THE ART OF MANUFACTURING

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monozukuri

MITSUBISHI ELECTRIC
Changes for the Better

ISSUE 6

Mitsubishi Electric Factory Automation Customer Magazine

FARM TO FORK

AUTOMATING THE WORLD
Towards a smooth transition to a sustainable food system

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DID YOU KNOW?
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MITSUBISHI ELECTRIC
Changes for the Better

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Meeting the challenge of change

The pace of change in today's world is faster than ever before, and it is not going to slow down any time soon.

There are great challenges ahead of us, and industry and social norms will bear the brunt of those challenges.

For example, as many people recognize there are two changes occurring to the world population. The first is that it is still growing, but not necessarily because birthrates are increasing, rather because of great healthcare and better living conditions people are living longer - that is a good thing by any stretch of the imagination. However, more people means more demand on various aspects of our social infrastructure, and for the food and beverage industry that means pressure to meet the rising demand.

The second, related, trend is the reducing workforce. While many people talk about this, it is not so readily understood how dramatic this is going to be. According to the most recent OECD data, if we set the year 2000 as our datum, by 2060 in some countries like Japan and South Korea the working population will have reduced by more than one-third for the age group 20-64. In Germany and Italy, it will have reduced by between 13 and 20%. You may say that 2060 is a long way off, but we are already rapidly approaching 2030 so these changes are already in process. That means fewer workers available, reducing skill pools and lost know-how.

This is why Automating the World is so apt, it is about meeting the challenges and helping to overcome them for the benefit of all. In this edition of our magazine, we are going to look at how this applies to the food and beverage industry as it faces the double challenge of needing to produce more with less resources. ■

Malte Schlüter,
Sales director, F&B, CPG Industries,
Global GKAM manager for Nestle

The evolution of food production and processing through automation

The phrase “Farm to Fork” encapsulates the intricate journey that food undertakes from its origin in the fields to its final destination on our plates. That journey has undergone a transformative evolution, with automation playing a pivotal role in shaping the modern food production and processing landscape.

However, you may also recognize the phrase from the European Union’s “European Green Deal” which aims to develop a new food-ecosphere which democratizes the food industry making it fairer, healthier, and more sustainable. One potentially critical enabler is the impact of automation on the entire food supply chain, highlighting its significance in enhancing efficiency, sustainability, and meeting the growing global demand for food. In this report we will take a high level view to how automation is impacting this important industry at each step in the chain.

Look out for the examples of each step of the process from Farm to Fork


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FARM TO FORK

The European Unions “Farm to Fork” initiative is part of its European Green Deal policy.

food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en

AI and automation are helping farmers in surprising ways, from knowing when to plant, to keeping crops healthy to finally harvesting for optimal yields.

The Farming Revolution: the surprising impact of automation

Automation’s influence on food production begins at the farm level, where technological advancements have revolutionized traditional farming practices. Precision agriculture, sometimes referred to as smart farming, is bringing change in surprising ways. Some of the more obvious areas are related to energy management for irrigation systems and greenhouse heating, and indeed these techniques have been combined to create new vertical farming solutions which are allowing greater food production density per square meter of ground space. However, more advance automation has been enabled by technologies such as GPS-guided tractors and drones, which has allowed farmers to optimize their resources by precisely managing inputs like water, fertilizers, and pesticides. This not only increases crop yields but also minimizes environmental impact.

Moreover, the use of robotic systems in agriculture has gained prominence. Automated machinery, equipped with sensors and artificial intelligence, can perform tasks such as planting, harvesting, and sorting with unparalleled accuracy and efficiency especially when paired with AI systems. This not only addresses the labor shortage in the agricultural sector but also reduces the reliance on manual labor and mitigates the risks associated with human error.

In addition, one other emerging area for the application of automation control systems is the increasing focus on sustainability, and the adoption of circularity. For example, many farmers are now investigating the reuse of traditional biproducts, such as animal and bio-waste, as a potential new alternative fuel/energy solution for which automation provides the method for treatment and creation.

Smart Processing and Manufacturing

As crops leave the farm, the focus shifts to food processing and manufacturing facilities. Automation has revolutionized these operations by introducing smart processing technologies. Automated sorting systems utilize machine vision to inspect and sort fruits, vegetables, and grains based on size, color, and quality. This ensures that only the highest-quality products reach the consumer, reducing waste and improving overall efficiency.

In meat processing plants, robotic and automated systems have been employed for tasks such as carcass cutting and packaging. These systems can handle large volumes of meat with precision and speed, enhancing both productivity and safety for workers.

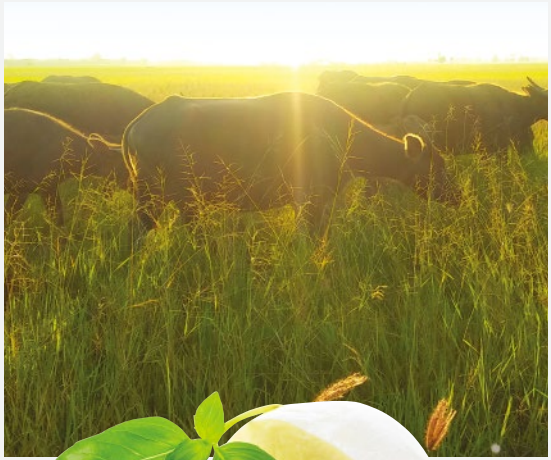
Automated systems have become indispensable for many production management tasks as they speed up product switchover, ensure recipe management is reliably executed, log and record every step and process that has occurred to the produce. Such actions support traceability, quality control and not to mention efficient maintenance activities.

Those same automated technologies also play a crucial role in maintaining hygiene standards, reducing the risk of contamination, and ensuring food safety. In fact, it also provides the opportunity to add a layer of "security" to the production process by monitoring who was on duty at the time and what they did so that on the rare occasions when disgruntled employees have taken to malicious acts, the automation systems have been able to quickly identify the problem and the perpetrator.

Supply Chain Optimization

The impact of automation has extended to many parts of the food industry reaching beyond individual production facilities to streamline the entire food supply chain. The integration of advanced digital technologies like blockchain, Internet of Things (IoT), and artificial intelligence is now underpinning real-time monitoring and traceability. This not only enhances transparency but also helps in identifying and addressing potential issues such as contamination or spoilage quickly.

Automated food processing ensures consistency, efficiency while removing excess waste.



When a biproduct becomes a resource

Maximizing the use of agricultural by-products to reduce waste and improve sustainability has several positives; including reducing a business' environmental impact and maximizing an important profit opportunity. This is why Italian farm Roana has invested in a biomass plant that utilizes livestock manure and other organic waste to generate energy controlled by PLCs, advanced industrial networks and frequency inverters all managed by a SCADA command and control system.

https://www.mitsubishielectric.com/fa/the-art-of-manufacturing/pdf/art_of_manufacturing_magazine_03_en.pdf

Innovations in home delivery are happening all over the world as demonstrated by Uber Eats, Cartken and Mitsubishi Electric (Feb 2024)

Automated systems for inventory management and logistics have long been essential components of commercial retailing operation. Autonomous vehicles and drones are now being explored for the transportation of products, reducing delivery times and costs and the use of predictive analytics further aids in demand forecasting, optimizing inventory levels, and reducing waste throughout the supply chain.

Consumer Convenience and Customization

Food production and processing is not limited to the efficiency of the supply chain; it also extends to the consumer experience. Automated technologies enable the creation of customized food products and personalized nutrition plans. Smart kitchens equipped with automated appliances can prepare meals tailored to individual preferences, dietary restrictions, and nutritional needs. Numerous initiatives have emerged, some showcasing robots functioning as coffee baristas, taking orders online, and engaging in made-to-order preparations for pizzas and burgers. These represent just a few examples of the myriad of innovations in this field.

Additionally, the rise of food delivery services has seen the integration of automation in the last-mile delivery process. Drones and autonomous vehicles are being tested for delivering perishable goods, ensuring faster and more reliable service. This not only enhances convenience for consumers but also addresses the challenges associated with traditional delivery methods.

Challenges and Considerations

While the integration of automation in food production and processing brings numerous benefits, it also poses challenges and raises ethical considerations. One of the primary concerns is the potential displacement of human labor. As automated systems become more prevalent, there is a need for upskilling the workforce to operate and maintain these technologies.

Small gains mount up when in mass production

United Biscuits, producers of the iconic McVities digestive biscuit, use Genesis SCADA (from Mitsubishi Electric daughter company Iconics) to not only capture and record 30 years of biscuit making experiences of their staff but also to speed switchover between products, increasing their productivity by 2.5%.

https://iconics.com/Resources/Success-Stories/United-Biscuits

Delicious automation: How machines produce our culinary joy

Not only is automation helping us get the food we want more quickly — it has also been instrumental in ensuring we get to enjoy flavours that will knock us off our feet! Here are four examples from the past.

https://in.mitsubishielectric.com/en/our-stories/article/xx_ww_k_sl2006_02.html

Moreover, the environmental impact of automation must be carefully considered. While precision agriculture can reduce resource usage, the production and disposal of automated machinery can contribute to electronic waste. Sustainable practices, such as the use of renewable energy sources and eco-friendly materials, should be prioritized in the development and implementation of automated systems.

