Food safety management

Prevention, monitoring, traceability & information
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Recent food scandals make it clear that food safety is a contentious and important issue that has not yet been adequately addressed in the industry. Strategy& has investigated which are the emphases already being set by the food and drinks manufacturers today, and has found that there are still a significant number of gaps.

Food processing companies have recognised how damaging it can be to neglect the safety of their products. However, they have not as yet clearly realised the opportunities that are open to them with appropriate investments in food safety. By exploiting leading technologies and open communication, they can profile themselves as committed companies on the side of the customer, acting responsibly and sustainably. Efficient and progressive food safety management that goes beyond working through the regulatory requirements calls for a comprehensive approach – prevention, monitoring, traceability and information.
A hot topic for the food and drinks industry

In recent times, barely a week has gone by without a new food scandal hitting the headlines: listeria in cheese made from unpasteurised milk, contaminated soya bean-sprouts, horse meat in minced beef, salmonella found in chicken meat, etc. Even if the theme frequently attracts an overly critical response from the general public, it has to be acknowledged that in some countries’ government institutions for food safety report that one in every four officially-monitored enterprises manufacturing, processing or selling food breaches the food safety standards. This applies for example to Germany, where, in addition, the level of complaints arising from official examinations of food samples has been high and unchanged for several years, at over 13%.

This relates to animal products (meat, eggs and milk), but also to grains, fruit, vegetables and processed products. Contaminations from pathogenic microorganisms such as bacteria or moulds were responsible for 40% of all recalls in Germany in 2012 (see Exhibit 1). In addition, physical

Exhibit 1
Reasons for product recalls of foods in Germany

Data basis: 128 recalls published on www.lebensmittelwarnung.de from October 2011 to December 2012
Source: German Federal Office of Consumer Protection and Food Safety; Strategy& analysis
contamination with foreign objects such as metal parts, fragments of bone, fruit stones or insects, and chemical pollution from residues of antibiotics or pesticides are also regularly-cited reasons for food recalls.

The causes of these contaminations are wide-ranging. In many cases, raw products from the field are by definition contaminated. In the onward processing, there are often shortcomings with regard to adequate hygiene within the enterprise, inadequate use of technologies for product control, a lack of binding analysis criteria for laboratory investigations, or even simply insufficiently trained personnel.

**Regulatory context**

There have been far-reaching reforms in the EU since 2000 (in part, as a consequence of the BSE scandal) to ensure higher standards of food safety. The EU regulation EC/178/2002, which came into force in 2007, sets out the general principles, methods of procedure and requirements under food law over the entire supply chain, and also made provision for the establishment of the European Food Safety Agency (EFSA). The regulation also imposes exacting requirements for proper labelling and traceability of foods and animal feeds. In Germany, the regulation was a decisive push behind the themes of consumer protection, hazard avoidance and commercial law being brought together in the German Foods and Feeds Code (Lebensmittel-, Bedarfsgegenstände- und Futtermittelgesetzbuch, LFGB), which has been enacted in Federal law since 2005. In the USA, the Food Safety Modernization Act (FSMA) was passed in 2011. It improves the opportunities for state interventions in food production, and for the first time it gives the Food and Drug Administration (FDA) the right to recall contaminated foods and take them out of circulation. In addition, the act covers preventive safety checks, inspections, stronger controls on imports and boosting the collaboration between actors working on food safety.

Moreover, food safety control of crop and animal products still starts too rarely in the countries of origin – something that is especially true for products from China, India and other emerging countries. Criminal enterprise by actors along the value chain also plays a part, even if in many countries this only concerns isolated cases. Lastly, consumers themselves may have a negative influence on food safety due to incorrect food storage or preparation. Instead of the earlier reactive measures, state regulation is increasingly focussing on prevention to avoid health risks.
The intensified EU regulations for the safety of foods and animal feeds, and the Food Safety Modernization Act (FSMA) passed in the US in 2011, impose significant requirements on the industry in relation to documentation and standardised processes.

