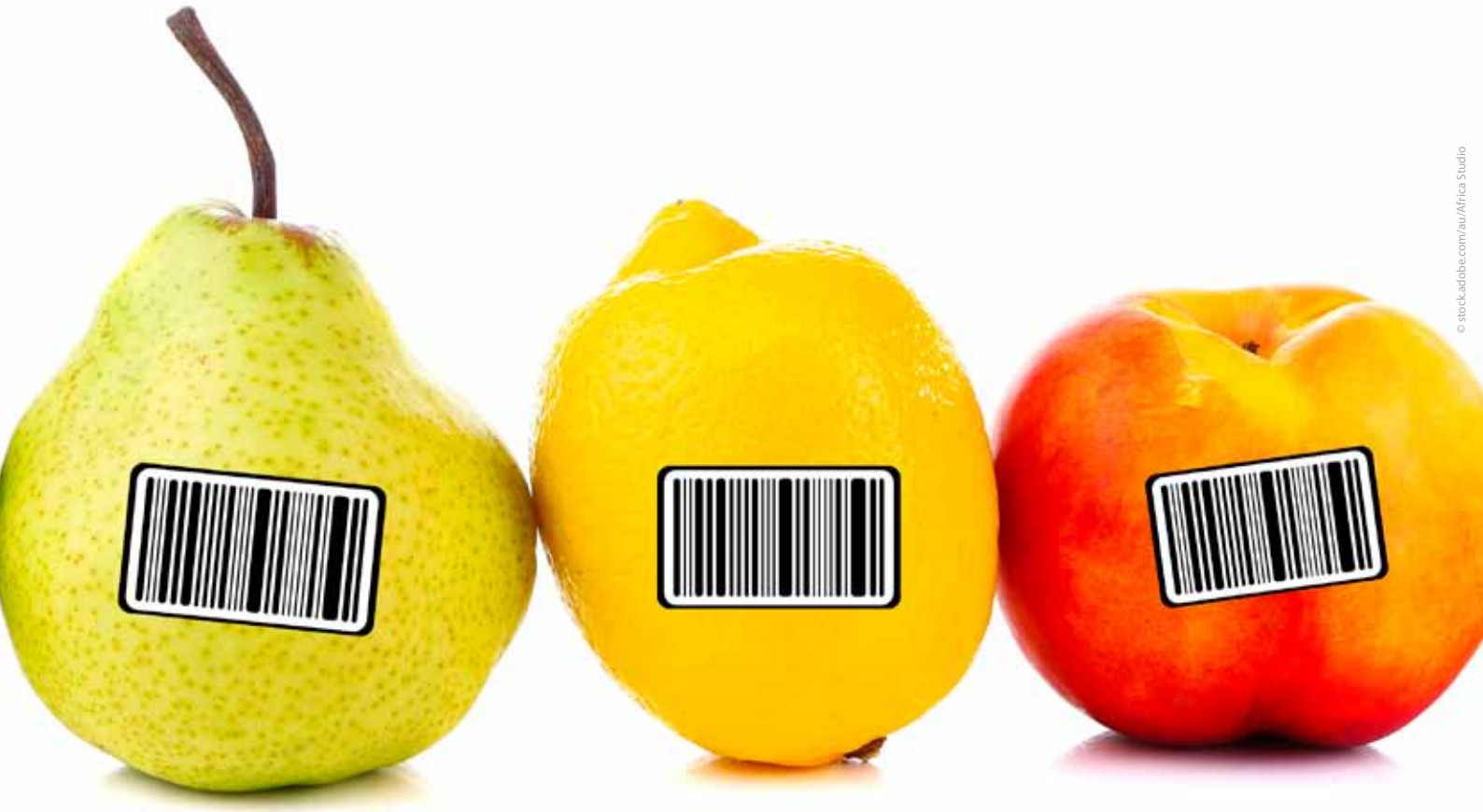
Flexible manufacturing



Contents

ebook | food processing .com.au
Food processing, packaging & design

From the editor ...

© stock.adobe.com/au/ ID1974

"Data, data everywhere and not a drop to drink" could be the case in the food industry unless manufacturers manage the data they collect to make their systems and processes more efficient.

Luckily many modern sensor and data handling systems make it both simple and inexpensive for manufacturers to collect and utilise data about their operations.

