



Food tech: technology in the food industry

Robot arm offers the food industry
a helping hand

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Preface

The impact of food tech on the food industry

Technology is increasingly contributing towards food's journey from farm to fork. The food industry is a crucial link in that process. The competitiveness of food industry enterprises is closely linked to their ability to implement new technologies. In it's first chapter this report reveals the driving forces behind 'food tech'. The second chapter then zooms in on the most promising food tech applications, robotics, data technology and novel processing techniques.

About this publication

This publication is the result of research by the ING Economics Department into promising food tech applications in the European food industry. This research is based on expert interviews, consumer surveys and ING's sector knowledge. The ING Question of the Day was used for the consumer survey. This representative survey among Dutch consumers is used by way of illustration.

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Conclusion

More and better food through food tech

Technology helps food manufacturers to produce more efficiently for a growing world population. Improving shelf life and food safety revolves around technology, and greater use of machines and software ensures affordability and consistent quality. The importance of technology for manufacturers continues to grow.

Demanding customers, consumers and society

Food industry customers, like retailers, set stricter product requirements and require larger volumes at low prices. Higher efficiency and labour productivity are essential to remain competitive. At the same time, consumers and society are demanding in terms of health and sustainability. Robotisation, digitalisation and novel processing methods enable companies to respond to this demand.

Food industry embraces robotics

The rise of robotics in the food industry is a tangible example of food tech. The number of robots in the European food industry is well over 30,000, while the number of robots per 10,000 employees rose from 62 in 2013 to 84 in 2017. Although Germany is the largest market, robot density is relatively highest in Sweden, Denmark, the Netherlands and Italy.

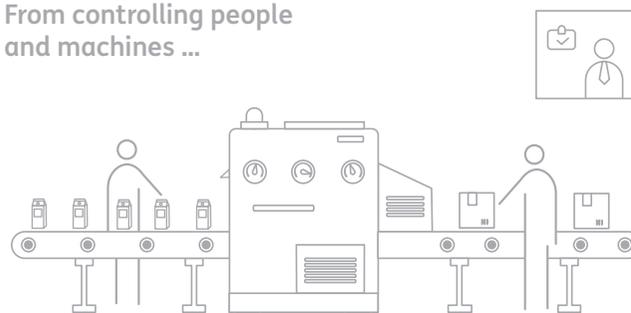
Impact of technology on the labour market

Robotisation and digitalisation increase the complexity of production processes and this impacts the labour market. Employees' duties change and the required level of education increases. Applying food tech therefore requires both investments in capital goods and attention to training current staff and recruiting new staff.

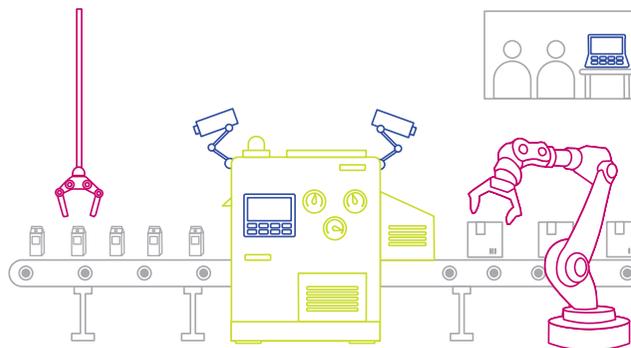
Food production is increasingly in the hands of data analysts and robots

Evolution of the food industry towards 2030

From controlling people and machines ...



... to fully automated production with remote control and monitoring.



Promising applications in food tech

Robotisation

Using robots makes the production process more stable (higher production volume, improved food safety) and less labour-intensive (lower personnel costs).

Example: Robots are increasingly used to cut, move, package and palletise products.

Digitalisation

Data technology increases predictability and artificial intelligence contributes towards the streamlined use of production lines, thus improving efficiency.

Example: Connected machines, meaning that processes can be increasingly inspected and controlled remotely.

Novel processing techniques

These techniques ensure quality is maintained and offer opportunities to make production processes more sustainable.

Example: Milder production processes, for example with high pressure or steam, ensure that taste and nutrients are better preserved.



