Improve Machine Performance With IIoT Solutions

AVENTICS™ Smart Pneumatics

Solutions for digital transformation that turn data into actionable insights to improve OEE and energy management.

EMERSON

Smart Pneumatics
## Brochure Overview

Introduction

The history of industrialization extends over several centuries but the latest industrial revolution has triggered fast-paced changes like nothing before. It raises many questions but also yields a huge potential.

For years, terms such as the Internet of Things and digitalization have dominated many press releases, trade show discussions, and industry conventions. The more widespread the discussion, the more definitions vary and remain ambiguous.

In this brochure we review the current situation, identify typical challenges customers face, clarify different concepts and explain the solutions that Emerson offers companies and machine builders – now and in the future.

"Future standards for the Industrial Internet of Things are being defined right now – and Emerson has already been developing suitable solutions for several generations of products."

Wolf Gerecke, Director Strategic Product Management at Emerson
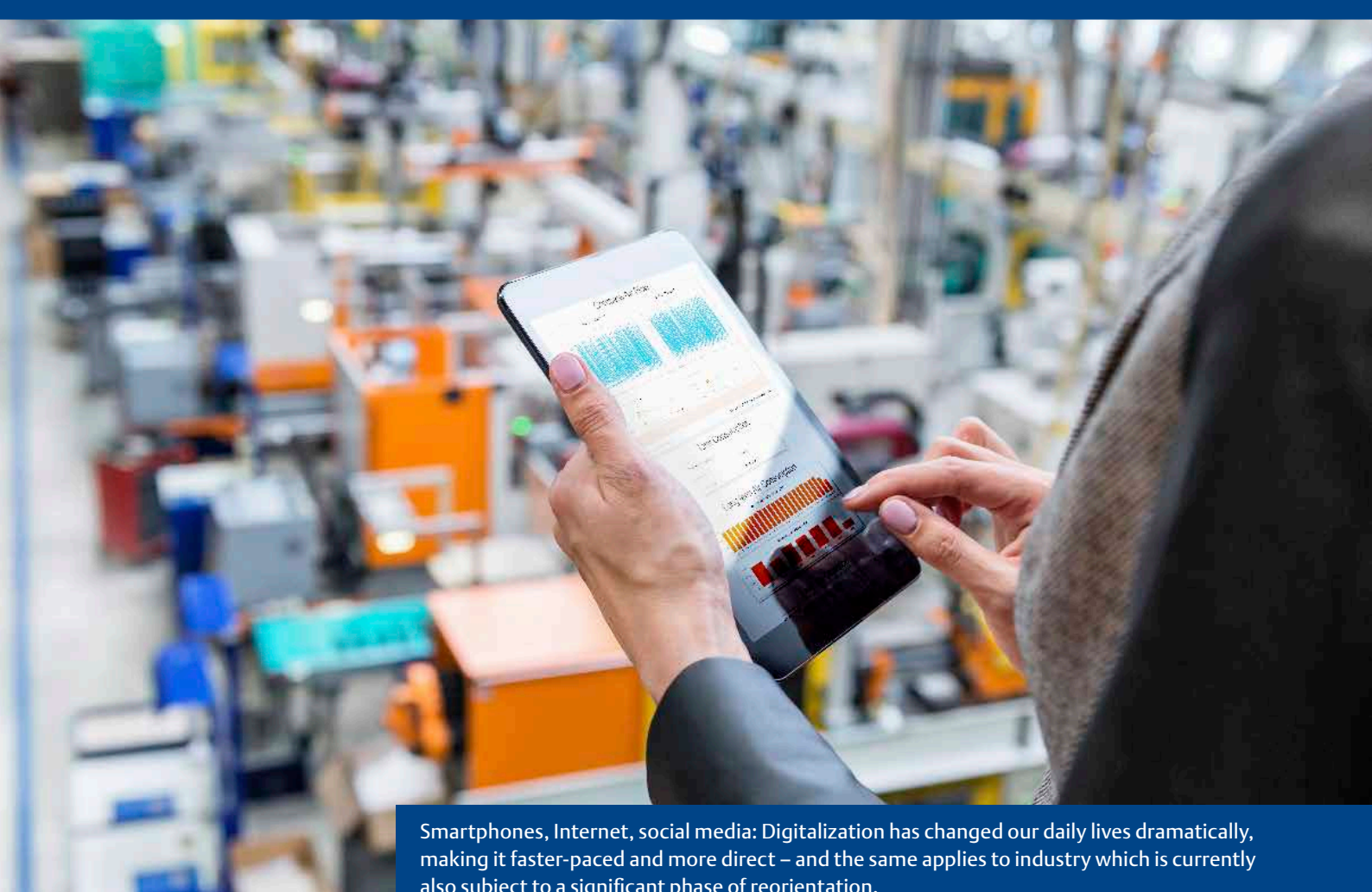
Smartphones, Internet, social media: Digitalization has changed our daily lives dramatically, making it faster-paced and more direct – and the same applies to industry which is currently also subject to a significant phase of reorientation.

