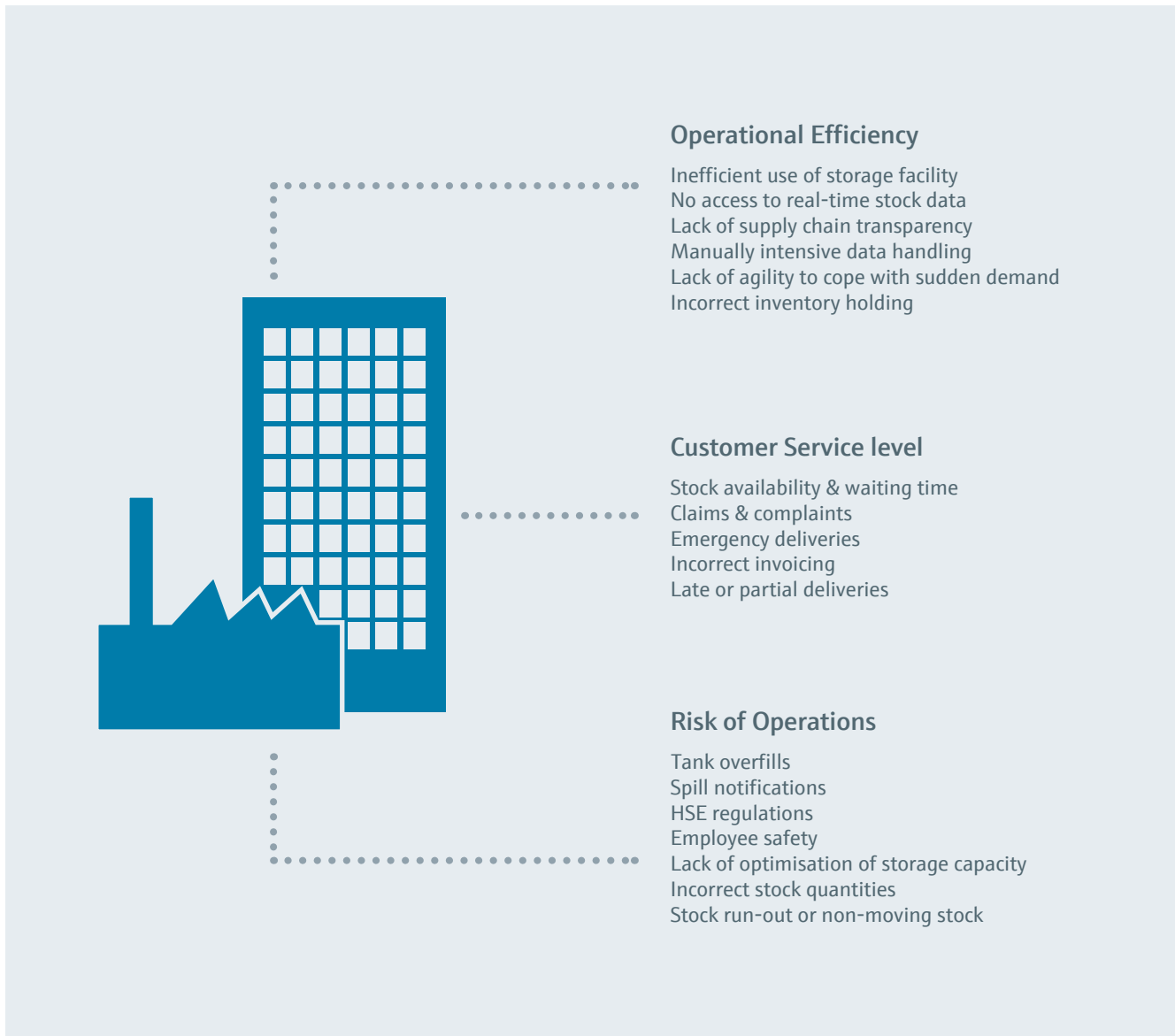


business integration





Typical pain points for a fuel storage or distribution network

Harvesting data from your tank farms

The Australian fuel landscape has changed significantly in the last decade, and particularly in the last five years, with half of the refineries effectively closing down and converting to import terminals.