Chapter 1 | The driving forces behind food tech

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1 | The driving forces behind food tech

1.1 Food tech: promising technologies within the food industry

Core technologies in the food industry

Food tech covers all technological applications in the food industry. Innovations in robotics, data technology and processing techniques create new application possibilities in food production. As a result, more and more technology is involved in both primary production and food processing.

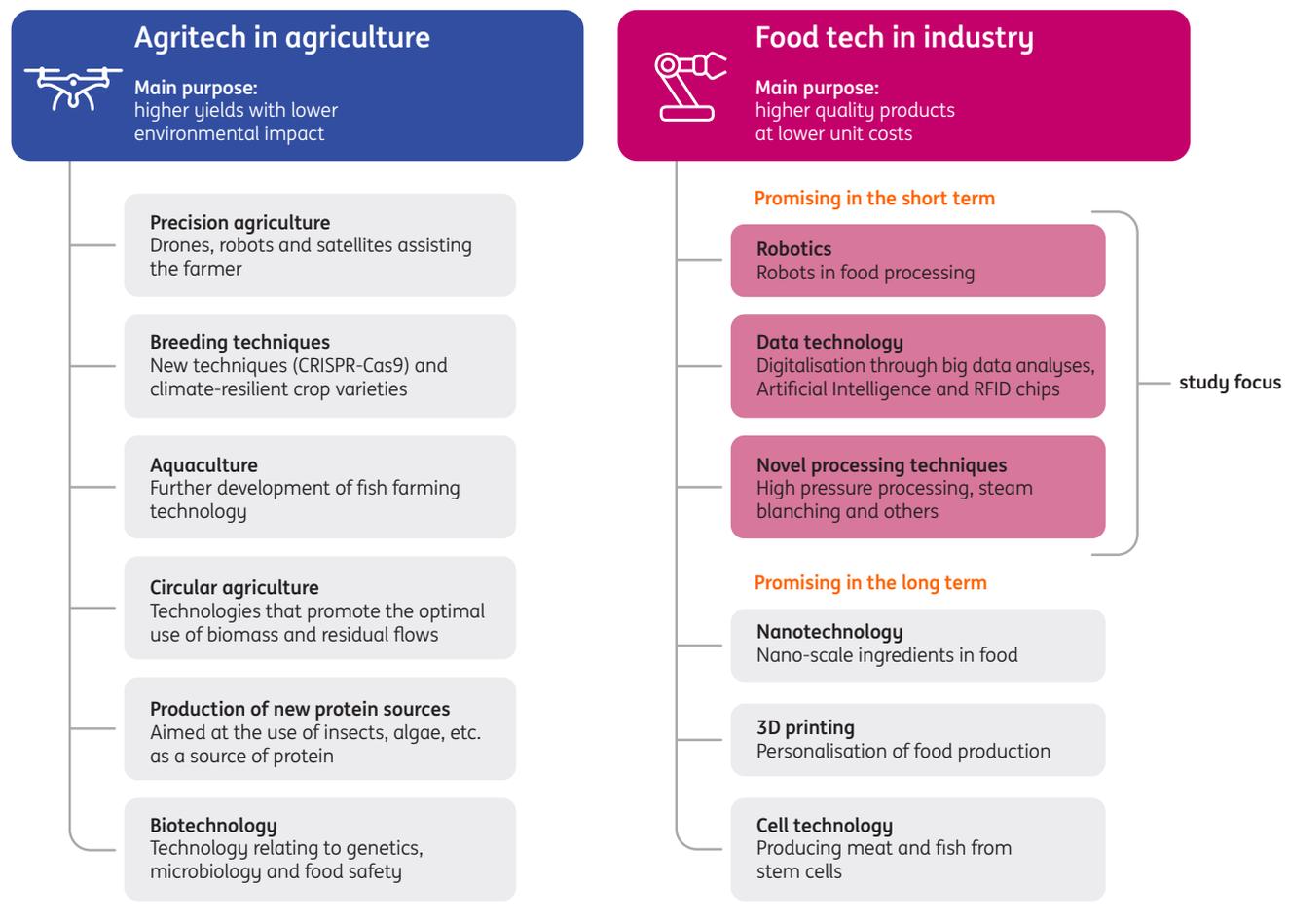
Hurdles for 3D printing, nano- and cell technology

Compared to the above core technologies, the application of nanotechnology, 3D printing and cell technology is still at an earlier stage. Before these technologies can or will be applied more widely, barriers in the area of regulation, consumer acceptance and/or industrial-scale applicability must be removed.

