

Food sector challenges and the role of technical and quality management

1

Mark Swainson

National Centre for Food Manufacturing, University of Lincoln, Holbeach, Lincolnshire, United Kingdom

1.1 Food industry overview

As one of the largest industries in the world the food sector is dynamic, often complex and always multifaceted. To work effectively the ‘food system’ requires the application of science and technology, coupled with business and management skills, across the agri-food supply chain ‘from farm to fork’.

The nature of the food manufacturing sector being operated in will usually define the appropriate science, technology, systems and approaches best placed to assure the quality, safety and legality of the product manufactured. When seeking to control such matters it is very helpful to reflect on the breadth and complexity of the global ‘food system’.

Providing for one of the most basic needs of mankind, that of the requirement for safe and nutritious food, the food industry faces an ever-growing challenge to feed a rapidly rising global population, which is predicted to reach 8.6 billion in 2030, 9.8 billion in 2050 and 11.2 billion in 2100 (United Nations 2017) (Fig. 1.1).

Consequently, food production and supply is often one of the largest employers and manufacturing sectors in countries as they focus on the provision of safe and nutritious food to their populations. The rapid and continuing population growth across the globe means that this is likely to continue. There is also an additional increasing productivity requirement as due to population growth, agriculture and food systems will have to operate on land resources which are increasingly limited by population growth.

Key aspects of the agri-food supply chain or ‘food system’ chain include:

- agriculture/farming;
- transport and distribution;
- food processing/manufacturing;
- food sellers – e.g., retailers (shops and supermarkets), food service outlets (restaurants, canteens) and food markets; and
- consumers.

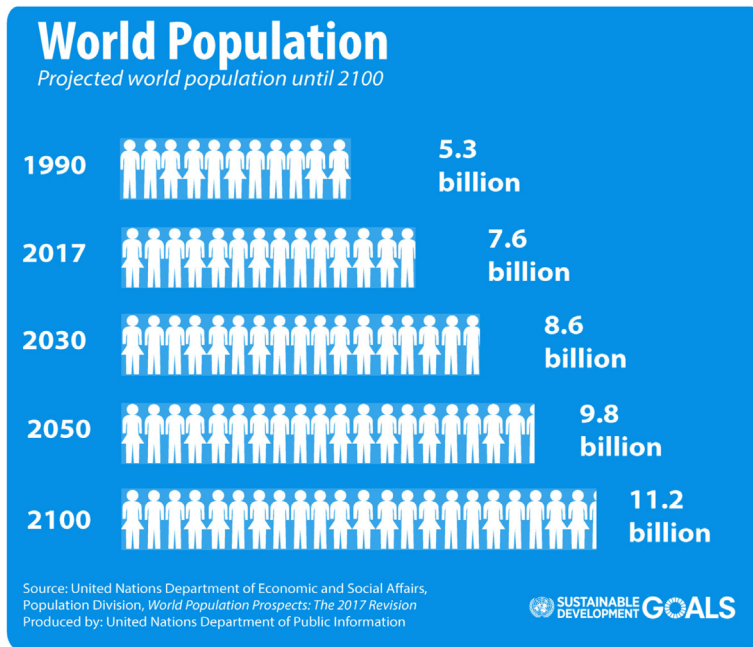


Figure 1.1 UN projected world population until 2100.

Source: From United Nations Department of Public Information, https://www.un.org/development/desa/publications/wp-content/uploads/sites/10/2017/06/Population_Graphic_R.jpg. © 2017 United Nations. Reprinted with the permission of the United Nations.

Alongside the food supply chain being often global and always critical to human survival, health and wellbeing, there are a significant amount of business interests engaged across the sector (Fig. 1.2).

All parts of the system require services such as:

- equipment manufacturers;
- technology providers;
- utilities – e.g., energy and water;
- packaging businesses;
- waste and recycling services; and
- transport and storage.

