compacer
Member of >eurodata Group

BUILDING A SMART FACTORY – STEP BY STEP TOWARDS NETWORKED PRODUCTION

BUILDING A SMART FACTORY– A SHORT PRIMER

The concept of "Industry 4.0" appears in the media almost every day, to the point that people don't want to hear about it anymore! While it may sound very promising, most companies have long since realised that the digital networking of productions is time and cost intensive, it involves risks, it requires resources and it means that staff must be retrained to master the digital revolution.

But is the path towards a "smart factory", a concept closely related to Industry 4.0 or the Industrial Internet of Things, really so full of obstacles? We think it's not, and we would like to give you this e-book as a guide to help you reach your goal faster. We will show you how to network and harmonise heterogeneous production environments so that they can begin to communicate, which may lead to condition monitoring and predictive maintenance as further steps along the path. Before we start, however, let's first look into the most fundamental question:

What advantages does Industry 4.0 bring for production and why should you build a smart factory at all?

THE BENEFITS OF SMART FACTORIES IN MANUFACTURING AND PRODUCTION

The intelligent recording and analysis of relevant production data will help in optimising the following four key areas in manufacturing:
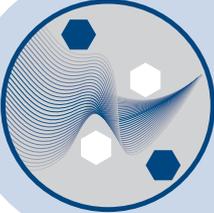
Adaptive optimisation:

Self-learning algorithms operating on production data bring an unprecedented form of flexibility to manufacturing processes and entire process chains, allowing to optimise them automatically.
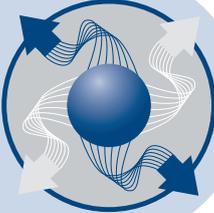
Flexible production:

Manufacturing can be adjusted intelligently and flexibly to new product and process variants without sharply increasing production costs.

The goal: a self-orchestrated production.
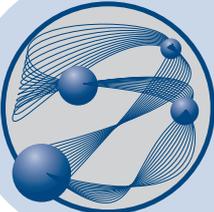
Integrated process control:

Simplified and more efficient operations, a smooth data exchange, less training and familiarisation time, and lower system costs along with higher reliability – an intelligent control system has many advantages, but above all, it leads to the decentralisation of tasks.

Smart maintenance:

Use existing process and machine data to plan ahead, and even to minimise unplanned downtimes and avoid machine failures.

HOW TO PUSH THROUGH THE DATA BARRIER

The key to success lies in the data: added value for companies can only be created by collecting, aggregating and evaluating machine and production data. But therein lies the challenge! A range of questions are on the table:

- **Where can I find useful data?**
- **How do I get the data?**
- **What information do I need on the data?**
- **How to deal with different data formats? Which level of data precision is required?**
- **What about data throughput and real-time data?**
- **How to handle the generated data volume?**
- **How much data are there and which data do I need to collect?**
- **Which data do I really need? Which will benefit my company?**

Many projects fail because companies limit themselves to mere data collection. However, data alone does not create any added value – what matters are concrete use cases and applications. It is therefore important to not only look at the existing data, but also to consider what information is really needed to benefit from their potential. Those who have the above questions under control have already tackled the first obstacles and taken the first hurdle towards their own smart factory.

One thing should be clear right from the start: it is neither necessary nor sensible to begin the journey towards Industry 4.0 by buying a new asset. In most cases, it is much more economical to modernise existing machines and systems by means of a digital retrofit. Now, what do we understand by "digital retrofit"? For us, this is not just about connecting some sensors, but rather a whole methodology that we will be glad to explain in detail below.

DIGITAL RETROFIT – YOUR FIRST STEP TOWARDS DIGITALISATION

Let us go through the retrofit method using a simple, everyday example, so that it becomes clear that a digital retrofit can be done with any "thing". Therefore, we will first describe a scenario about connecting a simple washing machine before we move on to real use cases and projects we have implemented:

ANALYSIS

Before you start, you should ask yourself the following questions:

1. **Which capabilities does my machine possess already?**
2. **Are there any findings from existing signals yet?**
3. **Is there already a modern, integrated bus system?**