Food industry also boosts agritech

This study focuses on the use of technology within the food industry. Food industry companies are also closely involved in developing agritech applications in agriculture and fisheries. The importance of a high-quality and predictable supply of raw materials plays a central role in this regard. However, such agritech applications have been largely disregarded in this study due to its focus.

What do we mean by food tech and what is the emphasis of this report?



1 | The driving forces behind food tech

1.2 Consumers expect healthier products

From quantity to quality

The emphasis within food supply is shifting from more to better. Specific moments of use and individual nutritional needs of consumers are becoming prime concerns. 'One size fits all' is a long outdated concept in product development. As the number of products aimed at specific target groups and needs increase, the scope and demand for new products for the masses decrease.

Consumers mostly want healthier food

The health aspect of nutrition is gaining importance. [Previous ING research](#) has shown that health plays an important role in consumers' desire to eat less meat. In the ING Question of the Day, consumers indicate they are particularly concerned about healthier food in the future.

What do the interviewed experts say about the consumer?

"Consumer desire for food with fewer 'baddies' (sugar, salt and fat) and more 'goodies' (fibres, minerals and vitamins) stimulates the application of technology."

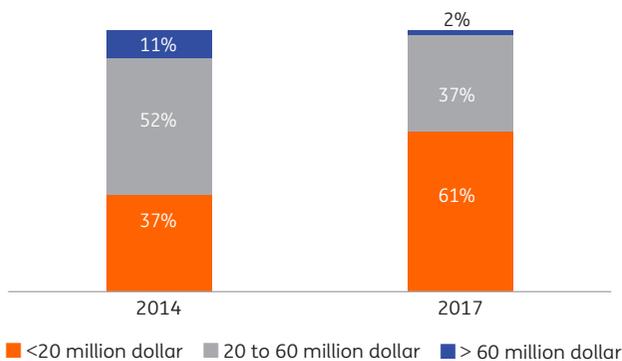
"One basic principle applies to everything we make: it must be tasty for consumers to keep wanting to buy it."

Sugar as the main priority

The contribution of sugar, salt and fat to nutrition-related health problems (such as obesity) receives a great deal of attention. Consumers therefore have a strong need to avoid sugar, among other things.

Shift towards smaller product launches

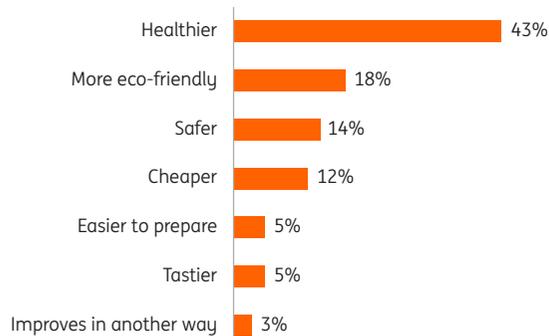
Year one sales distribution for new consumer-packaged goods in the US



Source: IRI - New product pacesetters 2017

Consumers find it particularly important that food will be healthier in future...

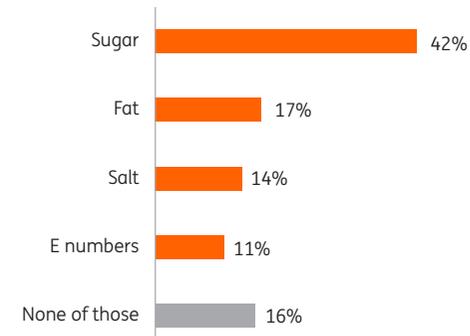
% of respondents to the question: I think it's particularly important that my food in the future is...



Source: ING Question of the Day - 33,409 and 41,990 respondents in the Netherlands, 2018

40% of consumers try to avoid sugar

% of respondents to the question: Which of the following nutrients are you particularly trying to avoid?