This change coupled with the Australian geography makes for an interesting challenge; how does a company maintain terminals and depots that are widespread across Australia and still get real-time data from each location on inventory and stock on hand, and use the data to gain efficiencies in their business processes?

This is particularly important as the far flung depots across the Australian outback are, for many companies, the end distribution point of a long supply chain that starts with fuel imports coming from mega-refineries like the ones in Singapore, or crude imports for the four major refineries that are still operating across Australia.

Understanding the supply chain from start to finish is key to optimising the end-to-end performance of the system for the companies that are playing in the fuel refining and distribution market.

Process network vs. Business network

One of the biggest contributing factors to the decoupling of the process data from assets, like refineries and terminals, and the business systems, where production and raw material planning happens, has been the need for segregation of the Process Control Systems (PCS). Due to the requirement for security of the operations of these facilities, the older control systems favoured proprietary communication protocols on the PCS layer, which didn't support or interface to business software layers used in the head offices and planning centres.

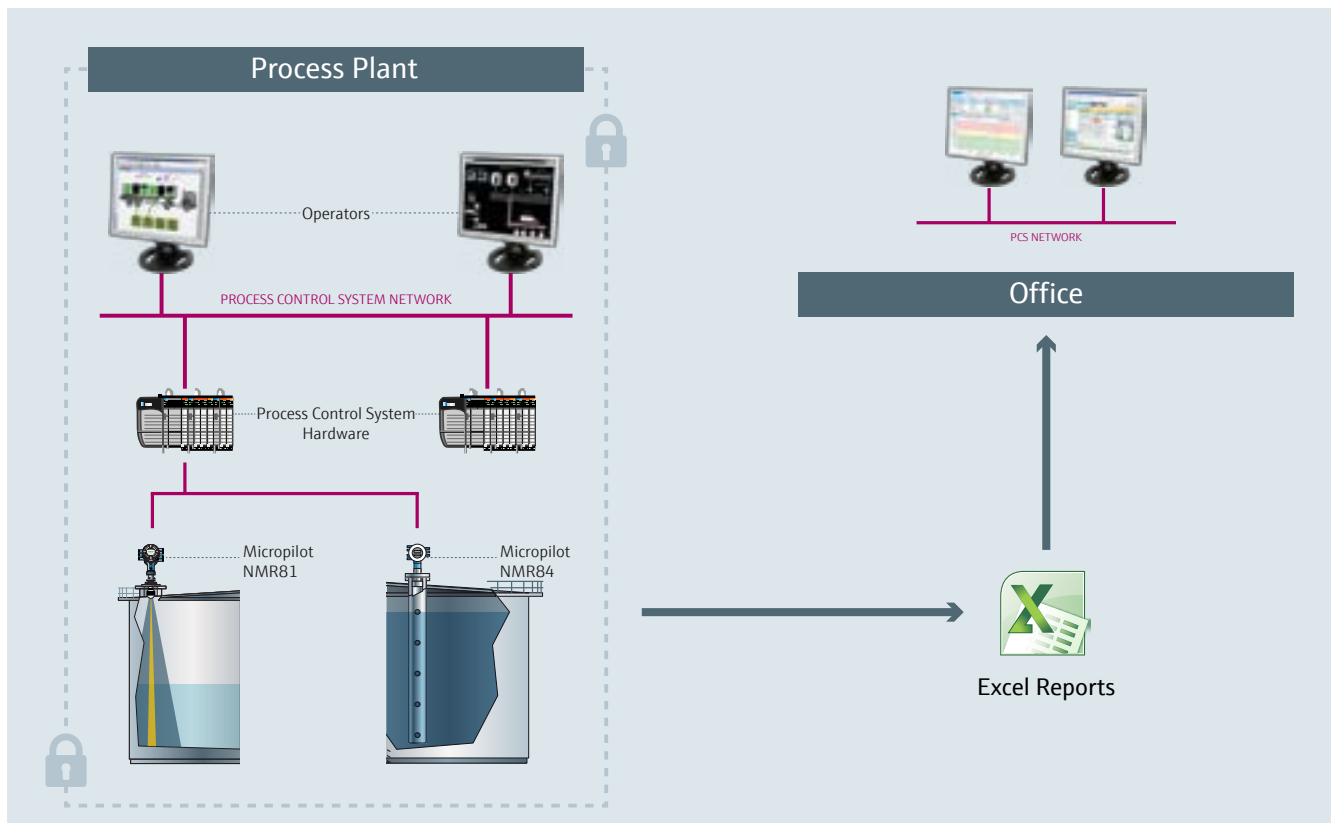
This enabled control system companies to operate in their own proprietary sphere with no physical connection to the outside world. Therefore, all data transfer was managed by running reports, which in best case scenario ended up being Excel sheets, which required manual manipulation of data and often merging of documents from multiple sources to provide a holistic view for the business to then enact their processes.