The Industrial Internet of Things

We are currently experiencing the fourth industrial revolution: After the start of mass production around the 1800s, the invention of electricity and the assembly line towards the end of the 19th century, and the use of electronic, software-based control systems from 1970, everything is now focused on digitalization.

A predominant feature: interlocking production with the latest information and communications technology while simultaneously integrating customers and business partners into business processes. Today, all participants in the complete value-added chain are principally able to exchange information thanks to the advanced technologies used for networking, intelligent components, and workpieces - no matter whether it is a drive reporting its status in a production system or the operator's maintenance control station communicating with the machine manufacturer's spare parts service.

Challenges manufacturers are facing today

Emerson´s solutions deliver the flexibility and insights needed to address customers´ challenges.

Overall Equipment Effectiveness (OEE):
Programs are not delivering the expected returns.

Energy Management:
Emmisions and energy use have been reduced but are being asked to do more.

Interoperability, integration and security:
All devices should be capable of communicating with each other and our system to see real transformation.

IIoT Solutions to solve your key challenges

| Customer Challenges	Discrete Manufacturing Solutions
Improve OEE	**Predictive Maintenance** • Compressed air leakage detection • Pressure monitoring • Condition monitoring – cylinders, valves, shock absorbers
	Improve Throughput • Irregularities in product quality (driven by anomalies in the manufacturing process) • Cycle time monitoring
Improve Energy Management	**Energy Efficiency and Sustainability** • Compressed air consumption • Reduce CO_2 footprint • Energy optimization
Interoperability, Integration & Security	**Secure Connectivity** • Key protocols (OPC UA, MQTT...) and cybersecurity embedded in technology enables secure device monitoring and overall machine connectivity

Software Solutions for Pneumatic Applications

Air Leakage Detection

- Detect compressed air leakages during manufacturing processes
- Energy savings
- Fits for Brownfield and Greenfield machines
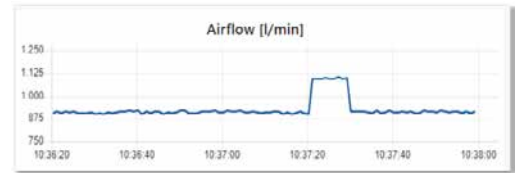
Cylinder Monitoring

- Detect anomalies in manufacturing process driven by cylinder movement
- Measure usage and cycle time to monitor wear
- Provide insight into remaining life, enabling less unplanned downtime

Valve Monitoring

- Counting switches of the valves to monitor wear
- Combined with cycle indicators will provide insight into remaining life, enabling less unplanned downtime
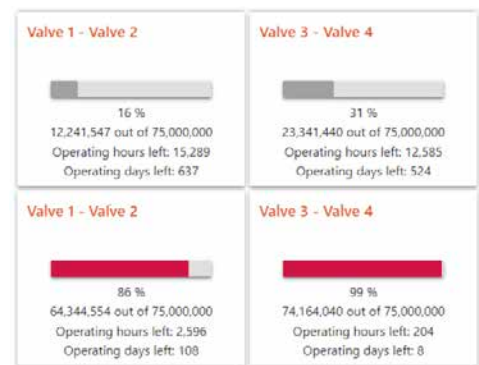
Air / Energy Consumption

- Continuous monitoring and visualization of compressed air consumption
- Different scales like per day, hour, piece or process step
- Better inform the maintenance and production teams of potential issues with machine
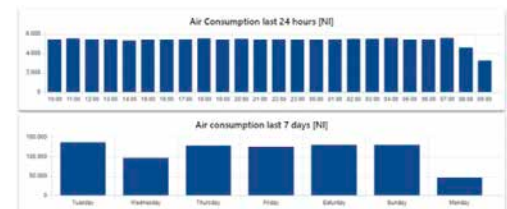
Energy Consumption Optimization