The use of artificial intelligence in food production also warrants careful consideration. Striking a balance between technological innovation and ethical considerations is crucial to ensure the responsible development of automated systems in the food industry.

Future Prospects

Looking ahead, the role of automation in food production and processing is set to continue evolve and expand. Advances in robotics, artificial intelligence, and data analytics will contribute to even greater efficiency, sustainability, and innovation. Precision agriculture is expected to become more sophisticated, with the integration of technologies like drones and sensors becoming commonplace.

In food processing, the development of more advanced robotic systems and automation technologies will further enhance safety, quality, and productivity. The adoption of 3D printing in food manufacturing holds the potential for personalized and on-demand food production, reducing waste and providing consumers with greater choice.

Conclusion

The journey of food from farm to fork has already been significantly transformed by the integration of automation across the entire supply chain, and that trend is set to continue. From precision agriculture on the farm to smart processing and manufacturing, and finally to optimized supply chain management and consumer convenience, automation has played a pivotal role in shaping the modern food industry. What lies ahead is only limited by our imagination, automation will be a key enabler for many more creative and innovative steps in the food and beverage industry. ■

General example of a robotic coffee barista

There are many variations and suppliers of automated coffee barista's, this example animation gives a general idea of how they work.

https://www.youtube.com/watch?v=UPQExA0KdGg

A history of supporting the global food and beverage industry

Mitsubishi Electric has enjoyed a transformative journey in the food and beverage industry. From pioneering technologies to streamlined processes, elevating industry standards, ensuring efficiency, profitability, and ensuring greener future.

Famiel Confectionery

Visualization, monitoring and management of plant utilities result in savings of nearly 10 million yen over five years.

Country: Japan

Produce: Cheesecakes etc.

Topic: Energy and utilities management

2023

Lotte

Real-time millisecond level data acquisition and analysis overcoming quality issues and skill shortages.

Country: Japan

Produce: Ice cream and snacks etc

Topic: AI data analytics

2021

Equitek CE

350 fills a minute. Mitsubishi Electric has been our supplier for 20 years; they are always there when we need them.

Country: Mexico

Produce: Packaging machines

Topic: Flexible high speed processing

2019

2020

Qingdao Golden Packaging Machinery

Comprehensive solutions for the packaging process by using the e-F@ctory framework.

Country: China

Produce: Packaging machines

Topic: Packaging for digital manufacturers

AB Technology

Cost savings with increased efficiency across plants with high reliability.

Country: United Kingdom

Produce: Baking, additives

Topic: Automated ingredient management, reporting and visualization

1999

Virgin Drinks

Highly efficient production facility with an on-site staff of 6 producing up to 2 billion litres of Cola per year.

Country: Ireland

Produce: Cola concentrate production

Topic: Automation, control and visualization of production

1998

SHIKOKU KAKOKI

By using a motion controller to electrically control the cam drive, the time and effort required to change the cam is dramatically reduced.

Country: Japan

Produce: Milk filling machine

Topic: Motion controller and servo motor

1992

Milklink dairy

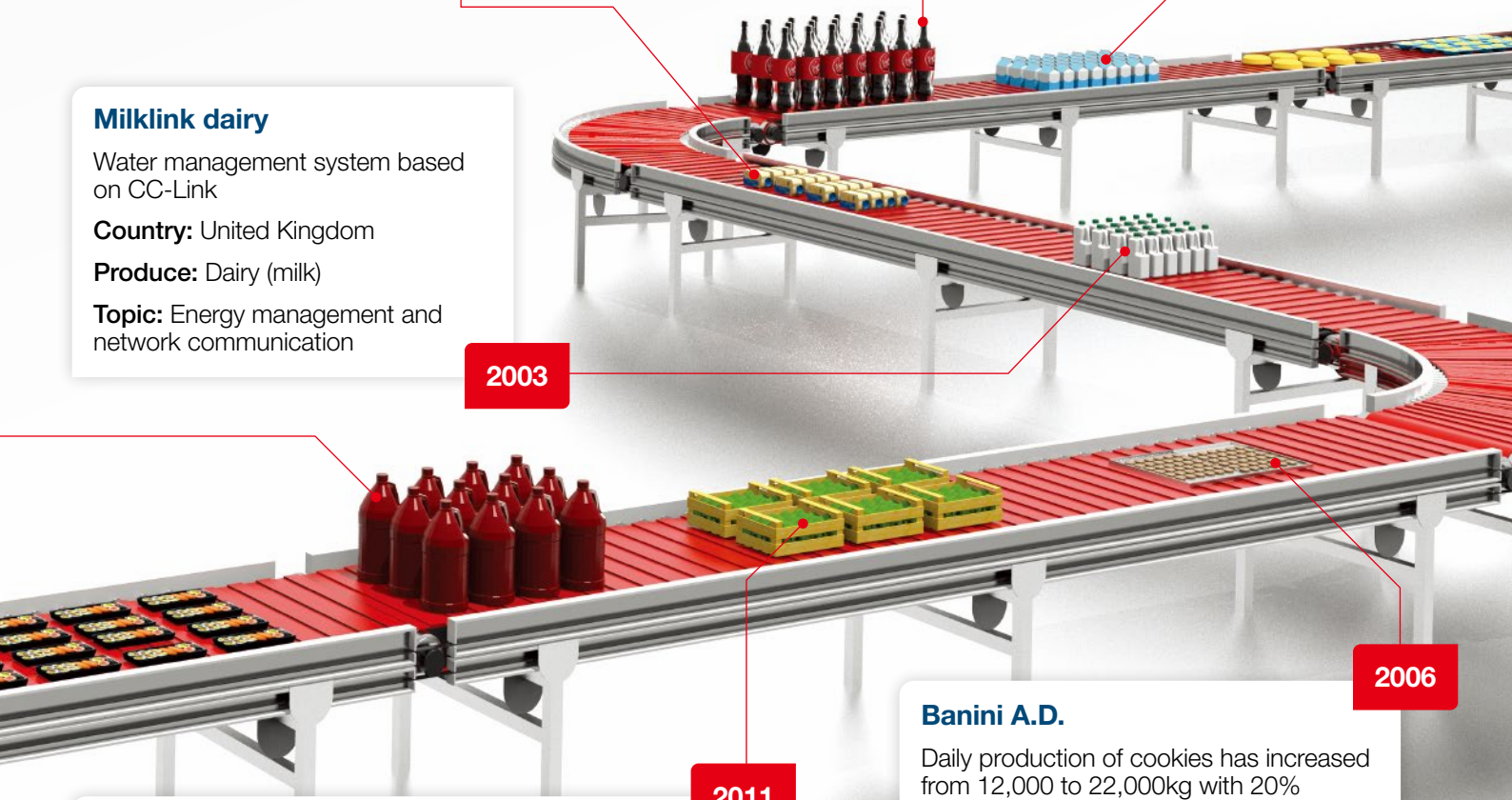
Water management system based on CC-Link

Country: United Kingdom

Produce: Dairy (milk)

Topic: Energy management and network communication

2003



2006

Banini A.D.

Daily production of cookies has increased from 12,000 to 22,000kg with 20% product quality increase.

Country: Slovenia

Produce: Cookie production

Topic: Increased production volume and quality using robotics

2011

Feltracon B.V.

Vegetable processing machine improves product quality

Country: The Netherlands

Produce: Salad preperation

Topic: High speed salad drying centrifuge

To learn how our e-F@ctory IoT solutions can benefit your industry please visit the Mitsubishi Electric website. ■

https://www.mitsubishielectric.com/fa/solutions/efactory/index.html

The future in everyone's hands

We talk to renowned environmental expert Professor Norichika Kanie about the UN's Sustainable Development Goals (SDGs) and what each of us can do to help meet the challenges around climate change.

Interview with Professor Norichika Kanie of Keio University

What made you decide to tackle the issues facing the global environment?

When I was working on my PhD in the late 90s, specializing in international relations policy, I saw that the Kyoto Protocol had set out a policy up until 2012, but with nothing decided beyond that point. Since then, while teaching at a university, I have been involved in policy discussions centered on climate change at the Ministry of the Environment, the Ministry of Economy, Trade and Industry, the Ministry of Foreign Affairs, etc.

2030 has been set as the target date for achieving the SDGs. So how do you see the current state of progress?

The UN's Sustainable Development Goals have become a kind of global buzz-phrase, but I'm sure many people who hear it are not completely sure what it means. About 80% of the SDGs relate to climate change. Three factors have hampered progress; the effects of climate change in different parts of the world, COVID-19, and the war in Ukraine.

Becoming 'carbon neutral' is a hot topic around the world. But what does the phrase actually mean?

Carbon neutral refers to efforts to reduce net emissions of carbon dioxide (CO_2), the main greenhouse gas, to zero. Carbon 'neutral' is about the idea that emitted carbon should be offset in some way, to effectively balance things out. Planting trees for example, to absorb unavoidable emissions of greenhouse gas. If one country cannot achieve net zero emissions on its own, others can work together to achieve overall carbon neutrality.

Environmental issues must be addressed urgently. Perhaps one of the challenges is a lack of public awareness of how critical the current situation is?

"About 80% of the SDGs relate to the tackling of climate change. Three factors have significantly hampered progress; the effects of climate change in different parts of the world, COVID-19, and the war in Ukraine."

