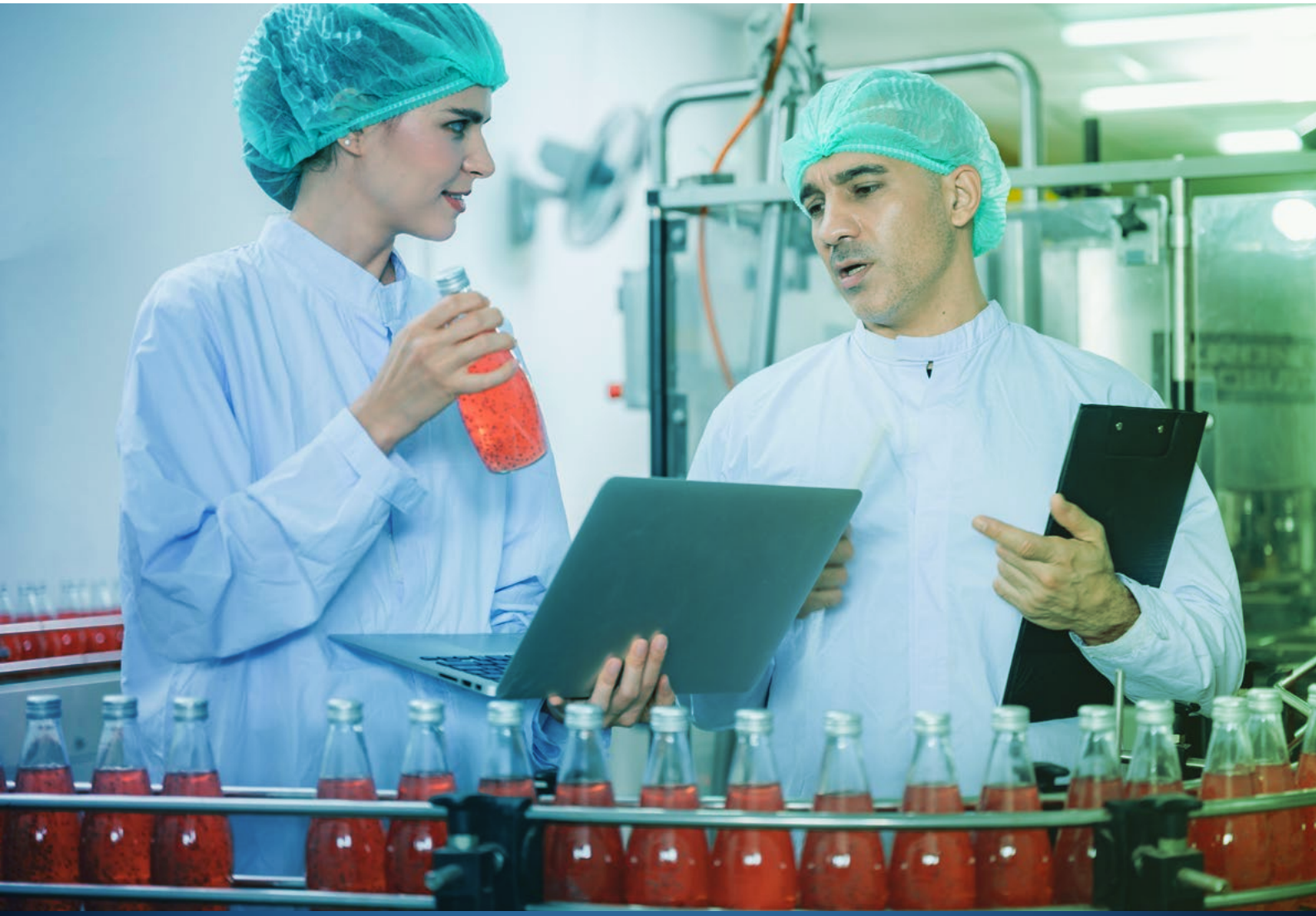
ADVANTECH

Enabling an Intelligent Planet

www.advantech.eu



Overcoming the challenges of IoT adoption in the food & beverage sector

Industry: Food/Beverage

Author: Tony Milne, Industrial IoT Business Development Manager, Advantech

February 2022

Table of Contents

Introduction

European laws on food safety and other government legislation is increasing the need for traceability in the food and beverage sector. Meanwhile, fierce global competition especially of brand goods, forces companies to seek new ways of increasing profitability and reducing operating costs. Both these factors are driving the adoption of industrial IoT.