- Reducing pressure in the system, leads to less airflow and energy costs, but keeps optimal cycle time
- Easily identify the optimal parameters to keep cycle times high and lower costs
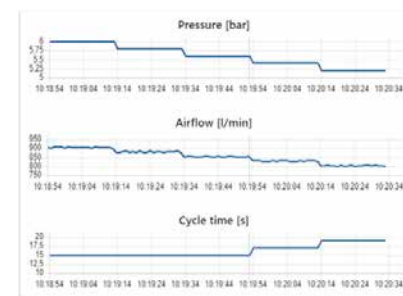
Notifications / Alerts

- Notification overview for detecting leakages and anomalies during manufacturing
- Email alerts when a critical threshold is breached in the manufacturing process

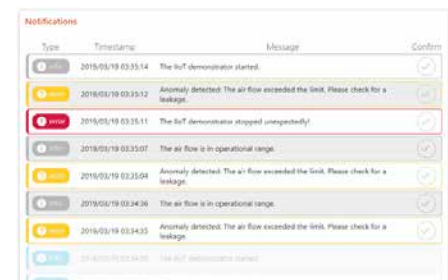# AES fieldbus node as data hub for IIoT services

AS3-AFS
Flow rate sensor

PE5
Pressure sensor

AV03
Valve system
with AES fieldbus
connection and
I/O modules

RTC
Rodless cylinder

ST4-2P
Two-point
sensor

SPM
Smart Pneumatics Monitor
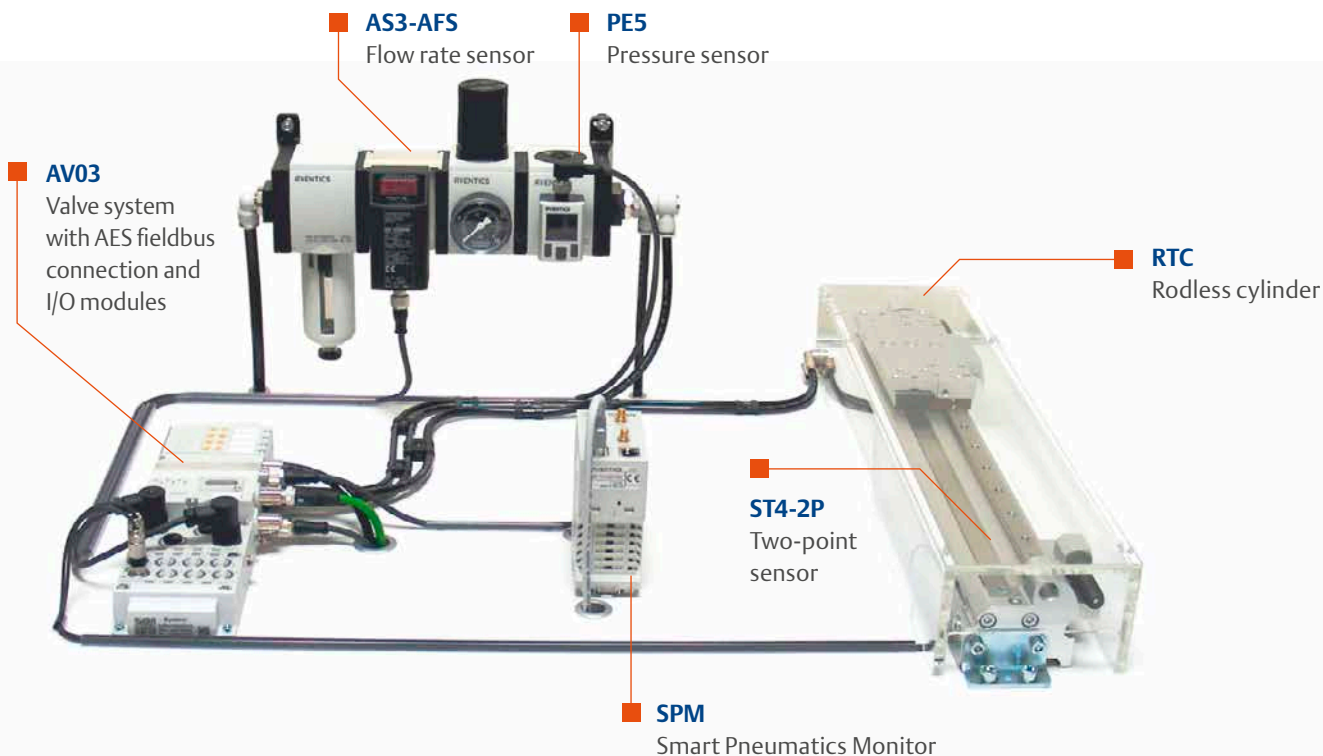
Local Dashboard for customers´ pneumatics applications
Together with the AVENTICS AES fieldbus system, the SPM module detects in advance when critical limits will be reached and provides users with key information for early intervention. In line with the IIoT concept, the system records local data independently of the control, and prepares and supplies the information via standard interfaces wherever it is required, whether in a local IT network or in the user's cloud solution.