Professor Norichika Kanie is one of fifteen scientists appointed to write the 2023 edition of the Global Sustainable Development Report (GSDR), compiled every four years by the UN. He stresses the importance of understanding our objectives, then taking concrete action to achieve them.

Professor Norichika Kanie - international environmental expert.

Born in Tokyo in 1969, Dr Norichika Kanie is a Professor at Keio University Graduate School of Media and Governance. He graduated with a PhD from Keio University in 2000 and was Associate Professor at the University of Kitakyushu and Associate Professor at the Graduate School of Tokyo Institute of Technology before starting his current position in 2015. He is actively involved in work on the United Nations' Sustainable Development Goals including as a member of the Japanese government's SDGs Promotion Roundtable, the Cabinet Office SDGs Promotion and Evaluation Committee, and the Ministry of Environment's SDGs Stakeholders Meeting.

That's right. In the early 2000s, the thinking was that once we begin to see the effects of climate change, it will be too late to take action. But now, those visible effects have started to appear. Back then, it was thought that a 60-80% reduction in greenhouse gases by 2050 would be sufficient. We have now reached a point where we must aim to be carbon neutral, meaning 'zero' emissions.

Towards sustainable manufacturing

Why do you think there is not more of a widespread sense of urgency when it comes to environmental issues?

Public awareness is definitely changing now that there is global action taking place via the Kyoto Protocol, the Paris Agreement, and the SDGs. The notion that greenhouse gases have a negative effect on the global environment is fairly widely accepted, although difficult to prove scientifically. We see various parts of the world being affected by extreme weather events. But it's still difficult to state definitively that these individual events are caused by climate change due to greenhouse gases. The relationships of cause and effect are so complex. I believe that people with a scientific background should communicate a real sense of urgency.

Companies are required to take action to cut greenhouse gas emissions and become carbon neutral. What should they do as a first step?

Firstly by knowing your company's greenhouse gas emissions. 'Scope' is a way of calculating these throughout the entire supply chain. 'Scope 1' refers to a company's direct emissions, such as fuel combustion and industrial processes. 'Scope 2' covers indirect emissions from using electricity, heat, and steam supplied by other companies. 'Scope 3' refers to all other emissions related to the company's business activities.

Ministry of the Environment / Ministry of Economy, Trade and Industry: "Green Value Chain Platform"

www.env.go.jp/earth/ondanka/supply_chain/gvc/en/supply_chain.html)

Do you have any notable examples of corporate initiatives to tackle climate change or help create a sustainable society?

Apple and Volvo both have plans that will require their suppliers to use 100% renewable energy in the near future. Developing a business that achieves decarbonization throughout the entire supply chain means looking beyond the company itself. In 2021 for example, Toyota plans to develop an experimental place called Woven City, where people, goods, robots and vehicles are connected in harmony with nature and the environment, with carbon neutral housing and transport systems emitting no CO_2 at all. It is important to take such a holistic approach to becoming carbon neutral.

Is it also important to take a holistic approach to achieving sustainability in the manufacturing world?

It is important to optimize the whole lifecycle of a product from a sustainability perspective. Developing an understanding of each stage of the process – sourcing of materials, fabricating, transporting, selling and recycling – will highlight which areas should be changed. Thinking of a product in reverse, creating designs that can be easily taken apart for recycling, can lead to innovation.

What do you think about companies that are actually tackling carbon emissions and the SDGs?

The earlier a company takes the lead, the more serious they are about their future success. One organization told me that developing sustainable products has broadened its customer base. Regarding recruitment, job applicants are increasingly saying: "I want to work at a company that is committed to tackling environmental issues." Where many companies are struggling to find new employees, this is a huge benefit.

What we have learnt from the COVID-19 pandemic

What kind of industry-wide efforts are required for the Japanese manufacturing industry to achieve sustainable development?

The industry needs to keep an eye on the market to stay in line with global standards. There is a growing focus on environmental, social and governance (ESG) investment. In Europe, there is a growing movement to reject greenwashing company [#1]. Similar movements are emerging in the US, so this is sure to become the standard thinking around the world in three to five years' time. If Japan is slow to adopt this trend, it risks being squeezed out of the global market. As large corporations start to require sustainability throughout their supply chains, small and medium-sized enterprises that do not respond will lose work and also feel the effects in terms of bank lending.

What should managers keep in mind when a company is promoting carbon neutral and sustainability initiatives?

One piece of advice is to listen to young people. I founded the xSDG Consortium at Keio University in 2018, to share initiatives aimed at meeting the SDGs. One of the most common comments from companies is: "We want to hear what students think." Once, at a summer camp for young people, a school student asked a question during a discussion about global poverty: "Rather than sitting in Japan thinking about poverty in other countries, why don't we build a campus in one of those countries?" Adults tend to think in terms of what can or cannot be done. Young people have more ability to think outside the box.

What are your hopes for the future of the manufacturing industry?

We have six years to achieve the SDGs. By then, I would like to have seen a rapid shift to sustainable manufacturing. Japan has incredible manufacturing skills. I would like to see these technical capabilities harnessed to achieve the SDGs and carbon neutrality. In the past, Japan forged ahead, manufacturing good products but taking no notice of emissions. It is possible to achieve sustainable manufacturing without compromising on quality. For example, as electric vehicles become mainstream, some components in conventional fuel vehicles will no longer be needed. Plants that produce these components might lose work, but the technology they develop to make them can be applied elsewhere.

Earlier, you mentioned the pandemic as one of the factors that has hindered progress towards the SDGs. How do you view the COVID-19 pandemic now?

When COVID-19 temporarily put a stop to virtually all aspects of life, it showed us that our society was not sustainable. We realized we needed to create a sustainable society, so we learned new ways of working and communicating. The pandemic also highlighted the need for digital transformation. In terms of the SDGs, we could say the 17 goals illustrate the risk of everything stopping as it did during the pandemic. Energy shortages, natural disasters, growing poverty. I'm sure many people realized the need to make the world sustainable in the face of these threats.

[#]1. Greenwashing is a marketing tactic used to make a product or service appear better for the environment than it is.

Automating the World

For a Sustainable Future.

Manufacturing made sustainable.

Welcome to Mitsubishi Electric's vision for the future enabled by factory automation.

It is a place where sustainable manufacturing can be created for all.

We believe sustainable manufacturing supports the creation of a sustainable world.

Efficiency is not only good business sense, it also has less impact on the environment.

Sustainable manufacturing will set people free to be more creative and productive.

It will transform our world and its future.

A sustainable world driven by factory automation means a brighter future for you and your children.

Automating the World
For a Sustainable Future.

Never underestimate the power of the individual

We have talked about what can be done collectively towards achieving carbon neutrality and the SDGs. Do you have any advice about what we as individuals can do?

Do something easily achievable, something you enjoy doing, and keep doing it. There is sure to be one of the SDGs' 17 goals that you are interested in. If you are interested in the issue of energy, for example, small actions like switching off lights and using LED lighting will not only help achieve the SDGs, they will also save on energy bills. If you love the sea, using a reusable bottle instead of buying drinks in disposable plastic will help combat pollution in the oceans. Small changes to your habits make for a future-friendly lifestyle. Why is it good to do what you can? This is because by doing what you can do, you will be able to see what you cannot do on your own. If we do this, we will start thinking about what we need to do to move society forward, and I think this will lead to major changes in society as a whole.

So people should not think: 'I can't change the world by myself'?

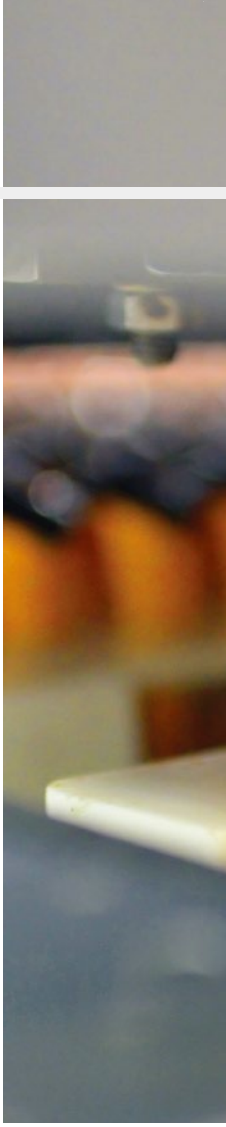
That's right. Always think of yourself as a leader. We can all share our ideas and actions with the wider world through social media and videos. I am quite particular about clothing. One day I realized that clothes are not sustainable; they are mass produced, then thrown away. So now I get most of my clothes made to order. I specify long-lasting, sustainable fabrics, and choose natural shell or recycled plastic for the buttons and so on. Because my clothes are made to fit me, I am minimizing waste and I treasure each garment. At the same time as being good for sustainability, tailored clothing is a small pleasure for me. Something might take very little effort, but if you don't enjoy it, it won't last.

Speaking of your own sustainability efforts, the 'SDG House' you built for yourself has featured in the media and the project will soon be published as a book.

When I was thinking of a new apartment, I asked an architect friend of mine if he knew any good developers. He slapped me on the shoulder and said, 'You're involved in the SDGs – so put them into practice in your own home!' I am always saying that the SDGs bring global issues and goals closer to home, but I had never thought of applying them to my own house. So I incorporated as much as I could: insulation, solar panels, and so on. I learned a lot from this construction project. For example, we shouldn't waste the wood that took decades to grow. I am now considering installing an energy storage system and I keep coming up with new ideas.