Food and drink manufacturers therefore have a very significant economic and social impact locally, nationally and globally. Food industry manufacturing businesses typically combine the produce from farms and primary production businesses, processing and ‘adding value’ to foodstuffs before the onward journey of the finished packaged product through to the end consumer, typically via retailers or food service groups.

The products manufactured in the sector range from base foods such as vegetables, fruits, cereals, raw meats, eggs and dairy products, oils, herbs, spices and

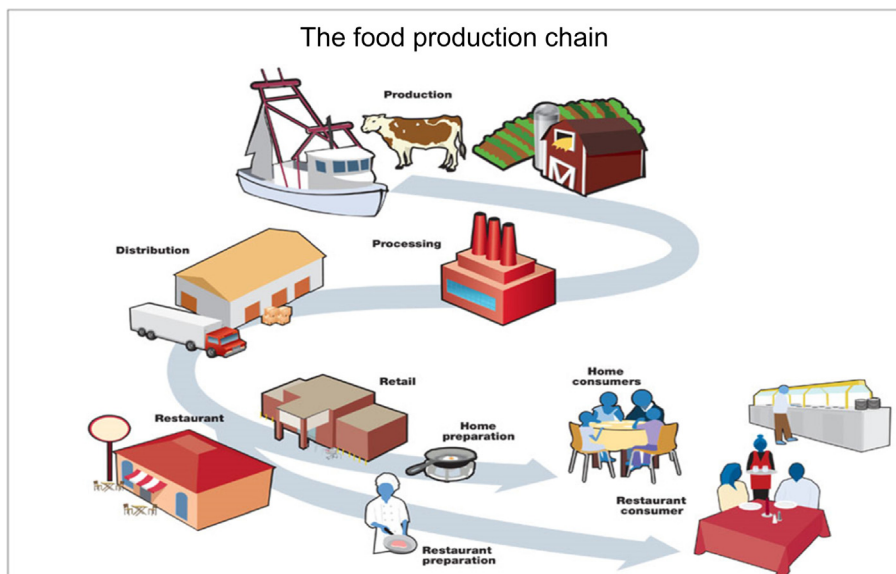


Figure 1.2 The food production chain.

Source: Centers for Disease Control and Prevention, 2017.

sugars, through to further processed foods which include ready-to-eat (RTE) foods such as sandwiches, wraps, salads and prepared fruits and ready-to-cook (RTC) foods such as ready peeled and washed vegetables and prepared meats, through to multicomponent products e.g., ready meals.

1.2 Typical challenges faced by the food production and supply system

1.2.1 Food safety: HACCP, TACCP and VACCP

HACCP: As foods are inevitably intended for consumption they have significant potential to cause harm if the food contains a particular hazard. Recognised hazard categories in the food industry include microbiological, chemical, physical and allergenic contaminants. These hazards and the approaches to their control form a significant part of the workload of the Quality or Technical Manager, working to identify the threats to food safety, form control strategies and then implement and manage appropriate systems/procedures which eliminate or reduce these hazards to an acceptable level. This approach is often termed the *hazard analysis and critical control point (HACCP)* system.

Adopted by the Codex Alimentarius Commissions the principles and practical application of this internationally recognised HACCP approach to controlling food safety is presented online by the United Nations Food and Agriculture Organisation (FAO) Corporate Document Repository (<http://www.fao.org/docrep/005/y1579e/y1579e03.htm>).

While HACCP is focused on **controlling accidental contamination of foods**, over time the potential for intentional contamination or other criminal activities with regard to food production has highlighted the need to develop a food safety assurance system focused on the prevention of deliberate food safety incidents or food fraud.

Threat assessment critical control point (TACCP). Due to a number of high profile food safety issues caused by criminal activity or malicious intent, TACCP has recently become recognised as a key aspect of food safety management. TACCP is defined by PAS 96:2014 as the 'systematic management of risk through the evaluation of threats, identification of vulnerabilities and implementation of controls to materials and products, purchasing, processes, premises, distribution networks and business systems by a knowledgeable and trusted team with the authority to implement changes to procedures'.