Over time it has become clearer that there is a need for closer integration between Operations and Business Planning processes. With advances in network security and the use of demilitarised zones (DMZ) in the process network,

the control system companies have started to provide a way for the data from the operations to make its way out into the business world, and resulted in the introduction of Manufacturing Execution Systems (MES). These MES products aim to provide better tracking of manufacturing from raw material to finished product, tracking operational efficiencies and improving uptime, and streamlining raw material inventories based on planned end-product turnover.

However, these solutions required the legacy control systems to be upgraded and relatively expensive network infrastructure to be put in place to transfer the information from operations to business.

The business world on the other hand cannot afford to lag behind the latest technology. Businesses that don't adopt social media, latest telecommunication technologies, and use relatively up to date operating systems on their business networks, begin to get outpaced by their competitors very quickly. With the advent of smart phones and high speed telecommunication networks, businesses are quickly becoming used to having all the information literally at their fingertips.



Typical Process Control System (PCS) architecture, which is secure and isolated from the business systems, and reliant on report transfers instead of real time data transparency

Bridging the gap between Process and Business

“Is there a way to build a bridge between the process and business world, without sacrificing security, yet still passing on the information required to optimise decision making?”

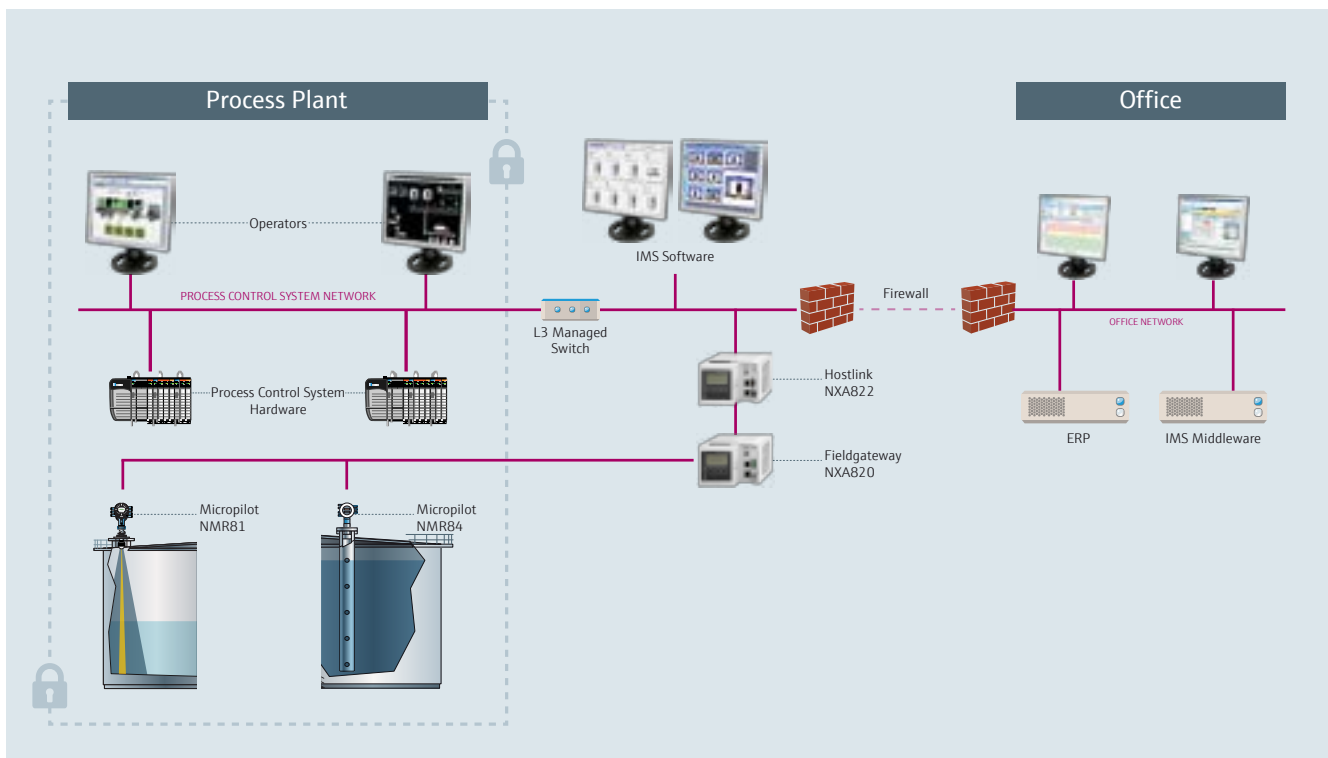
In order to find a way to bridge the information gap, we need to understand what information is actually needed. An operational asset, like a refinery, typically has many complicated processes happening in unison. These processes are controlled using inputs from field instrumentation, through control systems and highly trained process engineers and operators. Their job is to run the plant efficiently to deliver the end-product. But do the business planners really need to know every pressure reading on every process in a refinery to plan their activities?