The wonderful story of the 'SDG House' shows how human interaction can lead to discovery and development. Do you have a final message of encouragement for our readers who are working hard in the manufacturing world?

The manufacturing industry consumes huge amounts of energy, so its CO_2 emissions will inevitably increase. We must change the paradigm in terms of awareness and values of everyone working at a production site, however large or small. No matter how loudly managers shout about the SDGs, the company will not change unless the employees are in agreement. If each individual tackles these issues with an awareness of themselves in the leading role, I believe there is a bright future for the manufacturing industry and our society. Manufacturing sites are home to Japan's world-class technical capabilities. So, continue to work hard and never stop learning. I am cheering you on! ■



Automation challenges in the food and beverage industry

The food and beverage industry is increasingly turning to automation to enhance efficiency, reduce costs, and improve overall productivity. While automation holds immense promise, it also presents a unique set of challenges for manufacturers in this sector. This second part of our food and beverage report explores the key automation challenges faced by the food and beverage industry and offers insights into potential solutions to address these issues.

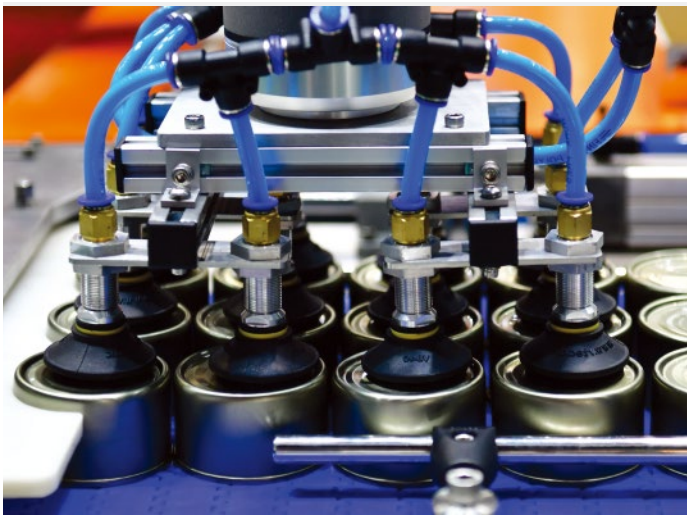
In the era of modern manufacturing, automation has become a pivotal force driving efficiency, cost reduction, and overall productivity. However, for the food and beverage industry, embracing automation is a journey fraught with challenges unique to the sector. In fact, one rather obvious challenge right from the outset is while we frequently talk about the food and beverage industry as a single “unit” the reality is there are many sub sections, each of which have their own unique challenges, from the handling of dry or fragile oat cookies, to the liquids and chemical processes unique to making beer or the frigid temperatures needed to create our favorite ice creams. In this report we will look at some of the most common issues that are shared across the industry and try to illustrate points with some examples.

Even the humblest of ingredients still need to be managed efficiently to ensure tight margin targets are achieved.

Complexity of Production Processes

It's complicated. Anyone who tells you otherwise hasn't walked a mile in the "shoes" of the industry. Let's start by considering the raw materials. In general, the food and beverage industry is a difficult business which relies heavily on volume sales to realize its margin targets. However, intense price and quality pressures from its customers coupled with the uncertainties of raw material supplies, due to failed harvests, natural disasters etc. mean it's common for larger companies to buy ingredients/commodities as "futures", as a countermeasure to mitigate pricing fluctuations. However, daily tactical adjustments to recipes are also a supportive measure, i.e., by adding a little more of a cheaper ingredient and a little less of one that is increasing in cost, yet keeping within the bounds of the recipe, some recovery of margin is possible. However, such changes can affect the product processes such as chocolate taking longer to "set," or a thickening product viscosity requiring more pressure to extrude it to a final form. This is where the role of integrated automation really plays a strong part. Interfacing and translating the business dynamics into actions in the production environment requires a sturdy OT-IT integration, comprehensive command and control visualization initiatives, and robust automation concepts, so that the effects of these macroeconomic factors can be countered at once, often in real-time on the production line.

Digitalized recipe management, tracking and traceability all aid quality control.



Automation and innovation work seamlessly to solve a broad spectrum of challenges from picking and mixing to packing and testing.

Getting the right information to the right people, so that prompt decisions can be made is one of the next big challenges. This is where edge control can really come into its own, by allowing the rapid collection and processing of current conditions and reporting back to the main control center. Such secondary data collection systems are needed if the original machinery is some years old or does not have the latest strategic technologies such as local AI analytics or optimization tools. Furthermore, wide use of Andon style displays is also an effective way to share that information with the workforce, so that they are aware of any potential problems early on and can take the right actions in time. The more seamless the operations between people and the systems, the more effective those systems tend to be. All of this is made possible by having a comprehensive networking environment which helps the rapid sharing of information and data in context. That's especially important to maintenance teams who may have to remotely access machines and equipment over an extensive area.

Now let's consider some of the "physical" challenges. For example, handing natural produce without damaging them presents several added challenges including the automation of non-repetitive movements. Just think of naturally irregular shaped produce such as potatoes or handling something as delicate as a lettuce leaf or even something that can easily deform like picking up a bag holding a liquid where the center of gravity shifts as the bag material deforms – a tricky challenge for any robot! However, combining 3d vision systems, feedback sensors in robot grippers, and AI analysis, robots can become very efficient at meeting such challenges. Those may be the obvious hurdles, but there are also others which perhaps are even more obvious yet paradoxically less recognized. What are we talking about? Packaging. This is a challenge all by itself.

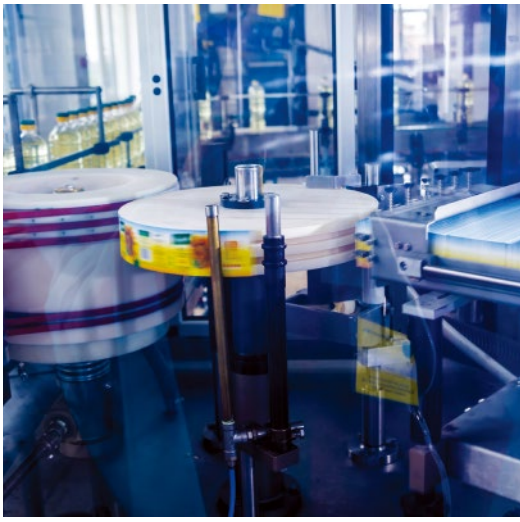
Let's consider all the different packaging variations that one particular product could be available in, for example, your favorite beans in tomato sauce. They could be delivered in a small, medium, large, or catering size tin can. Or then maybe they are combined in to a three, four or six pack, or perhaps a set of plastic blister bubbles or even a bag! The same contents, but packaged in multiple ways, delivered to customers who each have their own preference. And if you add "own brand" label variants, then the issues simply multiply beyond imagination. The solution of course is flexible automation, high speed motion systems and strong integration with the supply chain elements so that the right labels arrive at the right time for the right container ...and don't run out halfway through the production run. But that's not all, now the food and beverage production engineers need to consider the impact of social change as well. The current example of which is the change of the public attitude towards single time use plastic packaging. Now new materials need to be considered along with each of their unique handling problems. Machines and processes need to be adapted and the impact of those changes quantified and qualified so that they can be implemented seamlessly into the current operations.

For sure the use of digital twins is a great boon to understanding the impact of change on the operational aspects of the line, but the digital twin concept can also be extended as a model for managing production in general so that the impact of fluctuating demand can also be simulated for optimal planning and selection of production assets.

No, it's clear the food and beverage industry is complex and challenging, but automation is evolving and adapting to meet that challenge.

Other areas that raise significant challenges are:

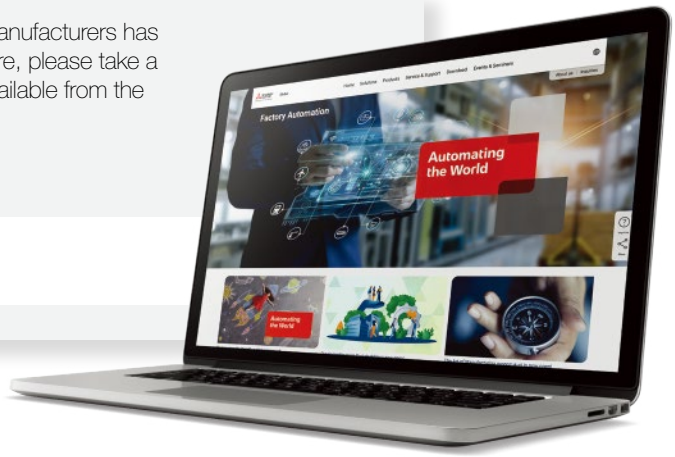
1. **Integration with Legacy Systems:**
   - Many food and beverage manufacturers have existing manual or semi-automated systems in place.
   - Challenges in seamlessly integrating new automation technologies with legacy systems.
2. **Cost of Implementation and ROI Concerns:**
   - High upfront costs associated with the purchase and implementation of automation technology.
   - Concerns about the return on investment (ROI) and the time it takes to realize cost savings.
3. **Skilled Workforce Shortage:**
   - The need for a skilled workforce to operate, maintain, and troubleshoot automated systems.
   - Challenges in finding and retaining employees with the necessary technical expertise.
4. **Regulatory Compliance:**
   - Navigating complex regulatory landscapes and ensuring that automated systems comply with industry standards.
   - Regular updates and changes in regulations that may require adjustments to existing automation processes.