The threats considered and sought to be controlled by TACCP include: economically motivated adulteration (EMA), malicious contamination, extortion, espionage, counterfeiting and cyber-crime.

A particular aspect of TACCP is the importance of seeking to understand the mindset, motives, capabilities and opportunities of the potential 'attacker' of the food production system. The potential attacker is defined by seven separate categories of individual: the extortionist, the opportunist, the extremist, the irrational individual, the disgruntled individual, the hacktivist and other cyber criminals, and finally the professional criminal.

TACCP system development is best progressed by a multidisciplinary team in order to ensure knowledgeable coverage of as many aspects as possible. Many of the multidisciplinary team may be the same team members who make up the business HACCP team, though care should be taken not to assume that this is the case, as the TACCP team members will need to possess a number of different skill sets compared to the standard HACCP team. The TACCP team will need to consider: who might want to conduct an attack? How might the attack be carried out? Where are the vulnerabilities in the current system? How can they be stopped? (These are very different questions to those considered by the HACCP processes.)

'Attacks' can take many forms, from the replacement/substitution of ingredients, false or misleading marketing/labelling (often for commercial gain), through to intentional contamination. Once the threats, vulnerabilities and risks have been assessed then critical controls can be developed to provide the level of assurance required. The TACCP team should then routinely review these food protection arrangements.

Publicly available specification PAS 96:2017 'Guide to protecting and defending food and drink from deliberate attack' provides further details and is available via this link: <https://www.food.gov.uk/sites/default/files/media/document/pas962017.pdf>

VACCP (vulnerability assessment and critical control point). TACCP and VACCP can be viewed as interrelated processes which combine to help control intentional product safety threats. The TACCP focus is to identify specific threats of criminal/malicious activity which seek to undermine food safety or food quality. The VACCP focus is to consider how vulnerable each point in the supply chain is to that threat of criminal/malicious activity.

VACCP involves scanning the operational horizon for possible indicators of adulteration, contamination or substitution and any other potential breaches of supply chain integrity. The VACCP team are typically encouraged to ‘think like a criminal’ when seeking to identify opportunities for illegal commercial gain, or ‘consider malicious intent’ if seeking to contaminate the food products under consideration.

Product adulteration, dilution, counterfeiting, unapproved adjustments to recipes, mislabelling (or misdescription), incorrect species and incorrect country of origin labelling are all examples of actions to be considered when reviewing where these issues could occur in the product supply chain and manufacturing processes.

Vulnerabilities could be identified based on historical data (e.g., scanning for news reports of issues which have happened related to products or supply chains similar to those of the business in question) and also on the VACCP team’s own thoughts and opinions of the potential opportunities for criminal/malicious activity.

Once a range of possible ‘vulnerabilities’ have been identified, the next role of the VACCP team is to design and apply ‘mitigation strategies’ (establish appropriate preventative measures) which will serve to either reduce or eliminate each specific vulnerability.

Example mitigation measures may include:

Raw material specifications – to state the key criteria/parameters that define product authenticity.

Supplier approval processes – to ensure that only checked and trusted suppliers are used.

Analytical test regimes – routine screening for indicators that food authenticity may have been compromised.

Ensuring use of tamper evident packaging.

Reducing the number of steps in the product supply chain to reduce the potential for sources of risk.

These ‘food safety assurance’ and ‘food defence’ activities and the expectation placed upon food business operators to always maintain and demonstrate ‘due diligence’ will be discussed in subsequent chapters.

1.2.2 Nutrition

There is a basic requirement for the consumer to derive from their food intake sufficient nutrients to help ensure their health and wellbeing. Most commonly the nutritional content of foods is defined in the food ‘nutrition information’ as the levels of energy (calories), total fat, saturated fat, carbohydrate (stated as a total and also the proportion derived from sugars), fibre, protein and salt.