SPM – the basis for the Industrial Internet of Things

Smart Pneumatics Monitor – the intelligent solution from Emerson

Want to check the state of wear? Need information on energy efficiency? The Smart Pneumatics Monitor will provide you with reliable answers. It sends status messages to defined employees and parent IT systems without detouring to the machine controller. This minimizes the risk of machine downtime and substantially lowers operating costs.
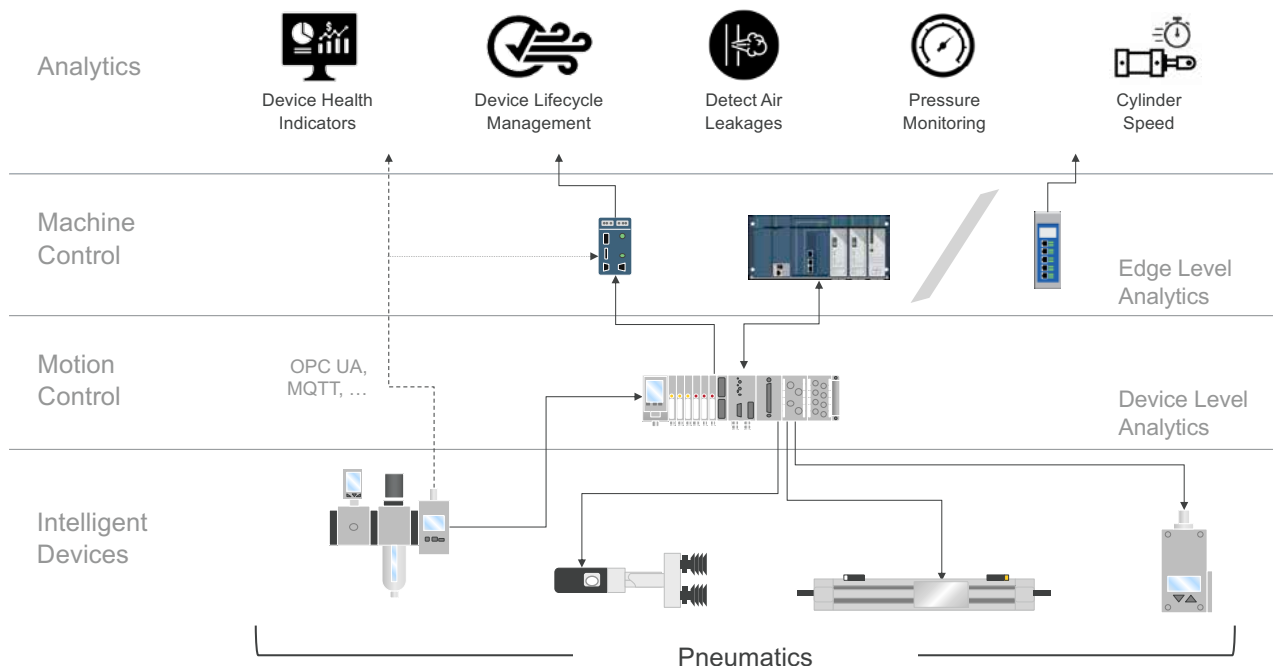
Together with our valve systems fieldbus solutions AES and G3, the scalable Smart Pneumatics Monitor (SPM) IIoT gateway analyzes existing sensor signals and uses the result to generate status information. To monitor the wear of the components, for example, the SPM helps to prevent unplanned Downtimes to improve the Overall Equipment Effectiveness (OEE).

Algorithms written by Emerson based on the company's application experience analyze this data internally and send the information either to defined people or to the parent MES or ERP systems via the OPC UA interface.

Smart Pneumatics – it's that easy.
Using drag and drop, the components to be monitored are combined and linked in the SPM. On request, the module monitors the current energy consumption or the degree of wear, for example. Users can take measures for optimization early on and thereby meet the requirements set out in the EU Energy Efficiency Directive as well as minimize unplanned system downtime.