And the systems are not limited to continuous processes any more — discrete and batch processing systems, as are the norm in the food manufacturing industry, can also become more profitable, accountable and transparent through the implementation of connected sensor and data handling systems.

Find out more in this eBook.

Janette Woodhouse

What's New in Food Technology and Manufacturing

ebook | food processing .com.au
Food processing, packaging & design

Smart manufacturing
in the food and beverage industry

Glenn Johnson

Most of the smart factory discussion has centred around discrete manufacturing, but modern smart sensing technologies can also be applied to improve many aspects of the food and beverage industry, particularly for food safety and track and trace, improved packaging and new product opportunities.

The concepts of Industry 4.0, IIoT and 'smart manufacturing' have been gaining much press in recent times, particularly in relation to discrete manufacturing. Those working in an industry such as food and beverage — overwhelmingly driven by batch manufacturing processes — may find it difficult to see how such technologies could assist and improve their business. There are, however, definite areas in which these modern technologies can help modern food manufacturers improve efficiencies, market share and food safety.

Food recalls and traceability

A food or beverage product may be recalled for a number of reasons: complaints from consumers or customers, or by order of retailers or government. It might also be recalled as a result of testing and auditing at a food business or in the upstream supply chain (raw ingredients). Food Standards Australia New Zealand (FSANZ)[1] classifies the types of problems that can occur as including:

- **Microbial contamination:** Pathogenic microorganisms such as bacteria, viruses or parasites.
- **Labelling errors:** Non-compliant labelling, incorrect food ingredients on the ingredient list, incorrect date markings or other food labelling errors.
- **Foreign matter:** Contamination with material such as glass, metal or plastic objects.
- **Chemical or other contaminants:** Contamination with substances such as cleaning products, pesticides, machine oil, etc.
- **Undeclared allergens:** Due to incorrect labelling, incorrect packaging or contamination of the product by an allergen.
- **Biotoxins:** Contamination with biological toxins such as histamine in fish and paralytic shellfish toxin in oysters.
- **Other faults:** Those not covered above, such as packaging faults or unsafe levels of additives.

In recent times there has been mounting pressure on food and beverage manufacturers to initiate and achieve product recalls in ever decreasing time frames, making effective product track-and-trace imperative.

Complete food traceability involves the tracking of a product's history and sharing that data along the entire processing path — so-called 'farm-to-fork' or 'paddock-to-plate' programs. When it comes to food, knowing the exact source of where a raw ingredient came from is important should a recall be necessary. Studies have shown that the number of incidents of illness due to foodborne pathogens have been increasing with an increased consumption of fresh produce. The problem is that once an illness occurs in the community, it is often a complex and lengthy process to find the source of contamination. Traceability back to the source is therefore critical to shorten the time taken to find the source.

Modern smart sensing technology has a role to play in streamlining the entire farm-to-fork supply chain that makes identification and traceability as efficient and reliable as possible.

Technologies such as RFID are now making possible the tracing of raw ingredients from the original source. A good example is Japanese tomato processor Kagome, whose Australian factory in Echuca cultivates and processes tomatoes for food companies in Australia and overseas. Today, cultivating and processing tomatoes is automated, and it can be a logistical challenge to get the tomatoes from the field to the factory in the most efficient way.

Kagome operates 12 harvesters loading tomatoes into more than 300 bins, each with a capacity of 14 tonnes. Once a bin is full with fresh tomatoes, it is picked up by a truck and taken to a weighbridge close to the factory. As part of Kagome's quality control process, three samples from each bin have to be processed in the laboratory to ensure the quantity and quality of the yield. RFID tags are attached to the tomato bins, accompanying them right from the start of the harvesting process, and allowing real-time identification of where the tomatoes in each batch come from. With reliable real-time data made available by intelligent identification technology, Kagome has the ability to make better decisions, increasing productivity and efficiency, and making their products traceable to the source.

Consumer habits are changing

How consumers shop is changing, and many consumers today are turning to their smartphones for on-the-spot product research. A research report in 2014 from Deloitte Consulting[2] found that 84% of retail store visitors in the US use their smartphones before or during the visit to the store for product information and those that do convert to buyers at a 40% higher rate.