Many food operations have to significantly focus on the challenge of ensuring that their foods are formulated to meet required standards and are then produced in such a way as to be consistent in their nutritional content, especially where health claims are being made such as ‘low fat’, ‘sugar free’, ‘reduced salt’, ‘high in fibre’, or perhaps are being eaten as part of a calorie-controlled diet.

Meeting these expectations consistently requires a food manufacturing operation to have close control on the nutritional variability of any ingredients (via defined specifications and supplier testing/auditing practices) and also consistency of their food production processes including measurement and processing practices.

With regard to processed foods there is an increasing consumer demand to avoid the use of synthetic additives (e.g., colours and flavours) and preservatives, exemplified by 'clean dec' initiatives (removal and reformulation of recipes to no longer have such materials present in the product Ingredient Declaration). Consumers are tending to prefer foods to be more 'healthy' and 'nutritious' in their appearance and content. In many countries 'organic' foods have been seen to develop significant markets over recent years. Also, there have been trends toward 'minimally processed' foods which are more natural in their appearance and nutritional content.

Food manufacturers faced with these challenges often have to work hard to find natural replacers for the synthetic additives and preservatives that were previously used. Recipe reformulation and adjustment of processing parameters are also often required as part of such adjustments, and these steps can prove challenging to complete in a manner which does not add additional cost to the product.

In addition, the issue of whether genetically modified (GM) foods are acceptable to the consumer continues to divide opinion and consequently impacts upon food markets, legislation and labelling.

1.2.3 *Organoleptic quality*

The 'organoleptic' characteristics of a food product are a combination of appearance, aroma, taste and texture. Consumers are often attracted by the appearance of a food well before they have tasted it (e.g., the picture on the front of the food packaging) and tend to like a variety of choice with regard to the organoleptic properties of their foods. As a result, food production businesses tend to spend a great deal of time and money on new product development activities including market analysis, product creation/formulation, product sensory assessment and consumer taste panelling.

Market trends towards 'minimally processed' foods that are more natural in their appearance and nutritional content also routinely drive recipe reformulation initiatives and adjustments to the food processing parameters.

Reformulation and adjustment of processes can also be a challenge to the food business when seeking to 'cost reduce' products in order to make them more profitable. Often the challenge is ensuring that the product organoleptic performance is not reduced beyond acceptable limits, while changing the recipe/process to facilitate the use of less costly ingredients (or use a smaller amount of the more expensive ingredients).

1.2.4 *Product shelf life*

Product shelf life is often the most important factor in terms of whether a product will be commercially viable. If the product has too short a shelf life it may have

insufficient time to be produced, distributed, sold and consumed, leading to either the product not being launched, or if the product has already been launched before this is realised, then the occurrence of unacceptably high wastage levels at varying points in the supply chain will ultimately result in the product being delisted.

Achievement of an acceptable shelf life is therefore a key issue faced by the food manufacturer, often requiring a combination of activities in order to address the challenge. Depending on the product type/category, the shelf life achieved will be linked to the physical, organoleptic and microbiological properties of the raw materials and end product, the processes and packaging systems applied and finally the control and consistency possible in the storage and distribution chain, including when relevant to the in-home storage of the end consumer.

Food science & technology and sensory sciences combine when businesses are seeking to develop an acceptable shelf life as often the end point of the shelf life will be defined by either microbiological or organoleptic performance.

1.2.5 Commercial viability

As mentioned above, product shelf life is one of the largest contributors to the commercial viability of food products.

Other drivers of commercial viability which are challenges faced by the food industry are with regard to the cost of production and supply. Businesses must be able to make and supply the product at a low enough cost point to be able to then add sufficient margin to achieve a profit.