The SPM makes it easy for Emerson customers who are already using the AV or G3 valve systems to take a further step towards implementing IIoT solutions. Programming of the SPM can even be edited while the application is running, without any impact on communication to the controller.

Analytics: Device Health Indicators · Device Lifecycle Management · Detect Air Leakages · Pressure Monitoring · Cylinder Speed

Machine Control — Edge Level Analytics

Motion Control — OPC UA, MQTT, … — Device Level Analytics

Intelligent Devices

Pneumatics

Smart Pneumatics Monitor – the central module to digitize your pneumatics

Smart Pneumatic Monitor modules provide you with reliable information on the state of wear of the actuators as well as the energy efficiency of your pneumatic systems – without the need to involve the machine control. This minimizes the risk of unplanned machine downtimes and significantly lowers operating costs.

Digitized pneumatics achieves a new level of productivity

The collection of operating states and their prediction as the basis for anticipatory maintenance and control concepts offer direct advantages, particularly for customers using IIoT applications. Together with our fieldbus system AES and G3, the SPM module detects in advance when critical limits will be reached and provides users with key information for early intervention. Moreover, the sensor data collected via the I/O modules also provides a multitude of other options to optimize the pneumatic systems' energy efficiency, for example. In line with the IIoT concept, the system records local data independently of the control, and prepares and supplies the information via standard interfaces wherever it is required, whether in a local IT network or in the user's cloud solution.

Scalable solutions

- Full portfolio of edge gateways to meet your specific analytics requirements
- Optimizes data at the edge for visualization of devices and processes

Advantages

- PLC agnostic
  - No change to PLC sequence required
  - Works on greenfield and brownfield applications
  - Can change dataflow without stopping the machine
  - Local data collection and analysis independent of the PLC
- Predefined analytics by design
- Easy data configuration with Node-RED
- Edge computing for advanced analytics and calculations
- Supports open IIoT protocols like OPC UA or MQTT
- Flexible information aggregation to upper systems like clouds or customer systems
- Local dashboard
- Pre-installed analysis modules for condition monitoring and energy efficiency analyses
- Open platform for extensive customization

Optimum interaction: Products for the Industrial Internet of Things

Products for your IIoT application

Simple commissioning and parameterization, predefined plug-and-play concepts, intuitive use – perfect for IIoT applications. Emerson offers a solution package where each of the following products plays an important role.

Valve system AES and G3

- Large variety of signals processed: analog and digital input/output modules, analog combination modules, control modules and pressure measurement modules
- All relevant fieldbus protocols
- Consistent communication up to the valve
- Integrated web server
- Modular design
- Integrated graphic display providing plain-language diagnostics
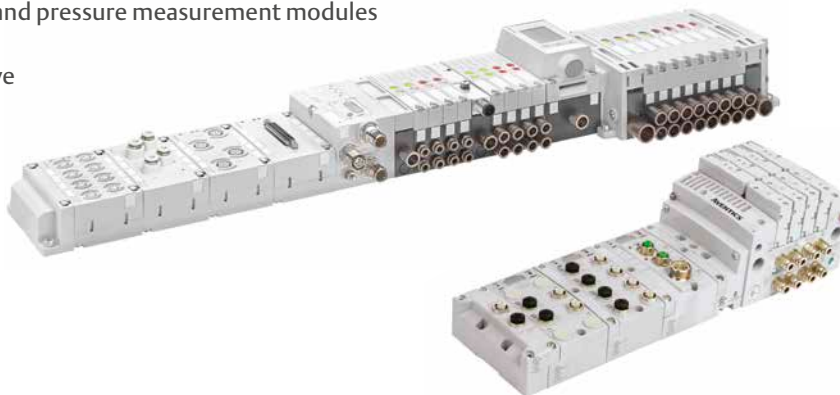
AF2 – Airflow Sensor

- Variants AS2 / AS3 / AS5
  Industrial: IO-Link / Analog / Frequency / Impulse / Switch
  Ethernet: Webserver (Dashboard) / OPC UA / MQTT
- Process parameter: Volumetric Flow Rate (l/min), Pressure (bar), Temperature (°C), Mass Flow Rate (kg/h), Flow Velocity (m/s)
- Integrated counter for volume, mass, energy to detect leakages
- Integrated statistics (min, max and mean) to detect anomalies
- Integrated logging (7d, 24h, 60min) readable via OPC UA
- OLED Display with configurable values and graphs