The short answer is no. In order to plan business activities, the most important information is how much raw material is coming into a plant (the cost to the business to buy crude in a refinery, as an example), how quickly is it being used, how much end product is being manufactured at the end

(what is available to be sold), and how quickly is the end product being run out.

This really boils down to inventory and in effect: level measurement. How much fuel is transferred into the tanks from the ship offload? At what rate are these tanks being depleted by the terminal or refinery? What are the levels in the end product tanks and at what rate are they being consumed and transferred into the distribution pipelines or onto trucks?

So, what if there was a way to get the inventory data out of an asset without needing the gain access to the process control system, and thereby removing the exposure of the PCS to the security threats posed by opening up the system to the outside world? The answer to this question is Inventory Monitoring Solutions.



Inventory Monitoring System (IMS) architecture, allows interface to process and business systems

The elements of inventory monitoring

The nuts and bolts of an inventory monitoring solution from Endress+Hauser basically consist of the following main elements:

- Tank gauges – radars, servo gauges, or other level devices, to fit every tank requirement
- Field gateways – to consolidate information from multiple tanks in the field and transmit data to a monitoring software
- Monitoring software – monitor and configure tanks, as well as carry out reporting, API calculations, etc.

- Business Process Middleware – the link between the monitoring software and the business ERP, e.g. SAP, Oracle, JDEdwards, etc.
- ERP Integration – use the data from the Inventory Monitoring Software in the ERP to collate reporting, generating work orders, and assist with planning activities

How these elements are used and integrated depends on each unique installation and the bespoke requirements of every customer. However, the elements within each solution largely remain the same.

Tank Gauging

The foundation of an inventory monitoring system is built on the tank gauging instrumentation. This is the primary element used to measure the level of the liquids in the tanks. Endress+Hauser is foremost an instrumentation company, and therefore has the most comprehensive portfolio for tank gauging instrumentation.