Key cost drivers within food production systems include the cost of raw materials (including ingredients and packaging), business staff/labour costs, utilities costs (often energy and water supplies) and distribution costs. Food businesses are therefore continually under pressure to keep these input costs as low as possible, and where such costs are subject to increase then cost savings will often be sought on other aspects of the production costs in order to still ensure an adequate profit can be made.

Typically, in food production systems such 'cost rise mitigating actions' include:

- Reducing staff/labour and replacing with computerised systems, automation and robotics.
- 'Cost engineering': the product to have a reduced recipe cost or a reduced cost of production.
- Increased pressure placed upon the raw material supply chain to supply ingredients and packaging at more competitive process, often leading to global sourcing and increased movement among different suppliers.
- Added pressure to apply lean manufacturing techniques which can lead to pressure to reduce cleaning and changeover times and increase the potential for operators to rush, potentially leading to a greater potential for processes not to be thoroughly completed and for mistakes to be made.
- Increasing application of microprocessor systems which control and link food processing machinery and equipment to better coordinate product flows and operational controls. Whole production systems can now be completely automated and controlled via a series of sensor and microprocessor technologies.

All of these actions can place additional pressures on the quality and technical team members as the food manufacturing site seeks to still maintain product quality, safety and legality, while dealing with changing workforce numbers, the application of new technologies, adjustments in product formulation and associated changes in suppliers (which often will require quality/technical checks and approval) and changes in processing techniques/technologies, often becoming more complex/sophisticated and therefore providing additional challenges with regard to their operation.

1.2.6 Environment

Food businesses have significant scope to affect the environment. Such potential business-related impact points can include:

- sourcing of raw materials;
- energy use/efficiency;
- waste outputs;
- transport;
- pollution (e.g. business noise/aromas); and
- water use and effluent.

The food industry has become increasingly aware of its impacts on the environment, often due to increasing government influence and legislation. This has led to a wide range of initiatives including to reduce energy use, change refrigerant gasses to more environmentally friendly alternatives, encourage cleaner air emissions, increase awareness of the business carbon footprint and reduction of 'trade effluent' (food process waste) emissions into water courses.

Increased consumer awareness of the potential environmental impacts of the industrial sector has also led to significant pressure for food processors to address any shortfalls in their environmental standards. Environmental pressure groups have become very adept at highlighting issues and swiftly building pressure on food businesses, especially major brands, to address matters. One such example is the environmental impact of transport and logistics, especially when transporting fresh product from abroad via air freight, typically expressed as 'air miles'/'carbon footprint'.

In the developed world there is typically very well-established legislation that serves to compel businesses to operate in an 'environmentally responsible manner', whereas in the developing world a lack of such legislation enables environmental pollution/damage to occur with usually very limited consequences (if any) applied to the businesses responsible.

In the developed world it is a commonplace for businesses to have formally written and implemented their own 'Environmental Policy', which considers the key impacts that the business can have upon the environment and the steps that the business is taking in order to ensure that these 'impacts' are at best positive, and at the very least any adverse impacts must be minimised/managed.

International Organization for Standardization, ISO 14001, provides an environmental management standard/framework within which to consider and control such environmental matters. 'ISO 14001 is an internationally agreed standard that sets out the requirements for an environmental management system. It helps organisations improve their environmental performance through more efficient use of resources and reduction of waste, gaining a competitive advantage and the trust of stakeholders' (ISO 14001 Key Benefits 2015).

ISO 14001 Key Benefits (2015) PDF document. https://committee.iso.org/files/live/sites/tc207sc1/files/ISO%2014001%20-%20key%20benefits_EN.pdf

1.2.7 Corporate social responsibility (CSR)

'Corporate social responsibility' typically applied in the context of businesses and organisations could be considered as a general term which encompasses ethical practice, social responsibility and environmental awareness.