SELECTING SENSORS AND DEVELOPING A RETROFIT STRATEGY

Sensors have to be selected according to the needs and objectives of the company and the type of machine to be retrofitted. Afterwards, the sensors constantly capture and transmit both technological and process-related data. To our washing machine, we will attach three sensors: they will allow us to draw conclusions about the number of revolutions, vibrations and power consumption in the analysis. But first, the generated analogue signals must be digitised. This can be done by installing a vBox, developed and sold by our technology partner Fraunhofer Institute for Production Technology (IPT). Fraunhofer IPT's vBox is compliant with the latest industry standards: the compact system synchronises position data as well as other digital inputs and outputs with sensor data and can display the information to operators as needed – independently of the control technology used.
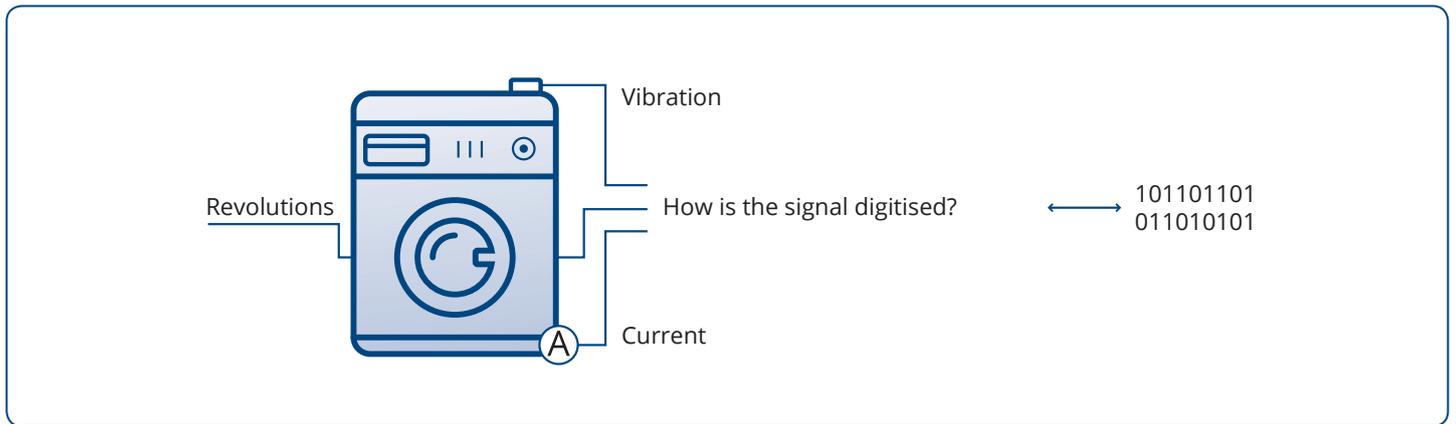
INSTALLATION OF SENSORS AND OF A PREPROCESSOR

The data are sent to the middleware of the edbic platform, our business integration cluster, where they are pre-processed and aggregated. The preprocessor is necessary because there are almost always large amounts of data (streams), of which only a few are actually needed in analyses – therefore, edbic first "filters" the data.
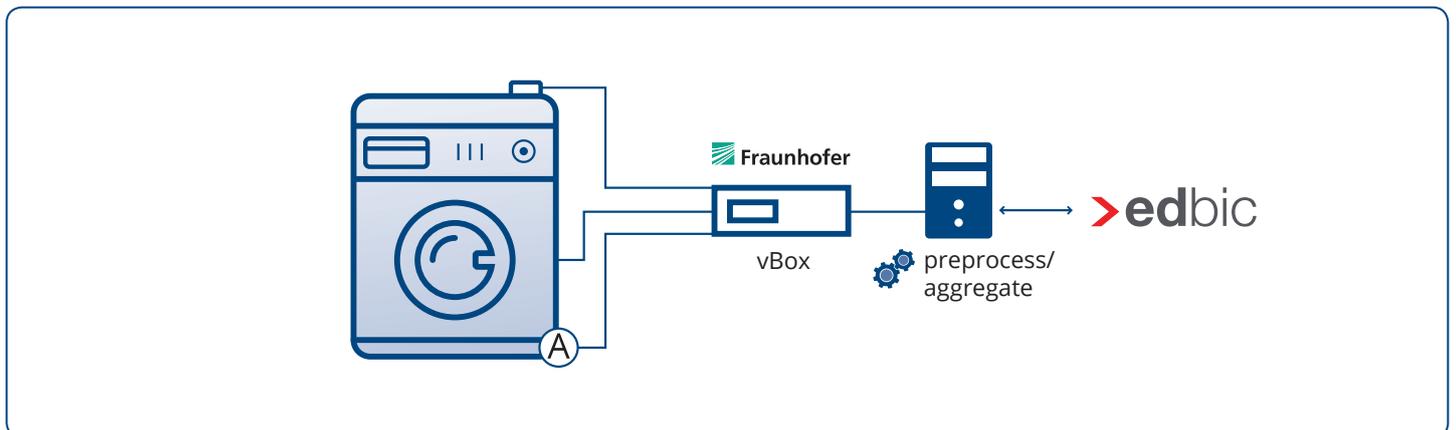