However, food safety should be at the top of the agenda for the food industry in any case, since it is in the industry’s own economic self-interest. Extensive product recalls are expensive and, in some cases, even threaten a company’s existence; they damage the reputation of the food and drinks manufacturers and destroy consumer confidence. For instance, the scandal of peanuts contaminated with salmonella in the USA in 2008/09 ended with the insolvency of the company at its source, the Peanut Corporation of America (PCA), and caused losses for many PCA customers running into millions. At the insolvency proceedings, the breakfast flake manufacturer Kellogg Company alone put in a claim for 60 million dollars for product recalls.

Food safety versus food quality

Food producers rarely separate the themes of food safety and food quality, since both are dependent on comparable measures and processes. Yet the boundary between quality impairments that do not place health at risk and a definite food safety hazard is a fluid one. Incorrect product labelling as an organic or a “fair trade” product does not generally represent a deficiency in terms of food safety, but it is detrimental to quality since the consumer is being deceived as to the origin or the nature of the processing involved. Another instance is the failure to declare all the ingredients on the product label. Certain ingredients in foods are unproblematic for the majority of consumers, but can cause severe allergic reactions in some people.
Food safety is a difficult issue to handle for food and drinks manufacturers, due to the different types and causes of hazards, the pressure from outside, and the economic risks involved. For the company management, taking a holistic view of food safety management is the most effective way to increase product safety. The experience of Strategy& is that this holistic approach needs to be underpinned by an understanding within the company that food safety cannot be bought in, but originates in the value creation process for the product „from farm to fork“.

In this regard, there are four vital stages which are critical for safety, which apply equally across the entire value chain and for each enterprise involved (see Exhibit 2): prevent contamination, monitor standards, track products in the supply chain, and inform consumers.

A product's food safety is built over these four elements which can be considered stages. The challenge for a “Chief Food Safety Officer” (a post which to date only a few food companies have had) and for quality management is to devise suitable measures for each stage. That is made easier depending on how highly the company management ranks the theme of food safety as a competitive unique selling proposition, rather than seeing it simply as a way of complying with the regulations.

Exhibit 2
Vital stages in ensuring food safety

Source: Strategy&
Necessary measures over the four progressive stages for food safety outlined above fundamentally fall into two areas: (a) organisational and process-based measures, and (b) capital investment in suitable technologies, tools and infrastructure.

**Analysis of measures relating to food safety**

To find out where the current emphasis lies in terms of the measures adopted by food and drinks manufacturers, Strategy& has analysed the public image of 25 well-known food processing companies (see Exhibit 3, next page). For this, descriptions of measures in company reports, sustainability reports and on company websites were evaluated, and underpinned by interviews with experts. The sample covered large to medium sized enterprises with annual turnovers of several hundred million euros, and also international companies with turnovers of several billion euros.

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**Exhibit 3**

**Measures to ensure food safety (nominations in per cent)**

<table>
<thead>
<tr>
<th>Overall food safety</th>
<th>Internal quality management</th>
<th>96%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevent contamination</td>
<td>Food safety organisation</td>
<td>52%</td>
</tr>
<tr>
<td>Monitor standards</td>
<td>Active supplier management</td>
<td>60%</td>
</tr>
<tr>
<td>Track products</td>
<td>Staff training</td>
<td>48%</td>
</tr>
<tr>
<td>Inform consumers</td>
<td>External certifications</td>
<td>92%</td>
</tr>
<tr>
<td></td>
<td>Laboratory tests and analysis</td>
<td>32%</td>
</tr>
<tr>
<td></td>
<td>Track-and-trace initiatives</td>
<td>24%</td>
</tr>
<tr>
<td></td>
<td>Full traceability</td>
<td>12%</td>
</tr>
<tr>
<td></td>
<td>Publishing of KPIs</td>
<td>32%</td>
</tr>
<tr>
<td></td>
<td>Dialogue forums</td>
<td>12%</td>
</tr>
</tbody>
</table>

Source: Strategy& analysis
Data basis: Public image of 25 food processing companies with turnover of over EUR 200 million
Our finding was that practically all companies report that they have a **quality management system** and that they are also **externally certified**. The certification can also occur on the basis of a variety of standards, and it is actively requested by retail chains at the end of the value chain. Over 40% of the companies investigated are certified under the HAACP concept. Other audits for certification purposes are conducted under ISO 9001, IFS (International Featured Standards), ISO 22000, British Retail Consortium (BRC) standards and Global Food Safety Initiative (GFSI) standards, and also under regionally-applied standards such as SQF in North America or QS in Germany.