Corporate social responsibility as a concept is not new. Major global brands have recognised for many years the importance of being seen to be 'doing the right thing', and not being found to be guilty of poor practice, be it adversely affecting their direct workforces or those within their supply chains, or perhaps damaging the environment either directly via the presence of their production plants or indirectly via the sourcing of their raw materials or the impacts of their finished products.

Many companies progress certain aspects of CSR without even realising that such activities could be considered as (and attributed to) CSR. For example, for cost efficiency reasons many organisations will already have implemented energy and waste reduction initiatives which could be considered beneficial to the environment and natural resources (e.g., carbon emission reduction schemes) and hence contribute toward the business CSR agenda.

A current and rapidly developing theme is the range of individual factors which collectively are covered by the term CSR. New CSR expectations are being routinely generated and developed, often as a result of increased consumer expectation, sometimes led by businesses seeking to 'do the right thing', and also as a result of pressure being brought to bear either via governmental compulsion or the orchestrated media campaign work of pressure groups who have become particularly adept at progressing their objectives via the use of 'name and shame' style campaigns.

Generally accepted aspects of CSR currently include:

- sustainability;
- workers' rights;
- ethical trade;
- health and safety;
- community wellbeing/impacts; and
- environmental protection/impacts.

1.2.8 Health and safety

Formal legislation covering the health and safety responsibilities of businesses and their workers is well established within most developed nations. As an example, with particular regard to the United Kingdom there is a clear expectation placed upon employers to ensure 'so far as is reasonably practicable the health, safety and welfare at work' of all employees (Health and Safety at Work etc. Act, 1974).

To help accentuate business focus and commitment to health and safety standards this legislation in the United Kingdom expects businesses which have a total number of employees of 5 or more to draft and display a written; 'Health and Safety Policy' within the workplace. Interestingly with regard to a more global perspective this particular law also makes provision for the health and safety consideration of *nondirect* employees such as designers, manufacturers, importers and suppliers. These nondirect employees may well be based overseas within developing countries operating to health and safety standards which are far less stringent than those in the United Kingdom.

While much of the developed world applies a similar legislative approach to compel businesses to consider and control health and safety, some of the developing world remains in a position where businesses seeking to save money or time can operate without due care and attention paid to the health and safety of those employed, without fear of particularly punitive consequences.

1.3 Management approach: overview of technical-related and quality-related roles

This book reviews the very wide ranging and demanding world of 'technical and quality management' operating within the food sector. Such technical/quality roles are many, varied and often overlapping/interlinked, including technical and quality managers, raw materials and specification technologists, hygiene managers, process and product development technologists and product/process innovation roles.

The wide range of 'technical' and 'quality' roles often operating within food manufacturing teams combine to ensure that the foods produced are safe to consume, of the required quality and legally compliant. Some of these roles are outward facing, routinely liaising with the raw materials supply base, customers or other stakeholders such as audit/accreditation bodies and government officials/enforcement agencies. Other roles are more factory focused including quality assurance and quality control staff who routinely check the production systems and products to ensure compliance, and also audit the site to maintain high standards of good manufacturing practice (GMP) and uphold the food safety and quality management system (FSQMS) including particular focus on the critical control points (CCPs) of the manufacturing operation.

These roles often require a combination of food science and technology knowledge, coupled with a detailed appreciation of the particular food processing system,

and an ability to communicate with a wide range of internal and external stakeholders. Usually it is only by working as a team that food manufacturing businesses can ensure compliance to technical and quality standards while also operating efficiently and effectively to ensure a profitable, 'commercially viable' business which meets all of its customer expectations.

The 'technical manager' and/or 'quality manager' are key roles within a food business as these managers are expected to champion and oversee all aspects of the operation related to product safety, quality and legality. Typically, the individual will oversee the quality and technical staff on site and will be a key member of the site operations management team, often reporting directly into the site managing director or operations director. The technical manager will sometimes also hold responsibility for a hygiene department and also a process/development department, due to the major impact which these two sections can have on the correctness and safety of the products.