OVERVIEW OF THE RETROFIT ARCHITECTURE

Let's become more specific about the implementation:

edbic can merge and integrate not only this washing machine, our representative "thing" in the Internet of Things, but also production and factory machines, plants, processing centres and appliances, and even bring together industry protocols like OPC-UA and Siemens S7 in addition to a wide range of cloud services. It can orchestrate processes and other workflows and store, display and analyse the associated data on a clear dashboard.

edpem, our process event monitoring system, visualises the "raw" data in its Controlling Dashboard, alerts operators when thresholds are exceeded and sends out e-mails or Slack messages in case of any anomalies.

Of course, the information can just as well be sent to an existing ERP or MES system.

The aim of the architecture is to eliminate the "spaghetti system", i.e. the chaos of numerous point-to-point connections between individual applications, by channelling everything through one unifying middleware. The middleware will take care, in a standardised way, of what previously had to be configured individually in a host of direct interfaces, which leads to process-controlled communication mechanisms.
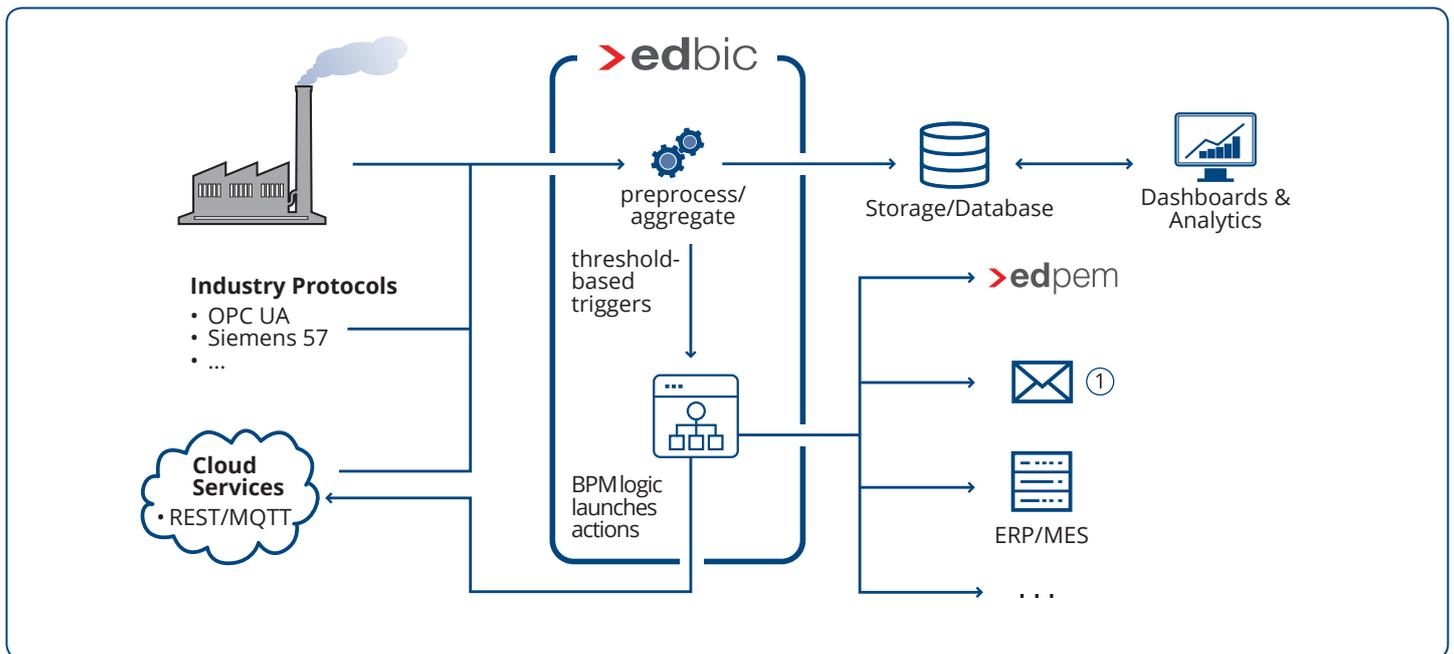
With these measures, you will already be much closer to having a "smart" factory, and in any case, new business potential will have grown out of your data. We would now like to explain what the added value and advantages for companies can be like in practice, by means of two real projects.