1 | The driving forces behind food tech

1.3 Food producers want to produce more efficiently

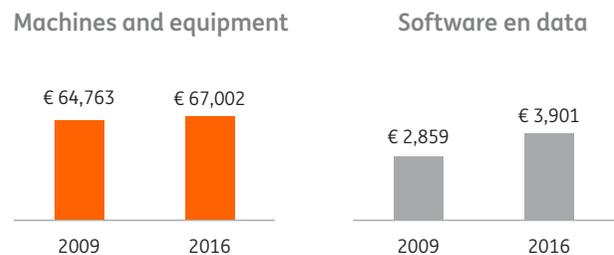
Market demands higher volumes and low prices

Major buyers in the food industry, such as supermarkets and restaurant chains, are consolidating. Concentration of the market share in food retail* means that supermarkets require higher volumes at lower prices per product unit. Food producers facilitate this by increasing their production capacity, innovating, and improving their efficiency.

* In most Western European countries, the five largest supermarkets have a combined market share of 70-80%.

Employees in the food industry have access to more machines and software

Value of machines, software and data per employee



Source: Eurostat, based on data for Belgium, France and the Netherlands

Food industry invests in automation and digitalisation

Further automation, digitalisation and new technologies enable the food industry to improve efficiency. As a result, the number of machines and availability of hardware and software per employee increase.

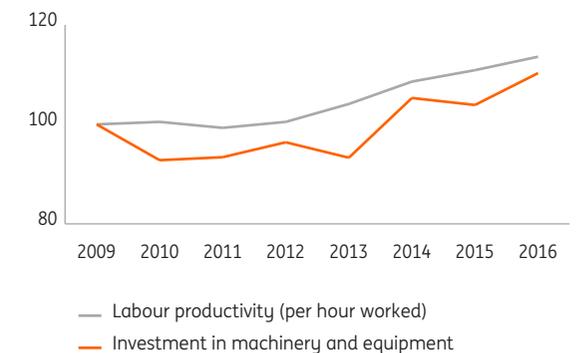
Investment potential is high

In future, several factors will stimulate further growth of tech investments.

- 1. New application areas of technology**
Innovations increase the applicability of technology in the food industry.
- 2. Improved affordability**
Reducing the cost of technology and improving specifications.
- 3. The demand for more and higher quality products**
Food demand is rising and the market requires higher and more consistent product quality.
- 4. Reduced availability of staff and higher costs**
Wage costs are rising and the availability of technical personnel is under pressure.

Labour productivity in the food industry grows with investments

Labour productivity of the added value per hour worked in the eurozone, index 2009=100



Source: Eurostat, processed by ING Economics Department based on data for Belgium, Germany, Italy, the Netherlands and Spain

What do the interviewed experts say about the use of technology in production?

“No product is touched by a human hand in the production line any more.”

“Without highly trained operators, it is no longer possible to run this factory.”

“Our team of data analysts has grown strongly in recent years.”

1 | The driving forces behind food tech

1.4 Society places emphasis on climate and health

Society's guiding role

Governments and social organisations loom over the food industry's shoulder on themes such as food safety, health, animal welfare, climate and the environment. This leads to legislation and covenants aimed at reducing sugar, salt and fat in food and beverages. Climate change and international climate agreements are also driving forces behind reducing energy consumption and minimising waste.

What do the interviewed experts say about the role of society?

"Due to public debates, buyers set additional requirements for the production method."

"New technological solutions are often still incompatible with the government's control frameworks."

Support for new technology is not self-evident

The application of new technology in food is more sensitive than in many other consumer goods. For example, genetic modification is widely used in developing medicines, but still lacks broad support within the EU for use in nutrition. And although food authorities have found production methods (such as microwaves) or ingredients (such as E-numbers) to be safe, this does not translate into blind acceptance in society.

Digitalisation and robotisation also yield benefits for consumers and society

	What does the technology deliver for business?	What does the technology deliver for the consumer?	What does the technology deliver for society?
 Digitalisation	Greater grip on information in the chain	Information on origin, production and certification	Traceability and control options
 Robotisation	Automation and cost savings	Affordable products	Greater food safety, lower waste and improved working conditions

1 | The driving forces behind food tech

1.5 No high tech means no high touch

From human hand to robot arm

The number of food products no longer requiring human intervention in the factory is on the rise. However, consumer opinions on the use of robots are divided. According to consumers it does make food cheaper on balance. In terms of safety, more than one-quarter of the respondents expect robotisation will make food safer. However, an equally large group sees food becoming less safe because of robotisation.