Large businesses may have a number of managers specifically concerned with aspects of product safety, quality and legality, there may be a specifications manager, a systems manager, a quality manager, an internal audit manager, etc. However, typically in large food organisations these individuals will all ultimately report to a site technical manager (or sometimes a technical director).

Small businesses may not have the resources to split the technical function of the business into a number of different management roles and therefore often the 'technical manager' role operates in a way which also absorbs and delivers the duties which could be conducted by a quality manager, a specifications technologist, a hygiene manager, and a process development manager. One model does not fit all businesses.

Ultimately the technical manager's goal is to ensure that the business has the right systems and procedures embedded to deliver consistently safe, quality products which meet all legislative requirements. Their role is also to be an ambassador for the business on all such matters, internally within the business, with the business customers, Third-Party Certification Schemes and Enforcement Authorities including the Environmental Health and Trading Standards Departments.

1.4 Skills, knowledge and expertise requirements

To be able to operate effectively in the food sector technical/quality staff will need to utilise and express a range of capabilities linked to food science and technology, coupled with management acumen and other business skills.

Key food science and technology aspects of the roles include: food processing technologies; principles of food physics and chemistry; microbiology; health and nutrition; global food supply chains; ingredients technology (e.g., chemical, physical and microbiological attributes of common food groups including cereals, fruit, vegetables, meats, dairy produce, herbs and spices); allergens and food intolerance; food safety management systems (including hazard analysis and critical control

point (HACCP), risk assessment and measures to counter food fraud); specifications; traceability systems; packaging technology and food packaging systems; new product design and development; hygienic design (processing facilities and equipment); corporate social responsibility; ethical trade; environmental awareness; labelling requirements and food legislation.

Management and skills include: people supervision/management; data collection, interpretation and analysis; process monitoring systems; project management; ability to collate and present technical information; experimental techniques; regular review and consideration of food sector and related scientific developments; decision making; commercial awareness; complaints management (including trend analysis and design and implementation of corrective actions); continuous improvement (CI) ethos; investigation and problem solving techniques (e.g., root cause analysis); audit skills (both to be able to conduct audits and also host and progress customer and other stakeholder audits); recall and crisis management; interpersonal skills; leadership and staff development capability.

Accumulating such knowledge and skills to best advance a career in the food industry is usually achieved via a combination of study (both long and short courses across basic, intermediate and advanced levels), personal research, learning from others in organisations, coupled with 'experience' of working within the sector in technical and operations related roles.

1.5 Conduct of technical and quality personnel

Technical and quality personnel in the food sector are required to display and encourage high standards at all times. Typical identifiers of strong, capable technical personnel include:

- readily takes responsibility for tasks/areas of monitoring and control;
- has pride in their work and seeks to be proactive whenever possible;
- exhibits high integrity and always shows respect for colleagues and other stakeholders;
- ability to set and work to clear timelines, milestones and goals;
- tendency for self-development, always looking to further understand the operation and its underpinning science and technology or perhaps improve decision-making skills and supervisory/management practices;
- good communication skills, both verbally and written;
- forms effective relationships and has the ability to influence others, particularly on the maintenance of standards related to food safety, quality and legality;
- capable of working both as part of a team and also equally comfortable working alone when required;
- flexible and responsive to unexpected issues or change within the organisation;
- tenacity and focus to achieve the required outcomes;
- keen to share knowledge/information; and
- commitment to continuous improvement, always looking for ways to improve themselves and the organisation.

1.6 Concluding remarks

Often the biggest challenges for those attempting to maintain appropriate quality/technical standards within a food manufacturing business occur during times of trouble or change, for example, when a business is encountering a number of product safety or quality issues, requiring constant focus on the manufacturing operation and regular dialogue with the customer technologists and local authorities. Or perhaps when new products are being created for which there may be no previous ‘track history’ to be drawn on when seeking to control and take decisions with regard to the correctness of the end product.