DIGITAL RETROFIT – A PROVIDER OF ELECTRICAL INSTALLATION TECHNOLOGY DIGITALISES LEGACY MACHINES

A German supplier of electrical installation technology uses special punching machines driven by special gear wheels in manufacturing. If such a gear wheel fails, this does not only mean an unplanned downtime for this particular machine, but it disrupts the entire production. Since these special gear wheels are very expensive, they are not kept in stock. Therefore, a primary goal of the company is to avoid such a standstill and to be able to predict in good time when a gear wheel might fail.

To be able to forecast the failure, the company first needed to collect live data on the condition of the machine. After a professional analysis of the current situation, it is therefore equipped with additional sensors. In this case, these are: a temperature sensor, three vibration sensors and a structure-borne sound sensor. Their analogue signals are converted into digital data by Fraunhofer IPT's vBox. In order to collect, process and analyse the data, we implement edbic, a platform for data integration and interpretation. It renders the data usable for constant condition monitoring, which provides real-time information on the current state of the machine.

The next step towards a "smart" factory has been realised after a longer observation period: after having collected sufficient benchmark data from the monitoring, the system can now generate condition forecasts and provide early warnings. In future, this will enable the company to identify anomalies, wear and tear, breakdowns or other problems within the production process in good time.

As soon as sufficient data is available, the focus will switch to achieving predictive maintenance. Data will have to be collected and compared over a longer period of time in order to derive further actions from them.

Thanks to this digitalisation project, this company can now consolidate its market leadership and even seize new opportunities.

# DIGITAL STRATEGY: CONDITION MONITORING AT BURKHARDT+WEBER

BURKHARDT+WEBER is renowned in the world of large machining centres. The company based in Reutlingen, Germany, delivers to all parts of the world – wherever top-notch quality is required. For 130 years, the company has been specialising on the development of efficient and innovative production solutions for the high quality machining of steel, cast iron and titanium parts. The machining centres are further developed in interdisciplinary teams and all core components and in-house developments are manufactured in-house. Permanent further training and the use of the most modern CAD and ERP systems ensure our client's technical leadership.

Our joint project at BURKHARDT+WEBER enables condition monitoring and generates visible and measurable added value.

BENEFITS

The benefits for BURKHARDT+WEBER are quite obvious:

- **Better predictability by evaluating the machine's condition in real-time, so that unplanned maintenance downtimes are avoided and downtimes are reduced to a minimum**

- **A transparent analysis of the actual consumption of operating resources**

- **Cost reductions thanks to**
  - **improved maintenance planning**
  - **optimised and well-scheduled operating times, based on power measurements**
  - **increased transparency thanks to mobile remote controlling (via an app)**