Retailers and manufacturers are therefore having to come up with new ways to engage the consumer at the point of sale so they can influence the purchase decision. That means packaging, shelf labelling and point-of-sale displays that can communicate with consumers through their smartphones. Some companies are also turning to technology to protect against product tampering, counterfeiting and theft. Some companies have an interest in extending the shelf life of fresh produce and reducing food and packaging waste.

A key enabling technology for all these applications is printable electronics (PE) — inks which can conduct electricity, made from materials such as graphite, silver and copper — that can be printed on a substrate thin enough to have negligible impact on package size. The substrate can be rigid, flexible or even stretchable, such as paper, plastic, fabric or glass.

PE can be used to create discreet components such as displays, conductors, transistors, sensors, light-emitting diodes, photovoltaic energy capture cells, memory, logic processing, system clocks, antennas, batteries and low-voltage electronic interconnects.

An example of a company utilising such technology is Canadian company NFC Authority, which is providing printed near-field communication technology[3]. Pilot trials began in June 2016 with three target customer groups — wine, craft brewers and craft distilleries. NFC Authority's solution combines a wireless tag with a printed antenna design and software application with a cloud-based platform. Consumers don't have to install an app — they just need an NFC-enabled device. They tap the bottle to confirm its authenticity. That same tap reveals more information on the product and offers digital engagement opportunities like video, loyalty, ratings, reviews, etc. With each tap, the brand owner can collect and analyse data such as user demographics, location, likes, social shares and number of taps through NFC's cloud-based analytics tool.

NFC Authority's printed electronic tags come on industry-standard rolls for adhesive lines that are already equipped to place tags. The tags are already pre-encoded with the hardware to scan and register them.

Smart labelling and packaging is only as good as the available information. While collecting customer information is useful, providing up-to-date information to customers depends on that information being available from the manufacturer. Today's smart sensor technologies in the food and beverage plant are at the core of enabling up-to-date product information to be presented directly to the consumer, including raw material provenance, sustainability data and allergen information.

Is 'batch size 1' feasible for food and beverage?

Perhaps the Holy Grail of Industry 4.0 is the concept of a single-unit batch. Smart sensor technology coupled with adaptive automation systems will be key to achieving this goal, in which manufacturing plants are flexible enough to adapt to individual customer requirements. This might not at first seem particularly feasible for batch-oriented manufacturers such as those in the food and beverage industry.

Some food companies have tried to achieve this and failed — one notable exception being German breakfast cereal manufacturer mymuesli GmbH[4], which allows customers to build their own muesli recipe that is then packaged with their own customised labelling and shipped to them direct. Of course, simple mixing of dry ingredients makes such a customisable food product feasible, where other types of food or beverage may not be so easy to manufacture in a single-unit batch.

One area that may be more promising is customisable packaging. An example of a step in this direction in packaging is that it will be possible to pack items of differing sizes (such as different sized beverage bottles) on one system using smart sensor detection with automatic format adjustment. The system continues running automatically and does not require line shutdowns to change batches. Or, like the customised muesli, perhaps customers will in the future be able to order customised, and personalised, labelling and packaging for their products, offering a product differentiation that some manufacturers may want to take advantage of — which ultimately would be a market-driven decision.

The data is the important thing

Depending on how the data is to be used, the data may be stored and used locally, or stored and processed by a cloud service. In the case of cloud applications, local consolidation of data at the source can improve data efficiency.

Smart sensors that incorporate their own smart logic can reduce the data demand by providing only necessary information as desired. In the bottle-packaging example, the smart sensors also assist in automatically reconfiguring the process, keeping the running production data within the packaging line for best efficiency. Only final production data should need to be forwarded on for batch track and trace.

Reliable and unambiguous identification of goods in the production process and supply chain is a vital prerequisite for efficiency and full traceability. Whether it's a single product on a conveyor or data about thousands of bottles of beer that are transported every day, the status of all recorded data must be easy to retrieve and analyse. This is where the cloud comes into play, allowing data to be collected from multiple locations, analysed, and further read and shared from still other locations.

While the concept of 'smart manufacturing' may not intuitively seem to apply to the food and beverage industry, the opportunities for improving food safety and quality, as well as improving customer engagement, mean that smart sensing and smart manufacturing technologies should be high on the agenda of any forward-looking food or beverage manufacturer.