With typically a high number of new food and drink products launching every year, the managers can be assured of many challenges to the robustness of the quality/technical procedures on site, especially so when all too often businesses are rushing to hit launch deadlines and therefore sometimes sacrifice the provision of sufficient trial time, research and development of appropriate ‘right first time’ standards.

Being able to manage effectively in the challenging food manufacturing sector is therefore a core focus of this book.

Further reading

United Nations 2017 – World Population Prospects: The 2017 Revision, published by the UN Department of Economic and Social Affairs. A comprehensive review of global demographic trends and future prospects. <https://esa.un.org/unpd/wpp/>

A wide range of helpful sources of information with regard to Food Defense, TACCP and VACCP, including:

Guidance:

– UK Food and Drink Federation (FDF)

http://www.fdf.org.uk/corporate_pubs/Food-Authenticity-guide-2014.pdf

– TACCP (Threat Assessment and Critical Control Point): a practical guide 2014

(Campden BRI) <http://www.campdenbri.co.uk/publications/pubDetails.php?pubsID=4640>

Self-assessment:

– US Food and Drug Administration (FDA)

Vulnerability Assessment Software – Food Defense Plan Builder

<https://www.fda.gov/food/fooddefense/toolseducationalmaterials/ucm349888.htm>

Alerts and databases:

– US Food and Drug Administration (FDA)

Recalls and Enforcement Reports

<http://www.fda.gov/Safety/Recalls/default.htm>

– US Food and Drug Administration (FDA)

Import Alerts and Refusals

<http://www.fda.gov/ForIndustry/ImportProgram/default.htm>

– European Union Rapid Alert System

http://ec.europa.eu/food/safety/rasff/portal/index_en.htm

– UK Food Standards Agency (FSA)

<https://www.food.gov.uk/business-guidance/food-incidents>

– UK Serious Fraud Office

<http://www.sfo.gov.uk>

– Australia and New Zealand

<http://www.foodstandards.gov.au/science/surveillance/Pages/default.aspx>

– The Department of Food Safety, Govt. of NCT of Delhi

http://www.delhi.gov.in/wps/wcm/connect/DoIT_PFA/pfa/home

Standards:

– BRC Global Standard Food Safety Issue 8

<https://www.brcbookshop.com/>

Supply chain security

– BS ISO 28000, Specification for security management systems for the supply chain

– BS ISO 28002, Security management systems for the supply chain – Development of resilience in the supply chain – Requirements with guidance for use

Sources of information and intelligence about emerging risks to food supply:

– Infosan

http://www.who.int/foodsafety/areas_work/infosan/en/

– FAO Early Warning Bulletin

<http://www.fao.org/food-chain-crisis/early-warning-bulletin/en/>

– Global Information and Early Warning System (GIEWS)

<http://www.fao.org/giews/english/index.htm>

– Centre for the Protection of National Infrastructure Holistic management of employment risk (HoMER). London: CPNI, 2012. <http://www.cpni.gov.uk/advice/Personnel-security1/homer/>

– US Michigan State University, Food Fraud: <http://foodfraud.msu.edu/>

ISO 14001 Key Benefits (2015) PDF Document.

https://committee.iso.org/files/live/sites/tc207sc1/files/ISO%2014001%20-%20key%20benefits_EN.pdf

International Organization for Standardization, ISBN 978-92-67-10647-2.

Food Industry Standards and Interest Groups:

GlobalGAP – www.globalgap.org

British Retail Consortium (BRC) – www.brcglobalstandards.com

International Featured Standards (IFS) – www.ifs-certification.com

Global Food Safety Initiative (GFSI) – www.mygfsi.com

International Organisation for Standardisation – www.iso.org

Food Safety System Certification (FSSC) 22000 – www.fssc22000.com

Codex Alimentarius Commission – <http://www.codexalimentarius.org>