In the mid-range of measures named, one finds **active supplier management** in relation to quality and safety of the raw materials and products supplied, establishment of a dedicated **food safety organisation**, and **training programmes for employees**.

However, the corresponding measures are communicated in far less detail in the publicly-available materials for the companies investigated. It can be concluded that many food manufacturers are not committed beyond the necessary minimum scope.

With regard to internal organisation on the theme of food safety, this is not always a dedicated team with the corresponding competence to carry out interventions should deficiencies be identified. What is often found are virtual organisations which act for the occasional qualification of new suppliers and/or only in the event of a crisis. The quality of training, similarly, often fails to go beyond communicating the regulations governing hygiene. Conversely, increasing the sense of responsibility felt by each individual employee for the quality and safety of the company’s products is rarely the central focus of training. One positive example in this regard is the American food group ConAgra, which has firmly anchored the theme of food safety in its corporate culture. ConAgra uses targeted training to promote this sense of awareness amongst all employees, by putting across a simple message: “Your family is also going to eat the food produced.” At the same time, all staff are motivated and empowered to take decisions in favour of high food safety, even to the detriment of financial or operational targets when there is some doubt involved; this might conceivably include a decision to halt production.

As part of active supplier management, the Swiss chocolate manufacturer Barry Callebaut and the American food group General Mills provide examples of best practice. For instance, Callebaut regularly evaluates the quality of its suppliers, using a dedicated team; it maintains a performance scorecard for each supplier and records the results of quality tests and deviations from the agreed standard on its central ERP system. General Mills regularly runs a “supplier school” to support suppliers in improving food safety through hygiene standards and quality management.
At the lower end in terms of nominations of measures associated with food safety, one finds firstly the publication of KPIs. Barely one-third of all the food and drinks manufacturers investigated regularly evaluate KPIs and communicate the findings. They are often associated with the Global Reporting Initiative (GRI) standards and generally include, as a single published figure, the annual number of product recalls.

A different approach is taken at the dairy group Arla, for example, which also communicates the volume of milk contaminated with antibiotics and therefore not further processed. The US meat producer Smithfield also publishes the total of all fines and the reasons for these, together with the number of recall actions, while the French food group Danone communicates a food safety index for each business division that combines seven indicators (such as good hygiene practices (GHP), good manufacturing practices (GMP), HACCP and traceability). Danone constantly refines the points scale for these indicators, taking account of the demand for continuous improvement.

Similar to the measuring and publication of KPIs, measures such as laboratory tests and analyses, track-and-trace initiatives in supply chain management, communication with consumers via dialogue forums and ensuring full traceability of ingredients over the whole chain and not just over the stages immediately up- and down-stream of the company play a subordinate role in ensuring food safety. These are all measures that can be implemented efficiently via the use of appropriate technical solutions and tools. It appears that the willingness of food manufacturers to invest in this area still remains limited (thus far).

**Summary – to date, companies are only inadequately countering food safety risks**

Before going into further detail, one result from the analysis which should be noted is that most companies continue to act relatively passively. They concentrate primarily on compliance with conditions, legal obligations, mainly using organisational and process measures for this, but they do not actively pursue investment-intensive measures capable of also contributing to differentiating the company from the competition. In relation to the food safety development stages, the food manufacturers investigated are, for the most part, active in preventing contamination and monitoring standards with the help of certifications. Food testing using technical analysis equipment, comprehensive data-based traceability and critical dialogue with consumers is less commonly found at the top of the agenda for ensuring food safety. Very few companies to date are well-placed in all four vital stages for ensuring food safety.
New technologies – an opportunity to stand out

It is particularly the measures rarely cited in the Strategy& analysis – laboratory tests and analyses, track-and-trace initiatives and full traceability – which, based on the project experience of the authors, offer companies the opportunity to actively increase food safety and to differentiate themselves from the competition.

Traceability – a purely defensive move?

Many companies view measures to improve product traceability as a defensive step, to enable them to react to problems concerning food safety and to minimise the costs of product recalls. It allows companies to have transparency on immediate upstream and downstream stages of the value chain (“one step up – one step down”), but for more extensive traceability of their ingredients and products they are reliant on collaboration with their suppliers and buyers. Some companies have set themselves the target of significantly improving the traceability of their upstream products, back to the originating source.