Consumers have to grow accustomed to higher standards

New processing techniques gradually improve the quality of processed products. Better quality is not always immediately appealing to the taste buds. Because consumers are attached to certain brands, products and tastes, acceptance is gradual and it can take a generation to change diets.

Gap between reality and perception

Food industry and retail communication with the consumer pays scant attention to the contribution of technology towards the product. A danger lurks within this practice. When the consumer's perception about how food is made is not keeping up with reality, the imbalance grows. This also increases the risk of misunderstanding the choices made in the sector.

Focus on technology also creates countermovement

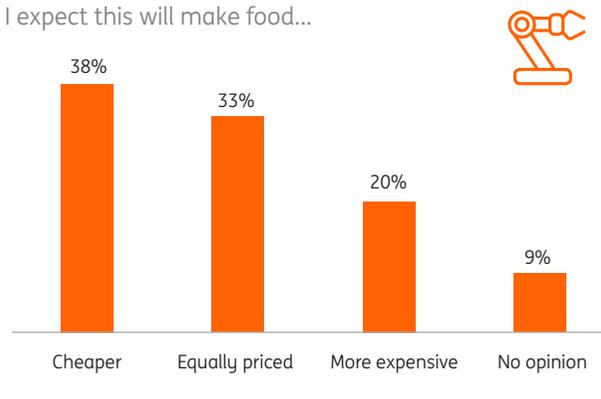
The more technology that exists to make everyday products in a 'high-tech' way, the more appreciation there is for 'high-touch' food made by human hands. Craftsmanship and traditional production methods among small producers create distinctiveness and justify a higher price. This differs for many medium-sized producers, whose choice is often to scale up or down.

Food industry wants to connect two worlds

Large food producers are looking for ways to respond to the high-touch need with all or parts of their brands or range. For example, bread producers invest in traditional production lines while large beer brewers respond to the craft beer trend through acquisitions or by facilitating small brewers. This often results in middle ground: production within large companies linked to a smaller scale brand and corresponding marketing.

On balance, consumers expect food to become cheaper because of the use of robots.

% of respondents to the question: If robots start performing more food production tasks, I expect this will make food...



Source: ING Question of the Day, December 2018, 20,350 respondents

Divide between high-tech and high-touch food

High tech



- Large scale
- Value for money
- Impersonal
- Consistent quality

High touch



- Small scale
- Premium
- Personal
- Variable quality



Chapter 2 | Promising food tech applications

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2 | Food tech applications - robotisation

2.1 Robots are becoming commonplace

Hurdles to robotisation in the food industry have been overcome

Robots symbolise the further automation of production processes. Robotics is on the rise in the food industry. Technological advances, such as image recognition and gripper technology, have overcome hurdles, making robots increasingly capable of:

1. handling delicate and diverse products;
2. complying with strict food safety requirements; and
3. functioning in a challenging working environment (heat, moisture, cold).

Robots are becoming increasingly versatile

Two types of robots can be distinguished in the food industry:

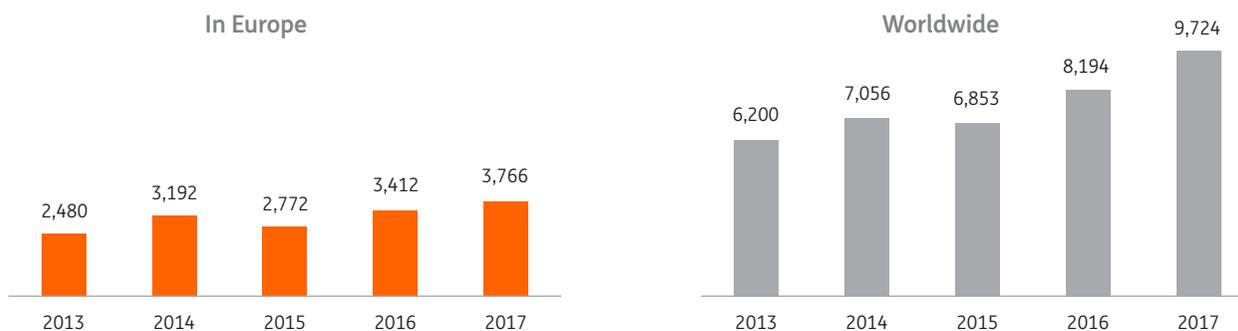
- generic robots for heavy standard tasks such as sorting boxes or storing pallets;
- specialised robots that perform more complex and specific tasks. Examples include a carcass opener in the meat industry, lettuce and paprika corers in vegetable processing, and packing robots for biscuits and confectionery.