References

1. Food Standards Australia New Zealand, Food recalls, www.foodstandards.gov.au/industry/foodrecalls/Pages/default.aspx
2. Deloitte 2014, Deloitte Study: Digital influences more than $1 trillion in retail store sales, www2.deloitte.com/us/en/pages/about-deloitte/articles/press-releases/digital-influences-in-retail-store-sales.html
3. NFC Authority Inc. 2016, www.nfcauthority.com
4. mymuesli GmbH 2016, uk.mymuesli.com

Quality, not quantity:
when data becomes information

With Industry 4.0 and an increasing number of communication-enabled sensors, transparency is on the increase, opening up new possibilities for both quality assurance and process optimisation in the production process. However, more information is needed so that the right decisions can be made.

One consequence of this is that higher-level systems find themselves faced with a massive flood of data. Sensor intelligence evaluates the data right away in the sensor and undertakes preprocessing accordingly: only the information that is actually relevant is forwarded.

Intelligent preprocessing directly in the sensor

Whether raw data or preprocessed information, neither data transmission nor bidirectional communication is possible without an appropriate industrial interface. However, new production and logistics concepts in the context of Industry 4.0 are demanding more and more communication-enabled sensors. Accordingly, there has been a tangible increase in the demand for IO-Link-enabled solutions.

With IO-Link, sensors are able to send information for process monitoring in addition to just detection and process data. This information is important for predictive maintenance as well as for process optimisation with a view to implementing safe and rugged detection. Even new set-up parameters can be transmitted via this route.

Solutions that support all standard interfaces for factory, logistics and process automation are accessible for virtually every system environment. In the context of Industry 4.0 in particular, this variability is the key to better investment security.

Smart sensor solutions based on IO-Link acquire data and convert it into the information that is relevant and necessary to the application. Equipped with intelligent automation functions, these sensors enable self-contained secondary tasks to be managed more quickly, more precisely and more efficiently than in the machine controller.

The advantages of this are:

- Condition monitoring in the sensor facilitates active self-monitoring and thus predictive maintenance.
- The process speed of the machine increases and, with it, its output. The information required for the control process is obtained by the sensor directly and forwarded to the machine controller.
- There is more efficiency from one end of the system to the other. Instead of large volumes of CPU- and time-intensive data, preprocessed information is sent to the controller. There is no need for data to be processed in the controller.
- Measured values are more precise, since the jitter caused by reading pulses into the controller cyclically no longer has to be contended with.

- The sensor calculates the measured values independently and precisely.
- The sensor takes over some of the tasks involved in data processing, thus relieving the load on the machine controller.

More transparency, more control

Full transparency of the automation functions and parameters of a sensor — at all levels of the automation pyramid — also improves control over the processes involved. In addition to the data that is related solely to the process and the information associated with the application functions (these are constantly available to the controller in real time), smart sensors can supply additional information for process monitoring and analysis. This information can be polled by the controller if necessary, enabling faults to be analysed or a secondary process to be monitored simultaneously.

More control also means that deviations occurring at any point within a workflow can be monitored and, if necessary, displayed. SICK's WFS fork sensors, for example, can be relied upon not only to detect labels, but also to supply information about the actual number of labels on a sleeve. As a result, deviations can be identified and brought to the attention of the label manufacturer.

Industrial image processing in the context of industry 4.0

Solutions from the field of 2D and 3D vision are used wherever checking, measuring, localising or identifying is the order of the day. Industrial applications have high expectations of these solutions: detection of the surrounding area; immediate data analysis; and immediate delivery of results so that specific action can be identified and taken, even under the most difficult of conditions. Alongside reliable image acquisition, efficient data processing directly in the sensor is decisive.

Diversity versus efficiency?

In the context of Industry 4.0, new challenges are arising all the time. Significant diversity of variants is a consequence of the desire for flexible, customer-specific production. However, high machine availability and production efficiency must also be ensured. 3D vision sensors in particular have a significant advantage in this context. Even if objects vary in size, height or shape, the sensor can be relied upon to detect them and provide the necessary information about them. Once the parameters of a machine or plant have been configured, this process does not need to be repeated. In practice, production efficiency also means high throughput. Vision sensors with ever higher resolution, faster detection speeds and maximum detection accuracy are essential if this is to be achieved.