High speed packaging is only realizable using advanced automation techniques.

If this brief look at some of the challenges facing manufacturers has piqued your interest and you would like to read more, please take a look at our separate extended discussion paper available from the Mitsubishi Electric website. ■

https://www.mitsubishielectric.com/fa/



We do it all.

SV Agri's Agri Business Division has an extensive storage solutions and a nationwide delivery network through which we make available process grade potatoes to the process industry round the year. Through our Engineering Business Division, we engineer and manufacture a wide range of processing equipment for pre-processing, processing, and post processing of potato-based snacks, as well as supporting other western and Indian traditional snacks. We cover the whole range of production skills from potato grading, to snacks production, flavoring systems, packing distribution and state of the art conveying systems. We also have an ingredients business that supplies potato flakes, starch powder etc. We are also actively helping new startups to produce snacks at our existing clients. So, in effect, we do it all.

Mr. Ram Manohar, Head of Engineering Division

FARM TO FORK

An insiders view to trends driving their industry

Recently we were lucky enough to be able to interview SV Agri, a vertically integrated snack food concern based in India. We wanted to understand, from their insiders viewpoint, what trends were they experiencing now and what were they expecting in the future. Several keywords became apparent in our conversation, "the potato ecosystem", "innovation", "healthy foods" which are signifiers of what is driving change for them.

A vertically integrated food business

One of the most surprising, but important, points about SV Agri's business is the level of vertical integration based around the humble potato. The reason this is so significant is because it highlights the trend towards the sustainability of business and society. SV Agri have recognized that by being fully involved in the overall "Farm to Fork" journey of the potato, they can harness a feedback loop integrating the needs of the farmer and the snack food manufacturer. As examples of this approach, through a subsidiary, they can provide seed potatoes to the farmers and help automate the overall production process for the snack food manufacturer. They have truly created their own "potato ecosystem". In the diagram below you can really start to appreciate the all-inclusive role that SV Agri plays.

The Potato-ecosystem

The "Farm to Fork" journey starts even earlier at consumer demand. Each step of the process can be modeled in SV Agri's Potato-ecosystem aiding the understanding of how the ecosystem satisfies the food/demand trends but also how it closely aligns with trends in sustainability.

SV Agri – Agriculture business

FARMERS

Seed potatoes
Receive new varieties of seed potato from SV Agri based on the requirements of snack food manufacturers.

Develop new potato varienties
R&D to develop new potato strains to meet the snack food industry needs.

Demand for potato innovations
To develop new snacks to meet consumers needs may require new potato porperties.

Grow to order
Produce a large volume of the required potato stock and deliver to SV Agri.

Stock and deliver new potatoes
Collect potatoes from the farmers, store and deliver to snack food makers.

Innovate new snack foods
Drive consumer value and demand, generate new business opportunities.

New entrant
Considering entering the snack food market, need know-how, systems and advice.

Develop new equipment
Innovate new machines, and consult on processes and techniques for maximum yield.

Enhanced production
Invest in new production equipment to improve profitability, quality and satisfy demand.

SNACK FOODS MAKER

SV Agri – Engineering business

> Innovation in processing potatoes
>
> ***PhD. Snehal Doke,***
> *Head of R&D (Food) Division*

SV Agri also offer a wide range of 100% millet-based pop chips 100% pulses-based pop chips

How does your Potato-ecosystem help you respond to new trends?

Mr. Ram Manohar Singh, Head of Engineering Division: We utilize our Potato-ecosystem to give us early insights into what consumers and producers are looking for and we then try to align with that. In some way, we at SV Agri are the hub, connecting potato farmers and snack makers, providing the process grade potatoes to the farmers and the production lines needed by the manufacturers. This allows all three parties to benefit from the flexibility to respond to changing market needs without wasting time and effort.

Can you give us some examples of snack foods that have been developed in response to new trends?

Ms. Snehal Doke, PhD, Head of R&D (Food) Division: Here are some of our newest customers, across a variety of categories. On the top shelf is the Happilo brand. They are producing extruded snacks. Here they are responding to the need for healthy products made with millet and other cereals. This is a big advantage for them, because traditionally the extruded snacks category is considered relatively unhealthy.

And then there are coated nuts which have many variations. The snack has two core parts. The part of the embedded nut and the part of the coating on top. We have a lot of new technology in this coating, varying texture, quality, and combinations, so we can offer exciting innovations in coated nuts.

Similarly, popchips are also available as potato snacks, 100% millet-based or 100% pulse-based or combinations of millet, pulses, and cereal grains that can provide a highly nutritious food alternative. We have also developed a technology for roasting pulses, freeing them of oils and other substances, which results in different textures. Therefore, the pulses remain perfectly processed with the proteins and fibers remaining. I'll leave it there for now.

Delivering future foods with innovations & engineering solutions.

I would like to ask you about your company's slogan "Delivering Future Foods with Innovations & Engineering Solutions" and what are the future trends in engineering?

Mr. Singh: Before we start making a machine, our inhouse food scientists develop food-based R&D innovations based on our customer's requirements. In our laboratory setup, food technologists work create new food innovations using different products, come up with new products, or improve existing products. Then we make machines to productionize that process.

Mr. Kaushik Malpani, Technical Director: The general trend in the food manufacturing industry is towards the implementation of automation based on two key objectives:

1. The first is increasing productivity and responding to labor shortages by scaling up automation.

2. The second is better quality products by using process automation.

Efforts to improve shelf life and freshness.

What about "innovations" that provide the "food of the future"? Please tell us about the R&D departments contribution there.

Dr. Doke: I would like to talk about one area of our expertise, value-added innovation in processing potatoes. In addition to improving the quality of potatoes, by reducing the moisture content for snacks, and year-round stocking solutions, we are working on a special theme: improving the products shelf life and freshness. With the help of process automation, we are working on giving snacks strength and smoothness. By combining the strengths of both food science and engineering, we are able and optimally customize the production line, to achieve quality and freshness. We believe that we can deliver "best-in-class" products, for healthier and more nutritious snack foods. That's one way that our R&D is working to stay ahead.

Finally, please tell us about the themes and trends you are currently seeing in the snack industry.

Mr. Malpani: We are always trying to think ahead, while monitoring market and customer trends. Our target is to be showcasing foods that lead the next F&B marketing trend.

In the next two to three years, as people become more health-conscious, the number of users of health and functional foods will expand, regardless of gender and age, and will probably account for nearly 30% of the market. Furthermore, the deliciousness of food is said to be the interaction of its texture, taste, and aroma. Over time, I think it can be said that the number of users will increase as people prefer foods that emphasize those features.

Therefore, I believe future trends include functional foods, health foods, and food textures, and I think this is a trend in general, not just related to snack foods and snacks. We are currently conducting research and development in these areas to stay ahead of this trend.

Dr. Doke: Although snacks have an image of being unhealthy, we research and offer snacks made from healthy ingredients, such as whole grain-based and vegetable-based snacks with no added sugar. The same goes for "clean label" snacks, such as those without starch. And we are also developing finger snack formats and highly nutritious snacks, just like Namkeen, a typical Indian snack where the processing of the raw materials is kept to a minimum, often simply roasted.

Mr. Malpani: In other words, we put our mission of delivering future foods with innovations & engineering solutions into practice every day. ■

FARM TO FORK

Siddhi Vinayak Agri Processing

A scene capturing process control on a seasoning line. As the automatically fed extruded snacks dance in the rotating drum, the right amount of oil and seasoning are sprayed at the right time and mixed together.

Siddhi Vinayak Agri Processing Pvt., Ltd. uses Mitsubishi Electric's FA products, such as programmable controllers, servo's and displays, to build machines and conveying systems for producing snack foods from a variety of ingredients such as pulses, maize, millet, and potato derivatives.

Siddhi Vinayak Agri Processing Pvt., Ltd. is a multi-discipline company, comprising of agriculture support, snack production and engineering services, based in India. The company was founded in 2008, but the engineering division started operations in 2012 offering consultancy and sharing know-how with food production companies. Over time the engineering division expanded their scope to provide engineering and systems services that are focused on the snack food manufacturing industry.

More than a supplier, a collaboration partner

Mr. Ram Manohar Singh, the head of the company's engineering division, noted that the relationship with Mitsubishi Electric factory automation started during the COVID pandemic, when SV Agri were searching for an alternative automation supplier. Mr. Singh explained "We finally settled on Mitsubishi Electric due to its high-quality products, friendly technical support, and accurate PID control (feedback control)."

There was a steep learning curve for SV Agri as they started to use Mitsubishi Electric's FA products. However, Mitsubishi Electric India's engineers supported them through every step, resulting in a strong bond of trust and collaboration between the two companies.

Singh explained, "one of the first areas that SV Agri's engineers applied Mitsubishi Electric's controllers and interfaces on was the roasting line". Before installation, the heating temperature of the roasting line was set at a static 100 degrees Celsius. However, this did not reflect the real operational needs which had to cope with varying production volumes from 200kg per hour to 1000kg per hour. Singh put this challenge in context, "the changing volumes can affect the roasting time and thoroughness of the applied roast." Furthermore, a variety of ingredients also needed to be catered for as the roasting qualities and parameters for nuts are different to those of beans and pulses.