Benefits in terms of costs, labour and food safety

A major driving force behind the increasing use of robots is the combination of rising labour costs and staff shortages. Robotisation increases companies' efficiency and reduces their dependence on the labour factor. In addition, food safety requirements are becoming increasingly stringent and less human interference in the production process can reduce the risk of contamination.

Robots sales to the food industry are increasing

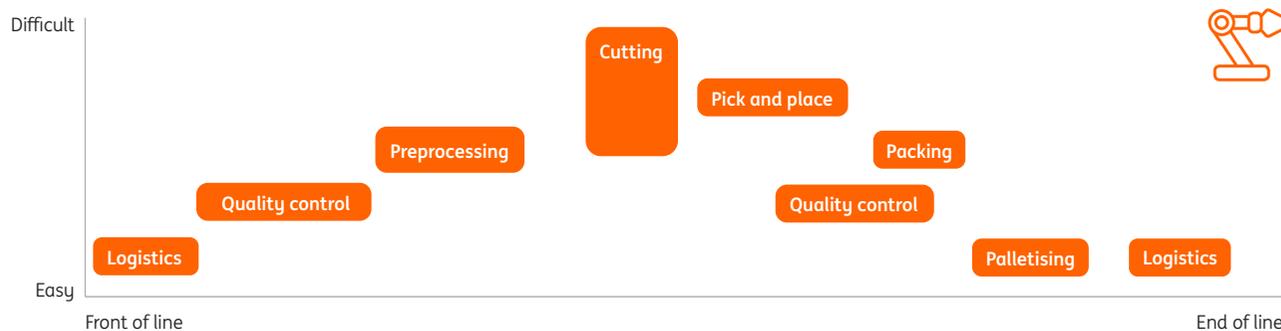
New robots sold to the food and beverage industry, per year



Source: International Federation of Robotics (IFR)

Robots do much more than just stack boxes

Examples of robot operations by degree of difficulty and their place in the production process



Source: ING Economics Department

2 | Food tech applications - robotisation

2.2 Large differences in robot density between countries

Robot stock concentrated in Germany and Italy

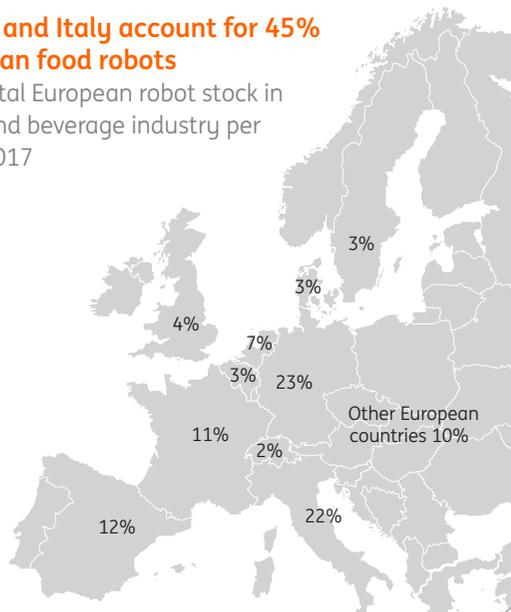
In 2017, the total number of robots in the European food and beverage industry exceeded 31,000. European food manufacturers therefore account for almost half of the world's robot supply in the food industry. Generally, the number of robots is particularly high in Western and Southern European countries, with Germany and Italy as the main markets.

Highest robot density in the Nordics

In 2017, the 10 main European robot countries had an average of more than 80 robots per 10,000 employees. This is an increase of over 35% compared to 2013. Sweden and Denmark have the highest robot density, followed by the Netherlands and Italy. These are all countries with relatively high labour costs and – in the case of Sweden, Denmark and the Netherlands – also relatively tight labour markets. In the United Kingdom and Germany, for example, labour costs in the food industry are relatively lower.