For instance, the sweet manufacturer Ferrero is looking to achieve seamless traceability of the source of all the hazelnuts it uses by 2020. The company has also launched programmes with which the route of all cocoa beans used can be traced back as far as the local growers.

Initiatives to standardise the information to be passed on at transfer points in the value-added chain are being driven forward by standardisation bodies such as GS1 or IT infrastructure providers like IBM. Providers of corporate software such as SAP or Oracle are also putting emphasis on traceability as a business area, and are integrating modules for traceability into their ERP system offers. They are thus offering their customers not only a key IT support for traceability of contaminated batches, but are also giving them the opportunity to optimise the storage and ordering process. Estimates indicate that food manufacturers and retailers incur avoidable losses amounting to over 3% of sales due to a lack of supply chain transparency.
**Upgrading track-and-trace using sensor-based technologies**

Beyond data processing along the value-added chain, innovative data recording technologies now offer promising potential for also exploiting investment in track-and-trace as a way of differentiating a company from the competition. The use of sensors enables more and more data to be recorded – and not just about the respective location of the foods. Temperature sensors can save information from the warehouse or during transport to a mobile data carrier. These are transferred over along with the product in order to demonstrate refrigeration chain continuity. Alongside the use of barcodes and RFID chips at transfer points in the supply chain, isolated additional infrared measurements are also performed, in order to confirm the origin of products beyond doubt thanks to the specific spectral signature.

**Consumer communication can be improved**

A further trend is stronger consumer involvement. Traceability offers manufacturers and retailers the opportunity to pass on additional information to consumers, even for products such as fresh fruit and vegetables, e.g. via a QR code. Providers such as HarvestMark in the USA offer customised solutions in this area. When a consumer scans the code using his smartphone, he can call up information about origination down to the local level, the type of farming or the harvesting date. For processed products, QR codes offer the chance of providing additional information on ingredients for allergy sufferers.

**Analyses and controls in manufacturing are challenging**

In the area of analysis and control instruments, there are numerous possibilities for increasing the quality and safety of foods. Proven measures include random-sample laboratory testing at critical transfer points in the value-added chain to test for biological and chemical contaminations. However, the challenge lies in the fact that it is not the entire production volume that is tested for contaminations, but merely samples. If a batch is only partly contaminated, the entire batch must nevertheless be destroyed. Moreover, with this type of “offline” testing in the laboratory there is a time-delay until the test results are available, often running to several days. Until that point, the food cannot be released for selling or onward processing. In this area, assistance may now be coming from rapid tests using easy-to-handle “at-line” lab instruments. The test results are then already available within a few seconds or minutes, even if the breadth of the analysis options is limited.

To minimise the risk of physical contamination, e.g. with metal parts, many companies rely on metal detectors at the end of the production
line. Through the supplementary use of accurate x-ray scanners, it is also possible to minimise the risk of fragments of bone or splinters of glass. However, one hundred per cent protection is not possible. The use of control devices such as this only at the end of a production line also offers no opportunity of stopping the processing of contaminated batches earlier and of eliminating the source of the error.

**Food analysis using optical spectroscopic sensors**

Analyses of foods are ideally undertaken on the line during production, cover the entire volume produced, and with the results being available immediately to enable direct intervention in the manufacturing process as necessary. Optical spectroscopic sensors, taking measurements in the near-infrared (NIR) spectrum or using lasers and integrated directly on the production line (“in-line”) are capable of this. Suitable analysis and control devices replace (in part) the traditional “off-line” laboratory tests and “at-line” analyses. The challenge lies in checking numerous objects moving at high speed in fragments of seconds, in order e.g. to test peanuts on a moving conveyor belt and to simultaneously interpret the smallest differences in the reflected or permeated light. To be able to do this with sufficient accuracy calls for “applications know-how”. Companies manufacturing such instruments have extensive experience in measurement, and possess databases with thousands of comparison values for each product examined.