IoT can provide companies with competitive advantage and help to future-proof their operations. However, it is not a simple case of plug and play as it is often portrayed. Just buying IoT and adding it in to an already crowded technological showcase that is a typical industrial plant aimed at production for human consumption is never going to be straightforward, but the problems and the solutions may not at first be obvious. The same legislation, the desperate need for rapid profitability from any investment, and the health implications of failure, make any IoT project a tense battle for support and success.

IoT's principal benefit comes from its much easier integration of disparate, even separate, machines, stocks and materials used in the production process to facilitate the collection of data and its presentation to management for decision making as well as to other processes for the purposes of control. IoT can provide assistance to the production control itself, but also to resource planning, maintenance, human resources, marketing, quality and many other areas of business. Any benefit comes from the use of all this data to improve production.

The growing role of IoT Technology in logistics & supply chain

A growing use of IoT technology is to create a data lake, a centralised repository of all the data in a plant relating to its physical assets and the consumables involved in its production process, as well as the products that are its primary output. The data lake is not an objective in itself, but a means to present this data to a wide range of analytical applications which can optimize production, quality, purchasing, and the most basic of management functions.

A key technology enabled by IoT and a data lake is the digital twin. This is a simulation of the production plant, and permits management to role play scenarios involving catastrophes such as accidents but also the introduction of new equipment or processes.

Another popular IoT focus area is logistics. Although first started in the automotive industry, quality initiatives such as Just-in-time deliveries, typically in small batches, are now favoured by retailers, who want to combine this with their own brand goods. COVID restrictions have increased the number of people working from home, confusing the logistics process. New technology can help to mitigate these problems, notably, IoT technologies that can provide real-time data acquisition and effortless and error-free recording. IoT is used to support track and trace across the entire supply chain, from raw material to the retailer.

With all the benefits and obligations faced by companies producing food and drink, it is pertinent to ask why IoT adoption has not been faster. The answer is the challenges that they face to do so.

Overcoming IoT Adoption Challenges

The first challenge is simply to find the time, money and senior management sponsorship for a new project, as most companies are already involved in hundreds of changes. In this sense, most IoT projects today are driven from the top down, either as a result of a corporate decision to invest in or seek funding from government or EU resources, or as a result of pressure from suppliers of technology or machinery.

The second most common problem is to develop sufficient practical expertise in a new technology before starting a project that utilises it. While some employees may be familiar with IoT, either from spare time applications such as home automation or from previous employment, most engineers working in a factory environment will be experts in their own technology and applications, which rarely includes IoT. IoT is a new technology that requires knowledge of networking, often both wired and wireless, both personal (PAN) and local area (LAN), as well as IT (information technology) and the industrial applications (often now referred to as OT, operational technology, as opposed to IT. This challenge is often reduced to an extreme simplification, OT/IT integration, which hides numerous pitfalls and dangers, not least the assumption that the “other side” must function the same as “this side”, an assumption made regularly by even experienced IoT staff, which sometimes hilarious consequences.

The third problem that faces IoT projects is the business process used to implement such change. If the project is implemented in ways that fail to address the people involved, then it will lack the grassroots support needed for its successful implementation. Equally, if the business process itself is faulty, then no amount of IoT will correct it. All change programmes need to be managed for success, but IoT combines the human element, the business process, telecommunications and automation. All need to be addressed in order to deliver a successful project.

The key priority is always to start with a good business process. The best way to test this is to implement it manually, without IoT. When automotive companies implemented Kanban, the just-in-time production process, they did so using manual methods, pieces of paper. Only many years later did they automate and then computerise the system. The same should be the case with IoT processes. The manual process can operate for a period and then it can be optimised. Optimisation of the process should always be carried out before automation. Automation of an inefficient process will merely increase the inefficiencies, producing errors, faulty goods or wasted time and energy. Once a process is optimised as much as possible, then it can be automated. Again, there is no need to use IoT at this stage. Many technologies exist to automate business processes without the need for IoT-specific devices. The final stage is the incorporation of IoT to bring together all parts of the process.

Introducing IoT in the food & beverage production process

Following this process of business process re-engineering will have two effects. The first is the development of successful IoT projects. The second is the identification of which projects produce the greatest benefits, fastest, and which are not suitable for automation or IoT, and can be dropped. Some business processes can be improved without any additional technology. With the disruption of the last few years, some companies are postponing or removing many Industry 4.0 initiatives from their focus list. Instead, there is more attention on targeted areas, where the greatest benefits can accrue. Some call it Industry 5.0, while others refer to it as digital transformation, which appears to be emerging as the more common reference.

When an optimised, automated business process is producing beneficial outcomes, for example as a pilot project or proof of concept, the company can then proceed to roll out the project in bulk. In every industry, there are specifications necessary for the devices used, and the food and beverage sector is no different. Producing goods for human consumption requires that all devices are installed in such a way that they neither induce any health concern nor suffer from the aggressive treatment. This typically means that any IoT device installed openly in the plant needs to handle high-pressure hot water used for cleaning and sterilising equipment.