3D vision inspection offers powerful technology, easy commissioning and intuitive operation. Vision sensors can be supplied with precalibrated 3D data, with overlaid intensity values. This enables the sensor to reliably check the presence and position of labels or printed patterns. The vision sensor can be used for cost-effective 3D inspections, such as checking the content of totes or quality control of consumer goods.

Data-driven decision-making in the oyster industry

As filter animals, oysters are highly susceptible to water quality. If there's been a lot of rain flooding into the estuaries where oysters grow, they can quickly pick up contaminants that could make people ill. Farmers and regulators want to avoid that at all costs — so when there is a perceived risk, oyster farms have to close until conditions improve.

The lack of supply is frustrating for the consumer — but it's financially excruciating for farmers. During periods of high demand, such as Christmas and Chinese New Year, a day's lost production can cost farmers $120,000 in foregone revenues.

In the Tasmanian oyster industry, Pacific Oyster Mortality Syndrome (POMS) has been wreaking havoc. Barilla Bay Oysters, once one of the state's largest farmers, lost 70% of its harvest to the disease in February 2016, crippling its operations.

"We have no control over what oysters consume — if there is something coming down the river that isn't appropriate we have no control. We could be closed for a couple of days or a couple of months depending on what is coming down the river," explained Justin Goc, manager of Barilla Bay Oysters.

Harnessing data

The problem has been that in the past the industry has relied largely on rainfall gauges to assess when there may be a risk, and often been required to shut shop when there's actually been no need. Analysis has revealed that around 30% of closures based on rainfall gauge readings are in fact unwarranted — the water quality and the oysters are fine.

However, the future looks brighter for Barilla Bay Oysters and the wider Tasmanian oyster industry, with the deployment of a technology solution developed by AgTech business The Yield, in partnership with Microsoft, Bosch and Intel.

The technology

The Yield is working with the Tasmanian Government and oyster farmers in 14 of the state's estuaries to deploy the new system, which uses in-estuary sensors to collect data that is fed through Bosch's ProSyst software through to the Microsoft IoT Hub in Microsoft Azure, where it is stored alongside national weather data. Environmental data and near real-time sensor data is combined

and presented to oyster growers and regulators as rich dashboard visualisations for the previous week, today and tomorrow to enable faster decisions based on local information.

The Yield believes that its technology could be more broadly deployed in aquaculture and agriculture, allowing crop growers to know exactly when and how to irrigate, for example.

Planning during uncertainty

In the oyster industry, while salinity measurement is clearly important in terms of identifying contamination risks, water temperature is equally critical to assess the risk of the POMS virus. Knowing there is bad weather ahead, when it might be hard for crews to get out in boats to harvest oysters, means oyster farmers are able to fine-tune their rosters — shaving cost and boosting efficiencies.

Barilla Bay's Justin Goc is optimistic that having access to more information much faster will help oyster farmers gain a better understanding of what is happening and "how we can plan in an uncertain future".

He now knows the salinity and temperature of the water, and has tide and weather details at his fingertips to help roster staff. In the future he's hopeful that even more data could be collected, such as algal profiles in the bays, which could provide insight as to which algae promote oyster growth, or potentially act as a POMS vector.

But ultimately he acknowledges: "It's a hard business and you can't control Mother Nature."

Microsoft Pty Ltd
www.microsoft.com.au

Sensors in hygienic conditions

Achieving reliable results, even in harsh conditions, is particularly important in food production and processing. Supplying contaminated or inedible food can result in considerable financial losses and a damaged reputation.

One method of fulfilling the strict hygiene standards that apply in this context is to clean the systems using high pressure every day; however, this means that the individual components are exposed to strong thermal and mechanical loads as well as aggressive chemical cleaning agents, which presents a real challenge to sensors.

Organisations such as the EHEDG (European Hygienic Engineering & Design Group) and the American 3-A Sanitary Standards are developing guidelines for hygienic machine and system construction — including the components used in the systems. In an age of globalisation, we rely more and more on harmonisation between these guidelines and the certification criteria.

In Australia, HACCP Australia operates an accredited product certification scheme, titled 'Food Safety Assurance'. The company's 'Certificate of Conformance' confirms a non-food product's ability to support the integrity and safety of food as demanded by industry expectations, legislation and GFSI (Global Food Safety Initiative) endorsed standards.