Germany and Italy account for 45% of European food robots

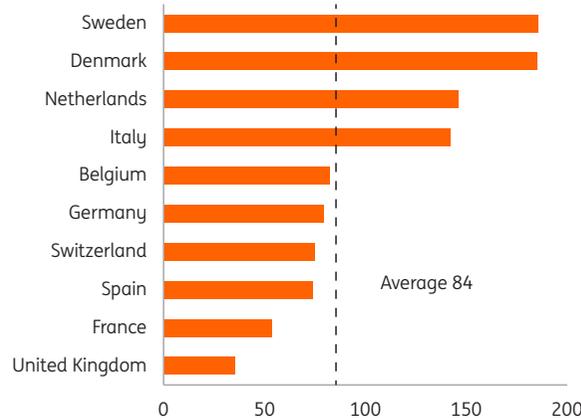
Share in total European robot stock in the food and beverage industry per country, 2017



Source: IFR

Nordic countries have the highest robot density in the food and beverage industry

Robot stock in the food and beverage industry per 10,000 employees



Source: IFR, Eurostat, calculations ING Economics Department

2 | Food tech applications - digitalisation

2.3 Data can bridge the gap between producer and consumer

Increasing complexity feeds demand for data technology

Internationalisation of supply chains and industrialisation of production increase the complexity of production processes. The use of software and data technology in the food industry is increasing rapidly and helps companies to fathom the increased complexity. Compared to machines and robots, the investment threshold for digitalisation is relatively low. This also makes it more accessible for food producers to invest in digitalisation themselves or to buy external expertise.

Consumers are receptive to more information

More than half of Dutch consumers would like to know more about the production of their food, especially meat. Data technology applications (such as RFID chips) improve the traceability of products throughout the chain. Quality marks and QR codes make it easier to share information about the composition, origin and production of food with consumers. Label limitations, such as limited space and the emphasis on text, can thus partly be solved. But there is much room for improvement: although 85% of consumers read labels, almost one-third find the information insufficient.

Core applications of data technology in the food industry

Predicting and planning production

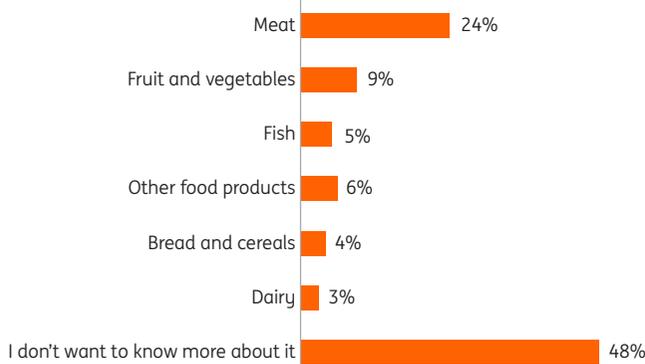
- Systems that combine data on the status of production lines and planning will advise employees who control the production process on how to optimise different production lines. Through artificial intelligence, these systems learn from previous situations and the advice is continually improving.
- Better measurements and data collection in the field (at the farmer/grower) make it much easier for food processors to predict supply (including quantity and quality). On this basis, food producers can look for suitable buyers at an earlier stage and achieve a better match between supply and demand.

Transparency from farm to fork

- With the aid of data technology, product traceability for the entire chain can be increased to 100%. This leads to distinctive products, adds value, and increases consumer willingness to pay more, as with antibiotic-free meat, for example.

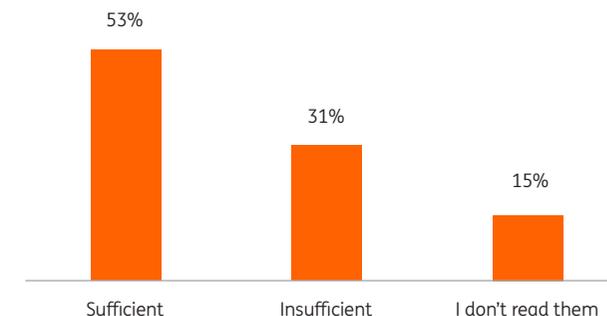
Most Dutch consumers would like to know more about the origin of products

% of respondents to the question: I would like to know more about the origin of my ...