Some of the simplest IoT devices are the sensors that measure temperature, humidity and vibration. Most factories' production processes use rotating motors to move the raw materials through the process to produce the finished product. These motors are critical parts of the plant and require regular maintenance to prevent an unscheduled stop. However, unnecessary maintenance is both an expense and an unproductive halt for the line. Vibration and current sensors can detect changes in a motor's operation and help predict when it needs inspection or intervention.

Sensors connected close to mechanical processes need to communicate their data with gateways. Wired sensors, those that need a power supply, for example, will need to connect to the factory network. Increasingly, however, sensors connect wirelessly to gateways located in the roof space. Bluetooth is often used to collect sensor data from rotating or moving machinery, while WiFi is popular in fixed installations. Both are relatively limited in the range of communication within a factory environment, which contains many sources of interference, including the building structure itself, made of steel and steel-reinforced concrete, metal moving machines, and other wireless devices. This means that many access points are necessary to provide complete coverage. For large numbers of small sensors, LoRa technology is often used, such as with Advantech's vibration sensors. As only small amounts of data are transmitted, the sensor can be mounted wirelessly on the motor, and the battery power is sufficient to transmit the vibration data once an hour. LoRa is better at penetrating concrete and steel structures and transmitting at longer distances, so fewer gateways are needed than with other wireless technologies.

As well as WiFi and LoRa sensor nodes and gateways or access points, Advantech also supplies NB-IoT sensor nodes. The gateway for these is provided by the mobile network operator, the same that provides the SIM card for your mobile phone. For a large food processing plant, this can be a private network, or the company can just take advantage of the nearby public network. NB-IoT, like LoRa, is a low-bandwidth technology that is good at penetrating walls and has long transmission capabilities.

All these sensors together with their gateways can acquire data and transmit it to a Cloud. However, much of this data can benefit from pre-processing, at the so-called Edge. Pre-processing helps to reduce the amount of data sent to and stored on the Cloud, and also helps to provide real-time interaction with a control system, such as the raising of alarms or the sending of instructions. Edge processing is essential in order to avoid a shutdown in the event of a loss of communication. In addition, many companies avoid sending confidential corporate information to a 3rd party or international cloud server.

Among the latest IoT technologies is a new generation of Edge HMI for the front end. This is not simply an HMI for changing or checking settings, but for IoT data gathering. Installed near or even on the machines it is monitoring, the Edge HMI needs to support the full range of operational and cleaning hazards present. They are typically made from stainless steel with a special design to discourage pools of liquid, and are fully impermeable.

One kind of sensor that produces vast quantities of data is the camera, increasingly used to guarantee quality in all kinds of factories, but recently added to the technologies in those producing food and drink for human consumption. The camera streams are used to detect anomalies in production that can indicate machine failure. While a simple comparison is often enough, carried out by the computer or by a human operator, the latest technology added is artificial intelligence, the incorporation of the human's experience into an ever-learning application that eventually becomes as sensitive as the best human operator. The massive data flow requires equally massive data processing capabilities, and these are now provided by GPU cards installed in industrial PCs. Advantech, as the leading manufacturer of industrial PCs is also now a supplier of the GPUs that can facilitate this application.

With all the applications now using the data provided by IoT, it also makes sense to consolidate them on powerful servers. Just as in datacentres, the centralisation of computing hardware makes it easier to manage cybersecurity, power supplies, cooling and communications. On the production floor, it is also easier to concentrate computing resources and use the techniques of virtualisation to support all the different applications - cybersecurity, communications, control, HMI, quality, computer vision and AI/ML, as well as IoT.