**New instruments offer lasting economic benefits**

One example of market-mature technology products are advanced sorting machines, which in addition to using laser measurements to sort by visually detectable quality criteria (such as colour, shape and size) are also capable of identifying microbiological contaminations (e.g. the mycotoxin aflatoxin).

Another example is instruments that use NIR measurements to determine the fat and water content and other criteria for meat. This allows for near-time adjustment of mix ratios to ensure consistent product quality. If the data gathered by such devices is processed in an integrated manner with additional information, e.g. from temperature and pressure sensors at a different point in the production process, the food manufacturer achieves significantly higher, real-time transparency over the entire production process (“process analytics”). Suitable instruments thus offer not only an increase in food safety, but wide-ranging economic benefits.

Unnecessary rejects are avoided, product quality and compliance with specifications is continuously guaranteed, and continuous supplier benchmarking for quality of the products supplied can be realised. The
business case for suitable investment is positive, and investment in analytical instruments is amortised within a very short period, particularly in large processing operations. “Process analytics” should therefore penetrate into increasing areas of the food industry.

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**Interview with Stefan Ranstrand, President and CEO of the TOMRA Group**

**How do TOMRA’s products help to increase food safety?**
Our sensor-based sorting plants remove foreign objects, misshaped items and damaged or incomplete products, and are capable of identifying toxins (aflatoxin). For this, we use a wide range of technologies, from camera systems, LED technology to near-infrared, transflection, and through to laser and x-ray technology. Another area is process analytics, e.g. in meat product production. This is where the QVision system with its advanced spectroscopy engineering is used. It analyses product flows in real time, looking at the product composition, e.g. fat/lean content, proteins, collagen or water content. I should also emphasise the capability to identify types of meat.

**What other benefits does in-line analysis offer?**
In-line analysis instruments guarantee consistently high product quality and compliance with specifications, thus offering additional economic benefits. Take QVision as an example: through accurate monitoring of the fat/lean content, the fat content can be taken close to the specified maximum and increased by two to four per cent. Given an analysis capacity of over 30 tonnes per hour, this represents a massive potential saving.

**What are the challenges for increasing food safety that TOMRA is working on?**
Specifically, we are continuing to emphasise on-line/in-line solutions, e.g. implementing analyses for bacterial contamination that are carried out today in the laboratory to operate as an automated analysis on the product flow whilst in motion. In doing so, we are also guided by technological developments outside the food technology field. For instance, the spectroscopy technology that is now used in our QVision system was originally developed in our recycling division. In addition to R&D in the area of accurate spectroscopy instruments with fast data processing, we are investing in expanding our “applications know-how” and strengthening our global organisational footprint. That is the only way for us to deliver lasting competitive advantage for our customers.
Many food and drinks manufacturers are far from exhausting all the possibilities for offering the consumer safe foods. Only few companies aim to differentiate themselves from the competition in the market by applying a holistic approach towards food safety management. For that reason the issue remains an important one – not only for quality assurance, but also for executive management.

The main focus of the efforts being made by companies is on organisational and process-based measures. Companies are building on internal quality management and external certification, and are less frequently investing in promising technologies for traceability and product analysis. The differentiation potential of measures to increase food safety, for instance through comprehensive analysis carried out in real time in production, is rarely exploited strategically.

From the Strategy& perspective, the comprehensive concept for food safety management, built on prevention, monitoring, traceability and information, should be applied more widely. There are best practice examples in each stage – and considerable opportunities lie in matching these together meaningfully and exploiting this for market positioning.

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**TOMRA**

TOMRA is a leading global company for sensor-based solutions to increase resource productivity, and has two business divisions: TOMRA Collection Solutions and TOMRA Sorting Solutions. TOMRA Collection Solutions offers technologies for automated collection and reprocessing of reusable waste materials, and is the global market leader for automated recovery of empty drinks packagings. TOMRA Sorting Solutions is a leading solutions provider for sensor-aided sorting and process analysis in the food processing industry and in the recycling and mining sector. TOMRA has around 2,200 employees and in 2012 realised sales of around 4.1 billion NOK (c. EUR 548 million). TOMRA’s head office is in Asker in Norway, and the company is listed on the Oslo Stock Exchange.

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**Conclusion**

The trend is clearly heading towards real-time recording and in-line analysis of entire product batches.
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