ST4-2P and ST6 – sensors for IIoT automation

- Robust sensor housing
- Mounting from above in the slot ("drop-in")
- LED function indicator
- Secure fixing through eccentric screw
- Shock and vibration-resistant

SM6-AL – analog sensor with high operating comfort

- Measurement range setting from 107 to 1007 mm via teach-in button
- LED function indicator
- Robust aluminum housing
- Output signal: 4–20 mA (0–10 V)
- High precision: resolution 0.06 mm, scanning rate 1.15 ms

## PE5 – electronic precision with extensive functions

- Measurement ranges for relative pressure (vacuum and overpressure)
- Large display for system pressure, switching states, and set switching points
- PNP, NPN switch outputs and optional analog output (current and voltage)
- Zero point offset function

OPC UA – the communication standard for the Industrial Internet of Things

Open, high-performance, and globally available communication protocols are vital for the successful implementation of the industrial Internet of Things. Emerson therefore supports further development of the OPC-UA architecture as the standard for smart components.

User interface and programming
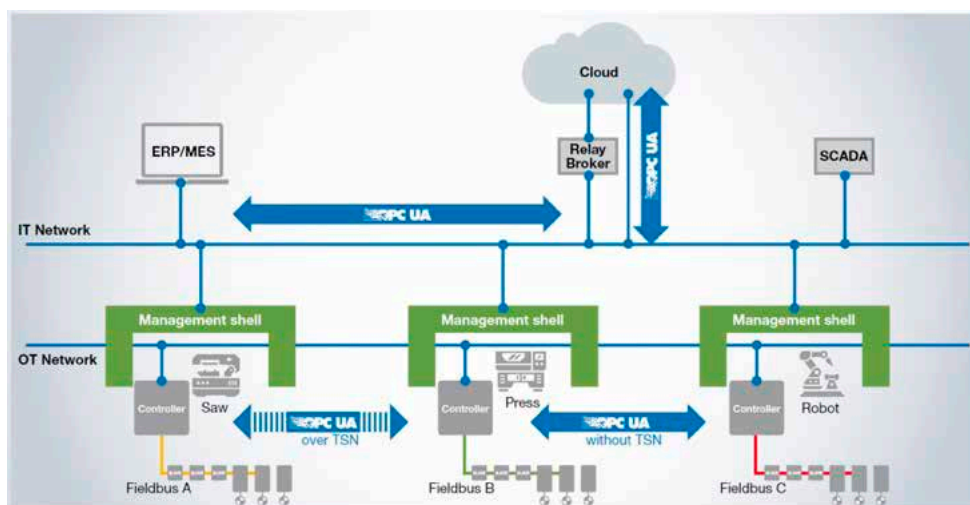
OPC-Unified Architecture (OPC-UA) is the innovative data exchange standard of the OPC Foundation. It ensures secure, reliable, and both manufacturer and platform-independent transfer of information that is not restricted or tied to any proprietary technology or manufacturer. OPC-UA allows access to any authorized application and to retrieve any information from anywhere and at any time.

Since 2007, the OPC-UA architecture has been providing a scalable, platform-independent solution, based on the concept of service-oriented architectures in industrial automation systems. This offers the advantage that web services and integrated security can be combined with a uniform data model.

OPC-UA is standardized in IEC 62541 and has become well-established as the leading communication standard for IIoT applications.

- Open Platform Communications Unified Architecture
- Open Standard for information exchange for industrial communication
- Platform independent (Windows, Linux, Android, MAC)
- Scalable (Embedded controllers and mobile devices to cloud environments)
- Security and encryptionby design
- Internal and external usage
- Information Modeling

Example 1:

| Valve #3 Cycle Count | ← | OPC Valve #3 Cycle Count |

Example 2:

Analogue Input #10 ← *f* Convert to [NI/min] ← Current Air consumption ⬥))