Typical tank gauging technology includes free space radar, guided radar, and servo. The application of these technologies depends on many factors including:

- Tank geometry and potential obstructions
- Tank roof design, e.g. external floating, fixed, internal floating, etc.

- Liquid being measured and the presence of any vapours
- Parameters required, e.g. density profile, interface, level, temperature, etc.
- Wiring convention at the top of the tank, e.g. explosion proof or intrinsically safe
- Accuracy requirements, e.g. monitoring or custody transfer

Endress+Hauser offers a solution to match any application, and thus provides one of the most solid basis for an inventory monitoring solution.

Field Gateways

Sites requiring inventory monitoring can range from small depots with a single or a few tanks, to medium sized farms with twenty or thirty tanks, to large tank farms at refineries with fifty or more tanks. With each tank having multiple instruments for level and temperature detection, as well as high level and high-high level switches; the number of instruments can quickly grow to large numbers.

Field gateways provide the interface in the field to collate the tank instrumentation into a single unit, which then transfers the information to the monitoring software. This reduces the number of direct connections to the software, but also assists in creating segregation of tanks and simplifying the wiring on site, as fewer cores need to be run back into a central location. In some cases field gateways can utilise a 4G connection to send data over the telecommunications network, ideal for remote sites.



Building Blocks for Inventory Monitoring

Tank gauges - This instrumentation forms the basis of any inventory monitoring solution. The devices required depend on each application. These versatile devices are designed to incorporate multi-spot temperature inputs, a range of customisable analog and digital outputs, as well as redundant Modbus communication.

Fieldgates - These field panel mount devices are able to integrate signals from multiple tanks and output a variety of protocols, such as Modbus or OPC, as well as having in-built web and email server capabilities. Fieldgates offer a variety of methods for getting data out of a process plant.

Monitoring Software

The field gateways are able to feed data into various monitoring software platforms. These can range from process control systems, especially at large tank farms or refineries, to cloud-based supply chain software, used for monitoring depots over a large geographic area, forecasting usage, and scheduling deliveries.

The monitoring software essentially provides visualisation of the storage tanks. It is used for providing reporting on storage levels, storage capacity, and the ability to group tank data based on liquid types, locations, etc. For fuel custody transfer applications, the software can also be used for OIIML based volume correction.

For companies with multiple tank farm locations, such as fuel depots, which are distributed over a large geographic location, the monitoring software is also used for collation of data from these multiple sites, forecasting of usage, and scheduling of deliveries.

Building Blocks for Inventory Monitoring

Monitoring Software - For process plants that still require tank inventory visualisation, but do not have an existing SCADA; various types of inventory

monitoring software are available. Apart from visualisation, the software includes the ability to generate reporting, configuration of devices, OIIML based volume corrects, and many more features.