- **Simplified supply chain processes, e.g. through automated order proposals, either for the replacement of defective components or for minimising errors in the reordering of operating resources**
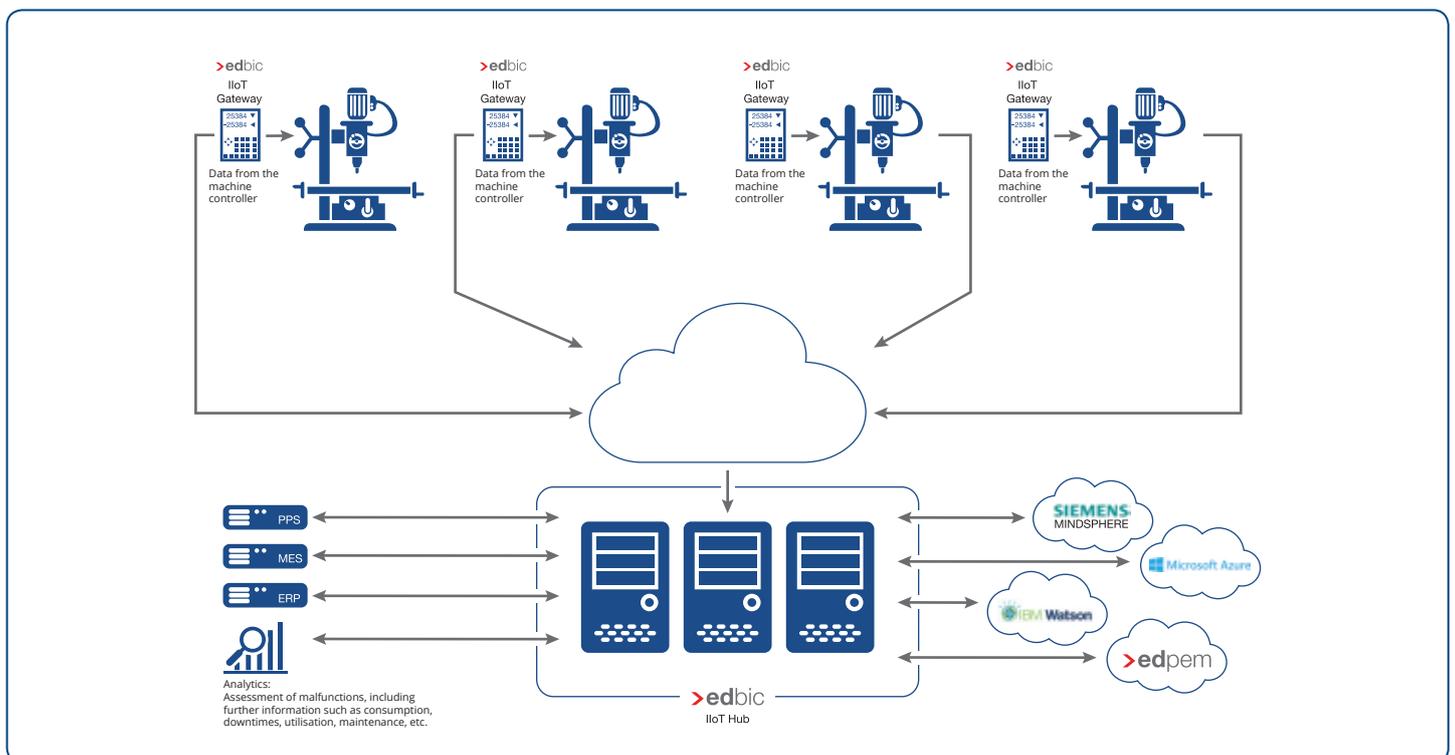
In the long term, compacer's IoT solution is to be integrated into all of BURKHARDT+WEBER's machining centres. By installing the compacer IoT Gateway, based on edbic, the operator will benefit from data collected from the machine control system. BURKHARD+WEBER's machines will therefore be able to provide a lot of information on an easy-to-understand dashboard that displays the current state of the machine and its performance in real time. The IIoT Hub prepares these data so that various evaluations become possible and so that the operator always has a complete overview. By connecting the machines to compacer's IIoT solution, we can provide condition monitoring as a first step that will lead to predictive maintenance.

In this way, BURKHARDT+WEBER creates optimal conditions for its customers to implement upcoming digitalisation projects in production processes.

CONCLUSION

The concerns of many manufacturing companies with regard to setting up a smart factory are understandable, but on closer inspection, they are mostly unfounded. Once a digital strategy has been formulated, along with clearly defined goals, a project team can realise the technical implementation rather quickly. However, a structured approach has proven itself essential in practice. We therefore recommend that you first take stock of the different degrees of automation already existing in your plants. You might even start with a pilot project and retrofit only a small number of machines at first. In this way, the machinery can be successively harmonised and networked to make machine-to-machine (M2M) communication real. The main difference and true advantage of a methodical retrofit, as we understand it, is its stable complexity: project complexity does not increase with the number of machines, but remains viable thanks to our business integration cluster edbic. This will also make your digital project much easier and more agile.

At last, we would like to give you the following tip: if you really want to leverage the power of digitalisation, you should also connect and collaborate with your partners, customers and suppliers. This is the only way to create an efficient ecosystem that creates added value for all stakeholders!

For further information please visit **www.compacer.com**