Σ Sum [day] ← OPC Air consumption per day
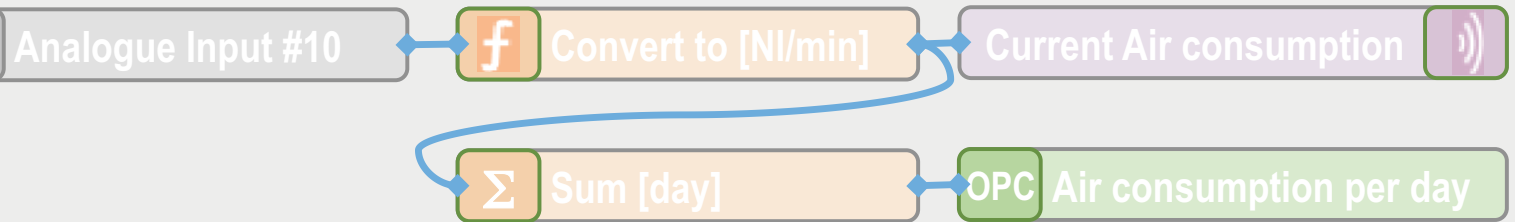
Easy to use and simple to configure, even during operation: The advantages of the interface are clear – and ideally complement the overall digital concept.

The SPM user interface: simple, intuitive, reliable

A predominant feature: interlocking production with the latest information and communications technology while simultaneously integrating customers and business partners into business processes. Today, all participants in the complete value-added chain are principally able to exchange information thanks to the advanced technologies used for networking, intelligent components, and workpieces - no matter whether it is a drive reporting its status in a production system or the operator's maintenance control station communicating with the machine manufacturer's spare parts service.

Example 1:

The switching cycle count from valve 3 is read from the valve system and stored in the OPC-UA Server of the SPM.

Example 2:

A flow sensor is connected to analog input #10 on the valve system. The applied analog signal is converted to the corresponding flow rate value and passed on as the current compressed air consumption via an MQTT message. At the same time, the consumption is summed up over the day and stored in the OPC-UA Server of the SPM.

Optimal support for the implementation of your IIoT strategy

Machines are becoming key strategic factors of success: maximum utilization of machine capacities, short maintenance breaks, short cycle times, and just-in-time production are essential topics. To prepare your company for upcoming demands, we offer solutions that dovetail with your existing IIoT strategy.

AV valve system

with Profinet/ Ethernet IP/ Ethercat/Powerlink

Smart Pneumatics Monitor

with basic analyses modules

+

Application-specific analysis modules

Custom analysis modules for the SPM developed in collaboration with the customer

+

Creation of local infrastructure

for data storage, consolidation and visualization

+

Integration in existing cloud solutions

for data storage, consolidation and analysis

Our aim is to support you in implementing your IIoT strategy and to adapt it optimally to your needs. Whether you want us to provide components, develop custom analysis modules, or create the infrastructure for data recording and processing – locally or in your cloud: we will happily accommodate all your requirements.

- Smart components that can be seamlessly integrated in an IIoT environment
- Decentralized intelligence
- Communication standards
- Added benefits for your systems

Criteria for the definition of IIoT products

As a rule, industrial products require clear-cut definitions to provide guidance to customers but also distinct criteria for manufacturers. The ZVEI has therefore developed general, manufacturer-independent product criteria for IIoT products which are used by Emerson as a firm guideline for product development.

Criteria for IIoT products			
Criteria		**Requirements**	**Emerson implementation in the Smart Pneumatics Monitor**
1	Identification	Cross-manufacturer identification of the asset with unique identifier (ID) attached to the product[6], electronically readable. 1) Development 2) Goods transport (logistics), production 3) Sales, service, marketing 4) Network	1) QR code 2) QR code 3) QR code 4) Identification of participants via TCP/UDP and IP network
2	I4.0 communication	Transfer of product data and data files for interpretation or simulation, for example, product data in standardised form. Product[6] ca be addressed via the network, supplies and accepts data, Plug & Produce via I4.0-compliant services	3D CAD, parts lists, operating instructions, technical data, etc. can be accessed via QR codes. Relevant data can be read directly on the SPM via OPC-UA or other interfaces.
3	I4.0 semantics	Standardized data with manufacturer-independent unique identification in the format of Properties with syntax for (as example): 1) Data related to business (Commercial data) 2) Catalog data 3) Technical data: Mechanics, Electric, Function, Location, Capabilities 4) Dynamic data 5) Data describing the life cycle of the product instance	3D CAD, parts lists, operating instructions, technical data, etc. can be accessed via QR codes. Dynamic data as well as product instance lifecycle information can be read directly on the SPM via OPC-UA or other interfaces.
4	Virtual Description	Virtual representation in I4.0-compliant semantic. Virtual representation for the complete life cycle. Important properties of the physical component, information regarding the relation between Properties, relations relevant for production and production process-relevant relationships between Industrie 4.0 components, formal description of relevant functions of the actual component and its processes.	3D CAD, parts lists, operating instructions, technical data, etc. available via QR codes. Spare parts lists and service information available via QR codes. Additional relevant data and information stored on the SPM OPC-UA Server.
5	I4.0- services and states	Definition still open (service system) General interface for loadable services and report of states. Necessary base services, which have to be supported and provided by an I40-product.	All interfaces are open and described. OPC-UA Server is implemented. All relevant information can be depicted.
6	Standard functions	Basic standardized functions, which can be executed manufacturer-independently and which provide same data in same functions. These basic functions serve as base for the functionality, on which every manufacturer can build their own extensions.	Functions for preventive maintenance and energy management have been implemented.Functions can be parameterized for individual instances via the existing interfaces for the application.
7	Security	Minimum requirements for providing security functions.	Available Linux operating system is documented and can be secured accordingly. wSecurity concept for the application is implemented within the scope of the respective customer projects.