The application of programmable logic controllers and servo systems have now helped overcome these issues. With a combination of research and development, automated feedback control using PID, now the roasting line can flexibly adjust timings and temperatures to deliver the perfect produce with the required color, texture, and crispiness regardless of the volume, raw material, or environmental conditions.

"Through our collaboration with Mitsubishi Electric, we could adjust the heating cycles to the required levels and provide our clients with the results they wanted, " commented Singh.

Added benefits

In addition, the new control methodology has also stabilized product quality, and lowered energy consumption, which for a roasting line is a high proportion of the operating costs. These added benefits are significant for operators in the food industry where low margins per unit produced are the norm.

The next challenge

Looking forward, Singh explained that his team was now investigating the use of robots in combination with the company's equipment, but Mr. Singh clearly stated, "I'm looking to create a unique robot application dedicated to the needs of the snack food industry. I'm not interested in anything else, only producing snack foods." ■

Mr. Ram Manohar Singh is head of engineering at SV Agri's engineering division. He is passionate about snack food production.

Despite the steep learning curve, the engineering team at SV Agri have put a lot of effort and diligence in creating their control systems.

Seasoning line

FARM TO FORK

Catania Oils

Massachusetts-based Catania Oils is a leading provider of conventional, non-GMO (non-genetically-modified) oils to the global ingredients, foodservice and retail markets. Its 250,000 square-foot operation is one of the world's largest indoor bulk oil processing facilities.

Challenge

Multiple efficiency issues around data-gathering

The company's production team had identified significant data-leveraging issues which were affecting the visibility and overview of its entire manufacturing operation. The need for focused visualization-related insights had significant bearing on the overall efficiency of its operation.

Catania Oils required detailed knowledge about the status of its individual lines, as well as better information about the resources required for determining tank levels – vital for efficiency in the whole process of ordering raw materials. There was a further identified need for accurate information on potential efficiency gains in the company's manufacturing processes. This included the ability to investigate the overall equipment efficiency (OEE) necessary for evaluating KPI performance.

There was also a perceived need for improved batch management and materials handling capability along with regulatory information about the quantity of additives and manufactured products.

With all of these requirements in mind, Catania Oils set out to find an automation software package that could capture all the requisite data and display in such a way that it would enable them to make more strategic, data-driven decisions.

Solution

Joining the dots with ICONICS:

Turbo-charged efficiency through big-picture visualization

Catania Oils was introduced to the system integrator Data Acuity which in turn selected its long-term partner ICONICS to develop the SCADA* (Supervisory Control and Data Acquisition) system. Located in Hampton, New Hampshire, Data Acuity is an automation software company focused on manufacturing, energy, and service delivery efficiency for Automated Systems. Their consulting services, the technologies they represent, and their engineering design efforts all focus on solutions for the client resource areas that stand to bring the greatest efficiency gains.

The ICONICS software that was introduced had been developed to address all of Catania Oils' identified data issues. It centered on the monitoring of the Overall Equipment Effectiveness (OEE) and loss deployment required to improve production efficiency. The key to all of this work was, to put it simply, focusing the right resources on the right problems. As a metric, OEE provided a clear understanding of the difference between the quantity of sellable product that could be made and the actual quantity of product manufactured. This metric provided them with a detailed understanding of which resources needed to be assigned to any particular priority problems. So now, using the ICONICS system, Catania Oils could measure production efficiency, breaking OEE into three separate, measurable areas of availability, performance, and quality.

The company was also able to make gains in efficiency by monitoring loss of deployment. The ICONICS software enabled Catania Oils to determine how much product had been made, the loss of efficiency that could be attributed to the fault of a particular machine or asset and the extent to which loss of efficiency could be attributed to the process around that asset. By monitoring OEE and loss deployment, Catania Oils gained even greater insight into any potential loss of efficiency. The company was now able to focus on the entire process as opposed to focusing on a single machine fault or quality defect. All of which meant that Catania Oils could capitalize on ever greater efficiency gains.

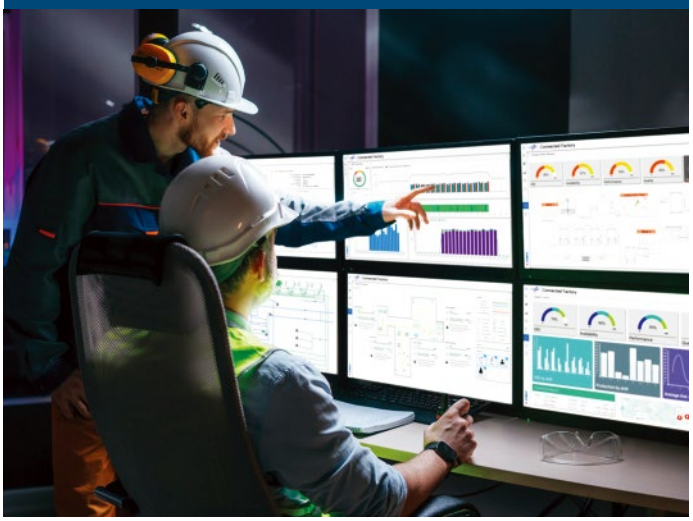
Conclusion

A solution to ensure continuous improvement

Catania Oils' adoption of ICONICS' software will enable it to optimize its operations still further, including deployment in the whole area of predictive maintenance. This involves correlating their production information with the CMMS system to enable them to schedule maintenance actions predictively – as opposed to scheduling maintenance actions based on a calendar. The company has plans to utilize its acquired expertise and experience in using ICONICS' software in the continuous improvement of its operations. ■

What is a SCADA system?

SCADA stands for 'Supervisory Control and Data Acquisition'. It refers to systems incorporating software and hardware to let industrial organizations see and control their processes through the monitoring, gathering and processing of real-time data. SCADA systems help ensure maximum efficiency, mitigate downtime and make smarter, more informed decisions.



News from around the world

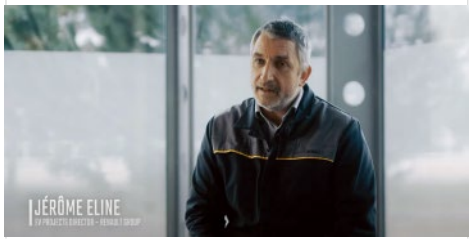
FRANCE

Mitsubishi Electric partnership ramps up sustainability benefits for Renault

Business Partnership

Since 2017, Renault has been engaged in a highly fruitful partnership with Mitsubishi Electric, working to embed automation and digitization and drive sustainability through smarter manufacturing processes at its megafactory in Cléon, Normandy. This is its production site for internal combustion engines, gearboxes and components for hybrid engines.

Discussing the difference that the partnership has made to the efficiency of its processes, EV Projects Director Jérôme Eline said: "We are proud to be part of the way that Mitsubishi Electric's advanced technology is accelerating the digitization and decarbonization of the automotive industry. Today it is a question of demonstrating that this industry makes it possible to make a positive difference to the environment."



FINLAND

Joint Venture to unleash 3D Simulation possibilities

Joint Venture

Mitsubishi Electric Corporation has partnered with Visual Components headquartered in Espoo, Finland, in a joint venture company Industrial Simulation Software Corporation, to develop and sell 3D simulators for manufacturing applications. Mitsubishi Electric and Visual Components hold 70% and 30% stakes respectively in the company, which began operating in November 2023.

"For companies aiming to optimize the entire product lifecycle, 3D simulation is essential," said Mikko Urho, CEO of Visual Components. "This joint venture allows us to maximize synergy by combining Visual Components' excellent 3D simulation software with Mitsubishi Electric's manufacturing expertise. Through this synergy, we will accelerate the realization of digital manufacturing and contribute to enhancing our customers' competitiveness."

INDIA

New FA manufacturing plant joins Make in India initiative

National initiative

Mitsubishi Electric's new FA manufacturing facility in Maharashtra, India will help meet a fast-growing demand for manufactured products, as well as contributing to the Indians government's Make in India initiative.

The two-storey 15,400 square-meter factory, built on 40,000 square meters of land near Pune, Maharashtra, incorporates a variety of features to help achieve carbon neutrality. Carbon dioxide emissions are reduced through the use of highly efficient air conditioning systems and LED lighting equipment, and by reusing wastewater through underground filtration treatment and greening, the new factory meets its initial sustainable development goals (SDGs).

BRAZIL

Engineering talent thrive at first MECA in Brazil

Event

Brazil recently hosted its first MECA (Mitsubishi Electric Automation Cup) – an educational competition where engineering students from all over the country came together to present ideas and technology. Around 150 educational institutions were invited to take part and more than 60 registered projects were whittled down to 14 finalists, selected by an examining committee from across the company.

Prizes for the two winning teams were industrial robots for their respective institutions and for the students, the opportunity to intern at Mitsubishi Electric.

The projects included solutions for agribusiness, sustainability, logistics, among others. “We found that the teams were well aligned with the job market of which they will soon be part,” said Fabiano Lourenço, President of Mitsubishi Electric Brazil.