One in three find label information insufficient

% of respondents to the question: I generally find the information on food labels...



Source: ING Question of the day, 29.241 and 31.326 respondents in the Netherlands, 2018

2 | Food tech applications – novel processing techniques

2.4 Further blurring of the boundary between fresh and processed food

Blurring of the boundary between fresh and processed food

Fresh is a relative concept in food. By applying novel processing techniques (see box), food producers are increasingly able to ensure that processed products retain a fresh appearance and their quality. This also requires fewer additives. Processed fresh products, such as ready-meal salads and fresh juices, pasta and soups, are gaining ground because they combine fresh quality with greater consumer convenience.

New market opportunities through technology

New generations of fresh products continue to develop categories. This is partly at the expense of sales of existing products with lower added value, such as unprocessed vegetables or long-life juices. Because 'milder' preservation techniques, such as high pressure processing, extend the shelf life of freshly processed products, new export markets are opening up.

Emergence of novel processing techniques

The emergence of novel processing techniques is a direct result of consumer demand for fresh and healthy products free of chemical preservatives. This leads to the development of milder and more energy-efficient processing techniques able to maintain structure, function and product quality (Source: Foodsafetymagazine).

Examples of novel processing techniques:

- High-pressure processing: can be used for pasteurising and sterilising products. For pasteurization, this is a commercially available and applied technology; for sterilization, the technology is under development. Used for juices, meat, ready-to-eat meals and spreads, among other products.
- Pulsed electric field: forms an alternative to pasteurising liquid foodstuffs, such as juices and soups, and is also used in potato processing. Processing at low temperature better preserves nutrients and requires less energy.

2 | Food tech applications – cases

2.5 Food tech in practice: Westfort and Ardo

Westfort Vleesproducten

Robotisation offers new application possibilities

“Robotisation produces major benefits for the food industry, not only from a cost perspective but also because of food safety and easing working conditions,” says Robbert van ‘t Hoff, CEO of the Dutch firm Westfort Vleesproducten (turnover: €500 million). The comparison with the automotive industry is easy to make: Van ‘t Hoff indicates that demand from food producers focuses more on smaller numbers of more specialised robots. Robots are coming onto the market for an increasing number of meat processing operations. The scale created at Westfort now supports profitable investments in robotisation. The more times an operation has to be repeated in production, the sooner automation pays off. Westfort is building a new processing facility in which the end of the production process is highly automated. Sorting products and placing them in cold storage are not only very labour-intensive tasks, but are also performed under cold and tough conditions for employees.



Food industry can unlock valuable data in the chain

Abattoirs have useful data for the supplying pig farmers, while pig farmers have interesting data for the abattoir. Westfort sees great value in sharing data within the chain. Proper arrangements about data exchange and a sound data infrastructure are essential. The weight and percentage of fat of each slaughtered pig are known. By combining this data with data on genetics exchanged within the chain, for example, it is becoming easier to predict what kind of ham a pig will produce and how maximum value can be extracted from it. As these predictions are becoming increasingly accurate through continuous feedback with the actual measured data, Westfort is able to optimise value creation and improve efficiency.

Ardo

Technology aids the next quality leap

Ardo in West Flanders (turnover: over €1 billion) notes that the balance in market demand for fresh frozen vegetables, fruit and spices is shifting more and more from quantity to quality. The bar is being set higher at all levels in the chain: from growers to retail and food service. At its 21 production sites, Ardo’s response includes camera technology for sorting products and robotisation for cutting products. As buyers are setting increasingly stricter food safety requirements, preventing contamination during production is essential to meeting these requirements. The number of people entering protected areas is therefore limited as much as possible.



Making processing techniques more sustainable is a priority

The way in which fresh products are processed is crucial for maintaining quality and improving ease of use for consumers. Vegetables from the soil are blanched, fried or grilled at Ardo and then immediately frozen and stored in the fully automated deep-freeze warehouse. Blanching is traditionally done in boiling water, but steam blanching is becoming more common. This results in enhanced product quality while ensuring lower energy consumption.

Would you like to know more?

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