There are 10 key components in HACCP Australia's validation of a product's 'fitness for purpose':

- Materials and specifications
- Toxicity
- Contamination risks
- Ease of cleaning
- Operating instructions
- Consequences of error
- Batch and process controls
- Claims
- Packaging and labelling
- Contribution to food safety

The HACCP Australia scheme and its independent conformance certification is designed to meet that precise demand, giving assurance, to the buyer and seller alike, as to the fitness for purpose of such products, materials or services.

Washdown and hygienic design

Machines and systems which process foodstuffs are arranged in different zones in accordance with the relevant hygiene requirements:

Zone B

Splash zone (cleaning zone, washdown): Washdown indicates that the splash zone of a machine can be wet-cleaned well and quickly. With this type of cleaning, there will be very few or no residues (foodstuffs, cleaning agents, water) left on the surfaces. Sensors in the splash zone must therefore be rugged when exposed to cleaning agents and high-pressure cleaning.

Zone A

Foodstuff zone (hygiene zone): For 'hygienically designed' machines and the sensors used in these machines, certain additional standards apply. A machine is considered to be hygienically designed if it remains free from product residues during use, as this forms an ideal breeding ground for germs. Consequently, it is important to avoid dead space and open joints when designing components.

Sensors that are designed in accordance with hygiene standards are constructed in such a way that they can be used directly in the foodstuff zone (hygiene zone) of a machine. Fewer build-ups of product deposits means less cleaning, in turn reducing the amount of detergent, water and energy required. The system throughput increases thanks to shorter cleaning intervals — this can be an economic benefit, particularly if products are changed frequently.

The material makes all the difference

To ensure the reliability within the particular requirements of the food industry, sensors are manufactured in a range of housing materials:

Stainless steel (Inox)

Sensors enclosed in stainless-steel housing are chemically resistant, rustproof and durable. They guarantee chemical material resistance and absolute tightness during intensive cleaning and disinfection.

VISTAL

A high-strength plastic, reinforced with glass fibre, boasting mechanical properties which exceed those of conventional plastics. A VISTAL housing can reach a level of mechanical strength and tightness sufficient to receive a rating of IP69K.

PTFE

A PTFE coating ensures all-round protection for the sensors and cables. The PTFE plastic is not affected by solvents or other aggressive chemicals. Its surface is so smooth and slippery that hardly any external substance can stick to it, making it suitable for use in hygienic and wet areas.

Housing with the enclosure rating IP69K

Housing with the enclosure rating IP69K guarantees that the sensors and their accessories will stand up to intensive cleaning processes, regardless of whether these involve a high-pressure jet of up to 100 bar or water temperatures of up to 80°C.

Hygienic accessories

What use are hygienic sensors if the mounting components provide a breeding ground for germs? Mounting systems should also fully comply with EHEDG recommendations; connecting cables can be made of PVC with M12 plug connectors for use in the food and beverage industry. With Ecolab certification and enclosure rating IP69K, users can be sure that connecting cables are resistant to the cleaning agents and disinfectants for which they have been tested.

resources
from our sponsor

SICK
Sensor Intelligence.

About SICK

SICK is one of the world's leading manufacturers of sensors, safety systems and automatic identification products for factory automation, logistics automation and process automation. As a technology and market leader, SICK provides sensors and application solutions that create the perfect basis for controlling processes securely and efficiently, protecting individuals from accidents, and preventing damage to the environment.

SICK Pty Ltd

Address: 5 Helen Street, Heidelberg West VIC 3081
Phone: 03 9457 0600 Fax: 03 9457 2023
Toll free: 1800 334 802 **Email:** sales@sick.com.au
Website: www.sick.com.au

www.sick.com/au/en/suppliers-of-information-for-industry-40-smart-sensors-ensure-efficient-machine-communication/w/press-2016-SPS-Smart-Sensors/

www.sick.com/au/en/smart-sensors/w/smart-sensors/

www.youtube.com/watch?v=ta3dp6M_zmQ

www.sickinsight-online.com/safe-food-chain-only-possible-with-reliable-track-and-trace-solutions/

another ebook from
www.FoodProcessing.com.au

published by
wfmedia
westwick-farrow media