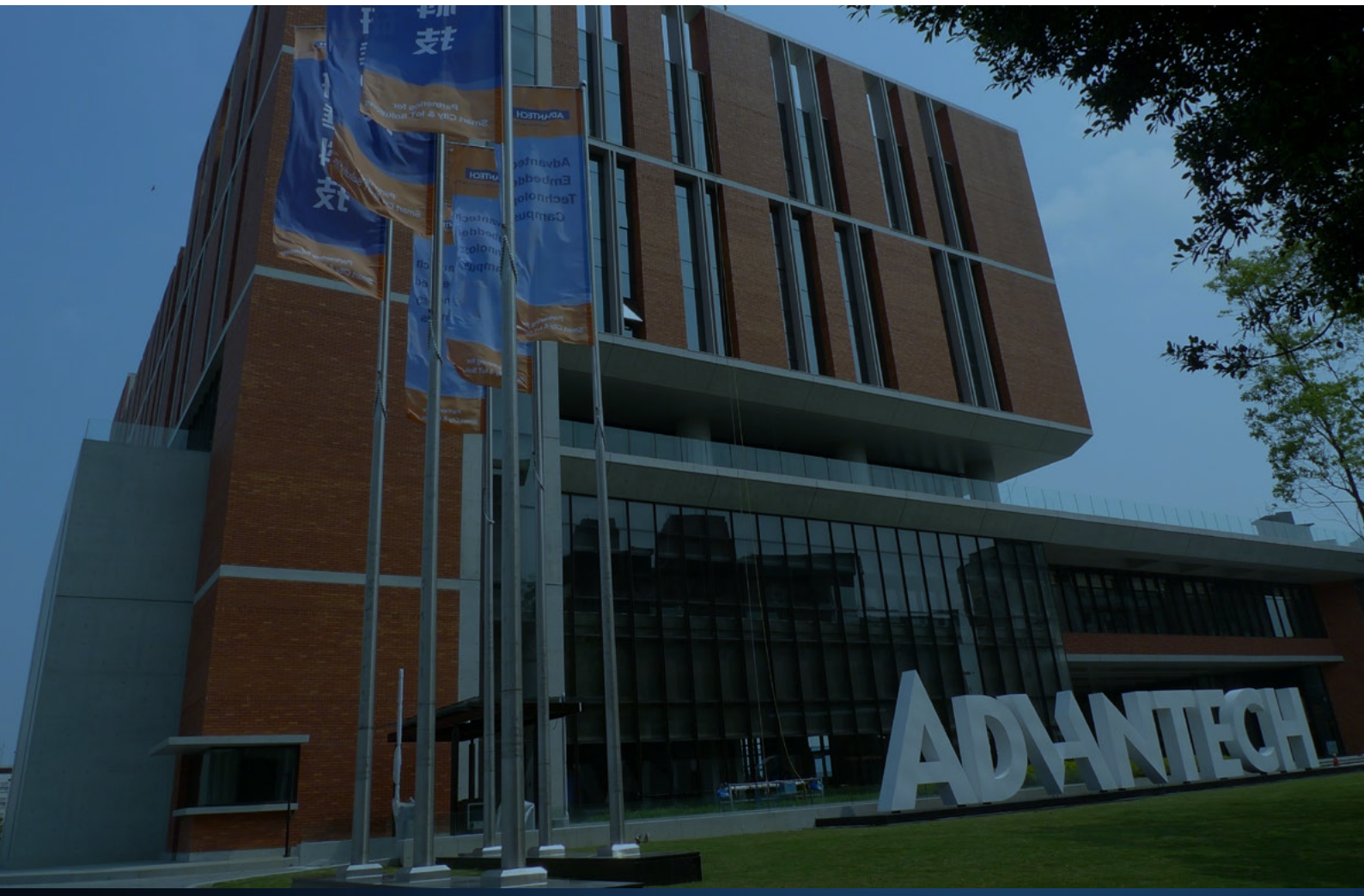
Virtualisation does not mean the end of the individual controller or dedicated computer. Just as in the office environment, where virtualisation in the data centre is allied to multi-tasking or even virtual desktops at the desk, industrial virtualisation will see an increase in the overall automation, while maintaining many of the current technologies. The most critical functions, the real-time data acquisition and high-speed motion control, will continue to be managed by dedicated hardware. However, much of the processing of data and commands will be offloaded to edge computers, connected by high-speed networks, including the latest low-latency 5G cellular networks.

Over the past few years, companies operating in the food & beverage sector – both food and drink producers and builders of machines that help them – have learned about IoT. For companies looking to adopt IoT technologies, the best advice is to work with existing standards, such as OPC UA, which is being widely embraced to communicate plant floor data, and MQTT, which is used to communicate between the IoT layers and the Cloud.

Advantech works closely with other companies to build end-to-end IoT solutions in an eco-partnership called co-creation. The customer thus receives a total solution that is easy to adapt to future challenges.

ADVANTECH

Enabling an Intelligent Planet



About Advantech

Founded in 1983, Advantech is the leading manufacturer of industrial computing, display and communications products. Advantech offers its build, configuration and design services worldwide, through a global sales, logistics and support organisation that works with its customers and their end-users wherever our equipment ends up. We cooperate closely with our distribution partners, software, hardware and communication partners, system integrators and consultants to provide complete solutions to complex computing and communications challenges. Our mission is to enable an intelligent planet by developing the automation and embedded computing products on which it will run. With Advantech products, the application and innovation potential is unlimited.

Advantech Europe

IIoT.AdvantechEurope@advantech.eu
www.advantech.eu