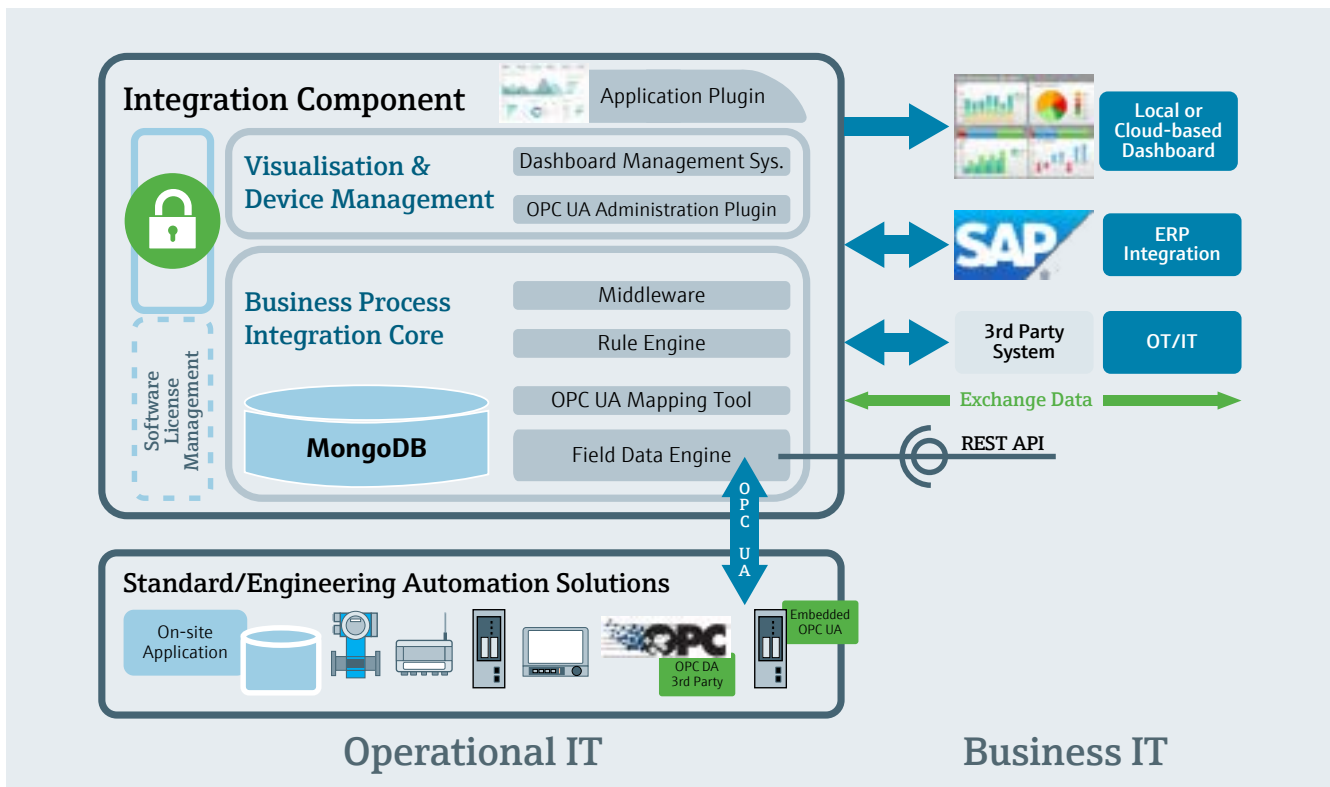
Business Process Middleware

Once the data is available within the database of the monitoring software, the next challenge is to pass this data into the ERP (business system) of the company. This is where materials handling, order creation, deliveries and scheduling all take place.

The Business Process Middleware is essentially a protocol converter, which transforms the inventory data from industrial standards to business standards. Depending on the requirements of the ERP, protocols like SOAP/REST web services, HTTP(S), and FTP are typically used for mapping data from the inventory monitoring software to the ERP system.

ERP Integration

ERP integration goes hand-in-hand with the Business Process Middleware, as the transfer of data through the middleware is based on mapping the data into the right fields within the ERP system, such that the data can be utilised in the ERP to generate accurate and usable reports and enable real-time decision making.



Business Process Integration (BPI) component architecture

Integration is the first step to optimisation

“We have integrated field data and information from our process plants into our ERP, but what do we do with this data?”

Manufacturing companies need to differentiate by offering products compliant with individual customer specifications, exactly when it is needed, against market competitive prices and with a certain added value for that customer. This requires reliable and robust supply chain management.