JAPAN

Record numbers at Japan’s International Robot Exhibition 2023

Event

The 2023 International Robot Exhibition – one of the largest and most interesting robot exhibitions in the world – was the perfect stage for Mitsubishi Electric to demonstrate its concept for a fully automated lithium-ion battery assembly line. The demonstration attracted a great deal of attention and comment, as did the many and varied forms of humanoid robot designed to assist in virtually every field of human endeavor, from health & elderly care to leisure & entertainment and work in dangerous environments.

The December show, which featured contributions from more than 650 companies from around the world, illustrated just how far the world of robotics has come as well as the many new fields in which robotics is beginning to be deployed.

GLOBAL

“So much more than a slogan”

Reflecting on our ‘Automating the World’ brand campaign

Global initiative

The past 12 months have shown the power of our ‘Automating the World’ campaign, with increased reliability, wider choice, and shorter delivery times in every conceivable area of our operation. As a campaign theme it has been an excellent means of articulating the many ways Mitsubishi Electric Factory Automation’s technology, thinking and support work together to create a better, more sustainable world for all.

Our strategies may change, but our corporate vision ‘Changes for the Better’ remains a constant, helping to show how automation technologies can make things work better everywhere, from design & planning to maintenance and customer support. Implementing strategies to grow our factory automation business provides the intelligent manufacturing solutions that our customers need to transform their businesses.

Automating the World

Would you like to be featured in the next edition of monozukuri – The Art of Manufacturing? **Get in touch and share your success story.**

FARM TO FORK

Unpacking the packaging industry

Japanese packaging specialist Shikoku Kakoki Co. Ltd. is not only a leading supplier of packaging machines in Japan but also on the global stage. We hear from their CEO about his company's experiences and its view of the current market trends and his drive towards digital transformation (DX) for his company.

Various steps such as production, processing, and packaging are involved in the manufacture of food products. And critically, automation plays a significant part in every aspect of this flow. In this article, with the help of Shigeru Ueda, CEO and President of Shikoku Kakoki Group (here after referred to as President Ueda), we narrow down the focus to packaging machinery destined for the food industry, typically the last stage of manufacturing before shipment.

Shigeru Ueda, CEO and President of Shikoku Kakoki Group

Packaging. It comes in every size, shape and form you can imagine. Even when are only talking about food containers there are various types for solids and liquids. And then, even for liquids there are paper packs for juice and plastic containers for “semi-liquids” like yogurt. The variations are endless. However, they all require machines to efficiently form, fill, and seal those containers at speed and Japanese packaging machine specialist Shikoku Kakoki Co. Ltd. is no stranger to that complex world. They have been driving innovations for the design and manufacture of liquid filling machines, packaging machines, and related equipment for tens of years, complemented by their packaging material business and a food processing business. In the category of filling machines, Shikoku Kakoki have a commanding market share in Japan of around 70%, and in the global market a 20% share worldwide. In the past decade, they have significantly expanded their business and have been recognized as a top global niche company by the Japanese Ministry of Economy, Trade and Industry. They are an ideal interview partner to help unpack the packaging machinery industry for us.

The basics

President Ueda describes the basic operational elements required for liquid filling machines as follows. “The basic requirements for a filling machine are to convey the container, fill the container (with the liquid or food substance), seal the opening of the filled container, sort and align the filled containers.” For example, in the sealing process, different methods are applied depending on the packaging material being used, such as high frequency sealing when Aluminum lid materials are joined to PS containers (as seen in lactic acid drinks), and heat sealing for standard PET bottles. To meet the sealing performance required by customers, Shikoku Kakoki has prepared multiple methods. In the case of aseptic filling (the process of filling commercially sterilized products into pre-sterilized containers), sterility is achieved by combining multiple methods such as chemicals and ultraviolet lamps. “Having multiple options for a single need is important for the flexibility of our end customers,” says President Ueda. This is the source of Shikoku Kakoki’s high customer responsiveness.

> “ It is often the case that customers outside of Japan are more willing to allow for some misalignment in sealing as long as the contents do not leak. That’s practical rationalism. On the other hand, Japanese customers will not accept any misalignment or distortion of the seal at all.”

Beverage filled and packed by Shikoku Kakoki machine.

Demanding customers lead to benefits for all

Interestingly, although these functional requirements do not differ significantly between countries, the Japanese and the other markets have different requests regarding “accuracy of appearance and sterilization”.

President Ueda explained “It is often the case that customers outside of Japan are more willing to allow for some misalignment in sealing as long as the contents do not leak. That’s practical rationalism. On the other hand, Japanese customers will not accept any misalignment or distortion of the seal at all. Additionally, the orders regarding sterilization of the filling system are different. For customers in Europe and America, the residual amount of the drug is specified numerically as 0.5 ppm or less. On the other hand, there are no clear standards in Japan, so customers make abstract orders.” For this reason, Shikoku Kakoki delivers a system with a high sterilization level that does not detect drug residues to customers in Japan.

In other words, responding to the stricter requirements of Japanese customers has been an opportunity to cultivate higher technical skills for Shikoku Kakoki. As a result, the acquired know-how has helped Shikoku Kakoki satisfy the demands of overseas customers as the achieved quality exceeds the quality demanded by customers themselves.

Moving away from plastic

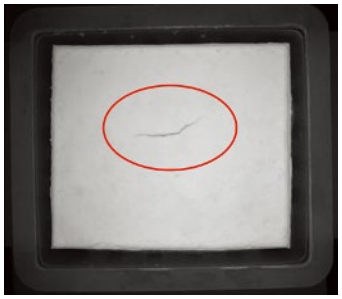
There are some trends in packaging materials that simply cannot be ignored. According to Shikoku Kakoki, in Europe and the United States, plastic containers for products such as yogurts are still the mainstream. On the other hand, in Japan, the trend of “moving away from plastic” is accelerating, and the transition to paper containers is progressing well.

"The transition from plastic to paper is partly a response to the SDGs, but the image of the 'gentleness' or 'kindness to the community' of paper containers is also a major factor" observed President Ueda. Unfortunately, in some countries, there is still a strong preconception that "if you use a paper container, the liquid will leak", which has made it difficult to popularize paper-based containers. There is also a logistical hurdle, because of that same lack of popularity, it is sometimes difficult to locally procure the high-quality packaging paper needed to manufacturer the paper packaging. "However, in the medium to long term, if the momentum around moving away from plastic and to adopting decarbonization increases, especially in Europe and the United States, the transition to paper containers cannot be avoided. We at Shikoku Kakoki are ready and eager to support such a change" offered President Ueda.

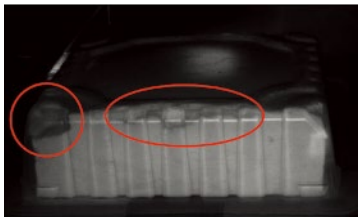
AI is driving change

In addition to the production of filling machines, the Shikoku Kakoki Group is also engaged in the packaging materials business and the food production business (they manufacture the Japanese soya bean curd called tofu). Having direct access to their own food production business gives Shikoku Kakoki the advantage of being able to check operational processes, before and after packaging and filling, and then use this knowledge in future product designs and enhancements.

Cracked tofu.



Chipped tofu.



Automated inspection system with AI technology

Special emphasis is placed on the food and packaging inspection process. Shikoku Kakoki has introduced an automated inspection system that combines AI and diagnostic imaging at the Groups food factories.

President Ueda explains "We take six photos of each completed tofu and AI distinguishes whether it is a good product or a defective product. Initially, we simply used diagnostic imaging, but there were multiple factors that would be difficult to determine without AI. And there was the added challenge of misjudging 'good' product as defective. We spent a lot of time training the AI, supporting it with human based review to simulate deep learning to improve the AI's judgement accuracy."

As a result, it is now possible for Shikoku Kakoki to automatically inspect products without the need for human intervention, which is important as there is an increasing trend towards a shortage of workers. An additional benefit has been that an ID is assigned to each product and the six photo elevations, one from each side, are associated and stored against it, enabling full traceability.

President Ueda concludes "The use of AI in the inspection process corresponds to the 'post-process' of the filling machine. What we learn at this stage can become the source of future machine improvements and new designs."

Another innovation now being discussed is the use of AI enabled predictive maintenance systems. These systems monitor the status of parts and consumables used in the filling machines and notify operators in advance in the case of the replenishment of materials or replacement of worn parts. The use of AI is impacting food production and packaging at every stage of its delivery to the table.

Don't forget the people

While AI is making a strong impact on the food industry, there are still some areas where the creative human mind still adds value. For example, the basic performance of a filling machine, such as "filling as fast and accurate as possible" or making the machine as compact a design as possible are areas which are still outside of the capabilities of AI at the current time. President Ueda observed "In mechanical design, I believe that the part where you wrestle with the machine design, check its operation and accumulate know-how, where you make transition from nothing to something, still benefits from the human input."

Where does tomorrows path lead?

Shikoku Kakoki, under the leadership of President Ueda, have a clear vision of where they think the market is heading towards. It is one where food processing companies are considering overall efficiencies, not only upgrades to individual machines, but addressing the whole food packaging ecosphere around the filling machine. President Ueda shares his thoughts, "In a world where the Internet has become so common that a variety of information can be managed in real time, people don't necessarily have to reside in the area where the filling machines are located. With a network, it can be monitored and controlled remotely from distant management sites. In fact, we are developing the idea of building a remote monitoring and control system in cooperation with various partner companies. A comprehensive support system is being developed that transcends geographical constraints."

