productivity and commercial competitiveness. As a key part of this work, NAPCON [7] and Neste are collaborating to digitalize Neste's production facilities [8]. The work began with a production information platform, where a pilot was built on top of NAPCON Informer to collect and transfer production data from Neste's refineries to Neste Google Cloud Platform for machine learning and artificial intelligence applications. The production information platform uses NAPCON Informer OPC UA interfaces, versatile configurability, new interfaces to Google cloud tools, and proven performance in data processing and transfer. As a basic installation, the system is capable of reliably transferring over 50,000 tag's changes to cloud, which is sufficient for very diverse industrial needs. And by scaling up, performance is easily increased if needed.

In addition to the process information platform, NAPCON has delivered to Neste the KPI Dashboards implemented with NAPCON Analytics for the Porvoo refinery. KPI Dashboards cover the entire product chain and units of production. A strong start for dashboards came from a workshop where product chains and descriptions of key KPI metrics were defined with experienced consultants from Neste Engineer Solutions and Neste's production experts. KPI Dashboards were implemented with Neste's agile operating methods, demonstrating progress on a regular basis.

NAPCON is a business unit of Neste-owned Neste Engineering Solutions, which focuses on delivering advanced software-based data, optimization and training solutions for production processes to several external customers in addition to Neste - "We lead the process industry to a safe and sustainable future". In addition to the data solutions mentioned here, NAPCON has a comprehensive range of customer solutions globally for leveraging process optimization, training simulators and games to maximize the operational intelligence of customer production.

Neste develops responsible solutions for the needs of transport, companies and consumers. We help our customers reduce climate emissions with a wide range of renewable products. We are the world's largest producer of renewable diesel refined from waste and residues, and we also bring renewable solutions to the aerospace and plastics industries. We are a technological pioneer in refining high quality petroleum products.

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NAPCON software solutions are developed by the Finnish solution provider, Neste Engineering Solutions, which is an experienced pioneer in engineering and technologies for a variety of heavy industries