Register for your Digital Transformation Introductory Session today

If you have any questions on our products or the possibilities of IIoT applications in your company, please feel free to contact us at any time. Our experts will be happy to advise you on investment security, compatibility with existing systems, and further ways to utilize data in your production.

Schedule a Digital Transformation Introductory Session to learn how to reduce machinery downtime, increase equipment reliability, enhance safety, make energy efficiency savings and improve production efficiency.

Emerson Digital Transformation Introductory Sessions provide the opportunity to learn how to build successful IIoT strategies, turn actionable insights into operational improvements and calculate a return on your IIoT investment.

Sign up here: **go.emersonautomation.com/IIoT-introductory-sessions**
Your local contact: **Emerson.com/contactus**

Engineering Tools

The homepage for non-stop service
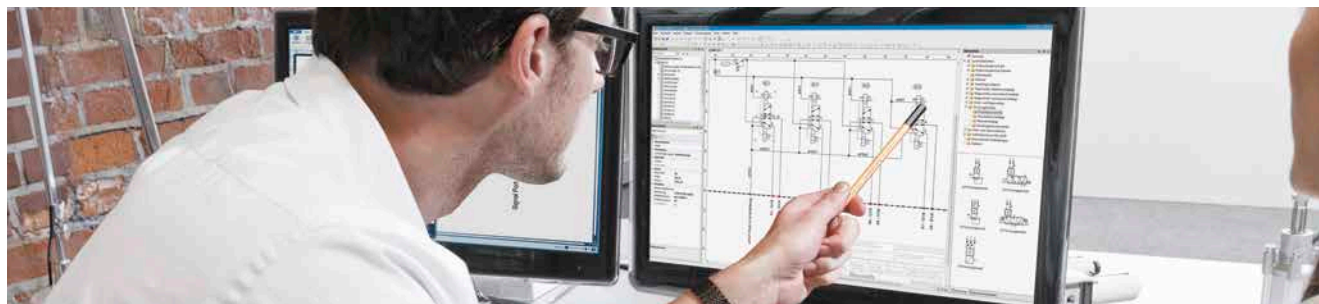
AVENTICS' Engineering Tools bundle the entire pneumatics range and comprehensive expertise at one convenient location – www.engineering-tools.com

CAD

Objects can be issued here directly as a CAD file in various formats, as a PDF file, or for further configuration in our customers' software.

Configurators

To create customized products matching their individual requirements, customers can set their parameters in the configuration program, which then presents a product tailored to their specifications.

Calculation programs

With transparent calculations, our customers can determine the size or durability needed for their products and can even keep an eye on energy consumption.

Circuit diagram software

With the Scheme Editor, our customers can quickly and easily create circuit diagrams that are based on their components and linked their your catalog selection.

Cross Reference Tool

This tool shows our customers the right alternatives to competitor products from within the AVENTICS catalog.

CylinderFinder

This free online tool helps our customers find the right cylinder for their application with just a few clicks.

Sales Partner Portal

The Sales Partner Portal establishes a direct connection between AVENTICS and our sales partners and speeds up communication. It also contains a great deal of valuable information.

Smart shopping for pneumatics professionals

In the new Online Shop, you can easily, quickly and securely order your pneumatics products – www.pneumatics-shop.com
Your advantages:
• Intelligent search and filter functions
• Spare parts and accessories available for every product
• Track your orders online
• Transparent pricing
Simply register with your e-mail address, password and order directly.

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