But this is not the only area where the impact of digital transformation is being felt. "We are already pioneering the use of AI for demand forecasting for our tofu business. Major supermarkets are now placing orders using AI demand forecasts, enabling the delivery of the right volume of tofu without loss. This is important as tofu, being perishable, has a short shelf-life, but equally shortages should also absolutely be avoided." says President Ueda. This is a strong example of utilizing digital transformation (DX) to strengthen close collaboration between different businesses within the Shikoku Kakoki corporate group.

Know your strengths

Every age brings a new wave of technology. That's why Shikoku Kakoki focuses on two things: the thorough deepening of basic technology and the active monitoring of new technology trends. In the core areas of mechanical design, such as applying straight seals, the company will continue to make full use of the know-how it has accumulated over the past 30 years - it is foundational. However, being open to rapidly identify and utilize innovative technology such as AI and remote monitoring and control as opportunities, is critical for long term growth. President Ueda sums up the situation in one sentence "It is only with these two wheels that we can create filling machines and related packaging technology that constantly adapt to the times." ■

FARM TO FORK

Shikoku Kakoki Co. Ltd.

Shikoku Kakoki Co. Ltd. is an international packaging machine maker originating from Japan. They have deeply acquired knowledge and skills but have been transforming themselves and their machines over the past decades, achieving the goal of producing advanced machines and staying ahead of the technology curve. The collaboration with Mitsubishi Electric factory automation has been active since the 1980's.

> Looking back we might laugh at the 2-3 weeks it took to make a new cam shaft.
>
> ***Takahiro Sawabuchi,***
> ***Head of Production Control Department***

Mechanical cam challenges

Shikoku Kakoki's filling machine operates differently in each section, so the main shaft is fitted with a cam tailored to each specific section. This cam synchronizes the movements of multiple sections to achieve high-speed filling and complex machine motions.

However, changing the way each section moves requires altering the shape of the cam. This necessitates the production and replacement of the cam each time, which is time-consuming, costly, and labor-intensive.

Takahiro Sawabuchi, Head of the Production Control Department at Shikoku Kakoki Co. Ltd. recalls "I remember a case where we got a late-night call from a customer in Denmark. The cam driven action was not performing as it should, with inconsistent filling or bubbling of the filled liquid. So, we ordered a new cam from our manufacturing hub in Shanghai. Two to three weeks later our sales representative collected the new cam shaft, put that lump of metal in his case and flew to Denmark. The cost and inefficiencies are too much to think about! That's why we moved to a servo-based solution." This marked the start of the shift to electrification and digitalization of the filling machine.

Collaboration with Mitsubishi Electric

The relationship between Shikoku Kakoki and Mitsubishi Electric began in the 1980s based on PLC technology that could be exported to Europe. The collaboration led to further work including a project to develop motion control based around the conversion of mechanical cam drive technology to electrical control, a topic that Shikoku Kakoki had already obtained a patent for the basic technology of electrical control for.

The first steps in electrification and digitalization of the filling machines was the use of PLC control. This expanded to servo systems as they evolved to develop electronic cam functions.

"By working closely with Mitsubishi Electric, they now understand the process of machine design and the use of servos and can anticipate and 'meet our demands from the initial proposal'" commented Fukui. (2nd person from far right)

Sawabuchi added "for long term supply of filling machines, we wanted to develop our ideas with a technology partner who was a top manufacturer of FA products, so we teamed up with Mitsubishi Electric." The core of the joint development was the servo system. "I think it's a historic hit product from Mitsubishi Electric" mentioned Shin Fukui, Chief of Electrical Design Section, Technical Department II, Shikoku Kakoki Co. Ltd., he goes on to say "other manufacturers were also able to 'reproduce' an effective electronic cam but that was just a plot of the movements. However, Mitsubishi Electric servo system was processing data as a "motion curve" based on time and displacement." This mean that it was automatically recalculating instantly, and so the accuracy was outstanding.

Driving change to electrification

Shikoku Kakoki believe there are some fundamental functions that a packaging and filling machine needs to have.

1. Synchronization and linkage after on-site reassembly
2. Electrical reproduction of mechanical cams
3. Motors that accurately reproduce the machines' curves
4. Software that can create free curves in programming

With these principles, machine design, operation and maintenance costs can be significantly reduced. Additionally, constant development and improvement is also a key point.

Targeting peak performance

In 1993 Shikoku Kakoki achieved their initial dream of a fully electronic cam-based filling machine. Since then, they have continued to push the technology boundaries. Filling speed is now 14,000 packs/hour. The size of the machine has also decreased. A feat made easier due to its use of the latest MELSERVO servo technology from Mitsubishi Electric.

New automatic cleaning functions for Shikoku Kakoki's filling machines bring added benefits. Sawabuchi explains "We have adopted a chamber structure in the area where the liquid filling process is performed, enabling us to sterilize the inside of the carton with sterile air. In addition, we also have an automatic cleaning function, so by using our filling machine, users can extend the 'best before' of European standards from 28 days to 50 days."

In the case of machine cleaning by hand, it is unclear how much cleaning is necessary to meet hygiene standards. With automatic cleaning, the hygiene level can be standardized, and labor can be saved. This is the power of automation. ■

Taste of Japan

Sake is a rich tradition in Japanese culture, where every sip tells a story of craftsmanship and heritage. Delve into the world of Shimenawa, sacred ropes that bind the spiritual and earthly realms, symbolizing harmony and reverence. Explore the essence of Japanese rice culture, where cultivation techniques and culinary artistry converge to create the cornerstone of Japanese cuisine. Join us on a journey to uncover the depths of Japan's cultural tapestry.

Sake - Japan's national alcoholic beverage

Sake is made from fermented rice and undergoes a similar process to that used for beer. Before any brewing can begin, the rice must be polished to remove all the bran. In beer brewing, starch is converted to sugar, then sugar to alcohol. But with saké, these conversions occur simultaneously. And while beers typically contain 3-9% alcohol by volume, for saké the figure is 18-20%. When served ceremonially, the saké is gently warmed, then sipped from a porcelain cup called a sakazuki.

Shimenawa - protecting Japan's Shinto shrines

Shimenawa - giant ropes crafted from rice straw and hemp - play an important role at holy sites, where they are used to define sacred areas. The word itself comes from 'shime' meaning to hold or embrace and 'nawa' meaning rope. Often seen festooned with shide, or traditional paper streamers, Shimenawa can be from a few centimeters up to several meters long. The largest one can be found at the grand shrine at Izumo Taisha, which is 13.5 meters long and weighs 4.5 tonnes.

Rice - at the heart of a nation's culture

There is no country in the world where rice is more embedded into the national consciousness than Japan. It is interesting that one of the ancient names for Japan was mizu ho no kuni - 'land of the water stalk plant'.

Gohan, the Japanese word for 'cooked rice' also means 'meal'. Gohan produces the words for breakfast (asagohan), lunch (hirugohan) and dinner (bangohan). In Japan, it would be hard to think of a meal without rice. But Japanese rice culture is about much more than mealtimes. Recognizable aspects of Japanese social behaviour - wa (harmony, concensus-seeking) and amae (feelings of dependency) can be seen to originate in the traditions of wet rice cultivation.

Rice cultivation was highly labor-intensive, so families needed to pool their labor and their water resources to live in harmony with neighbours and workmates. This developed a profound sense of commitment to shared interests - traits reflected in modern Japan, where 124 million people must work and live together in a relatively confined space.

Did you know?

Japan's space satellites are a technology leader

Did you know that when farmers check the weather on their smartphone or tablet, the data they rely on comes from space satellite systems like those developed by Mitsubishi Electric?

Mitsubishi Electric Space Systems

https://www.mitsubishielectric.com/bu/space/index.html

Mitsubishi Electric's range of business areas encompasses many fields and among these is advanced satellite systems. In fact, Mitsubishi Electric is the only Japanese manufacturer with the integrated capabilities to cover the entire satellite development process - from concept and design to assembly and testing. Over the years, the company has played a key role in dozens of satellite programs for a variety of government agencies and communications providers both inside and outside Japan.

The Japan Meteorological Agency's Himawari-8 and Himawari-9 satellites, currently operating in geostationary orbit, were both developed and built by Mitsubishi Electric. These satellites, which capture images of the earth over the eastern Asia and western Pacific Ocean regions, have a vast range of benefits and are invaluable for disaster prevention. In March 2023, the Japan Meteorological Agency awarded the contract for Himawara-10 - the nation's newest geostationary meteorological satellite - to Mitsubishi Electric, its fourth straight contract, awarded on the basis of its extensive experience with satellites, as well as the JMA's high evaluation of the company's proven DS2000 standard satellite platform and ground-data processing software.

The data from Japan's Himawara systems has proven invaluable for the agriculture industry, allowing farmers to monitor conditions and make weather predictions much more reliable. By providing information to help farmers decide what they should grow and when, this technology is also helping to optimise crop yields and prevent wastage.

Mitsubishi Electric's state-of-the-art satellite production facility in Kamakura has the capacity to produce 18 satellites per year, helping to meet the growing demand for governmental satellites in Japan and commercial communication satellites worldwide.

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