A chain is as strong as its weakest link; therefore proactive management of supply chain is mandatory. This requires business decisions to be based on reliable and accurate information. Efficient, effective, and proactive supply chain consists of at least:

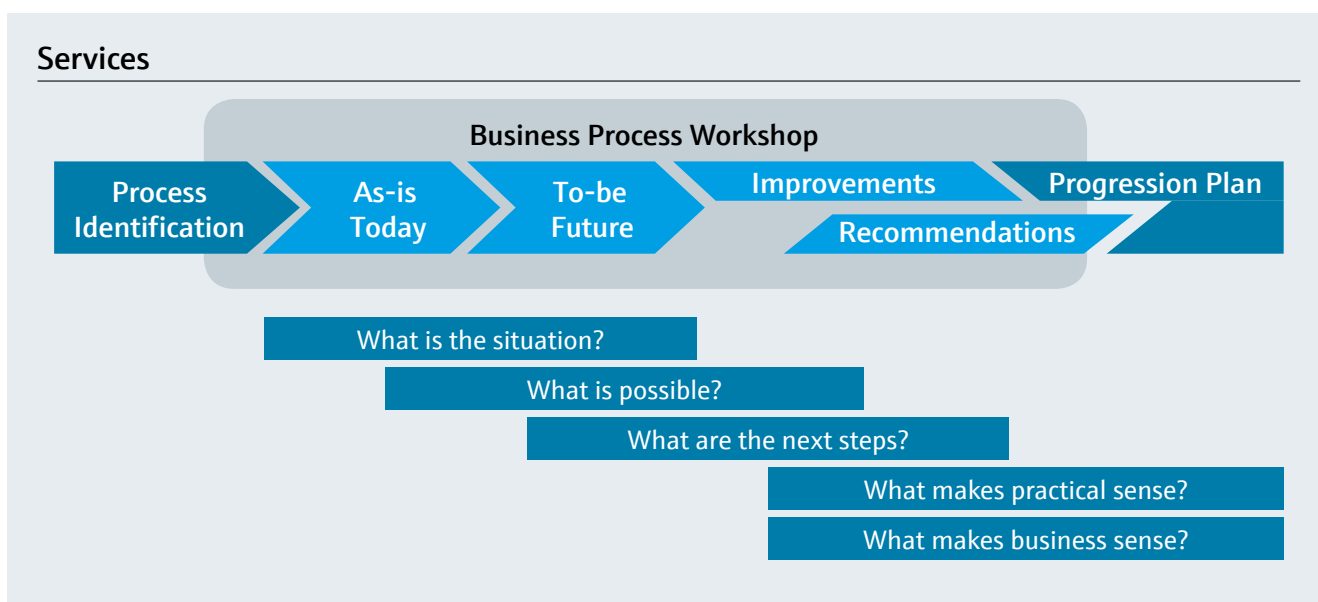
- Accurate and up to date information about the company inventory
- 24/7 “anytime anywhere” availability with complete transparency
- Reliable and integrated inventory management solution
- Durable source of information

When a company’s supply chain information is compliant with all the above, then they are in the position to optimise the business processes. Having transparency in your inventory, planning, and supply processes, enables the agility to adjust to varying customer and market demands. This agility to adjust to the customers and market provides a cost differentiator, which could be the difference between you and your competitors.

In addition to providing all the building blocks for a complete inventory monitoring solution, Endress+Hauser can assist with facilitation of business process improvement workshops, which are structured to include the following steps:

- Determination of “As-Is” process – this requires moderation of a workshop with various business partners to understand the current process utilised by the company and map out the process flows. This step is key to determining where improvements can be made
- Develop a “To-Be” process – following on from the initial step, the future processes are determined and can be classed with low-hanging optimisation gains and longer term gains and includes the development of the system architecture to support the “To-Be” process
- Define the improvements – it is important to get a clear understanding for all business partners on what is required in terms of “pain relievers” and “gain creators”
- Documentation – our consultant will document the findings and recommendations based on the outcomes of the workshop in a comprehensive Process Document. This document will include recommendations based on the different scenarios and potential pay-back periods
- Presentation of results – Findings, gap analysis, and improvement proposals are presented to all key stakeholders and management. This ensures buy-in from all decision makers and sets the next actions

This structure for process optimisation is facilitated in order to ensure forward momentum. Too often, businesses invest in business integration and fail to ensure that the transparency now available from the field is utilised in a meaningful way within the business processes. Endress+Hauser assists with this process to ensure best possible return on investment.



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